The 3rd International Congress of the Turkish Journal of Agriculture - Food Science and Technology

TURJAF2023

13-16 September 2023, Malatya/Türkiye

In memory of Prof. Dr. Kemal ESENGÜN



ONLINE

İLETİŞİM

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3rd International Congress of the Turkish Journal of Agriculture - Food Science and Technology

CONGRESS BOOK

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The responsibility of all the papers contained in this book belongs to the authors. The book can be utilized provided that reference is made.

September 2023

PREFACE

Dear Colleagues…

The "3rd Congress of "International Agriculture - Food Science and Technology Journal (TURJAF) " has been held in Malatya/Turkey on 13-16 September 2023, with the participation of scientists working in agriculture and related sciences, with the aim of sharing scientific developments, proposing scientific solutions to international problems, increasing cooperation and creating scientific outputs that will benefit humanity by using international resources economically.

168 papers from 20 countries were presented to our congress. 88 of these papers came from foreign countries and 80 came from Türkiye. The countries of the participants who sent papers to the congress and the number of incoming articles are as follows; Afghanistan (1), Algeria (2), Bangladesh (6), Chad (1), Côte d'Ivoire (2), Ghana (5), Indonesia (2), Iraq (1), Kenya (2), Nepal (3), Nigeria (22), Pakistan (24), Philippines (1), Poland (1), Rwanda (6), Somali (1), Spain (1), Sri Lanka (6), Sudan (1) and Turkey (80). The rate of international papers is56% (more than one paper by the same author was received as one; (100*82/(82+65))= 56%).

At the congress; participants discussed such topics as animal production, crop production, aquaculture, food science and technologies, agricultural technologies, soil science, sustainable agricultural systems, agricultural economics, genetics, biology, agricultural ecology, landscape architecture and agricultural environment issues related to original, advanced technology on agriculture and natural life.

During the organization and congress phase of the congress; Dr. Burak Şen, Dr. Emre Aksoy, Dr. Mustafa Duman, Dr. Kadir Erensoy, Ahmet Akyol, Furkan Baş, Ali Kaan Yetik, Brian Tainika and Muhammet Talha İnce took on important duties in the congress secretariat.

We would like to express our gratitude to all our stakeholders who supported the successful realization of our congress and all the scientists who participated and supported us with their papers.

Kind regards

Congress Co-Presidents

Prof. Dr. Ahmet ŞEKEROĞLU
Niğde Ömer Halisdemir University

Prof. Dr. Hasan Eleroğlu
Sivas Cumhuriyet University

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ÖNSÖZ

Sayın Meslektaşlarımız…
Tarım ve ilgili bilim dallarında çalışan bilim insanlarının katılımıyla, bilimsel gelişmeleri paylaştıkları, uluslararası sorunlara bilimsel çözümler önermek, iş birliklerini artırarak uluslararası kaynakların ekonomik kullanılmasıyla insanlığın yararına olacak bilimsel çıktıların oluşturulması amacıyla, 13-16 Eylül 2023 tarihinde Malatya/Türkiye'de "3. Uluslararası Tarım - Gıda Bilim ve Teknoloji Dergisi Kongresi (TURJAF)" gerçekleştirilmiştir.

Kongremize 20 ülkeden 168 bildiri sunulmuştur. Bu bildirilerin 88'i yurt dışından, 80'i ise Türkiye'den gelmiştir. Kongreye bildiri gönderen katılımcıların ülkeleri ve gelen makale sayıları şu şekildedir; Afganistan (1), Cezayir (2), Bangladeş (6), Çad (1), Fildişi Sahili (2), Gana (5), Endonezya (2), Irak (1), Kenya (2), Nepal (3), Nijerya (22), Pakistan (24), Filipinler (1), Polonya (1), Ruanda (6), Somali (1), İspanya (1), Sri Lanka (6), Sudan (1) ve Türkiye (80). Yurtdışı bildiri oranı %56 'dır (aynı yazara ait birden fazla bildiriler tek olarak alınmıştır; (100*82/(82+65)=56).

Kongrede; tarım ve doğal hayat ile ilgili özgün ve ileri teknoloji ile ilgili; hayvansal üretim, bitkisel üretim, su ürünleri, gıda bilimi ve teknolojileri, tarım teknolojileri, toprak bilimi, sürdürülebilir tarım sistemleri, tarım ekonomisi, genetik, biyoloji, tarımsal ekoloji, peyzaj mimarlığı ve tarımsal çevre konuları katılımcılar tarafından tartışılmıştır.

Kongremizin düzenlenmesi ve kongre aşamasında; kongre sekretaryasında önemli görevler üstlenen Dr. Burak Şen, Dr. Emre Aksoy, Dr. Mustafa Duman, Dr. Kadir Erensoy, Ahmet Akyol, Furkan Baş, Ali Kaan Yetik, Brian Tainika ve Muhammet Talha İnce, kongre organizasyonunu üstlenmişlerdir.

Kongremizin başarılı bir şekilde gerçekleştirilmesinde desteklerini esirgemeyen tüm paydaşlarımıza ve bildirileri ile katılarak destek veren tüm bilim insanlarına teşekkürü bir borç biliriz.

Saygılarımızla

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YAYIN VE DÜZENLEMEDE GÖREVLENDİRİLMİŞ AKADEMİSYEN TEMSİLCİ

13-16 Eylül 2023 tarihinde Malatya/Türkiye'da "3. Uluslararası Tarım - Gıda Bilim ve Teknoloji Dergisi Kongresi (TURJAF)" gerçekleştirilmesinde, Niğde Ömer Halisdemir Üniversitesi Rektörlüğü'nün 13/09/2023 Tarih -87795264-903.07.02-408352 sayı ve Sivas Cumhuriyet Üniversitesi Rektörlüğü'nün 14.09.2023 Tarih ve E-15097355-679-334294 sayılı olurları ile aşağıda isimleri verilen akademisyenlere ***yayın ve düzenlemede akademik temsilci*** olarak yer almalarına izin verilmiştir.

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ULUSLAR ARASI KONGRE ÖZELLİKLERİ

1. Bilim kurulunda yer alan yurt dışından akademisyenler

Akademisyen	Ülke
Prof. Dr. Himayatullah KHAN	Agricutural University, Pakistan
Prof. Dr. Nazım Husain LABER	Bahuddine Zakariya University, Pakistan
Prof. Dr. Shafqat SAEED	Bahuddine Zakariya University, Pakistan
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Dr. Noosheen ZAHİD	University of Nottingham, Malaysia
Mr. Jiban SHRESTHA	Nepal Agricultural Research Council, Nepal

2. Yurt dışından katılım sağlanan ülkeler ve bidiri sayıları

Ülke	Bidiri sayısı
Afganistan	1
Algeria	2
Bangladesh	6
Chad	1
Côte d'Ivoire	2
Ghana	5
Indonesia	2
Iraq	1
Kenya	2
Nepal	3
Nigeria	22
Pakistan	24
Philippines	1
Polonya	1
Rwanda	6
Somali	1
Spain	1
Sri Lanka	6
Sudan	1
Turkey	80

3. Yurt dışı katılım oranı

Ülke	Bildiri sayısı (birden fazla bildiriyle katılım)
Yurt dışı	82 (88)
Yurt içi	65 (80)
Oran	%56 Yurt Dışı; %44 Türkiye

Yukarıda verilen bilgiler çerçecesinde, 13-16 Eylül 2023 tarihinde Malatya/Türkiye'da "3. Uluslararası Tarım - Gıda Bilim ve Teknoloji Dergisi Kongresi (TURJAF)", uluslararası kongre niteliği taşımakta, akademik teşvik kriterleri ve UAK Doçentlik başvuru koşullarını sağlamıştır.

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CONGRESS PROGRAMME

KONGRE PROGRAMI/ CONGRESS PROGRAMME

ÇEVRIMIÇI / ONLINE

	13 Eylül 2023 Çarşamba / 13 September 2023 Wednesday Time by Türkiye
Saat/Hour	AÇILIŞ PROGRAMI /OPPENİNG PROGRAMME **Başkan/ Moderator: Prof.Dr. Musa SARICA** **Kongre Sekreterya/Congress Secretariat: Ali Kaan Yetik**
10.00-11.00	**Açılış Konuşmaları/ Opening Ceremony**
	Prof. Dr. Ahmet ŞEKEROĞLU, Kongre Koordinatörü
	Prof. Dr. Hasan ELEROĞLU, Kongre Başkanı
	Prof. Dr. Musa SARICA, TURJAF Editörü
	SELAHATTIN GÜRKAN, Malatya Belediye Başkanı, Kongre Ev Sahibi
	Prof. Dr. RECEP BENTLI, Malatya Turgut Özal Üniveritesi Rektörü
	Prof. Dr. HASAN USLU, Niğde Ömer Halisdemir Üniveritesi Rektörü
	Prof. Dr. ALIM YILDIZ, Sivas Cumhiriyet Üniveritesi Rektörü
	Açılış Oturumu, Çağrılı Bildiriler / OPENING SESSION, Invited Papers
11.00-11.45	Prof.Dr. YUSUF DEMİR, Ondokuz Mayıs Üniversitesi — İklim Değişiminin Tarım ve Suya Etkilleri/ Effects of Climate Change on Agriculture and Water

13 Eylül Çarşamba	Salon1/ Hall1 1. Oturum/ 1st Session		13 September Wednesday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Deniz Damla Altan Kamer** Kongre Sekreterya/Congress Secretariat: Ali Kaan Yetik		
13.30-13.45	Deniz Damla Altan Kamer, Gülce Bedis Kaynarca	Türkiye	Emerging Trends In The Utilization Of Hydrocolloids For The Formation Of Oleogels
13.45-14.00			
14.00-14.15	Adeyeye Blessing, Ogunleye Gbemisola E, Oyinlola Kubrat A, Akintade Oluwadurotimi O.	Nigeria	Antibacterial Potential And Characterization Of Selenium Nanoparticles Synthesized By Saccharomyces Cerevisiae
14.15-14.30	Hacene Fatima*, Homrani Mounia, Homrani Abdelkader, Dahou Abdelkader Elamine	Algeria	Technological And Probiotic Effects Of Lactobacilli Isolated From Honeys
14.30-14.45	Ara		Break

13 Eylül Çarşamba	Salon1/ Hall1 2. Oturum/ 2st Session		13 September Wednesday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Ahmet Kinay** Kongre Sekreterya/Congress Secretariat: Ali Kaan Yetik		
14.45-15.00			
15.00-15.15			
15.15-15.30	Mohammed Alqazzaz	Iraq	Fatty Acid Profile And Cholesterol Contents In Egg Yolk Of Hens Fed Variable Energy To Protein Ratio Diet Using Hermetia Illucens Meal.
15.30-15.45	Ahmet Kınay	Türkiye	The Effects Of Planting Time And Density On Yield, Income And Quality Of Basma Tobacco
15.45-16.00	Ara		Break

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13 Eylül Çarşamba	Salon1/ Hall1 3. Oturum/ 3rt Session		13 September Wednesday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Samet Hasan Abacı** Kongre Sekreterya/Congress Secretariat: Ali Kaan Yetik		
16.00-16.15	Md. Masud Rana	Bangladesh	Farmers' Satisfaction On Extension And Advisory Services Of National Agricultural Technology Program For Sustainable Livestock Farming: A Field Level Study From Comilla District Of Bangladesh
16.15-16.30			
16.30-16.45			
16.45-17.00	Wadah Elsheikh*, İlknur Uçak, M. Cüneyt Bağdatli	Sudan	Food Crisis And Global Warming In Africa
17.00-17.15	Yasin Mohmed Ibrahim	Somali	Urban Agriculture In Mogadishu: Opportunities And Constraints
17.15-18.00	Ara		Break

13 Eylül Çarşamba	Salon1/ Hall1 4. Oturum/ 4rt Session		13 September Wednesday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Mehmet Noraslı** Kongre Sekreterya/Congress Secretariat: Ali Kaan Yetik		
18.00-18.15	Mine Sungur, İbrahim Bakır	Türkiye	Educational Space From Design To Implementation Process; Selçuk University, Faculty Of Fine Arts Project
18.15-18.30	Ekong, E. A., Oniwokpomayo A. P., & Dunstan E. E.	Nigeria	Agricultural Waste To Health, Safety And Environment: A Critical Review
18.30-18.45	Hafidha Mehallah, Noureddine Djebli	Algeria	Mercuric Chloride-Induced Hepatotoxicity In Female Wistar Rats
18.45-19.00	Muhammad Umair Asghar*, Qurat Ul Ain Sajid, Mariusz Korczyński, Zeliha Selamoğlu	Polonya	The Recent Advances In Poultry Nutrition: Utilizing Phytobiotics As Alternatives To Antibiotics
19.00-19.15	Ali Akçaova- Mehmet Noraslı	Türkiye	Museum At The Unıversıty Campus; Example Of Interıor Applıcatıon Project In Selçuk Unıversıty Museum
19.15-19.30	Muhammed Talha İnce*, Ahmet Şekeroğlu, Ahmet Akyol, Brian Tainika, Mabrouk Elsabagh, Fatih Mehmet Gür	Türkiye	The Influence Of Feather Score On Some Blood Parameters Of Laying Hens
19.45-20.00	Mehmet Noraslı, Ali Akçaova	Türkiye	Kurumsal Kimliğin Duvar Yüzeyi Tasarımıyla Eğitim Mekanlarına Yansıtılması

13 Eylül Çarşamba	Salon2 / Hall2 1. Oturum/ 1st Session		13 September Wednesday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Çağlar Gökırmaklı** **Kongre Sekreterya/Congress Secretariat: Furkan Baş**		
13.30-13.45	Nazir Kizzie-Hayford, Joshua Akanson, Esi Dankwa, Jerry Ampofo-Asiama	Ghana	Influence Of Sprouting Duration On The Nutrient, Functional, And Phytochemical Properties Of Tiger Nut Flour And Bread
13.45-14.00	Ammal Abukari	Ghana	Farmers' Indigenous Knowledge Indicators Employed For Climate Change Adaptation In The Tolon District, Ghana
14.00-14.15	Enoch Kwame Tham-Agyekum	Ghana	Urban Vegetable Production In Ghana: Investigating The Financial Viability And Key Drivers Of Irrigation Techniques
14.15-14.30	Çağlar Gökırmaklı*, Zeynep Banu Güzel-Seydim	Türkiye	In-Vitro Probiotic Properties Of Lactobacillus Satsumensis Lc311746.1 Isolated From Water Kefir Grains
14.30-14.45	Ara		Break

13 Eylül Çarşamba	Salon2 / Hall2 2. Oturum/ 2st Session		13 September Wednesday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Basri Omac** **Kongre Sekreterya/Congress Secretariat: Furkan Baş**		
14.45-15.00	Basri Omac*, Ali Goksu, Erdem Isik, And Serdal Sabancı	Türkiye	Kinetic Modeling Of Quality Changes In Couscous Cooked With Ohmic Heating At Various Times
15.00-15.15	Abdou Karim Darboe*, Mary K. Ambula And Anthony M. King'ori	Kenya	Performance Of Laying Hens Fed On Moringa Oleifera Leaf- Meal-And Descriptive Attributes Of Eggs
15.15-15.30	O. L. Alarape*, P. K. Migwi And J. O. Ondiek	Kenya	Effect Of Replacing Alfalfa Hay With Dried Moringa Oleifera Leaves On Rumen Fermentation, Rumen Microbial Protein Synthesis And Methane Production In Lactating Dairy Cows
15.30-15.45	Ruhugul Ozge Gemici	Türkiye	Landscape Design In Hospital Gardens: The Example Of Selcuk University Medical Faculty Hospital
15.45-16.00	Ara		Break

13 Eylül Çarşamba	Salon2/ Hall2 3. Oturum/ 3rt Session		13 September Wednesday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Charles Dushimirimana** Kongre Sekreterya/Congress Secretariat: Furkan Baş		
16.00-16.15	Charles Dushimirimana*, Sylvestre Habimana, Saidi Mbaraka Rumanzi & Joyeuse Nyiranshuti	Rwanda	Evaluation Of Adaptability And Performance Of Yellow Maize (Zea Mays L.) Under Busogo Environmental Conditions In Rwanda.
16.15-16.30	Charles Dushimirimana, Sylvestre Habimana & Saidi Mbaraka Rumanzi	Rwanda	Evaluation Of Nutritional Value Of Yellow Maize (Zea Mays L.) Grown Under Busogo Environmental Conditions In Rwanda.
16.30-16.45	Erastus Dushimeyesu, Patrick Rugwiro, Agnes Umutoni, Emmanuel Hakizimana, Edith Niyotwizera, Pancras Ndokoye	Rwanda	Unveiling The Enigmas Of Night Soil Composting: Boosting Carrot Length, Diameter, And Weight In Ruhango District, Southern Province, Rwanda.
16.45-17.00	Joyeuse Nyiranshuti*, Sylvestre Habimana,Aloys Fashaho And Antoine Karangwa	Rwanda	Influence Of Mulching Materials On Yield And Economic Returns Of Potato (Solanum Tuberosum L) In Gisesero And Muhira Sites Of Rwanda
17.00-17.15	Sylvestre Habimana*, Alphonsine Mukamuhirwa, Saidi Rumanzi Mbaraka, Innocent Ndikumana And Jean Paul Habinshuti	Rwanda	Performance Evaluation Of Upland Rice (Oryza Sativa L.) Genotypes In Three Agro-Ecological Zones Of Rwanda
17.15-18.00	Ara		Break

13 Eylül Çarşamba	Salon2/ Hall2 4. Oturum/ 4rt Session		13 September Wednesday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Ridwan Mukaila** Kongre Sekreterya/Congress Secretariat: Furkan Baş		
18.00-18.15	R.F. Okunade, A.E. Akinlabi, F.O. Abiodun, O. M Agbebi, B.O. Oladosu	Nigeria	Effect Of Poultry Manure Rate And Npk 15:15:15 On The Perfomance And Nutritional Content Of Sweet Potato (Ipomoea Batatas L.)
18.15-18.30	Ridwan Mukaila, Festus Eluwandedurojaye Awoyelu, Chisom Francisca Emeakayi	Nigeria	Driving Factors For Agricultural Graduates' Involvement In Agribusiness Enterprise In Nigeria
18.30-18.45	Ridwan Mukaila*, Sheu-Usman Oladipupo Akanbi, Osasa Kehinde Ojimiwe, Sheu Ahmad Olohungbebe, Emeka Solomon Fidelis	Nigeria	Economics Of System Of Rice Intensification Technology Usage Among Rice Farmers In Nigeria
18.45-19.00	S.G. Ibrahim And F.I. Jumare	Nigeria	Effects Of Preservation Methods On Ph, Proximate Composition And Microbial Quality Of Laboratory Scale Tiger Nut Milk Beverage
19.00-19.15	S.G. Ibrahim, M.Y. Sani	Nigeria	Effect Of Oil Marination On Nutrient Content Of Fresh Tomato
19.15-19.30	Oluwadurotimi O. Akintade*, Ifeoluwa E. Adeleke, Fausat O. Odujebe, Grace O. Ayorinde.	Nigeria	*Ecological Risk Indices Analysis On Heavy Metal Contamination In Akinyele Local Government, Oyo State, Nigeria*
	Ara		Break

14 Eylül Perşembe	**Salon1/ Hall1 1. Oturum/ 1st Session**		**14 September Thursday Time By Türkiye**
	Oral Presentation Online Başkan/ Moderator: Mumtazah Rahimah Rum Kongre Sekreterya/Congress Secretariat: Ali Kaan Yetik		
09.00-09.15	Yusma Indah Jayadi Sayful Muslim, Nurul, Andi Aina Al Mardiah, Fatana Surahman, Melyana Angreni Putri, Jumriatun Naillah	Indonesia	Observation Evaluation Of The Empowerment Stunting Prevention Program At The Samata Health Center
09.15-09.30	Mumtazah Rahimah Rum, Faradila Guhir, Annisa Nurfadillah, Primitasari Hardiyanti, Yusma Indah Jayadi, A. Syamsiah Adha	Indonesia	The Management Of Food At Rsud Haji Makassar
09.30-09.45	Renz H. Sale, Aimee Sheree A. Barrion	Philippines	Nutrition And Health Potential Of Philippine "Kurumbot" (Passiflora Foetida Linn.) Wild Fruit
09.45-10.00	Babor Ahmad	Bangladesh	Evaluating The Effect Of Agricultural Credit Facility On The Volume Of Rice Production In Selected Areas Of Dinajpur District, Bangladesh
10.00-10.15	Ara		Break

14 Eylül Perşembe	**Salon1/ Hall1 2. Oturum/ 2st Session**		**14 September Thursday Time By Türkiye**
	Oral Presentation Online Başkan/ Moderator: Prodipto Bishnu Angon Kongre Sekreterya/Congress Secretariat: Ali Kaan Yetik		
10.15-10.30	Ajay Poudel*, Bijaya Upadhayay, Pradeep Raj Rokaya, Santosh Chand, Bijay Regmi	Nepal	Farmer's Knowledge On Maize Pests, Their Management, And Cultivation Practices In Baitadi
10.30-10.45	Erastus Dushimeyesu*, Sylvestre Habimana, Fabrice Munyandamutsa, Patrick Rugwiro , Isaac Mubashankwaya, Drocelle Nyiransabimana	Rwanda	The Effect Of Water Hyacinth (Eichhornia Crassipes) Organic Fertilizer On The Vegetative Growth Of Carrot (Daucus Carota), Royal Chantenay Variety.
10.45-11.00	Monisha Mondol, Prodipto Bishnu Angon	Bangladesh	An Overview Of Microplastic Contamination In Soil
11.00-11.15	Sohag Talukder*, Md. Saiful Islam Siddiqui, Palash Kumar Das, Md. Shahadat Hossain, Rajib Bhabuk, Arpita Saha, Md. Obidullah, Mehedy Hasan, Md. Mosarul Islam	Bangladesh	Economic Impact Of Ivermectin As Anthelmintic On Body Weight Gain Of Goat In Bangladesh
	Gamze Erdoğanöz*, Ahmet Şekeroğlu, Muhammed Talha İnce, Ahmet Akyol, Brian Tainika, Mabrouk Elsabagh, Fatih Mehmet Gür	Türkiye	The Effect Of Feather Score On Egg Quality Traits
11.15-11.30	Ara		Break

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14 Eylül Perşembe	Salon1/ Hall1 3. Oturum/ 3st Session		14 September Thursday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Ajay Poudel** Kongre Sekreterya/Congress Secretariat: Ali Kaan Yetik		
11.30-11.45	Md Anwar Hossain, Md Mukhlesur Rahman*, Md Wakilur Rahman, Md Abul Hashem	Bangladesh	Effect Of Castration On Carcass Characteristics And Meat Quality Traits Of Jamuna Basin Lambs
11.45-12.00			
12.00-12.15	Krishna Prasad Thapaliy*, Kailash Nath Pyakuryal, Durga Devkota, Dhrub Panta, Anita Ghimire	Nepal	Impact Of Foreign Labour Migration On Labour Dynamics In Relation To Household Agricultural Activities In Sindhuli Districts Of Nepal
12.15-12.30			
12.30-13.30	Ara		Break

14 Eylül Perşembe	Salon1/ Hall1 4. Oturum/ 4st Session		14 September Thursday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Ali Kaan Yetik** **Kongre Sekreterya/Congress Secretariat: Ali Kaan Yetik**		
13.30-13.45			
13.45-14.00			
14.00-14.15			
14.15-14.30	Azime Özkan Karabacak, Şeyma Alime Bakirci, Ömer Utku Çopur	Türkiye	Effects Of Different Processing Methods On Bioactive Components And Their Bioaccessibility In Red Beet
14.30-14.45	Ara		Break

14 Eylül Perşembe	Salon1/ Hall1 5. Oturum/ 5st Session		14 September Thursday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Yapa P.N** **Kongre Sekreterya/Congress Secretariat: Ali Kaan Yetik**		
14.45-15.00	Dasanayaka G.M.P.M., Herath B.M. And Yapa P.N.*	Sri Lanka	Potential Causes For Rice Plant Yellowing In "Maha" Cultivation Season In Year 2023 In Anuradhapura District, Sri Lanka
15.00-15.15			
15.15-15.30	Pathirana B.K.W, Jayamanna J.M.A.I.K And Yapa P.N	Sri Lanka	Arbuscular Mycorrhizal Fungi And Organic Amendments As Alternatives For Inorganic Fertilizer On Growth, Yield And Vitamin C Content Of Chili (Capsicum Annum L.)
15.30-15.45	Pelawatta A.T. And Yapa P.N.	Sri Lanka	Effect Of Microgravity On Rhizosphere And Endophytic Microorganisms- A Review
15.45-16.00	Ara		Break

14 Eylül Perşembe	Salon1/ Hall1 6. Oturum/ 6st Session		14 September Thursday Time By Türkiye
	Oral Presentation Online Başkan/ Moderator: Başak Gökçe Çöl Kongre Sekreterya/Congress Secretariat: Ali Kaan Yetik		
16.00-16.15	Tdc Priyadarshani*, Dd Karunarathna, Gdn Menike, Pa Weerasinghe, Ma Madushani, Kwa Madhushan	Sri Lanka	Efficiency Of Locally Isolated Trichoderma Virens For Controlling Rice Brown Leaf Spot Disease Caused By Bipolaris Oryzae
16.15-16.30	Sanjaya Budhdhika, Chamika Keerthi, Ayesha Madushani, Asanka Madhushan, Dissanayake	Sri Lanka	Integrated Use Of Low Cost Materials With Traditionally Used Sawdust In Oyster Mushroom (Pleurotus Ostreatus) Cultivation In Sri Lanka.: Integrated Use Of Low Cost Materials With Traditionally Used Sawdust In Oyster Mushroom (Pleurotus Ostreatus) Cultivation In Sri Lanka
16.30-16.45	Başak Gökçe Çöl	Türkiye	Evaluation Of Total Polar Materials In Cooking Oils Obtained From Food And Beverage Establishments Within Shopping Centers
16.45-17.00	Arda Sözcü*, Aydın İpek, Merve Gündüz	Türkiye	The Effects Of L-Carnitine Supplementation Into Drinking Water On Growth Performance And Immunologic Parameters In Broilers
17.00-17.15	Arif Şanli, Tahsin Karadoağan, Fatma Zehra Ok	Türkiye	Chemical Constituents In The Essential Oil Of The Endemic Plant Prangos Platychlaena From The Lakes Region Of Türkiye
17.15-18.00	Ara		Break

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14 Eylül Perşembe	Salon1/ Hall1 7. Oturum/ 7st Session		14 September Thursday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: M. O. Adio** **Kongre Sekreterya/Congress Secretariat: Ali Kaan Yetik**		
18.00-18.15	An. Tuo-Kouassi, Dm.Yéhé , Ck. N'guessan-Gnaman , Ea. Odoh, Rd. N'kuitchou-Chouguo , A. N'guessan, Gja Lia , Saa. Aka-Any-Grah, I. Dally, Aa. Koffi	Côte D'ivoire (Fildişi)	Pharmacotechnical Characterization Of Pectins Obtained From Different Varieties Of Mango From Côte D'ivoire For Pharmaceutical Application
18.15-18.30	Joël Cyriaque Dadje*, Mariette Désirée Yehe, Jean-Kisito Kouame	Côte D'ivoire (Fildişi)	Determination Of Sulfites By Uv-Vis Spectrophotometry In Red Wine And White Wine
18.30-18.45	Hamza Badamasi	Nigeria	Impacts Of Biochar Treatments On Some Soil Properties And Micronutrient Availability In The Farmland Of Misau, Bauchi State, Nigeria
18.45-19.00	K. A. Oyinlola, G. E. Ogunleye And O. B. Saliu	Nigeria	Comparative Analysis Of Annona Muricata Linn (Soursop) Leaf And Fruit Extracts Against Selected Pathogens
19.00-19.15	M. O. Adio*, A. B.Ogunwale, M. D. Ayeni, O. O. Olugbemiga, And P. M. Falebita	Nigeria	Drivers Of Profit Among Leafy Vegetable Farmers During Covid-19 Lockdown In Oyo State, Case Study Of Egbeda Local Government Area
19.15-19.30	Moumouni Ousseini , Baba M, Inusa S.R, Soumane Idrissa, Keiba Dar, Idrissa Allassane	Nigeria	Rangeland Degradation, Its Perceived Impacts And Adaptive Mechanisms By Pastoralists And Government
	Ara		Break

14 Eylül Perşembe	Salon2/ Hall2 1. Oturum/ 1st Session		14 September Thursday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Aliza Iqbal** **Kongre Sekreterya/Congress Secretariat: Furkan Baş**		
09.00-9.15	Aliza Iqbal, Muhammad Saeed, Amjad Abbas, Hafeez Ur Rehman, Muhammad Amjad Ali*	Pakistan	Influence Of Seed Priming On Morpho-Physiological Traits Associated With Drought Tolerance In Maize
9.15-9.30	Aneeq-Ur-Rehman, Azeem Iqbal Khan, Iqrar Ahmad Rana And Muhammad Tehseen Azhar*.	Pakistan	Challenges And Mitigation Opportunities For The Development Of Climate Resilient Cotton.
9.30-9.45	Aqsa Parvaiz, Warisha Amjad, Saba Zafar, Ghulam Mustafa, Faiz Ahmad Joyia	Pakistan	Dna Marker-Assisted Diversity Analysis Of Mangifera Indica L. Populations
9.45-10.00			
10.00-10.15	Ara		Break

14 Eylül Perşembe	Salon2/ Hall2 2. Oturum/ 2st Session		14 September Thursday
	Oral Presentation Online **Başkan/ Moderator: Farah Deeba** **Kongre Sekreterya/Congress Secretariat: Furkan Baş**		
10.15-10.30	Ayesha Jabeen, Sabahat Ayub, Aliza Iqbal, Muhammad Amjad Ali, Amjad Abbas	Pakistan	Source-Sink Association Of Flag Leaf With Brown Rust Resistance Under The Application Of Bcas In Bread Wheat
10.30-10.45	Ayesha Saleem, Muhammad Amjad Ali, Muhammad Usama, Muhammad Jabran, Amer Habib, M. Huazifa Tanveer And Amjad Abbas*	Pakistan	Studies Of Laser Effects For Screening Of Resistant Plant Type Against Brown Rust In Wheat
10.45-11.00	Farah Deeba*, Nageen Arif, Zermina Rashid, Raheela Waheed, Humaira Saleem	Pakistan	Evaluation Of Antioxidant, Antimicrobial And Wound Healing Activities Of Zno-Cuo Nanoparticles Synthesized Using Azadirachta Indica Leave Extract
11.00-11.15	Ghulam Mustafa*, Faiz Ahmad Joyia, Aqsa Parvez, Muhammad Sarwar Khan	Pakistan	Genome-Edited Crops: A Hope To Mitigate Food Security Challenges In 23rd Century
11.15-11.30	Ara		Break

14 Eylül Perşembe	Salon2/ Hall2 3. Oturum/ 3st Session		14 September Thursday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Muhammad Anas** **Kongre Sekreterya/Congress Secretariat: Furkan Baş**		
11.30-11.45	Ikhlas Shafique, Muhammad Umar Shahbaz, Muhammad Ehtisam-Ul-Haq, Amjad Abbas, Muhammad Asadullah Wahid, Muhammad Anas, Adil Zahoor, Muhammad Amjad Ali*, Sohaib Nasir	Pakistan	In Silico Genome-Wide Comparative Analysis Of Auxin Response Factors (Arfs) From Brassica Oleracea And Arabidopsis Thaliana
11.45-12.00			
12.00-12.15	Gülden Sandal Erzurumlu	Türkiye	Yeşil Alanların Fakülte Alanlarında Değerlendirilmesi
12.15-12.30	Muhammad Anas, Muhammad Asad Ullah Wahid, Amjad Abbas, Sohaib Nasir, Muhammad Amjad Ali	Pakistan	Genomic Identification, Characterization And Phylogenetic Analysis Of The Ap2 Gene Family In Glycine Max
12.30-13.30	Ara		Break

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14 Eylül Perşembe	Salon2/ Hall2 4. Oturum/ 4st Session		14 September Thursday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Burak Şen** **Kongre Sekreterya/Congress Secretariat: Furkan Baş**		
13.30-13.45			
13.45-14.00	Muhammad Nazir Uddin, Saifullah, Sher Hayat Khan, Musharaf Ahmad, Aqib Iqbal, Wajid Khan	Pakistan	Visualization Of Interaction Between Pochonia Chlamydosporia And Meloidogyne Incognita And Their Impact On Tomato Crop
14.00-14.15			
14.15-14.30	Muhammad Saqlain Shabbir	Pakistan	Genetic Variability And Character Associated Studies In Pisum Sativum L.
14.30-14.45			
	Ara		Break

14 Eylül Perşembe	Salon2/ Hall2 5. Oturum/ 5st Session		14 September Thursday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Kadir Erensoy** **Kongre Sekreterya/Congress Secretariat: Furkan Baş**		
14.45-15.00			
15.00-15.15			
15.15-15.30			
15.30-15.45			
15.45-16.00	Ara		Break

14 Eylül Perşembe	Salon2/ Hall2 6. Oturum/ 6st Session		14 September Thursday Time By Türkiye
	Oral Presentation Online Başkan/ Moderator: Yahaya Zira Dia Kongre Sekreterya/Congress Secretariat: Furkan Baş		
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16.00-16.15			
16.15-16.30	Ugegeb.H.,Oyewoi.O.,Tunde-Francisa.A.,Azeezf.A	Nigeria	Analysis Of Sawnwood Marketingin Ibadan Metropolis
16.30-16.45			
16.45-17.00	Yahaya Zira Dia And Rhoda Dia-Johnson	Nigeria	The Determinants Of Livelihood Diversification Among Rural Farming Households In Toungo Local Government Area, Adamawa State, Nigeria.
17.00-17.15	Z.B. Nouruddeen*, M.A Adamu, A.U. Sani, A. Abdullahi,	Nigeria	Complementary Food Produced From "Atilla-Gan-Atilla" Wheat, Sorghum And Groundnut Fortified With Baobab Fruit Pulp
17.15-18.00	Ara		Break

14 Eylül Perşembe	Salon2/ Hall2 7. Oturum/ 7st Session		14 September Thursday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Mustafa Duman** **Kongre Sekreterya/Congress Secretariat: Furkan Baş**		
18.00-18.15	Muibat Olabisi Bello*, Mujeeb Ayofe Oladepo**, Asiata Omotayo Ibrahim	Nigeria	Utilization Of Two Essential Oil Bearing Plants As Adjunct In Annatto Based Food Seasoning Formulations.
18.15-18.30	Ogunleye Gbemisola E, Said-Ige Nuuriyyah, Oyinlola Kubrat A,	Nigeria	Antimicrobial And Biogenic Synthesis Of Selenium Nanoparticles By Lactobacillus Casei
18.30-18.45	Ogunleye Gbemisola E, akintade Oluwadurotimi O, oyinlola Kubrat A, Kazeem Muinat O, Oyewo Temitope S	Nigeria	Inhibitory Activities And Characterization Of Greenly Synthesized Silver Nanoparticles Using Culture Free Supernatant Of Lactobacillus Plantarum
18.45-19.00	Oluwadurotimi O. Akintade*, Ifeoluwa E. Adeleke, Fausat O. Odujebe, Grace O. Ayorinde.	Nigeria	Ecological Risk Indices Analysis On Heavy Metal Contamination In Akinyele Local Government, Oyo State, Nigeria
19.00-19.15	Oluwadurotimi O. Akiwumi, Rotimi A. Oderinde, Fausat O. Odujebe, Abiodun B. Ogbesejana, Gbemisola E. Ogunleye	Nigeria	Liquid-Liquid Extraction On Volatile Organic Compounds In Surface Water And Sediment Selected Zones Of Asa River, Kwara State, Nigeria
19.15-19.30	Oluwasubomi Ayinke Samson, Alao Omoniyi Solomon, Victor Folarin And Bukola Christianah	Nigeria	Production And Characterization Of Probiotic Mixed Fruit Juice Using Selenium Infused Lactic Acid Bacterial Starter, Sorghum Bicolor (Poporo) Extract, Ananas Comosus (Pineapple), Annona Muricata (Soursop) Juices
	Ara		Break

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15 Eylül Cuma	Salon1/ Hall1 1. Oturum/ 1st Session		15 September Friday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Muhammad Usama** **Kongre Sekreterya/Congress Secretariat:** Brian Tainika		
09.00-9.15	Wakil Ahmad Sarhadi, Wahida Yosofzai, Mohammad Hakim Osmani, Shamsruhman Shams, Kim Tungate, Steven Kwon	Afganistan	Fertilizers And Inoculants Effects On Soybean Yield And Yield Components
9.15-9.30			
9.30-9.45	Muhammad Shoaib	Pakistan	Comparison Of Bcas Application Method For The Management Of Leaf Rust In Bread Wheat
9.45-10.00	Muhammad Usama, Muhammad Amjad Ali, Ayesha Saleem, Aliza Iqbal, Amer Habib, Muhammad Huzaifa Tanveer, Amjad Abbas	Pakistan	Scoring Of Leaf Rust In Two Wheat Varieties After Magnetic Treatment Through Seed
10.00-10.15	Ara		Break

15 Eylül Cuma	Salon1/ Hall1 2. Oturum/ 2st Session		15 September Friday
	Oral Presentation Online **Başkan/ Moderator: Raheela Waheed** **Kongre Sekreterya/Congress Secretariat:** Brian Tainika		
10.15-10.30	Raheela Waheed*, Farah Deeba, Nayab Fiza, Tooba Hussain	Pakistan	Study Effect Of Zinc Oxide Nanoparticles On Helianthus Annuus L. Growth And Physiology For Mitigating Salinity And Drought Stress
10.30-10.45	Saba Zafar, Madiha Fatima, Rehan Sadiq Shaikh	Pakistan	Relationship Of Pcsk9 And Mtrr Variants With Myocardial Infarction In Southern Punjab Population Of Pakistan
10.45-11.00	Sabahat Ayub, Ayesha Jabeen, Aliza Iqbal, Muhammad Amjad Ali, Amjad Abbas	Pakistan	Seed Priming Through Selected Bio-Control Agents For The Eco-Safe Management Of Leaf Rust Disease In Wheat
11.00-11.15	Sabahat Shaheen, Sidra Aslam, Muhammad Baber, Muhammad Tehseen Azhar	Pakistan	Improving Salt Tolerance Of Cotton Through Breeding And Biotechnological Approaches
11.15-11.30	Ara		Break

15 Eylül Cuma	Salon1/ Hall1 3. Oturum/ 3st Session		15 September Friday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator:** Brian Tainika **Kongre Sekreterya/Congress Secretariat:** Brian Tainika		
11.30-11.45			
11.45-12.00	Sidra Aslam, Sabahat Shaheen, Muhammad Baber, Muhammad Tehseen Azhar	Pakistan	Opportunities To Enhance Seed Cotton Yield Through Various Biotechnological Approaches Under Water Deficit Conditions:
12.00-12.15	Syed Shams Ullah*, Amjad Abbas, Muhammad Amjad Ali, Muhammad Kamran, Muhammad Ibrahim, Sami Ullah	Pakistan	Efficacy Of Different Plant Extracts And Essential Oils Against Rhizopus Stolonifer And Aspergillus Niger Causing Post Harvest Decaying In Grapes
12.15-12.30			
12.30-13.30	Ara		Break

15 Eylül Cuma	Salon1/ Hall1 4. Oturum/ 4st Session		15 September Friday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Wajid Khan** **Kongre Sekreterya/Congress Secretariat:** Brian Tainika		
13.30-13.45	Umm-E-Habiba * And Raheela Jabeen	Pakistan	Biochemical Characterization And In Vitro Detection Of Promising Hepatoprotective Effects Of P. Viviparum Through Liver Slice Culture Assay.
13.45-14.00	Wajid Khan* , Afsar Sayeed, Muhammad Nazir Uddin, Muhammad Rizwan And Naseeb Zaman	Pakistan	Effect Of Extraction Solvent And Drying Condition On The Antioxidant Potential Of Peel And Pulp Membrane Of Punica Granatum.
14.00-14.15	Wajiha Khan, Amir Shakeel, Muhammad Naveed, Muhammad Tehseen Azhar	Pakistan	Phosphorus Solubilizing Bacteria And Cotton Yield.
14.15-14.30			
14.30-14.45	Ara		Break

15 Eylül Cuma	Salon1 / Hall1 5. Oturum/ 5st Session			15 September Friday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Mikail Baylan** **Kongre Sekreterya/Congress Secretariat:** Brian Tainika			
14.45-15.00	Muhammad Amjad Ali, Adil Zahoor, Zeenat Niaz, Muhammad Jabran, And Amjad Abbas	Pakistan	Arabidopsis Rap2.6 Gene Is Involved In Tolerance To Multiple Biotic And Abiotic Stresses	
15.00-15.15	Olivet Delasi Gleku	Ghana	Molecular And Pomological Characterization Of Blueberries And Their Role In Hidden Hunger	
15.15-15.30	Olivet Delasi Gleku, Sedat Şerçe	Ghana	Molecular Characterization Of Deschampsia Antarctica And Colobanthus Quitensis And Their Prospect In Sustainable Agriculture And Food Security	
15.30-15.45	A. Hacıoğlu, H.R. Öziyci, M. Karhan	Türkiye	Yumuşak Şeker Üretiminde Doğal Şeker Kaynakları Kullanımı Ürün Özelliklerini Nasıl Etkiler?	
15.45-16.00	Ara		Break	

15 Eylül Cuma	Salon1/ Hall1 6. Oturum/ 6st Session			15 September Friday Time By Türkiye
	Oral Presentation Online Başkan/ Moderator: Aysel Kekillioglu Kongre Sekreterya/Congress Secretariat: Brian Tainika			
16.00-16.15	Aysel Kekillioglu	Türkiye	A New Approach: Ecological Well-Being: "One Health"	
16.15-16.30	Aysel Kekillioglu, Ömer Eren Bostan	Türkiye	Agricultural Biodiversity And The Role Of Insect Taxa Of Derinkuyu District (Cappadocia:Nevşehir)	
16.30-16.45	Aysel Kekillioglu, Zekerya Bıçak	Türkiye	Analysis And Evaluation On Invasive Beetles (Insecta: Coleoptera) In Türkiye	
16.45-17.00	Ayşenur Güzel, Handan Akçaöz	Türkiye	Development Of Agricultural Credit Utilization In Türkiye	
17.00-17.15	Handan Akçaöz, Ayşenur Güzel	Türkiye	Examining The Relationship Between Risk Management And Cooperative Partnership In Agricultural Enterprises: The Case Of Antalya Province	
17.15-18.00	Ara		Break	

15 Eylül Cuma	Salon1/ Hall1 7. Oturum/ 7st Session			15 September Friday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Cenap Yılmaz** **Kongre Sekreterya/Congress Secretariat:** Brian Tainika			
18.00-18.15	Cenap Yılmaz	Türkiye	Nar Islahında Güncel Gelişmeler Ve Yeni Nar Çeşitleri	
18.15-18.30	Cenap Yılmaz	Türkiye	Nar Yetiştiriciliğinde Bitki Besleme Sorunları	
18.30-18.45	Dilvin İpek, R.Cüneyt Erenoğlu	Türkiye	Perception Of Employees In The Dairy Industry Towards Digital-Smart Tracking Systems: A Case Study On Ezine Cheese Producers	
18.45-19.00	Dilvin İpek, Z. Nur Adsız	Türkiye	Beyaz Peynirden İzole Edilmiş Laktik Asit Bakterilerinin Doğal Koruyucu Ve Pestisit Potansiyelinin Tespiti: Quorum Quenching, Antibakteriyel Ve Antitümör	
19.00-19.15	E. Ken, A. Semerci	Türkiye	Wheat Production And Support Policies In Türkiye	
19.15-19.30	E. Ken, A. Semerci	Türkiye	Forage Crops And Compound Feed Production In Türkiye	
19.30-19.45	Ali Göksu, Seda Çilingir, Serdal Sabanci, Mutlu Çevik	Türkiye	Greyfurt Kabuğu Tozundan Ohmik Isıtma Yöntemi Ile Pektin Ekstraksiyonun Optimizasyonu	
	Ara		Break	

15 Eylül Cuma	Salon2 / Hall2 1. Oturum/ 1st Session			15 September Friday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Ahmet Uçar** **Kongre Sekreterya/Congress Secretariat: Muhammet Talha İnce**			
09.00-9.15	Ahmet Uçar, Mehmet Akif Boz, Kadir Erensoy, Musa Sarıca	Türkiye	Kaz Yumurtalarında Depo Süresince Isıtma Ve Islatma Uygulamalarının Ağırlık Kaybı, Kuluçka Sonuçları Ve Palaz Kalite Özelliklerine Etkisi	
9.15-9.30	Ayse Ulusoy, Tugba Aktar	Türkiye	Zirai Uygulamalarda Gübre Çeşitliliğinin Meyve-Sebzelerde Ürün Kalitesine Etkisi	
9.30-9.45	Berhan Ulaş Sabah, Mehmet Musa Özcan, Nurhan Uslu	Türkiye	Effect Of Fruit Juice Addition On Bioactive And Sensory Properties Of Tahini Halva	
9.45-10.00	Burcu Çakmak Sancar, Meryem Akhan, Başak Gökçe Çöl, Melikenur Türkol	Türkiye	Spirulina In The Food Industry And Nutrition	
10.00-10.15	Ara		Break	

15 Eylül Cuma	Salon2 / Hall2 2. Oturum/ 2st Session		15 September Friday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Elife Büyüköztürk** **Kongre Sekreterya/Congress Secretariat: Muhammet Talha İnce**		
10.15-10.30	Elife Büyüköztürk, Murat Oral	Türkiye	Examination Of Kreuzberg Protective City Renovation Principles Specially Of Tepebağ-Kayalibag
10.30-10.45	Shitosri Mondal, Prodipto Bishnu Angon*	Bangladesh	Overview Of Agroforestry And Its Impact On Environment
10.45-11.00	Fatma Büşra Dereli, Ece Söğüt, Atıf Can Seydim	Türkiye	Monitoring Rainbow Trout Deterioration Using Smart Indicator Films Containing Eggplant (Solanum Melongena L.) Anthocyanins
11.00-11.15	Fatma Korkmaz, Ali Emre Andaç, Neşe Yilmaz Tuncel*, Havva Polat Kaya, Necati Barış Tuncel	Türkiye	Physicochemical, Sensorial And Textural Properties Of Vegan Ice Creams Produced From Cowpea Milk Analogs
11.15-11.30	Ara		Break

15 Eylül Cuma	Salon2 / Hall2 3. Oturum/ 3st Session		15 September Friday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Cemal Kaya** **Kongre Sekreterya/Congress Secretariat: Muhammet Talha İnce**		
11.30-11.45	Gülden Sandal Erzurumlu, Fatma Yücel	Türkiye	Use Of Thymus Sp. Plant In Landscape Design Studies
11.45-12.00	Ferit Ak*, Serdal Sabanci	Türkiye	Ohmik Evaporasyon İşlemiyle Elde Edilen Dut Pekmezinin Renk Değerlerinin İncelenmesi
12.00-12.15	Gülçin Şatır	Türkiye	Süt Ürünleri Ve Bitkisel Bazlı Sütler: Beslenme Ve Çevresel Etkileri
12.15-12.30	Gülşah Karataş*, Cemal Kaya	Türkiye	Yenilebilir Film Kaplamada Uçucu Yağ Kullanımının Gıdaların Fizikokimyasal Ve Duyusal Özelliklerine Etkisi
12.30-13.30	Ara		Break

15 Eylül Cuma	Salon2 / Hall2 4. Oturum/ 4st Session		15 September Friday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Hatice Çınar** **Kongre Sekreterya/Congress Secretariat: Ahmet Akyol**		
13.30-13.45	Hatice Çınar	Türkiye	Çağdaş Ofis Tasarimi Üzerine Bir Uygulama Projesi Örneği
13.45-14.00	Hatice Sena Azkur , Murat Oral	Türkiye	A Workshop Example Of Basic Design Education In Interior Architecture
14.00-14.15	İsmail Bayyiğit, Veysi Acibuca	Türkiye	Kaliteli Zeytinyağı Üretiminde Zeytin Üreticilerinin Rolü
14.15-14.30	Kemal. Karabağ, B.İ. Yildiz	Türkiye	Rnai-Mediated Post-Transcriptional Gene Silencing Strategies In Honey Bees
14.30-14.45	Ara		Break

15 Eylül Cuma	Salon2 / Hall2 5. Oturum/ 5st Session		15 September Friday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Mehmet Güldane** **Kongre Sekreterya/Congress Secretariat: Ahmet Akyol**		
14.45-15.00	Mahmut Baran, Özge Doğanay Erbaş Köse	Türkiye	Mikrobiyal Gübreler Ve Kullanım Alanları
15.00-15.15	Mehmet Güldane	Türkiye	Sumaktan Ultrasound Yardımıyla Antosiyanin Ekstraksiyonun Taguchi Optimizasyonu Ve Antosiyaninlerin Termal Bozulma Kinetiklerinin Araştırılması
15.15-15.30	Mehmet Güldane, Ali Cingöz	Türkiye	Sarı Soğan Kabuğundan Biyoaktif Bileşen Ekstraksiyonu: Taguchi-Saw Hibrit Optimizasyon
15.30-15.45	Meltem Sarioglu Cebeci, Mustafa Murad Karaahmetoğlu	Türkiye	Sivas Solid Waste Landfill Area Biogaz Electricity Generation Facility And Evaluation Of Establishment Of Greenhouse From Stable Heat
15.45-16.00	Ara		Break

15 Eylül Cuma	Salon2 / Hall2 6. Oturum/ 6st Session		15 September Friday Time By Türkiye
	Oral Presentation Online Başkan/ Moderator: Kubilay Kurtulus Bastas Kongre Sekreterya/Congress Secretariat: Ahmet Akyol		
16.00-16.15	Ahmet Şevki Taşkıran, Tuğba Yılmaz Asdemir	Türkiye	Ht-22 Hücre Hattında Kabak Çekirdeği Yağının Pentilentatrazol Ile Oluşturulan Nöronal Hasarlanma Üzerine Etkisi
16.15-16.30	Ahmet Şevki Taşkıran*, Ayşe Topçu,	Türkiye	Kuersetin'in 4-Aminopridin Ile Oluşturulan Nöronal Hasarlanma Üzerine Koruyucu Etkisinde Oksidatif Stres Ve Endoplazmik Stres Yolağının Rolünün Araştırılması
16.30-16.45	Aysegul Gur, Kubilay Kurtulus Bastas	Türkiye	Efficacy Of Copper Compounds On Transmitted By Seed Of Different Dry Bean Cultivars Against Xanthomonas Axonopodis Pv. Phaseoli
16.45-17.00	Aysegul Gur, Kubilay Kurtulus Bastas*	Türkiye	Effectiveness Of Phosphorus Acid, Bacillus Subtilis And Commonly Used Copper Compounds In The Control Of Fire Blight On Apple Cv. Gala With M9 Rootstock
17.00-17.15	Ruhugul Ozge Gemici	Türkiye	Investigation Of Selcuk University Of Alaeddin Keykubat Campus In Terms Of Xeriscape Landscape Design
17.15-18.00	Ara		Break

15 Eylül Cuma	Salon2 / Hall2 7. Oturum/ 7st Session		15 September Friday Time By Türkiye
	Oral Presentation Online Başkan/ Moderator:Gülden Sandal Erzurumlu Kongre Sekreterya/Congress Secretariat: Ahmet Akyol		
18.00-18.15			
18.15-18.30	Fatma Zehra Ok*, Arif Şanli	Türkiye	The Effects Of Foliar Gibberellic Acid Applications On Tuber Yield, Quality And Dormancy Period In Potato (Solanum Tuberosum L.)
18.30-18.45	Fatma Zehra Ok*, Arif Şanli	Türkiye	Antimicrobial Activity Of Some Essential Oils Against Agricultural Phytopathogenic Fungi And Bacteria
18.45-19.00			
19.00-19.15			
	Ara		Break

15 Eylül Cuma	Salon3 / Hall3 1. Oturum/ 1st Session		15 September Friday Time By Türkiye
	Oral Presentation Online **"Missed sessions"** **Başkan/ Moderator: Burak Şen** **Kongre Sekreterya/Congress Secretariat: Burak Şen**		
13.30-13.45	Ashiq Hussain*, Saima Akram, Tahira Siddique, Shazia Yaqub, Haya Fatima, Muhammad Rehan Arif, Atif Ali, Anjum Shehzad	Pakistan	Exploration Of Two Cucurbitaceae Fruit (Muskmelon And Watermelon) Seeds For Presence Of Phytochemicals, And Antioxidant And Antimicrobial Activities
13.45-14.00	Keiba Dar	Chad	Climate Change, Demographic Pressure And Adaptation Of Agropastoralism In The Tandjilé Province Southern Chad.
14.00-14.15	Shiva Basnet*, Pratikshya Lamichane, Aman Meheta, Yogesh Rajbanshi	Nepal	A Review On Biochemical, Nutritional And Medicinal Properties Of Okra
14.15-14.30	Aisha Idris Ali*, Munir Abba Dandago, Fatima Idris Ali, Daniel Amiteye	Nigeria	Bioactive Compounds From By-Products And Food Wastes: Recent Developments In Their Health Benefits
14.30-14.45	Ara		Break

16 Eylül Cumartesi	Salon1/ Hall1 1. Oturum/ 1st Session		16 September Saturday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Burak ŞEN** Kongre Sekreterya/Congress Secretariat: Burak Şen		
09.00-9.15			
9.15-9.30	Merve Kara	Türkiye	Identification Of Fungal Pathogens Belongs To Alternaria, Aspergillus, Fusarium And Penicillium Genera On Onion Plant (Allium Cepa L.) Growing In Hatay, Amasya And Tokat Provinces Using Maldi-Tof Mass Spectrometry
9.30-9.45	Meryem Akhan	Türkiye	Evaluation Of The Hygienic Quality Of Cutting Counters In Some Restaurants Operating In Istanbul
9.45-10.00	Meryem Akhan, Başak Gökçe Çöl, Burcu Çakmak Sancar, Melikenur Türkol*	Türkiye	Sustainable Food Technology And Nutrition
10.00-10.15	Ara		Break

16 Eylül Cumartesi	Salon1/ Hall1 2. Oturum/ 2st Session		16 September Saturday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Burak Şen** Kongre Sekreterya/Congress Secretariat: Burak Şen		
10.15-10.30	H. İbrahim Tuzlaci, Yaşar Ertürk*	Türkiye	Örtü Alti Ve Açik Alandaki Organik Çilek Yetiştiriciliğinde Bitki Gelişimini Teşvik Edici Bazi Bakterilerin Tekli Ve İkili Kombinasyon Uygulamalarinin Bitki Gelişimi İle Verim Parametrelerine Etkinliklerinin Belirlenmesi*
10.30-10.45			
10.45-11.00			
11.00-11.15	Antoni Sureda, Margalida Monserrat-Mesquida, Magdalena Quetglas-Llabrés, Miguel D. Ferrer, Xavier Capó	Spain	Effects Of Chronic Hydrogen Peroxide Exposure On Mitochondrial Oxidative Stress Genes And Mitochondrial Dynamics In Hl60 Cells
	Burak Şen*, Sevilay Topçu	Türkiye	Çukurova Yöresi Için Regcm Modelinin Gözlem Verileriyle Verifikasyonu
11.15-11.30	Ara		Break

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16 Eylül Cumartesi	Salon1/ Hall1 3. Oturum/ 3st Session		16 September Saturday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator:Mehmet Akif Boz** Kongre Sekreterya/Congress Secretariat: Burak Şen		
11.30-11.45	Murat Karataş, Mehmet Akif Boz*	Türkiye	Effects Of Environmental Enrichment On Behavior, Performance, And Slaughter And Carcass Traits In Guinea Fowl
11.45-12.00	Mustafa Alkan*, Turgut Atay	Türkiye	Insecticidal Effects Of Thymus Citriodorus L. (Lamiaceae) Essential Oil On Two Important Stored Product Pests
12.00-12.15	Mustafa Alparslan Umarusman, Kubilay Kurtulus Bastas	Türkiye	Enzymatic Responses Of Some Pear Cultivars Against Erwinia Amylovora By Salicylic Acid And Bacillus Subtilis Applications
12.15-12.30	Mustafa Alparslan Umarusman, Kubilay Kurtuluş Bastas	Türkiye	Potential Biological Control Agents Against Soft Rot Diseases Caused By Pectobacteria On Some Sugar Beet Cultivars
12.30-13.30	Ara		Break

16 Eylül Cumartesi	Salon1/ Hall1 4. Oturum/ 4st Session		16 September Saturday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Burak Şen** **Kongre Sekreterya/Congress Secretariat: Ali Kaan Yetik**		
13.30-13.45			
13.45-14.00	Yüksel Ünlükaplan, Elif Dilan Karagöz*	Türkiye	Peyzaj Çeşitliğinin Değerlendirilmesinde Yeni Bir Yaklaşım : Bağıl Çeşitlilik Endeksi
14.00-14.15			
14.15-14.30	Nasir Abdallah*, Oluwaseun Adeoye Oyebamiji, Kadriye Kursun, Yunus Emre Boga, Mikail Baylan	Türkiye	Unraveling The Shift: Exploring Factors Influencing Protein Preference And Consumption Patterns In Ga South Municipality Of Ghana
14.30-14.45	Vihi Samuel Keghter*, Jesse Birma, Markwin Francis Malel, Selzing Peter Musa And Ochelle Blessing.	Nigeria	Assessment Of Youth's Perception And Participation In Agricultural-Based Livelihoods In Shendam Local Government Area Of Plateau State, Nigeria
14.45-15.00	Ara		Break

16 Eylül Cumartesi	Salon2 / Hall2 1. Oturum/ 1st Session		16 September Saturday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Kadir Saltalı** Kongre Sekreterya/Congress Secretariat: Ahmet Akyol		
09.00-9.15	Nalan Yazıcıoğlu	Türkiye	Effects Of Leek Powder And Sunflower Oil In Guar Gum Edible Coating To Preserve Mushrooms (Agaricus Bisporus)
9.15-9.30			
9.30-9.45	Perihan Can Solmaz, Kadir Saltalı	Türkiye	Yüksek Kireçli Bir Toprağa Organomineral Ve Kimyasal Gübre Uygulamasının Alınabilir Fosfor İçeriğine Etkisi
9.45-10.00	Sabriye Melis Çinçinoğle Sertaç Güngör	Türkiye	Determining User Satisfaction Of City Parks- Antakya District Atatürk Park And Defne District Sevgi Park Example
10.00-10.15	Ara		Break

16 Eylül Cumartesi	Salon2 / Hall2 2. Oturum/ 2st Session		16 September Saturday
	Oral Presentation Online **Başkan/ Moderator:Suat Dikel** Kongre Sekreterya/Congress Secretariat: Ahmet Akyol		
10.15-10.30			
10.30-10.45	Serdal Sabanci, Gülseven Duran, Ali Göksu, Mutlu Çevik	Türkiye	Portakal Kabuğu Tozundan Ohmik Isıtma Ile Pektin Üretiminin Termodinamik Kanunlarınca İncelenmesi
10.45-11.00	Sertaç Güngör, Ebru Dikgöz	Türkiye	Evaluation Of The Capacity And Sufficiency Of Sakura Park In Selçuklu District Of Konya Province As A Post-Disaster Assembly Area
11.00-11.15	Suat Dikel, İbrahim Demirkale	Türkiye	Su Ürünleri Üretiminin Su Ayakizi
11.15-11.30	Ara		Break

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16 Eylül Cumartesi	Salon2 / Hall2 3. Oturum/ 3st Session		16 September Saturday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Turgut Atay** Kongre Sekreterya/Congress Secretariat: Ahmet Akyol		
11.30-11.45			
11.45-12.00	Şeyma Murdan	Türkiye	Zeytin Yaprağı Ekstraktının Gıdalarda Yenilebilir Film Ve Kaplamalarda Kullanımı
12.00-12.15	Brian Tainika*, Ahmet Şekeroğlu	Türkiye	Comparison Of Live Body Weight, Fluctuating Asymmetry And Location Effect On Behavior In Laying Hens Reared On Litter Floor With Or Without Access To Different Plant Compositions
12.15-12.30	Turgut Atay, Mustafa Alkan	Türkiye	Biological Activity Of The Schinus Molle L. (Anacardiaceae) Essential Oil On Granary Weevil, Sitophilus Granarius (Linnaeus) (Coleoptera: Dryophthoridae)
12.30-13.30	Ara		Break

16 Eylül Cumartesi	Salon2 / Hall2 4. Oturum/ 4st Session		16 September Saturday Time By Türkiye
	Oral Presentation Online **Başkan/ Moderator: Orhun Soydan** Kongre Sekreterya/Congress Secretariat: Ahmet Akyol		
13.30-13.45	Ahmet Akyol*, Ahmet Şekeroğlu, Salim Aktürk, Samet Hasan Abacı	Türkiye	The Effect Of Different Pollen Sources On Colony Foundation Success Of Bumblebees (Bombus Terrestris L.)
13.45-14.00	Orhun Soydan	Türkiye	Hava Kalitesinin Niğde Örneğinde İncelenmesi
14.00-14.15	Orhun Soydan	Türkiye	Peyzaj Planlamada Konfor Bölgelerinin Niğde Örneğinde Belirlenmesi
14.15-14.30	Elif Tuğçe Aksun Tümerkan	Türkiye	Aquafaba As An Emulgator For Spreadable Fish Pate
14.30-14.45	Elif Tuğçe Aksun Tümerkan	Türkiye	Aquatic Biopolymers Used In Edible Film And Edible Coating In The Food Industry
14.30-14.45	Yüksel Aksoy, Ahmet Şekeroğlu, Mustafa Duman	Türkiye	Evalution Of Some Reproductive Performance Of Ewes, Survivalability And Growth Traits Of Lambs Of Akkaraman Bred By Farmers In Niğde Region
14.45-15.00	S. D. P. N. Jayasinghe, S. U. Kumari, and P. N. Yapa	Sri Lanka	Culturing of nitrogen-fixing cyanobacteria in a bioreactor for the production of a biofertilizer

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Determining User Satisfaction of City Parks- Antakya District Atatürk Park And Defne District Sevgi Park Example

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Abstract

Urban parks are one of the most essential components of urban green spaces because they increase the quality of urban life and space. The effects of increasing construction, intense work tempo, and the obligation to work in closed areas have caused people to move away from built environments and turn to green areas. Urban parks are public spaces where citizens come together for their social, cultural, and recreational needs. Issues such as the variety of activities the park has, accessibility to the park, and security are effective on the satisfaction levels of its users in city parks. Within the scope of this study, we aim to question the user satisfaction and preferences of urban parks using the example of Atatürk Park in Antakya district of Hatay and Sevgi Park in Defne district. In this direction, as a result of the survey conducted with 323 people, the user satisfaction of the parks was tried to be determined. In the evaluation of the questionnaires, analyzes were made using SPSS statistical software. As a result of the study, it was concluded that the quality of the services provided in the park, the well-being, cleanliness, accessibility, and safety of the park are important for every element of society, and suggestions were made to improve the current situation

Key Words: *Hatay, urban open-green spaces, city parks, user satisfaction*

Introduction

The urban phenomenon is a dynamic concept that has different meanings in almost every period of history. So much so that it is seen that there is no definition of the city that may be necessary for every time and for every country in both the literature and legislative regulations (Karaman, 1998; Topal, 2004). A city is a living space where social, political, administrative and economic areas exist for all citizens (Kıvılcım, 2007; Hayta, 2016). The concept of city includes all dimensions that surround and are affected by urban dwellers. In addition, it has a quality that needs to be defined in a wide scope. The concept of city has a meaning beyond just being a physical space and population definition. Since it also refers to the process of deep-rooted structuring, studies and research on the city are carried out by many different disciplines. For this reason, the city is a multidimensional field of study with unclear boundaries, and trying to explain the concept of the city with a single definition is very difficult due to the fact that the city is a multidimensional element and changes from society to society in different time periods. When the definitions are combined, it comes to the fore that the city is a place where non-agricultural production is made, where control functions are gathered, and which has reached certain size, heterogeneity and integration levels (Hayta, 2016).

In the historical process, different approaches and definitions have been introduced for urban spaces throughout the civilizations that have existed in the world. According to Broadbent (1990), there have been three main approaches that have determined the design philosophy of urban spaces since the Ancient Greek era:

a) It must begin and end with a perfect plan, which is a rationalist approach.
b) It should start with a phenomenon that human senses can understand, which is an empiricist approach.
c) Through trial and error, it should be determined what can stand in the city, which is a pragmatic approach (İnceoğlu, 2007).

In dictionary meaning, a place is defined as a place where something or someone is located, where an action or event takes place or takes place, a place reserved for a certain use. Space, together with time, is one of the two conditions necessary for the existence of all objects. The two are inseparable, existence cannot be considered independent of time. According to Konuk (1979), space in the urban system is a whole formed by buildings, perceived by urbanites and related to all urban events, or a multidimensional view of the environment from the perceptions experienced. Norberg Schulz, on the other hand, defines architectural space as a piece of space that meets the physiological, psychological and social needs of the users living in it (İnceoğlu and Aytuğ, 2009). It is the space delimiters that

reveal and clarify the space. Earth, sky, shrubs, trees, ground covers, flowers, walls, ceilings, beams, columns or their combinations contribute to the definition of space by limiting the space (Erdönmez and Çelik, 2016).

Urban space is essentially the parts of the city that are defined by buildings but are outside the buildings. It is directly related to architectural space, which is basically the embodiment of existential space. In the past, urban space and architectural space were spaces in the same sense due to the continuity between them, but with modernism, architectural space became structurally and perceptually isolated and took on the character of the space of independent buildings. Despite the attention given to these independent buildings, the quality and organization of the spaces between the buildings were left to chance to a great extent, and as a result, urban spaces were left as spaces left over from planning (Çakmaklı, 1992; İnceoğlu, 2007).

Kentlerin oluşumundan bu yana, her kent içerisinde barındırdığı toplumu şekillendirmiş ve aynı şekilde bu toplumu oluşturan her bireyden birçok anlamda etkilenerek şekillenmiştir. Bu devinim hali, kentleri yaşayan organizmalar olarak tanımlamamızın temel nedenlerinden biridir (Erdönmez and Çelik, 2016).

O yüzden kentsel mekânlar, değişen sosyo- ekonomik koşullara ve kentlerin kültürel dokusuna cevap verebilen "yaşayan organizmalar" (Alexander, 1977; İnceoğlu, 2007) olarak da kabul edilmektedir. Kentsel mekânlar aynı zamanda insanların bütünlük/bütünleşme duygusunu oluşturmak için bir araya gelmelerine izin veren sosyal bağlayıcılar olarak hizmet etmektedirler. Kentsel mekânlar, kamusal mesajların ve fikirlerin paylaşıldığı, aktarıldığı yerlerdir. Bu aynı zamanda toplumsal bir aradalık ve kaynaşma sağlar. Bu mekânların kaybolması veya yok olması o kentte yaşayan insanların birbirinden uzaklaşmalarına ve birbirleriyle olan insani ilişkilerin azalmasına sebep olabilmektedir (İnceoğlu, 2007).

This important role of public spaces, especially open public spaces, in cities and in human life makes cities more livable and dynamic. Urban spaces, which are formed by the relationships and proximity of buildings with each other and with other elements in the outer space, and all the spaces between buildings in the city, are spaces with physical boundaries and forms and should give a sense of closeness. Urban spaces are also a set of spaces where people perform the four main functions related to human life: shelter, work, entertainment, rest and transportation, and they should have users (Erdönmez and Çelik, 2016).

City Parks as Urban Outdoor Spaces: Urban parks, which function as defined urban spaces, are places and symbols that bring people together and help to ensure communication between the individual and society. The gathering of multiple people in the same space constitutes a social activity at every moment. In this context, the more time people spend in urban open spaces, the more likely they are to encounter other urbanites. These encounters can take place through celebrations, actions, concerts, demonstrations and passive communication. Being together with other people, watching them and being influenced by them provide more positive effects and experiences than being alone and can lead to the formation of the desired urban identity (Özdemir, 2009). In modern societies, the first definition of planned urban green spaces was made by the American landscape architect Frederick Law Olmsted in the 19th century with the creation of the Boston Park System (Zaitzevsky, 1982). In this plan, pioneering steps were taken in recreational urban planning in parallel with the approach of bringing nature into the city, which started with Central Park in New York (Schuyler, 1988). In the planning process, geologists, engineers and public health professionals worked together to create spaces where people could live healthier and more comfortable lives (Little, 1995).

It can be seen that recreation is a type of need that includes many activities. Many definitions have been made regarding recreation and recreation activities have been tried to be explained. Recreation includes all physical and mental activities that a person does for resting, gaining strength and health, and having fun (Altınel, 1998; Özkır, 2007). The economic functions of urban open and green spaces are as multifaceted as their other functions. They increase the rent value of the area where they are located. If we consider agricultural areas while explaining the economic functions of urban open and green areas, although cities are defined as areas where non-agricultural activities are concentrated, the preservation of the agricultural system and culture in our traditional urban fabric is important in terms

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of being considered as a part of urban green areas. In addition, production and consumption activities in agricultural areas have an economic character (Ertekin, 1992; Özkır, 2007).

User Satisfaction in Urban Parks: User satisfaction is defined as the environmental conditions that include facilities that will help the user to perform recreational activities efficiently in the recreation area without social, psychological and physiological disturbances. User satisfaction is affected by the personal characteristics of the users, the characteristics of the recreation area and the type of activities in the area. (Güngör, 2002; Uzun, 2005). In order to maximize the satisfaction of users with recreation areas, recreation areas are expected to serve the needs and desires of various age groups, gender, education and occupational groups separately. For this reason, designs that give users peace and confidence, relaxation and rest, and most importantly, ensure that they are satisfied with the space should be considered as a priority in planning. Users' criticisms, reactions, requests, suggestions, various observations, monitoring, investigations, etc. about the space should be systematized and decisions for planning should be produced (Kart, 2002; Uzun, 2005). Although the wishes and expectations of the people who will use the park are determined by various methods during the planning phase, there are very few studies that measure the impressions and reactions of the users about the park after the realization of the park (Tepe, 2010).

Karlıer (2017) summarized the research objectives in user satisfaction studies conducted in urban parks as follows;

- To determine the socio-economic characteristics of park users,
- Identify the usage patterns of park users,
- To evaluate the performance, efficiency and functionality of parks by determining user preferences, satisfaction and dissatisfaction in parks,
- Identify design features that encourage users to be more physically active and socially engaged in urban parks (King 2012).
- Perceive the benefits of urban parks for people and the city in which they are located,
- It is to evaluate the data obtained and offer appropriate solutions (Gorner and Cihar 2011).

The strategy for a sustainable landscape development should not only focus on physical sustainability, but the sustainability indicators of cities for urban development should include more, and most importantly, it should guarantee that users can participate (Mahdavinejad and Abedi 2011). The fact that urban parks offer a variety of opportunities to users increases the duration of use by park users. The fact that the areas offer users different recreational uses together positively affects user satisfaction (Lee 2007). After the planning and implementation stages, it is of great importance to determine the satisfaction or dissatisfaction of the users in the parks in order to maintain sustainable use in urban parks. Such studies allow parks to be revised in accordance with changing expectations and desires over time. Satisfaction or dissatisfaction rates and other requests and uses are determined through surveys conducted in the field. With the evaluation of the survey results, new revisions to be implemented are decided and necessary arrangements can be made regarding park management (King 2012). In urban parks, applications made without losing natural features and more effective uses increase the satisfaction level of urban users (Syme et al. 2001). The main purpose of this study is to determine the satisfaction and dissatisfaction factors of recreational park users in urban parks, which play an important role in social terms, and to support more sustainable planning and management of these areas by considering the data obtained (Karlıer, 2017).

Materials and Methods

Hatay province is located in the eastern Mediterranean part of the Mediterranean Region of Turkey. It is bordered by Syria to the east and south, the Mediterranean Sea to the west, Adana to the northwest, Osmaniye to the north, and Gaziantep to the northeast. According to the results of the Address Based Population Registration System for 2021, the city has a population of 1,670,712 people (URL, 1). Although the city has a total of 15 districts, the district with the highest population is Antakya, which is the central district with 393,634 people. The surface area of the city is 5.524 km2 . In Hatay province, there are 302 people per square kilometer and the population density is 302/km2 (URL,2). Within the scope of this study, Atatürk Park in Antakya district of Hatay province and Sevgi Park in Defne district were selected as the study area. While selecting the parks, their location, size, intensity of use and the landscape elements they contain were taken into consideration. The park

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with the largest square meter area in the study area is Atatürk Park with 56770 m2 . At the same time, it is the largest green area used for recreational purposes within the urban fabric of Antakya (Bilgili, 2001).
The park, which is one of the oldest parks of Antakya, is also known as the Great Antakya Park, Antakya Municipality Park and Historical Antakya Park. This park is one of the most preferred parks for recreational activities of the city people. There are walking paths, semi-enclosed and open seating and recreation areas, children's playgrounds serving different age groups, outdoor sports areas, demonstration pools, artificial pond, ceremony area and cafes. In addition to its historical texture, the park is also important in terms of the variety of plant species it has (Çinçinoğlu, 2019).
Opened in 2017, Sevgi Park is 23000 m2 in total and consists of two stages of 13000 m2 and 10000 m2. The park includes children's playgrounds, a barrier-free playground for disabled children, pergolas, gazebos and benches, outdoor sports areas, walking paths, a skateboard track, basketball and volleyball courts (URL, 3).
Population and Sample of the Study:
The population of the research consists of local people who visit Atatürk and Sevgi Parks. A total of 323 park users, 170 males (52.6%) and 153 females (47.4%), selected by simple random sampling method, were reached.
The scope of the study consists of 3 stages. In the first stage, the relevant literature was reviewed to create the theoretical framework of the study and to determine the study model. Then, in line with the researches conducted, the areas were visited, on-site observations were made and photographed. After the formation of the theoretical basis, data collection was started and a questionnaire was applied as the main technique. The questionnaire form prepared on Google Forms was applied to the participants both online and face-to-face. In the first part of the questionnaire form consisting of 3 parts and 25 questions, questions were asked to determine the demographic characteristics of the participants. In the second part, the characteristics of the park users, the purpose of visiting the parks and the reasons for preference were determined. In the last part, questions were asked to determine user satisfaction levels. A 5-point Likert scale was used for these statements. The 5-point Likert Scale consists of statements such as "Completely Disagree", "Disagree", "Neither Agree nor Disagree", "Agree", "Completely Agree". The questionnaire data obtained from Google Forms were organized in Microsoft Excel software and statistical analysis of the data was carried out by analyzing the study data in SPSS 20 (Statistical Package for the Social Sciences) statistical package program.

Results and Discussion

The analysis of the data consists of three parts. In Section 1 and Section 2, descriptive analysis technique was used and the data obtained were presented according to frequency distributions supported by graphs. In Section 3, the answers given by the participants to the user satisfaction questionnaire were statistically analyzed according to gender, age, educational status and occupation variables. Independent groups t-test analysis was used for gender, and Kruskall Wallis analysis was used for age, educational status and occupation variables. Parametric analyses could not be performed because age, educational status and occupation variables were not normally distributed. In Kruskall Wallis analysis, Mann-Whitney-U analysis was performed one by one to determine which groups the difference was between.
Part 1
1- Distribution of the parks that the participants in Hatay city prefer to visit Which of the two big parks in the city the park users who participated in the research prefer to go to more: Accordingly, it was concluded that 226 of the 323 park users who participated in the research preferred to go to Antakya Atatürk Park more, while 97 users preferred to go to Defne Sevgi Park.
2. Participant opinions on whether the number of parks in the city of Hatay is sufficient The participant opinions on the proposition that the number of city parks is sufficient for the city of Hatay were examined and according to the results obtained, a large majority of 226 of the park users participating in the research found the parks in the city insufficient in number, while the number of people who found them fully sufficient was 38.
3. Distribution of participant opinions on whether the number of parks in Hatay city is sufficient or not according to gender
When the question asked to the participants about whether the number of parks in Hatay is sufficient was analyzed in terms of gender, it was seen that the number of men (f=73) who strongly disagreed was higher than the number of women (f=63). The number of men who strongly agree (f=24) is higher than women (f=14).
4. Distribution of participants' opinions on whether the number of parks in Hatay city is sufficient according to age categories

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When the question asked to the participants about whether the number of parks in the city of Hatay is sufficient was analyzed in terms of age, it was determined that the age group that strongly disagreed was the group between the ages of 18-25 (f=31) and 46-55 (f=31).

5. Distribution of participant opinions on whether the number of parks in Hatay is sufficient according to educational level categories

When the question directed to the participants about whether the number of parks in Hatay city is sufficient was analyzed according to their educational levels, it was determined that the group who strongly disagreed was higher education graduates (f=61).

6. Distribution of participants' opinions on whether the number of parks in Hatay city is sufficient according to occupational categories

When the question asked to the participants about whether the number of parks in Hatay is sufficient was analyzed according to occupational groups, it was seen that the group that strongly disagreed was composed of public sector employees (f=50), followed by private sector employees with (f=25).

Part 2

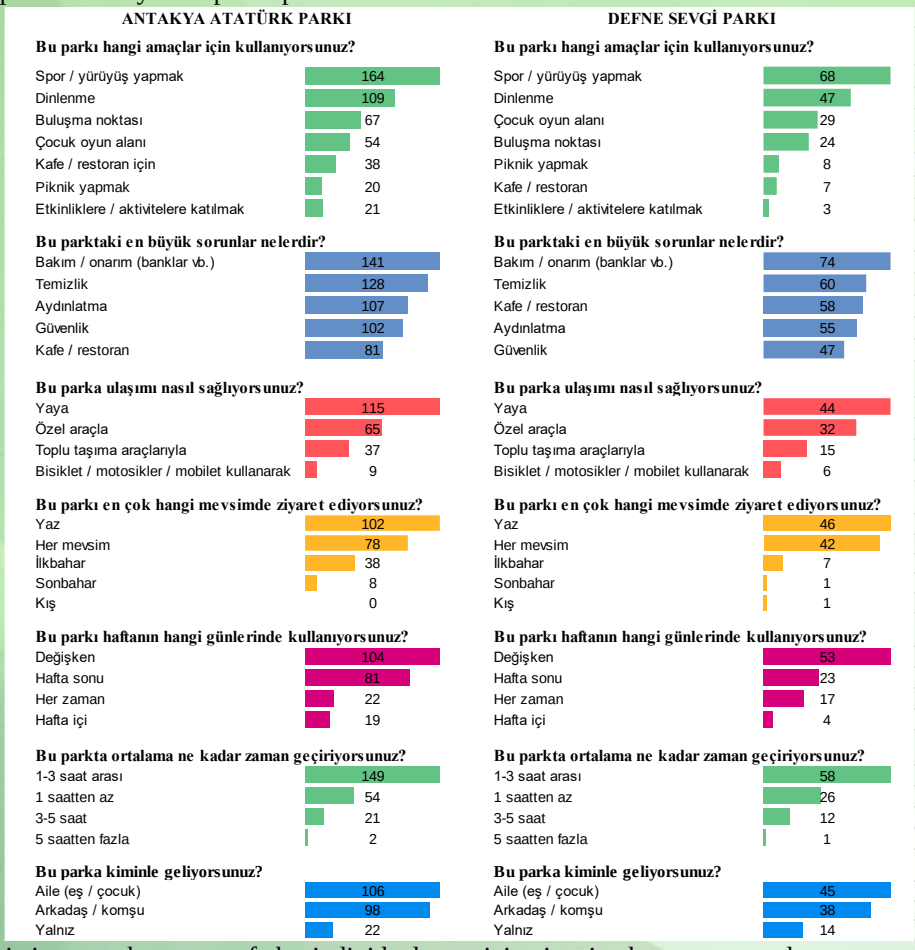
7. General evaluations of the participants about the urban parks in Hatay

Accordingly, it was determined that most of the individuals participating in the survey study conducted in Antakya Atatürk Park and Defne Sevgi Park use the parks for sports/walking and relaxation, and that they (f=232) access the parks on foot in all seasons (f=159). It was determined that the participants mostly preferred to come to these parks with their families and friends/neighbors (f=151) and spent 1-3 hours in the area (f=207). It was determined that the study areas were more frequently used on weekends and variable days, and in the summer season (f=148 summer, f=120 all seasons).

8. Participants' general evaluations of each urban park in Hatay

Comparative views of the participants about the parks in the city are presented in Table 1.

Table 1. Comparative analysis of participants' views



Accordingly, it is seen that most of the individuals participating in the survey study come to the parks for sports/walking and relaxation. The reason why Antakya Atatürk Park is preferred as a meeting point can be evaluated as the park is located in Antakya Köprübaşı in terms of accessibility, within walking distance to

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important points of the city such as Hatay Metropolitan Municipality, Atatürk Street, governorship, Historical Long Bazaar. The reason why Defne Sevgi Park is preferred as a children's playground is that there are playgrounds for different age groups as well as basketball and soccer fields and a skateboard track for sportive activities. With the multi-response question analysis for the individuals participating in the survey study, it was concluded that the common problems in the parks are the lack of equipment elements and the general cleanliness of the parks. According to the users, one of the biggest problems identified in Antakya Atatürk Park is lighting, and users think that the night lighting is inadequate, especially in the fall / winter months, and that this situation poses a problem in terms of security. According to the users, one of the biggest problems identified in Defne Sevgi Park is the lack of a café/restaurant in the park area. The survey is quite positive in terms of accessibility. It can be concluded that users prefer to come to the parks on foot due to the fact that both parks are located in the center of Hatay and can be easily accessed, the variety of different uses in the immediate vicinity and the strong relationship with the residences. It is seen that the majority of the respondents use the parks in the summer months. It can be said that the reason why the parks are not preferred in winter months is due to the insufficiency of winter use and function areas in both parks.

The majority of the park users who participated in the survey study stated that they use the parks on variable days and spend between 1-3 hours. In addition, it was concluded that users prefer to come to the parks with their families and children. This may be due to the presence of children's playgrounds and sports fields in the parks. The high number of people who come to the parks with their neighbors and friends can be associated with the presence of places where people can engage in activities together, relax and chat.

9. Comparative analysis of participants' views on parks in the city by gender

According to the results of the analysis, Antakya Atatürk Park is the park that both women (f=109) and men (f=117) of the participants prefer to visit the most.

10. Comparative analysis of participants' views on parks in the city by age

According to the results of the analysis, it was determined that Antakya Atatürk Park was the park that the participants, especially those between the ages of 26-35 (f=68) and 46-55 (f=35), preferred to visit the most.

11. Comparative analysis of participants' views on parks in the city according to their educational level

According to the results of the analysis, it was determined that Antakya Atatürk Park was the park most preferred by higher education level participants (f=105), followed by secondary education with (f=75).

12. Comparative analysis of participants' views on parks in the city according to occupation variable

According to the results of the analysis, Antakya Atatürk Park was found to be the most preferred park especially by public sector employees (f=95) and private sector employees (f=42).

Urban parks, which are one of the important components of urban open green spaces, are multi-purpose public spaces that improve the quality of urban life, strengthen the image of the city, and contribute to the health and welfare of urbanites in terms of socio-cultural, psychological, ecological, economic and aesthetic aspects. These areas, which host a large number of users from different age groups, are not only recreational areas, but also places where celebrations, exhibitions and festivals are held, providing many benefits to the city and urbanites. For the efficiency and sustainability of urban parks, it is very important to determine the preferences, expectations, satisfaction or dissatisfaction of the users. From this point of view, this study was carried out on the examples of Atatürk Park in Antakya district of Hatay province and Sevgi Park in Defne district of Hatay province to determine the user profile / diversity, park usage characteristics, accessibility status, preferences and expectations and satisfaction levels of the park. Both observation and survey studies were conducted to determine user preferences. The data obtained from the survey study conducted with 323 participants on park samples were analyzed and evaluated with various statistical techniques. The majority of the park users who participated in the survey answered 'strongly disagree' to the proposition 'The number of urban parks in Hatay is sufficient' and stated that they found the number of parks in the city insufficient. When this question is analyzed in terms of gender, it is seen that male users find the number of parks more insufficient than female users. When analyzed in terms of age, it is seen that the age group that 'strongly disagree' is the group between the ages of 18-25 and 46-55. When the same question is analyzed according to education levels, it is seen that the group that says 'strongly disagree' is the group of higher education graduates. Again, when the same question is analyzed according to occupational groups, it is seen that the group that answered 'strongly disagree' consists of public employees.

It has been observed that users mostly use the areas in the summer season, especially in the afternoon and evening hours, and this coincides with the data obtained from the survey. Again, according to the observations, it was determined that the areas were mostly used for walking, sports, children's playgrounds, recreation and meeting points, and this situation coincided with the findings obtained from the survey. The use of the parks in the fall (f=9) and winter (f=1) months is quite low. This may be an indication that the use of these parks outside of summer is insufficient. During the field visits during the research, it was observed that the parks were used intensively especially on weekends. According to the data obtained from the questionnaire study, it was

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concluded that the parks were used variably (f = 157). In this context, it can be concluded that parks are used to relieve the stress caused by work life or school, to spend time with family, children, friends and neighbors on weekdays and weekends after work and school, during lunch breaks. When the participants were asked with whom they preferred to go to the parks in the study area, it was found that (f=151) preferred to go with their family (spouse, siblings, children, etc.) (f=136) with friends and neighbors (f=36) alone. It was observed that similar results were obtained in previous studies. For example, Önal and Sağır (2018) stated that users prefer to visit parks mostly with their families, Ayhan and Atabeyoğlu (2020) stated that users prefer to visit parks with friends (62.7%) and family.

In the study, park users stated that they mostly prefer to come to the areas on foot. This is an important factor affecting the satisfaction of park users. It was observed that similar results were obtained in previous studies. For example, Çetinkaya, Erman, Uzun (2015) found that the most important factor affecting the satisfaction of park users is the accessibility factor. Users responded to the biggest problems they encountered in parks as maintenance/repair, cleaning, lighting, security, insufficiency of cafes and restaurants. In this case, the equipment and flooring elements used in the parks should be periodically maintained, and those that are not suitable for use should be replaced with new ones. Users find the restrooms in the parks inadequate in terms of cleanliness. Directional signs should be placed in the parks indicating the location of the toilets, the number of existing toilets should be increased, and cleanliness should be taken into consideration. The users who participated in the survey stated that the number of places where they can meet their food and beverage needs in the parks is low. In the case of Defne Sevgi Park, there is no organized space within the park. Therefore, they would like to have an indoor place that can be used for winter, which can be used for resting and eating and drinking. Parks should not only be used at certain times of the day. For this, a well-planned lighting design is needed. Functional and aesthetic lighting units that allow the use of parks especially in the evening should be used. Lighting design will reduce the security concerns of the users and increase the visual quality of the parks.

In the study, it was concluded that park users spend between 1-3 hours in the parks. This is an indication that parks are used only for walking/sports and relaxing and that there is a lack of activities for them to spend more time. The number of recreational activities should be increased and activity organizations suitable for all elements of the society should be organized in order to keep the visit time of the users longer. Appropriate playground and equipment elements should be placed so that parks can be used by people with disabilities without barriers. Winter garden designs should be considered in order to use parks actively in all seasons and to increase the intensity of use in winter months. Urban parks are very important prestige resources that increase the brand value and visual quality of the city they are located in. It is difficult to gain the appreciation of all levels of society in these areas. However, it is possible to determine the expectations and wishes of the users through user satisfaction surveys to be conducted from time to time and to transform the areas into a center of attraction with new strategies. User satisfaction surveys are an important source of data for meeting expectations and requests, as well as accessing many data such as users' participation in activities in parks, the status, frequency and duration of use of parks, strengths and weaknesses of parks. With the data obtained from the survey results, it is ensured that the parks can be maintained in a healthy way and that the satisfaction levels of the users reach the highest level. It also makes it easier to plan future urban parks in this direction and adapt them to the users. It is thought that the data obtained can be a reference for future satisfaction studies, and in line with the suggestions presented, both the space quality and user satisfaction level of Antakya Atatürk Park and Defne Sevgi Park will increase.

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Efficiency of Locally Isolated *Trichoderma virens* for Controlling Rice Brown Leaf Spot Disease Caused by *Bipolaris oryzae*

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Abstract

Rice brown leaf spot disease caused by *Bipolaris oryzae* is one of the major rice diseases in Sri Lanka and which effects the rising concerns of food safety. Biological control of brown spot disease is an alternative method for synthetic fungicide. *Trichoderma* is a widely studied bio-control agent and it is proven to be effective against a wide range of plant pathogens. In the present study a locally isolated *Trichoderma virens* was tested against the brown spot pathogen, *Bipolaris oryzae* in *in-vitro* conditions. Identity confirmation was done by using morphological methods and molecular through Polymerase Chain Reaction (PCR) with ITS 1 and ITS 4 primers and subsequent homology search. Antagonism of *T. virens* against *B. oryzae* was tested using dual culture technique. Locally isolated *Trichoderma virens* had an inhibition ability of 75 % in dual culture test. Finally, it is evident that *Trichoderma virens* can successfully inhibit growth of the pathogen under *in vitro* conditions.

Key Words: *Biological control, Polymerase Chain Reaction, Inhibition ability*

Introduction

RBLS caused by *Bipolaris oryzae* has been drastically impacting the rice production. Most of the farmers rely mainly on chemical control strategies to control RBLS disease, and there is an increasing inclination to reduce the use of chemical applications as it can have negative effects on the environment and human and animal health (Tariq et al., 2002). Therefore, in the new era of sustainable agriculture, a shift from chemical towards integrated methods have been promoted. Hence control of the pathogen through biological control is a good alternative approach to minimize the abusive use of chemicals.

Biological control is a mechanism in which the natural enemies diminish pathogens (Kamal et al., 2015; Pal and Gardener, 2006). Moreover, the introduction of micro-organisms into the phylloplane, the rhizosphere, or soil, stimulating indigenous antagonist, induced resistance, and bio-rational approaches are the main concepts in bio-control (Van Lenteren, 1988; IRRI knowledge Bank, 2020). Therefore, bio-control assumes special significance being an eco-friendly and cost-effective strategy that can be used in integration with other strategies for a greater level of protection with sustained rice yields (IRRI knowledge Bank, 2020). There are diverse groups of antagonistic micro-organisms such as bacteria and fungi that exist in nature.

Various species of fungi and bacteria have been proven effective as bio-control agents. Namely, *Pseudomonas*, *Serratia* and Bacillus-like bacterial species (Ganamanickam, 2009; Jaignesh et al., 2007; Harman, 2006; Nandakumar et al., 2001), *Trichoderma* spp. (De Franca et al., 2015; Khalil et al., 2011; Ganamanickam, 2009), *Aspergillu* spp., and *Penicillum* spp. (Kunyosying et al., 2018; Alam et al., 2011; Ade-bola and Amad, 2010). Moreover, antagonistic micro-organisms possess multiple beneficial characters such as competence in the rhizosphere, antagonistic potential, ability to produce antibiotics, lytic enzymes, and toxins (Mukherjee and Maheswari, 2018). According to the Verma et al., (2007), among all antagonistic micro-organisms, most studied members include those belonging to the genus *Trichoderma. Trichoderma* spp. grow in the rhizosphere and are capable of penetrating and internally colonizing plant roots. This symbiosis is driven by the ability of *Trichoderma* to derive sucrose or other nutrients from plants, in return for boosting plant immunity against invading pathogens as well as stimulating the growth of plants (Harman, 2006). *Trichoderma virens* in the rhizosphere is providing opportunities to plants by producing plant growth-promoting hormones (e.g. IAA). Accumulation of auxins or increased responses to auxins might lead to diverse outcomes on the plant side, such as enhancing root depth and root concentration; in turn, increased the water and nutrient uptake capacity of plants. Also, that promotes plant defense mechanisms (Contreras-Cornejo et al., 2009; Navarro et al., 2006). Nevertheless, *T. virens* is providing external protection to the plant as well by using its own mechanisms. *Trichoderma* gains more attention because of its effectiveness and ease of production for commercialization. *Trichoderma* species have been utilized to control rice diseases. For example, *T. viride* was used against rice

brown spot (Gomathinayajam et al., 2010), sheath blight (Mathivanan et al., 2005), and *T. harzianum* against brown spot (Khalil, 2011; Abdel- Fattah et al., 2007). Moreover, in the Sri Lankan context, *T. herinaceum* was used against *Rhizoctonia solani* (Herath et al., 2015). Therefore, this research was carried out with the objective of isolation and efficiency testing of locally isolated *Trichoderma* species against the RBLS disease.

Materials and Methods

This study was conducted from December 2019/2020 *Maha* season (wet season) including a field sample collection in the research field, Faculty of Agriculture (FoA), Rajarata University of Sri Lanka (RUSL).

Isolation and identification of rice brown spot pathogen using conventional methods

The brown spot-infected leaf samples were collected from the rice field maintained by the faculty for research purpose. Isolation and purification of the pathogen responsible for brown spot using the samples were done at the Plant Pathology Laboratory, Faculty of Agriculture, Rajarata University of Sri Lanka. Rice brown leaf spot infected leaves were surface sterilized using 1 % sodium hypochlorite solution and 70 % ethanol for 1 min. followed by a washing step with distilled water. Potato Dextrose Agar (PDA) medium was used for culturing the microorganisms. Surface sterilized samples were dried after placing them between two sterile filter papers. Then the samples were placed on PDA medium under aseptic conditions. Subsequently, the samples were incubated at 28 ± 1 °C for 72 h. Identification of fungi associated with brown spot lesions was done on the basis of spore size and shape, culture characteristics, other microscopic observations such as mycelial structure variations, types of conidia, and molecular techniques. Koch postulate was performed and confirmed the pathogen.

Molecular confirmation of the isolated rice brown spot pathogen

Fungal DNA extraction was done according to Mc Gravey and Kaper (1991) method with some modifications. Briefly, mycelia were scraped off from 7-day-old culture grown at room temperature and ground in the extraction buffer with the help of a pre-cooled motor and pestle. The macerate was mixed with 2 mL of homogenization buffer followed by incubation at 37 ºC for 15 min. After the incubation, 1 mL of extraction buffer, 300 µL of 20 % SDS and 0.5 % of mercaptoethanol (v/v) were added and mixed by inverting. Then the solution was incubated at 65 ºC for 1 h. Homogenate was extracted twice with the addition of equal volume from a mixture of phenol: chloroform: isoamyl alcohol (25:24:1 v/v/v). Phenol and aqueous phases were separated by centrifugation at 12000 rpm for 5 min. The aqueous phase was treated with RNase A (100 mg/mL) (Sigma Aldrich, USA) and Proteinase K (10mg / mL) (Sigma Aldrich, USA) and incubated for 15 min at 37 º C. DNA was extracted by using equal volume of chloroform: isoamyl alcohol (24 :1 v/v) and centrifuged at 12000 rpm for 5 min and precipitated by adding 0.6 x vol. of isopropyl alcohol followed by incubation on ice for 30 min. DNA was purified by re-precipitating with 2.5 x vol. ice-cold 70 % ethanol and 0.5 x vol. 7.5 M ammonium acetate (pH 7.7) and incubated at room temperature for 30 min. and centrifuged at 12000 rpm for 20 min. The final pellet was washed with 70 % ethanol, air-dried, and re-suspended in 15 µL TE buffer pH 7.5.

The resulted DNA was used for subsequent Polymerase Chain Reaction (PCR) assays using BIO-RAD My Cycler PCR machine with primers targeting the Internal Transcribed Spacer Region (ITS) of fungi. The nucleotide sequences of these spacer regions are often much more polymorphic between species than within species. Therefore, polymorphisms in ribosomal DNA (rDNA) and sequence data of the internal transcribed spacer 1 and 2 regions are widely used for differentiation of fungal pathogens. ITS1 (3' GCC GTA GGT GAA CCT GCG G 5') and ITS4 (3' GCC TCC GCT TAT TGA TAT GC 5') universal primer pair was used in the PCR (White et al., 1990). The PCR products were visualized by gel electrophoresis in a 1.5 % agarose gel and sent to Macrogen Inc. Korea for DNA sequencing. DNA sequence data of *B. oryzae*, generated from this study was subjected to homology search using the NCBI_BLAST software (National Center for Biotechnology Information – The Basic Local Alignment Search Tool) for the identification purpose and the sequence was deposited in the NCBI gene bank under the accession number of MZ618926.

Isolation and confirmation of locally isolated *Trichoderma* species

Soil samples were collected from various locations in the faculty farm premises. Old mushroom litter samples were collected from the mushroom unit in FoA, RUSL. Root samples of *Imperata cylindica* (*Illuk*) and *Megathyrsus maximus* (Guinea grass) were also collected from the particular field. All soil samples that were being taken using a soil auger of 2.5 cm diameter from the 0-30 cm top layer, were mixed to make a composite sample of around 0.5 kg. After placing the samples in sterilized plastic bags, they were brought to the laboratory and kept under cool condition. From each composite sample, 10 g of soil was weighed and mixed with 90 mL sterile distilled water and two drops of Tween 20. The mixture was vortexed (3500 RPM) and allowed to stand for 5 min to settle the soil particles. Serial dilutions were done up to 10^{-3} concentration. 100 µL from each dilution was plated onto PDA media. Plates were maintained at 28 ± 1 °C, for 6 days in dark and observed daily

(Montoya-Gonzalez et al., 2016). *Trichoderma* species was isolated from the old mushroom litter samples. Thirty-five grams from each of the fifteen samples of old litters were taken and mixed to make a composite sample of around 0.5 kg. Samples were cultured using the Serial Dilution Technique (Aneja, 2002). Dilution series were prepared up to 10^{-3} level in sterilized Petri plats and 1 mL from each dilution was cultured. Plates were maintained at 28 ± 1 °C for 6 days in darkness and observed daily. *Imperata cylindica* and *M. maximus* plants were uprooted and root sections of 0.5 kg were collected in plastic bags. Excess soil particles adhere to roots were removed by using distilled water. Subsequently, they were cut into small portions and placed in PDA plates. Plates were maintained at 28 ± 1°C up to 6 days in darkness and observed daily. Identification of antagonistic fungi was done on the basis of spore morphology and culture characteristics.

Molecular confirmation of the isolated *Trichoderma* species

Molecular identification was as same as described above procedure follow for the *B. oryzae*. The sequence was deposited in the NCBI gene bank under the accession number of MT256290.1.

Efficiency of *Trichoderma virens* against *Bipolaris oryzae*

Dual Culture Test (Dennis and Webster, 1971) was used to study the reduction in the growth of pathogens and inhibition zone formed due to the antagonistic activity of the bio-control agents**.** Five mm diameters gel plugs of the pure culture of each bio-control agent were placed on the PDA medium in opposite direction against pathogenic fungi. The plates were incubated at 28 ± 1°C, and the results were noted from the day after culturing until 6 days. The length of the mycelium growth was measured. Data were analyzed using proc mixed model in ANOVA followed by LSD mean separation by using SAS version 9.0 software.

Results and Discussion

Isolation and identification of brown spot pathogen using conventional methods

During the study after 72 h of incubation; initially, the molecularly confirmed *B. oryzae* colony appeared whitish in color. As the colony matures, it gradually turned grey to dark grey with a whitish margin. The fully matured culture was black in color (Figure 1). Similar observations have been made by Monisha et al. (2019) and Nayak and Hiremath (2019). Furthermore, the pathogen was microscopically confirmed by the presence of characteristic conidiophore that arises singly or groups, multi-septate, and brown in color. Conidia were curved or slightly curved; initially hyaline and later on maturity turns brown in color, fusiform with hilum at the base. Similar observations have been made by Monisha et al. (2019).

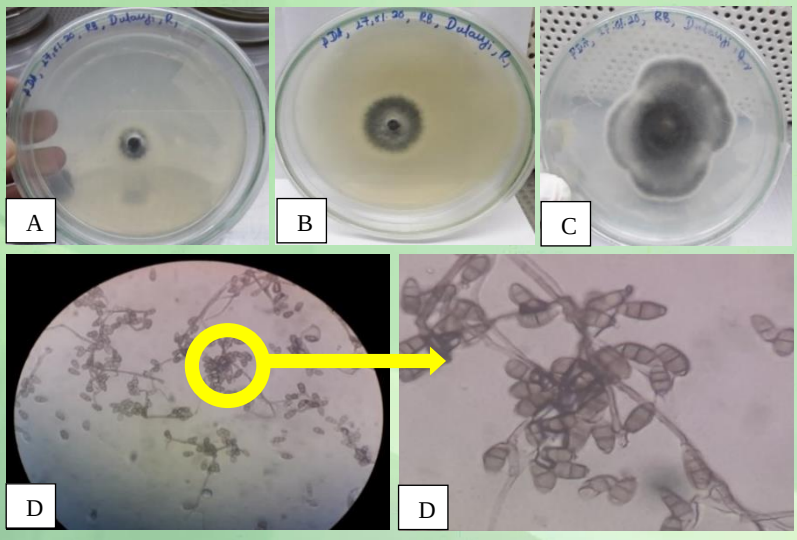


Figure 1: Macroscopic and microscopic features of *B. oryzae* (A) One-day old culture, (B) Three-days old culture, (C) Four-days old culture, (D) Three-celled, pyriform, hyaline conidia

Molecular confirmation of the isolated *Bipolaris oryzae*

Bipolaris oryzae used in this study gave 100 % maximum identity with a query cover of 100 % to the sample (MT446115.1) NCBI gene bank accessions.

Morphological basis confirmation of isolated *Trichoderma* species

The isolated three *Trichoderma* species appeared to be filamentous and white initially, turning into green to dark green colour. The growth was fast and it covered the plate just in 4 days. These observations were similar to the discription of Samuels (2006) and Druzhinia et al. (2006). Based on the microscopic observations, conidia were single-celled with hyaline hypea, globular shaped and greenish in colour (Figure 2). These characteristics compared well with the discription of USDA fungal database, reported by Samuels (2006) and Druzhinia et al.(2006).

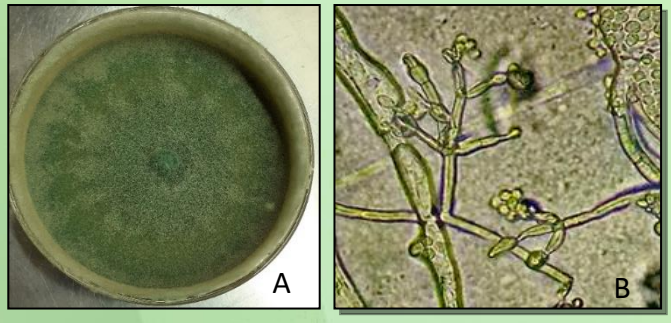


Figure 2: Macroscopic and microscopic features of *Trichoderma* spp. (A) Five-days old culture, (B) Microscopic structures

Molecular confirmation of the isolated *Trichoderma* species

Trichoderma isolate used in this study gave 100 % maximum identity with a query cover of 100 % to the sample (MT256290.1) NCBI gene bank accessions.

Efficiency of isolated antagonistic microorganisms against *Bipolaris oryzae*



Figure 3: Antagonistic ability of *Trichoderma* spp. against *B. Oryzae*

Trichoderma virens had an inhibition ability of 74.6 % (Figure 3). Ng et al. (2015) reported that *Trichoderma* spp. are soil-inhabiting microorganisms with a high degree of antagonism and mycoparasitic potential than other antagonistic agents. For instance, Mukherjee and Maheeshwari (2018) suggest that *Trichoderma* has a higher growth inhibition ability against some rice diseases such as Narrow brown leaf spot. Abdel-Fattah et al. (2007) and Khalili et al. (2011) found that *Trichoderma* spp. inhibit the growth of rice brown spot disease as well. Therefore, *Trichoderma* spp. will be a promising alternative treatment against *B. oryzae*.

Conclusions

The isolated pathogen associated with Rice brown leaf spot disease was morphologically and molecularly confirmed as *Bipolaris oryzae* (accession number MT256290.1). *Trichoderma virens* (accession number MT256290.1) was isolated from the local soil samples and molecularly confirmed. *Trichoderma virens* had an inhibition ability of 74.6 % in dual culture test.

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Water Footprint of Aquaculture Production

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Abstract

Water is a very familiar substance and is therefore often underestimated. The water footprint (WF) shows the extent of water use based on consumption by humans. The water footprint of an individual, community, or business is defined as the total volume of freshwater consumed by the individual or community or used to produce goods and services produced by the business. Water is a valuable resource that must be protected for present and future generations because both natural ecosystems and human society are highly dependent on an adequate and quality water supply. There is a shortage of fresh water in many parts of the world, and in many places, the quality of freshwater and seawater is deteriorating due to pollution. Agricultural production accounts for 92% of humanity's freshwater footprint; almost a third of this is related to animal production. The study shows that animal products have a larger water footprint (WF) than the production of plant products. All agricultural production activities require water, but water is particularly important for aquaculture as it is the medium in which aquatic food organisms are produced. Since aquaculture is often associated with intensive production patterns, those interested in water conservation have begun to explore the possibility of excessive water use in aquaculture. Therefore, aquaculture must continually struggle to use water efficiently and be prepared to defend water use practices.

Key Words: *water footprint, aquaculture, sustainability, water consumption*

Su Ürünleri Üretiminin Su Ayakizi

Özet

Su çok bilindik bir maddedir ve bu nedenle genellikle hafife alınır. Su ayak izi (WF), insanlar tarafından tüketime bağlı olarak su kullanım kapsamını gösterir. Bir bireyin, topluluğun veya işletmenin su ayak izi, birey veya topluluk tarafından tüketilen veya işletme tarafından üretilen mal ve hizmetleri üretmek için kullanılan toplam tatlı su hacmi olarak tanımlanır. Su, şimdiki ve gelecek nesiller için korunması gereken değerli bir kaynaktır, çünkü hem doğal ekosistemler hem de insan toplumu, yeterli ve kaliteli su kaynağına büyük ölçüde bağımlıdır. Dünyanın birçok yerinde tatlı su kıtlığı yaşanmakta ve birçok yerde kirlilik nedeniyle tatlı su ve deniz suyunun kalitesi kötüleşmektedir. Tarımsal üretim, insanlığın tatlı su ayak izinin %92'sini oluşturmaktadır; bunun neredeyse üçte biri hayvansal üretimle ilgilidir. Yapılan çalışmada, hayvansal ürünlerin, bitkisel ürünlerin üretimine göre daha büyük bir su ayak izine (WF) sahip olduğunu göstermektedir. Tüm tarım üretim faaliyetleri suya gereksinim duymaktadır, ancak su, suda yaşayan gıda organizmalarının üretildiği ortam olduğu için su ürünleri yetiştiriciliği için özellikle önemlidir. Su ürünleri yetiştiriciliği genellikle yoğun üretim modelleri ile anıldığı için, su tasarrufu ile ilgilenenler, su ürünleri yetiştiriciliğinde aşırı su kullanımı olasılığını araştırmaya başlamışlardır. Bu nedenle, su ürünleri yetiştiricileri, suyu verimli bir şekilde kullanmak ve su kullanım uygulamalarını savunmak açısından hazırlıklı olmak için sürekli olarak çaba göstermek durumundadırlar.

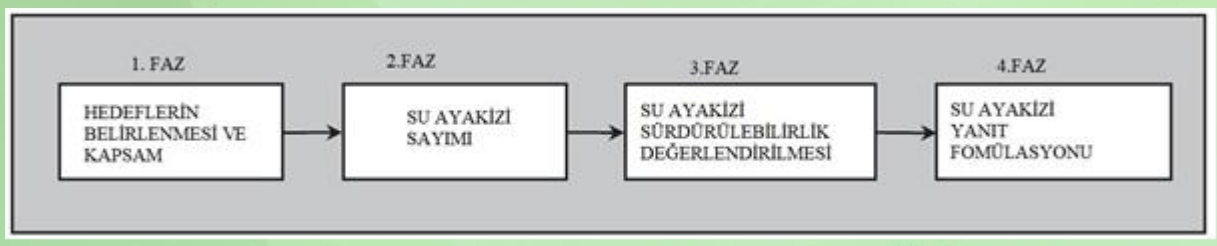
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Giriş

Kaynakların giderek azaldığı ve gereksinimlerin arttığı günümüzde mevcut doğal kaynakların gelecekte de kullanılabilmesi ve maliyetlerin makul seviyelerde kalabilmesi için yoğun çaba sarf edilmesi gerekmektedir. Bu bilinçle çevreye ve özellikle de doğaya daha az yük bindirmek için birçok bilim insanı ortak gözlemler yaparak katsayılar formüller ve oranlar ortaya koymaktadır. Üretimin gezegen için neye mal olduğu, gereksinimleri karşılarken doğaya ne kadar yük bindirdiği ve bu kaynakların ne kadarının kullanılmasının rasyonel olacağı gibi konular üzerinde çalışılmaktadır. Günümüzde tüm üretim değerlerinin sürdürülebilir nitelikte olmasına dikkat edilmektedir. Özellikle tarımsal faaliyetler açısından üretimde "karbon ayakizi" ve su ayakizi (WF) yine dikkat edilen önemli başlıklardan sadece bir kaçıdır. Kısaca karbon ayakizi bir insanın, bir ülkenin veya bir fabrikanın yaptığı faaliyetler sonucu atmosfere saldığı sera gazlarının karbondioksit cinsinden karşılığı olarak açıklanır (Plassmann ve Edwards-Jones, 2010). Normal şartlarda atmosfer denge halindeyken bu durumu dönüştürebilir, ancak zamanla bunu dönüştüremeyeceği süreçler düşünülerek önlemler alınmaya çalışılmaktadır. Günümüzde bu nedenle karbon ayakizini düşürmek için çabalanmaktadır.

Su ayak izi değerlendirmesi aktivitesi, (i) bir sürecin, ürünün, üreticinin veya tüketicinin su ayak izini ölçmek ve konumlandırmak veya belirli bir coğrafi alandaki su ayak izini zaman ve mekân olarak ölçmek; (ii) bu su ayak izinin çevresel, sosyal ve ekonomik sürdürülebilirliğini değerlendirmek ve (iii) bir yanıt stratejisi formüle etmek amaçlarını güder. Genel olarak, su ayak izlerini değerlendirmenin amacı, insan faaliyetlerinin veya belirli ürünlerin su kıtlığı ve kirlilik sorunlarıyla nasıl ilişkili olduğunu analiz etmek ve faaliyetlerin ve ürünlerin su perspektifinden nasıl daha sürdürülebilir hale gelebileceğini görmektir. Bir su ayak izi değerlendirmesinin nasıl görüneceği, büyük ölçüde ilgi odağına bağlıdır. Tüm üretim zincirindeki belirli bir süreç adımının su ayak izi ile veya nihai bir ürünün su ayak izi ile ilgilenilebilir. Alternatif olarak, bir tüketicinin veya tüketici grubunun su ayak izi veya bir üreticinin veya tüm ekonomik sektörün su ayak izi ile ilgilenilebilir. Son olarak, belediye, vilayet, ulus gibi belirli bir alandaki havza veya nehir havzasındaki toplam su ayak izine bakarak coğrafi bir bakış açısı edinilebilir. Böyle bir toplam su ayak izi, bölgede meydana gelen birçok ayrı sürecin su ayak izlerinin toplamıdır.
Su ayak izi değerlendirmesi analitik bir araçtır, faaliyetlerin ve su kıtlığı ve kirliliği ile ilgili ürünler ve ilgili etkiler ve emin olunması için neler yapılabileceği faaliyetleri ve ürünler tatlı suyun sürdürülemez kullanımına katkıda bulunmaz. Bir araç olarak su ayak izi değerlendirmesi içgörü sağlar, insanlara "ne yapacaklarını" söylemez. Aksine, insanların neler yapılabileceğini anlamalarına yardımcı olur.
Tam bir su ayak izi değerlendirmesi dört farklı aşamadan oluşur (Şekil 1):

- Hedefler ve kapsam belirleme.
- Su ayak izi muhasebesi.
- Su ayak izi sürdürülebilirlik değerlendirmesi.
- Su ayak izi yanıtı formülasyonu.



Şekil 1. Su ayak izi değerlendirmesinde dört farklı aşama

Bir su ayak izi değerlendirme çalışmasına girişirken yapılan seçimler konusunda şeffaf olmak için, çalışmanın hedeflerini ve kapsamını net bir şekilde belirleyerek işe başlamak gerekecektir. Su ayak izi çalışması birçok farklı nedenden dolayı yapılabilir. Örneğin, bir ulusal hükümet yabancı su kaynaklarına olan bağımlılığını bilmekle ilgilenebilir veya su yoğun ithal ürünlerin menşei olduğu alanlarda su kullanımının sürdürülebilirliğini bilmekle ilgilenebilir.
Bir nehir havzası yetkilisi, havzadaki insan faaliyetlerinin toplam su ayak izinin herhangi bir zamanda çevresel akış gerekliliklerini veya su kalitesi standartlarını ihlal edip etmediğini bilmek isteyebilir. Nehir havzası yetkilisi aynı zamanda havzadaki kıt su kaynaklarının ne ölçüde düşük değerli ihraç mahsullerine tahsis edildiğini bilmek isteyebilir. Bir şirket, tedarik zincirinde kıt su kaynaklarına olan bağımlılığını veya tedarik zinciri boyunca ve kendi operasyonlarında su sistemleri üzerindeki etkilerin azaltılmasına nasıl katkıda bulunabileceğini bilmek isteyebilir.
Su ayak izi muhasebesinin (sayım) aşaması, verilerin toplandığı ve hesapların geliştirildiği aşamadır. Muhasebedeki detayın kapsamı ve düzeyi bir önceki aşamada alınan kararlara bağlıdır. Muhasebe aşamasından sonra, su ayak izinin sosyal ve ekonomik açıdan olduğu kadar çevresel açıdan da değerlendirildiği sürdürülebilirlik değerlendirmesi aşaması gelir. Son aşamada, müdahale seçenekleri, stratejileri veya politikaları formüle edilir. Tüm adımları tek bir çalışmaya dahil etmek gerekli değildir. Hedeflerin ve kapsamın belirlenmesinin ilk aşamasında, yalnızca muhasebeye odaklanmaya veya sürdürülebilirlik değerlendirmesi aşamasından sonra durmaya karar verilebilir ve yanıtla ilgili tartışmayı sonraya bırakabilirsiniz.
Ayrıca, uygulamada, birbirini izleyen dört aşamadan oluşan bu model, katı bir direktiften çok bir kılavuz niteliğindedir. Genellikle daha öncesine dönüş adım ve aşamaların yinelenmesi gerekli olabilir. İlk etapta, bir şirket su ayak izindeki kritik bileşenleri belirlemek ve müdahale için öncelikleri belirlemek üzere tüm aşamaların kabaca araştırılmasıyla ilgilenebilirken, daha sonra hesapların belirli alanlarında ve sürdürülebilirlik değerlendirmesi konusunda çok daha fazla ayrıntı aramak isteyebilir.
Genel olarak gıdanın ve özel olarak etin su ayak izi, tüketim tarafındaki değişikliklerle önemli ölçüde azaltılabilir, ancak bu, mevcut beslenme modelinde büyük bir geçiş ve özellikle batı ülkelerinde gıda atıklarının

azaltılmasını gerektirecektir. Şu anda, gıda seçimleri artan refah, yerel kültürel mirasla bağın kopması ve çevreye çok az dikkat edilmesi tarafından yönlendirilmektedir (Burlingame, ve Dernini, 2012)
Hayvansal ürünlerin tüketimindeki artışın, dünyanın tatlı su kaynakları üzerinde daha fazla baskı oluşturması muhtemeldir. Bu belge, hayvan türü ve ülke bazında farklı üretim sistemleri ve yem bileşimi dikkate alınarak, hayvansal ürünlerin su ayak izinin kapsamlı bir açıklamasını sunmaktadır. Dünyadaki tarımın toplam su ayak izinin yaklaşık üçte biri hayvansal ürünlerin üretimi ile ilgilidir. Herhangi bir hayvansal ürünün su ayak izi, eşdeğer besin değerine sahip bitkisel ürünlerin su ayak izinden daha büyüktür. Sığır eti için kalori başına ortalama su ayak izi, tahıllar ve nişastalı köklerden 20 kat daha fazladır. Süt, yumurta ve tavuk eti için gram protein başına düşen su ayak izi, baklagillere göre 1,5 kat daha fazladır. Hayvansal ürünler için elverişsiz yem dönüşüm verimliliği, hayvansal ürünlerin tarla ürünlerine kıyasla nispeten büyük su ayak izinden büyük ölçüde sorumludur. Endüstriyel sistemlerden elde edilen hayvansal ürünler genellikle otlatma veya karma sistemlerden elde edilen hayvansal ürünlerden daha fazla yer altı ve yüzey suyu kaynaklarını tüketir ve kirletir. Artan küresel et tüketimi ve hayvansal üretim sistemlerinin yoğunlaşması, önümüzdeki yıllarda küresel tatlı su kaynakları üzerinde daha fazla baskı oluşturacaktır (Mekonnen ve Hoekstra 2012).
Herhangi bir etin su ayak izi çoğunlukla hayvanların beslenmesiyle belirlenir. Küresel olarak, hayvan yeminin WF'sinin ana bileşeni mera (toplam su ayak izinin %38'i), ardından mısır (%17), yem bitkileri (%8), soya küspesi (%7), buğday (%6) ile ilgilidir.), arpa (%6) ve yulaf (%3) (Mekonnen ve Hoekstra 2012) . Bununla birlikte, tek tek ülkelerdeki belirli üretim sistemleri, bu küresel rakamlardan farklıdır. Örneğin Hollanda'da yem endüstrisi domuz yemi için büyük miktarlarda manyok kullanır. Genel olarak, yem konsantreleri nispeten büyük mavi ve gri su ayak izine sahipken, mahsul artıkları, atıklar ve kaba yemler nispeten küçük su ayak izlerine sahiptir. Endüstriyel sistemler çok fazla yem konsantresi kullanır ve bunlar genellikle mera veya kaba yemden daha büyük mavi ve gri su ayak izine sahiptir. Gıda tüketim kalıplarında daha fazla hayvansal ürün tüketimine doğru bir kayma, üretim sistemleri üzerinde daha fazla üretme baskısı oluşturacaktır. Bu aynı zamanda, otlatma ve karma sistemlerden birim yem başına daha yüksek verim sağlayan endüstriyel sistemlere geçişi de teşvik edebilir. Üretim artışı ve daha fazla endüstriyel sisteme geçiş kombinasyonu, hayvancılık üretiminde konsantre yem kullanımını ve hayvancılık sektörünün genel su ayak izini artıracaktır. Toplam üretim için su ayak izindeki toplam artışın yanı sıra bu, özellikle ürün birimi başına mavi ve gri su ayak izini artıracaktır.

Balık yetiştirmek için ne kadar su gerekir?

Su yoluyla ulaşım yoluyla sadece az miktarda su kullanan okyanuslardan balık yakalamanın aksine, su ürünleri yetiştiriciliği çok daha yüksek bir su ayak izine sahip olabilir. Bu sezgisel görünebilir, ancak balık yetiştirmek havuzun buharlaşması, seyreltme ihtiyaçları ve balık yemi üretimi yoluyla büyük miktarda tatlı su tüketebilir.
Çin'e odaklanan bir çalışmada Su Ayak İzi Ağı (WFN) yaklaşımı kullanmış ve tatlı su ve acı ortamlarda su ürünleri yetiştiriciliğinin su ayak izinin 3,349-21,215m 3 / ton ve 2,204-57,125m 3/ ton olduğunu tahmin etmektedir. Bu, yem üretiminden buharlaşmaya ve seyreltme ihtiyaçlarına kadar doğrudan ve dolaylı kullanımları içerir. Alt sıralar endişe verici olmasa da, yüksek aralıklar sığır eti, kuzu eti ve çikolatanın su ayak izlerini bile geride bırakmaktadır. Bunu daha somut terimlerle ifade etmek gerekirse, sadece 1kg balık için 220 küvete kadar su kullanımı söz konusudur.



Şekil 2. Hayvansal üretimde Su Kullanımı Seviyeleri (Yuan ve ark., 2017)

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Etin su ayak izini azaltmak ve sürdürülebilir tüketime geçmek

Yakın tarihli bir raporda, (Burlingame ve Dernini, 2012) daha sürdürülebilir bir gıda üretim ve tüketim sistemine olan ihtiyacı vurgulamaktadır. Sürdürülebilir bir diyetin gerekliliklerinden biri, düşük doğal kaynak kullanımı ve çevresel etki ile birlikte gitmesidir. Kaynak kullanımı açısından, 1 litre yeşil su tüketimi, bir litre mavi su tüketimine eşdeğerdir, ancak yeşil bir WF'nin çevre üzerindeki etkisi genellikle mavi bir WF'nin etkisinden çok daha küçüktür. Gri WF'ler, yeraltı suyu yüzey suyunun kirlenmesine atıfta bulundukları için bir endişe kaynağıdır. Bu, sürdürülebilir bir tüketim açısından, özellikle büyük mavi ve gri WF'ye sahip et türlerinden kaçınılması gerektiği anlamına gelir. Ülkeler arasındaki farklılıklar, düşük WF yem bileşimi ile yüksek yem dönüştürme verimliliği arasında uygun bir denge bularak et üretiminin su ayak izini azaltma olasılıklarının olduğunu göstermektedir. Özellikle iki gelişmekte olan ülke, yem birimi başına WF'leri azaltma ve yem dönüşüm verimliliğini artırarak sürdürülebilirliği iyileştirme potansiyeline sahiptir. Örneğin Çin, verimsiz gübre kullanımına işaret eden ortalamanın üzerinde gri WF'ler gösteriyor. Hayvansal ürünlerin tüketimiyle ilgili su ayak izi, küresel olarak yılda 2422 Gm 3 (tarımın toplam su ayak izinin neredeyse üçte biri), hayvansal ürünlerin yerine bitki kaynaklı gıda ürünlerini koyarak veya gıda israfını azaltarak da azaltılabilir. Etin su ayak izi genel olarak eşdeğer bitki bazlı gıdaların su ayak izinden çok daha fazladır (Mekonnen ve Hoekstra 2012) . Hoekstra'nın (2010) gösterdiği gibi, sanayileşmiş bir ülkedeki bir tüketicinin gıdayla ilgili su ayak izi, ortalama ete dayalı bir diyetten vejetaryen bir diyete geçilerek %36 oranında azaltılabilir. Chapagain ve James (2011) Birleşik Krallık'ta önlenebilir gıda israfının su ayak izinin, bir Birleşik Krallık vatandaşının toplam su ayak izinin %6'sı kadar olduğunu buldu.

Kullanımda olan su koruma önlemleriyle bile, havuzlarda su ürünleri yetiştiriciliği, diğer birçok gıda üretim yönteminden daha fazla su yoğundur. Örneğin, güneydoğu ABD'de çoğu mahsulün sulanması için gereken su ihtiyacı yılda 30-40 santimetredir ve daha fazla su yoğun bir mahsul olan pirinç yılda 60-80 santimetre su gerektirir. Kanal yayın balığı yetiştiriciliği için su ihtiyacı, göletler yıllık olarak boşaltılmadığında yılda 50-100 santimetre, düzenli olarak boşaltıldığında ise yılda 200-250 santimetredir (Boyd 2000)

Ancak su ürünleri yetiştiriciliğinde kullanılan birim su başına üretilen ürün değeri diğer ürünlere göre daha yüksektir. ABD'deki soya fasulyesi, pirinç ve yayın balığı örneklerini kullanarak, hektar başına ortalama üretim sırasıyla 2191, 5510 ve 5000 kilogram ve bu üç ürün için kilogram başına fiyatlar sırasıyla 0,23 ABD Doları, 0,18 ABD Doları ve 1,56 ABD Doları olmuştur (ABD Tarım Bakanlığı, 1994 verileri). Bu nedenle, yukarıda verilen su kullanım aralıklarının yüksek uçları kullanıldığında, metreküp su başına üretim değerleri soya fasulyesi için 0,13 ABD Doları, pirinç için 0,12 ABD Doları, yıllık drenajı olmayan havuzlarda üretilen kanal yayın balığı için 0,78 ABD Doları ve kanal yayın balığı için 0,31 ABD Dolarıdır. yılda bir kez kurutulan havuzlarda üretilir. Tablo 1'de gösterildiği gibi, kurak iklimlerde yetiştiricilik havuzları için su gereksinimleri daha fazla olacaktır. Ancak diğer mahsuller için sulama ihtiyacı da daha fazla olacaktır. Bu nedenle, gölet balıkçılığı kurak iklimlerde bile muhtemelen suyu diğer karasal, sulu tarıma göre daha verimli kullanacaktır (Boyd 2000).

Sonuç

Özetle, su ayak izi (WF) kavramı bize tatlı su kaynaklarıyla ilişkimizi değerlendirebileceğimiz güçlü bir mercek sağlıyor. Çoğunlukla hafife aldığımız bir madde olan su, gezegenimizin ekosistemlerinin sağlığının ve insan toplumunun refahının sürdürülmesinde temel taş görevi görüyor.

Dünya genelinde tatlı su kıtlığı, nüfus artışı, iklim değişikliği ve verimsiz su yönetimi gibi faktörlerle daha da kötüleşen, baş döndürücü bir sorundur. Üstelik çeşitli kirlilik türleri nedeniyle su kalitesinin bozulması da bu endişeleri artırıyor. Artan bu sorunlar karşısında, bu paha biçilmez kaynağın koruyucuları olarak rolümüzün farkına varmamız zorunludur.

Küresel tatlı su ayak izimizin önemli bir kısmı tarıma atfedilmektedir ve hayvan üretimi bu kullanımın önemli bir kısmını oluşturmaktadır. Bu, su tüketimini en aza indiren ve çevresel etkileri azaltan sürdürülebilir tarım uygulamalarının benimsenmesinin aciliyetini vurgulamaktadır.

Özellikle su ürünleri sektörü bir dönüm noktasındadır. Dünyanın artan deniz ürünleri talebinin karşılanmasında hayati bir rol oynamaya devam ederken, aynı zamanda aşırı su kullanımı, çevresel sürdürülebilirlik ve sorumlu su ürünleri yetiştiriciliği uygulamalarına ilişkin endişeleri de ele almalıdır. Su ürünleri yetiştiriciliğinin zorunluluğu açıktır: su verimliliğini artırmak, çevresel etkileri en aza indirmek ve gelişen su tasarrufu standartlarına uyum sağlamak.

Temelde su kaynaklarımızı koruma sorumluluğu bireylerden topluluklara ve işletmelere kadar her birimize düşüyor. Sorumlu su kullanımını desteklemek, çevre dostu uygulamaları benimsemek ve su tasarrufuna öncelik veren politikaları savunmak ortak görevimizdir. Bunu yaparak, yalnızca şu an için tatlı suyun bulunabilirliğini ve kalitesini güvence altına almakla kalmıyor, aynı zamanda gelecek nesiller için suyun yaşam ve canlılık kaynağı olarak kaldığı sürdürülebilir bir geleceği de garanti ediyoruz.

Sonuç olarak, su ayakizi kavramı, su kaynaklarının etkili bir şekilde yönetilmesine katkıda bulunan önemli bir araçtır. Su ayakizi hesaplamaları ve bu verilerin bilinçli bir şekilde kullanılması, su kullanımının izlenmesi, su tasarrufu ve sürdürülebilirlik çabalarının desteklenmesi için büyük potansiyele sahiptir. Gelecek nesillerin temiz ve bol miktarda su kaynaklarından yararlanabilmesi için su ayakizi konusunda sürekli olarak bilinçlenmeye ve adımlar atmaya devam etmeliyiz.

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Drivers of Profit among Leafy Vegetable Farmers during Covid-19 Lockdown in Oyo State, Case Study of Egbeda Local Government Area

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Abstract
The research focused on determinants of profits among leafy vegetable farmers during COVID-19 lockdown in Egbeda Local Government Area Oyo State. Multistage sampling techniques were employed to choose 120 leafy vegetable farmers. Structured questionnaire was designed to gather data and was analyze using with the aid of descriptive statistics, Gross Margin analysis and Ordinary Least Square regression. Results showed that the mean age of leafy vegetable farmers was 50.81 years which indicated that the leafy vegetable farmers' area are relatively active and can participate in leafy vegetable production activities. Majority (83.3%) of the leafy vegetable farmers were married, most (87.6%) were educated with a mean farming experience of 19 years. The extent of profitability of the farmers involved in leafy vegetable production result indicated that the Gross Margin was N573,537. The drivers of profit among leafy vegetable farmers during COVID 19 lockdown in Egbeda L. G. were educational level (5%), farm size (1%), input cost (1%) and cooperative membership (1%). It is therefore, recommended that more effort should be put in place by policy makers and agricultural stakeholders inform of programs that will educate farmers on coping strategies during crisis period.

Keywords: *COVID 19, Lockdown, Leafy Vegetable, Profit, Regression Analysis*
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Introductıon

A global health emergency with far-reaching consequences is COVID-19 pandemic on the economy, basic services, social unrest and livelihood of the poor and vulnerable. In Nigeria, the pandemic led to the closure of many Micro and Small Enterprises (MSEs), jobs loss, stalled provision of basic services in poor communities and thereby increasing the population of Nigerians living below the poverty line, https://ngcares.gov.ng/(2019).The COVID-19 epidemic had an impact on farm families' livelihoods since they struggled to sell their farm products owing to government-imposed lockdown limitations and to obtain the materials, supplies, and labour needed for their farms to operate at their peak output. Additionally, the deterioration of perishable foods like vegetables, particularly leafy vegetables, had an impact on farm families' revenue. Although the disease's effects on health were minimal compared to worldwide trends, the disease's breakout severely disrupted the livelihood of millions of families in Nigeria, especially rural communities whose livelihoods are vulnerable to changes and emergency situations like COVID-19, Balogun, (2020).

The government of Nigeria implemented a number of steps to stop the disease from spreading, including social distance that prevented mass gatherings, lockdowns of public and private spaces, and movement restrictions. The agricultural activities of rural farm families were disrupted by these measures, making it hard for them to get details on agronomic practices, denying them facts to markets and inputs, which resulted in an increase in input prices, wastage of harvested agricultural produce mostly the perishable among which were vegatables due to problem of transportation, and a decrease in finance to meet up their family's desires, as a result, both their food security and that of the nation were put at jeopardy, Nigerian Communications Commission (NCC). (2020).

The value of vegetables as significant along with being effective micronutrients sources in Africans' food intake cannot be overstated. Vegetables are healthy foods because they provide trace amounts of all the nutrients that humans require, including protein, iron, mineral salts, carbohydrates, vitamins, aromatics, colourants, and essential oils that increase human resilience to disease. The average vegetable consumption in poor nations falls below the FAO's (Food and Agricultural Organization) annual recommended of 75 kg. Vegetable production has been going on for years in Nigeria, giving the expanding population work and a living, especially during the protracted dry season. However, insufficient infrastructure, agronomic, and socioeconomic factors limit productivity, Sabo and Zira, (2009). Additionally, Mofeke et al., (2003) stated that the production of vegetables is characterised by the use of primitive tools, inadequate inputs, inability to read, and high cost and complicated technology

Vegetables (most especially leafy) are extremely perishable since they begin to lose quality as soon as they are harvested and continue to do so until they are consumed. Vegetable farming is therefore a risky venture. Several factors outside of the farmers' control contribute to the riskiness of vegetable cultivation, Onyemuwa, et al., (2016). In Egbeda LG, parts of the major challenges encountered by vegetable farmers are listed as inadequate capital, inadequate storage facilities, pest and diseases and climatic conditions. Although there has been several studies on vegetable production, most especially on fruits vegetable, some of which are tomato, cabbage and cucumber. There are terse of study on the drivers of profit among leafy vegetable farmers during COVID-19 lockdown, most especially in the study area thereby opening a space to advance the body of knowledge.

Methodology

This research was done in Egbeda Local Government Area (LGA) of Oyo State, Nigeria. Egbada L.G. is a suburban situated in the rainforest agro-ecological zone. It is one of the 33 LGAs in Oyo State. The headquarters is Egbeda. It is situated to the East and to the North Eat of Ibadan City, bordered on the west by Irewole LGA which is now located in State of Osun, Nigeria. It lies between latitudes 7o21'N4o3E' and 8oN of the equator. It has a large area of 191.00 km2 and a total number of 281,573 people as at the census conducted in the year 2006, Osuji, et al., (2017).

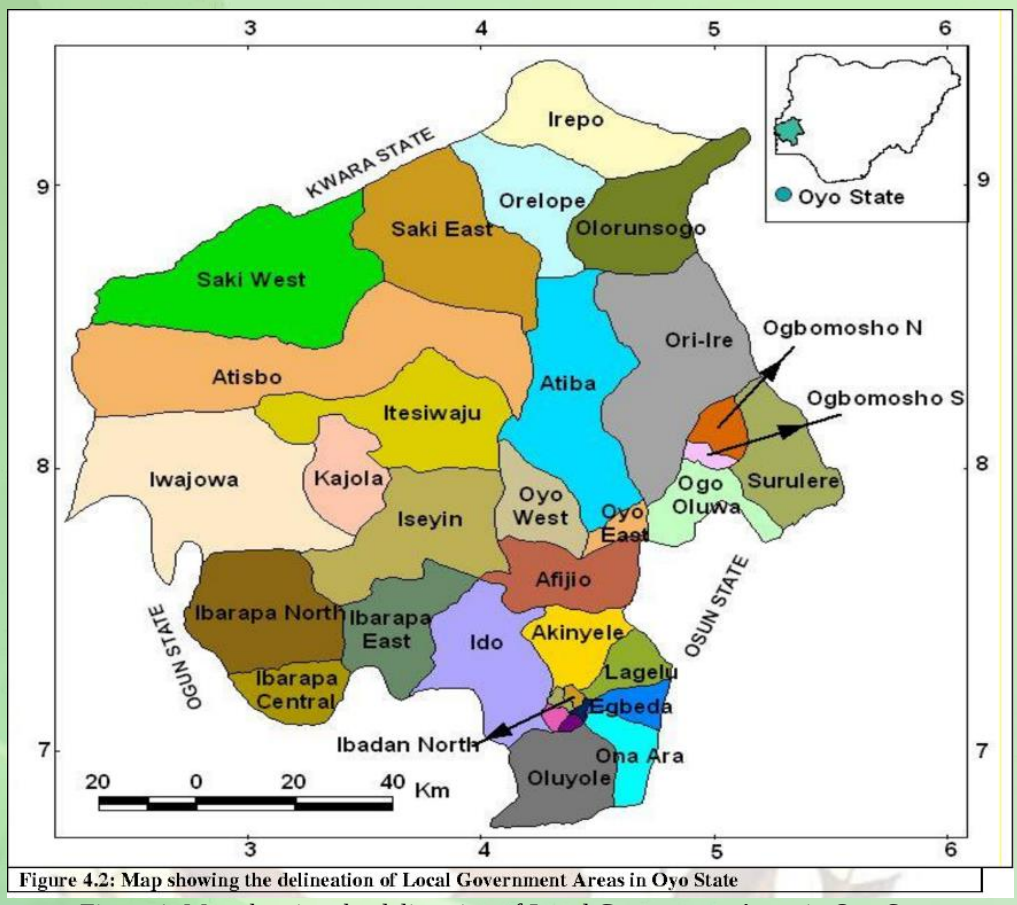


Figure 1: Map showing the delineation of Local Government Areas in Oyo State
Source: Johnson, (2015)

Multistage sampling procedure was employed in selection of the samples for this research. Purposive Selection was used to select Egbeda LGA from the 33 LGAs in Oyo State at the first stage due to the high number of leafy vegetable farmers in the LGA. Secondly, random sampling technique was employed to choose four wards out of the eleven in the LGA notable for vegetable production. At the third stage, two villages in each of the selected wards were randomly selected making a total of 8 villages. Finally stage involved random and proportionate selection of 15 farming households making a total of 120 leafy vegetable farmers. The list was gotten from the village listing at the Local Government.

Analytical Techniques
Descriptive statistics (frequency, mean, percentage), GM Analysis, and Ordinary Least Square regression were used to analyse the data collected.

Gross Margin Analysis
For the purpose of the study, gross margin analysis and profitability was used to assess the cost estimates and returns along the analysis of leafy vegetable by farmers in Egbeda LGA, Oyo state.
The gross margin relationship is stated as follows:

$$GM = (TR-TVC)$$

TR = Total Revenue (from leafy vegetable sales)
TVC = Total Variable Costs. These includes costs such as seeds, cost of labour, fuel cost, transports costs, fertilizer. Ogunji, et al., (2021)

Regression Model
Returns on leafy vegetable was used as the dependent variable (Y) while other socio-economic variables of the vegetable farmers; age, household size, level of education, sex, extension agent visit, years of farming experience and cost of production was used as the independents variables (X)
The multiple regression analysis is stated thus
$Y = f\ (X1, X2, X3, X4, X5, X6, X7 + e)$
Y = output, X1 = age, X2 = educational level (numbers), X3 = marital status, X4 = farm size (hectares), X5 = Input cost, X6 = cooperative membership, X7 = farming experience, e = error term

Result And Discussions
Socioeconomic characteristics of Leafy Vegetable Farmers
Result of age distribution in Table 1 indicated that the average age of the leafy vegetable farmers was 50.81 years. It is an encouraging result showing that the leafy vegetable farmers are still comparatively active. Moreover, majority (68.3%) of respondents were male, while 31.7% were females. This suggests that men are actively involved in vegetable farming compares to the females. The reason may be due to general saying of the people that vegetable production involves rigorous labour. This results is in conformity with the study of Adebisi et al.,(2011).The results of the findings also indicated that 83.3% of the farmers in the selected were married, 9.2% are single, 0.8% are divorced while 6.7% are widow. This demonstrates that a greater proportion of farmers growing leafy vegetables are married, which suggests that their wives are more likely to provide effective assistance, make wiser judgments, and take part in a variety of production activities in the research area. This findings collaborates the findings of Tijani and Audu, (2018) who revealed that choice by people who are married ease the level of involvement in vegetable farming and as a result reduces the constraint that might surfaced. In addition, the results revealed that 36.7% of leafy vegetable farmers completed secondary school, 16.7% had finished primary and secondary school, 25.8% had earned their Ordinary National Diploma and National Certificate in Education, and 9.2% had earned their Higher National Diploma. However, 11.7% of the respondents had not received any formal education and could not read or write. Farmers that have higher levels of education are more technically and economically efficient, and this will undoubtedly aid in their decision-making, particularly when it comes to the effective distribution and use of scarce resources.

Analysis of the Profitability from Leafy Vegetable Production
The result of profitability analysis in Table 2 revealed the TR generated was N846,237.00 per annum, and the TC of production was N467,646.00. GM equals to N573,537, while BCR was 1.81. The BCR of N1.81, shows that the farmers stand to gain an additional N1.81 for every one naira (N1) spent on vegetable production. If the Benefit Cost Ratio (BCR) is less than one, it results in a loss, when equal to one (1), it is break even, and when greater than one, it indicates profit. The Investment Rate of Return was 80.96%, which is an indication as thus: for N1.00 invested on vegetable production, N80.96 will be realized as profit. The Rate of Return on capital investment was analyzed to be high. Lastly, since the BCR is greater than 1 (1.81), vegetable production in the Egbeda Local Government of Oyo State, is a profitable enterprise.

Factors (Drivers) determining the Profit by Farmers in Leafy Vegetables
The linear regression findings of the estimated model are reported in Table 3. From the model summary, adjusted R2 of 0.8623 means 86.23% of the variables in the model are explained, whereas the others are unexplained variables, i.e., 13.77% of which exist in the error term.
From Table 3, the regression result revealed that there are some variables that are significant. Examples are educational level of respondents, farm size, cost of inputs, and membership of cooperative society.

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Table 1. Socioeconomic characteristics of the respondents

	F	%		F	%
Age			Experience		
25-35	17	14.2	1-5	12	10.0
36-45	23	19.2	6-10	22	18.3
46-55	41	34.2	11-15	22	18.3
>56	39	32.5	16-20	24	20.0
Total	120	100	>21	40	33.3
Mean= 50.81			Mean		
Sex			Land		
Female	82	68.3	Inheritance	40	33.3
Male	38	31.7	Lease/Rent	21	17.5
Marital Status			Gift	4	3.3
Single	11	9.2	Family land	33	27.5
Married	100	83.3	Purchase	6	5.0
Divorced	1	0.8	Borrowed	16	13.3
Widow	8	6.7	Variety		
Education			Jute Leaf (Corchorusolitorius)	60	50
No formal education	14	11.7	Bitter leaf (Vernoniaamy gadalina)	15	12.5
Primary	20	16.7	African Spinach (Amaranthus hybridus)	25	20.8
Secondary	44	36.7	Water leaf (Talinum triangulare)	6	5
OND/NCE	31	25.8	Lagos Spinach (Celosia argentea)	14	11.7
HND/University	11	9.2			
Cooperatives Membership					
Yes	55	45.8			
No	64	53.3			
Household size					
1-5	45	37.5			
6-10	71	59.2			
11-15	4	3.3			
Mean	9				

Source: Field Survey, 2022. Note: F = Frequency, % = Percentage

Table 2. Profitability Analysis

Items		Price (N)
Income generated per annum (A)		846237.00
VC		
	Manure cost	15500.00
	Vegetable seed	8300.00
	Fertilizer	43100.00
	Pesticide	56300.00
	Herbicide	50000.00
	Labour	100,000.00
TVC(B)		N272,700
FC		
	Wheelbarrow	18502.00
	Basket cost	19640.00
	Hoe cost	7103.00
	Matched	5701.00
	Land rent	144000.00
TFC (C)		N194,946
TC D = (B+C)		N467, 646.00
GM E = (A – B)		N573,537.00
Gross income/net profit E =(E-C)		N378,591.00
Profit /Net revenue (A- D)		N378,591.00

Source: Field survey, 2022.

Rate of returns in investment = net profit / total cost x 100

378,591/ 467,646 = 0.8096 * 100 = 80.96%

BCR = TR/TC= N 846237/ 467,646= 1.81

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The result implied that educational level is positive and significant at 5%, while farm size, cost of inputs as well as cooperative membership are positively significant at 1.0%.The implication of this is that the more educated the respondents are the more their net income. The findings could be credited to the reality that as a farmer becomes more educated, the more they are exposed and readily adapt to adopting new techniques or innovations, and this will lead to greater profit. This resonates with (Kalu, 2013) who asserted that education definitely impact farmers' participation in agricultural activities.

At a threshold of probability of 1.0%, the farm size coefficient was also significant and positive, which suggests an additional boost in size of farm will be accompanied by proportional rise in level of involvement in vegetable production. Larger-scale farmers typically have more access monetary resources and finance, allowing them to invest more in farming operations related to vegetable production. This supports the research of Onyeneke et al., (2016), that hypothesised that farm size affects participation of farmers in all production (farming) activities. The cost of inputs for vegetable farmers had a positive and significant coefficient of 1.0%.This suggests that every increase in the inputs used by vegetable growers will result in an equal rise in vegetable production output. This is consistent with (Umunakwe, 2015)'s findings, who believed that increasing the inputs from whatever production (farming)enterprise raises involvement level in vegetable production. Cooperative membership was positively significant at 1.0%. The implication of this is that been a member of cooperative society increases their profit level because of the inherent benefit. The involvement or participation of vegetable farmers in a cooperative society will bring about an increase in their farm income. Bulama et al.,(2015) opined that vegetable farmers joining or forming cooperatives create avenues through which they acquire loan and invest in storage facilities.

Table 3. Regression Result

Variable	Co-efficient	Std. Err.	p-value	mfx
Age	-0.308	0.409	0.454	0.452
Educational level	4.743	2.484	0.059**	0.056
Marital status	5.497	4.851	0.260	0.257
Farm size	277.856	50.416	0.000***	0.000
Input cost	0.00031	0.000071	0.000***	0.000
Cooperative membership	27.724	5.545	0.000***	0.000
Farming experience	0.392	0.427	0.360	0.358
Constant	-101.378	19.145	0.000	
Observations	120			
F(7, 110)	98.4			
Prob> F	0.0000			
R^2	0.8623			
Adj. R^2	0.8535			
Root MSE	26.887			

***, **, * Represents 1%, 5% and 10% significant levels respectively; mfx = Marginal Effects after Regression

Constraint Militating against Leafy Vegetable Production

The perishable nature of vegetables creates storage and processing problems from the farm during harvesting to point of sale (Mohammed *et al.*, 2013). Table 4 is a presentation of the limitations faced as reported by leafy vegetable farmers. Result revealed that major challenge encountered by vegetable farmers included inadequate storage facilities (55.83%), high cost of input (16.7%) which causes an increase in the cost of production, bad road network (35.83%) which often results in mechanical damage of vegetables and flood/erosion (43%) which causes damage to land and thereby reducing the production of vegetable by the respondents and most importantly COVID 19 (45%) pandemic which necessitated lockdown and prevent farmers from marketing of their produce and eventually resulted into great loses.

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Conclusion

This research profiles determinant of profit to leafy vegetable production as a result of COVID 19 lockdown and concluded that since vegetables, particularly leafy vegetables are perishable and the deterioration had an impact on farm families' revenue, leafy vegetable farmers should constantly be assisted most especially because of the significant benefit eating more fruits and vegetables as part of a balanced diet lowers the risk of developing various chronic diseases for example COVID-19, which is one of the health benefits of doing so. Vegetables give the body the necessary nutrients to fight external invasion to stay healthy and maintain its structure. Most vegetables naturally contain little fat. The research revealed the there was good prospects for leafy vegetable production in Egbeda L.G. of Oyo State and Nigeria, even during the COVID 19 lockdown. This is because leafy vegetable production was found to have Benefit-cost ratio of 1.81 and the factors that contributed to profit included educational level, size of farm, farm income and farming experience. The study also showed that leafy vegetable farmers are educated in some way, thus any effort to educate them in modern and improve methods of production will translate into a proportional rise in the amount of farmers' participation in leafy vegetable production in the study area. Respondents are more inclined to accept new technology, techniques, and innovations as a result of increased education, which also increases their level of involvement and productivity in vegetable producing operations. Likewise, their mean age showed that the farmers are active. An encouragement to farmers in growing more vegetable is sufficient in bridging the gap between demand and supply of food and also a means of cheap source of access to the nutrients the body needs to fight against diseases, for instance COVID 19 and others and likewise providing jobs for the several unemployed. In accordance to study's findings, leafy vegetable farming is not only feasible but also profitable in the study area.

Table 4. Distribution by Constraint faced by respondents

Constraints	F	%
Inadequate storage facilities	67	55.83
Lockdown arising from COVID 19	54	45.00
Inadequate/bad road network	43	35.83
Flood/Erosion	43	35.83
Inadequate rainfall	20	16.7
Rising cost of Input	20	16.7
Labour availability	13	10.83
Herdsmen invasion	12	10
Farmers Health Challenges	5	4.2
Land Encroachment	5	4.2
Communal Land issues	3	2.5
Total		100

*Multiple Response

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Fatty Acid Profile and Cholesterol Contents in Egg Yolk of Hens Fed Variable Energy to Protein Ratio Diet Using *Hermetia Illucens* Meal.

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Abstract

The impact of changing the energy-to-protein ratio using *Hermetia illucens* meal as a protein source on the fatty acid profile and cholesterol content in egg yolk for 90 days was evaluated in this study. Diets were formulated with levels of normal (155), low (140), and high (170) energy-to-protein ratio using *Hermetia illucens* meal at 0%, 5%, and 1% to form three treatments, respectively. A total of 54 nine-month-old local Arabian strain laying hens were randomly assigned to nine-floor cages. The analysis results of *Hermetia illucens* revealed that the total saturated fatty acid content was higher than the total unsaturated fatty acid content. Also, there was lower omega-3 polyunsaturated fatty acid content than omega-6 polyunsaturated fatty acid content. The finding of this experiment revealed that birds fed the low energy-to-protein diet containing *Hermetia illucens* at 5% meal increased ($P<0.05$) total unsaturated fatty acid content and depressed ($P<0.05$) total saturated fatty acid content in egg yolk compared to the birds fed the control diet and birds fed the high energy-to-protein diet. The total omega-3 polyunsaturated fatty acid content ($P<0.05$) and omega-6 polyunsaturated fatty acid content ($P<0.01$) were lowered by *Hermetia illucens* meal diets. There was a similar effect ($P>0.05$) on cholesterol content in the egg yolk of the hens fed dietary treatments. In conclusion, formulation of the diet with the low energy-to-protein ratio using *Hermetia illucens* meal had a positive effect on the fatty acid profile of the egg yolk.

Keywords: *Fatty acid, Hermetia illucens, village chicken, cholesterol*

Introduction

Globally, it is estimated that around 821 million people suffer from starvation every year (FAO, 2017; Ridge and Smith, 2018). It is expected that there will be 8.5 billion people on the planet by 2030 (Desa, 2019; Cleland, 2013). Along with a quickly increasing population, the demand for healthy food is growing due to an incline in health awareness among people. The impact of the quality foods such as their fatty acid composition, on people's health status has been well-evaluated (Borges et al., 2020; Lichtenstein et al., 2006; Hassan, 2009; Al-Rubae'i, 2010). The increased polyunsaturated fatty acid (PUFA) content in people's diets has had a positive health effect on common diseases (Jump et al., 2012; Yashodhara et al., 2009; Aljuboori et al., 2020). In addition, low levels of essential fatty acids in food such as linoleic (18:2), linolenic (18:3), and arachidonic (20:4) increase the possibility of getting growth retardation, skin diseases, and obesity (De Cerqueira and De Souza, 2017; Takic et al., 2022; European Food Safety Authority, 2008; Giménez-Arnau et al., 1997). Therefore, the current scientific interest tends towards healthy animal food origin products to meet consumer requirements.

Hermetia illucens is a fly (Diptera) belonging to the Stratiomyidae family, and they are spread in tropical and hotter temperate regions (Diener et al., 2011). The larvae meal of *Hermetia illucens* can be used in the broiler diet (Alqazzaz et al., 2019), and laying hen diet (Al-Qazzaz et al., 2016). Inclusion *Hermetia illucens* as alternative feed ingredients in poultry diets should take into consideration the alternative feed quality, especially cholesterol content and fatty acid profile (Eckel et al., 2014; Cherian, 2015; Lee et al., 2019). Changing dietary fat type in larvae growing media may alter the fatty acid profile of *Hermetia illucens*s thus the larvae meal can be employed as a source of saturated fatty acid (SFA), monounsaturated (MUFA), and PUFA in the animal diets (Li et al., 2022). Despite many works that evaluated the effect of *Hermetia illucens* in laying hen diets, the quality of the lipid in the egg yolk of hens fed *Hermetia illucens* meal is not established yet. This study aimed to evaluate the formulation of the laying hen diet by changing the level of energy-to-protein ratio (EPR) diet using *Hermetia illucens* meal as a protein substance in the laying hen diet on cholesterol content and fatty acid profile of egg yolk.

Materials and Methods

A total of 54 local nine months old Arabian strain hens were assigned to nine-floor cages (length 200 cm × width 300 cm/cage) at the University Putra Malaysia farm in Serdang. The physical traits, weight, and health factors of the birds were standardized. The six hens that made up each treatment replicate were placed in one cage according to a completely random design. The basal ingredients were formulated to form the first treatment (Table 1), which was based on the EPR= 155 (2777.16 kcal/kg energy and 17.86% protein). *Hermetia illucens* meal (5%) was included in the basal diet to form the second treatment based on EPR= 140 (2668.93 kcal/kg

energy and 19.05% protein). The third treatment included 1% *Hermetia illucens* meal to the basal diet based on EPR= 170 (2836.14 kcal/kg energy and 166.4% protein). Birds received 80 g of grain and ad libitum access to water during the experiment period. The *Hermetia illucens* meal was prepared by drying the fresh *Hermetia illucens* using an electric oven at 60 °C for five days.

The samples (egg yolk, diets, and *Hermetia illucens* larvae meal) were conducted for lipid extraction using a Trichloromethane: methyl alcohol solution (2 volume:1 volume) based on the method of Folch et al. (1957).

The fatty acid methyl esters of extracted samples were conducted using the method described in AOAC (2007). Gas-liquid chromatography was used to measure the fatty acid methyl esters using an Agilent 7890A GC system (Agilent, Palo Alto, California, USA). By comparing the peak retention durations of the fatty acid methyl esters in the samples to the standards received from Sigma, fatty acid identification was accomplished (St. Louis, MO, USA). The internal normalization (area %) was used to express the results.

Egg yolk samples were saponified according to the method described by Sim and Bragg (1977) before measuring the cholesterol content using the colorimetry method according to Abell et al. (1952).

The experimental design was completely randomized. The Statistical Analysis System software (version 9.3) was used to analyze the collected data. Also, Tukey's test was used to compare the differences among treatment means.

Table 1. Composition of the experimental diets

Ingredients (%)	Control 0% *Hermetia illucens*	Low EPR 5% *Hermetia illucens*	High EPR 1% *Hermetia illucens*
Rice bran	14	10.35	4.8
Fish meal	3	0	0
Corn	20.2	20	26.5
MBW	4	4	6
RW	30	31	35
Limestone	9	9	8.5
Di calcium phosphate	0.5	0.95	0.5
Soybean	18.5	19	17
BSFL meal	0	5	1
Sodium chloride	0.5	0.3	0.3
Methionine	0.2	0.2	0.2
Lysine	0.1	0.15	0.2
Calculated analysis			
Crude protein (%)	17.86	19.05	16.64
ME (kcal/kg)	2777.16	2668.93	2836.14
EPR	155.49	140.03	170.35
Phosphors (g kg-1)	4	4	4
Calcium (g kg-1)	4	4	4
Linoleic acid (g kg-1)	25.8	28.8	27.9

ME = Metabolizable Energy; EPR= energy-to-protein ratio; RW= rice waste; MBW= meat and bone waste.

Results

The fatty acid profile of *Hermetia illucens* larvae meal and dietary treatments is shown in Table 2. The majority of fatty acid contents in *Hermetia illucens* larvae meal were C14:0 (27.17%), C16:0 (25.4+8%), C 16:1-7 (7.39%), C18:0 (1.76%), C18:1 n-9 (28.59%), and C18:2 n-6 (8.15%), while the minor of fatty acid contents were C18:3 n-3 (0.58%), C20:4 n-6 (0.11%), C20:5 n-3 (0.59%), C22:5 n-3 (0.08%), and C22:6 n-3 (0.09%). The total SFA content (54.41%) was higher than the total unsaturated fatty acid (USFA) content (45.59%). The total monoene content was 35.98. Also, the total polyunsaturated fatty acid n-6 (PUFA n-6) (8.26%) was higher than the total polyunsaturated fatty acid n-3 (PUFA n-3) (1.35%).

The fatty acid profile in the egg yolk of hens fed the variable EPR diets using *Hermetia illucens* larvae meal is shown in Table 3. The lowest ($P<0.05$) total SFA content was reported in the egg yolk of hens fed a low EPR diet among treatments, although the C14:0 content was the highest ($P<0.01$) in the same treatment. The C16:0 content dominated the SFA was declined ($P<0.01$) in the egg yolk of hens fed *Hermetia illucens* diets. A similar ($P<0.05$) result was reported with C 22:6 n-3 content. Also, hens fed the high EPR diet reported the highest content of C18:0 ($P<0.05$), and C 22:5 n-3 ($P<0.01$) in the egg yolk. However, there was a similar effect between hens fed the low EPR diet and hens fed the control diet in terms of the C18:0 content. The hens fed the low EPR diet reported the highest ($P<0.05$) total USFA content in the egg yolk among treatments. Also, the contents of C18:2 n-6 and C 20:4 n-6 were decreased ($P<0.05$) by the low EPR diet compared with the hens fed the control diet. However, the C 18:1 n-9 content was increased by the low EPR diet. The content of total monoene fatty acid was high ($P<0.01$) with increasing the *Hermetia illucens* larvae meal in the diet. The total PUFA n-3 content was decreased ($P<0.05$) in the

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egg yolk of hens fed *Hermetia illucens* larvae meal diets. Also, hens fed the low EPR diet had depressed (P<0.05) total PUFA n-6 content in egg yolk compared with hens fed the control diet. The Poly: Sat ratio was decreased (P<0.01) with an increase of *Hermetia illucens* larvae meal content in the diet. In addition, the Unsat: Sat ratio was increased (P<0.05) in birds fed the low EPR diet compared with other treatments.
The effect of changing the EPR diet using *Hermetia illucens* larvae meal on the cholesterol content of egg yolk is shown in Table 4. There is no significant effect (P>0.001) of *Hermetia illucens* larvae meal on cholesterol content in egg yolk.

Table 2. Fatty acid profile (%) of experimental diets and *Hermetia illucens* meal

	Dietary treatments			*Hermetia illucens*
Fatty acid	Control	Low EPR	High EPR	
C14:0	1.21 + 0.02	4.38 + 0.14	2.14 + 0.10	27.17 + 0.14
C16:0	25.28 + 0.15	25.27 + 0.47	28.48 + 1.06	25.48 + 0.19
C 16:1-7	1.42 + 0.48	2.38 + 0.08	1.63 + 1.15	7.39 + 0.09
C18:0	4.89 + 1.68	5.79 + 0.02	3.07 + 0.41	1.76 + 0.22
C18:1 n-9	38.96 + 0.28	38.14 + 0.22	40.03 + 2.21	28.59 + 0.17
C18:2 n-6	23.23 + 0.20	21.28 + 1.06	21.42 + 0.51	8.15 + 0.10
C18:3 n-3	1.60 + 0.01	1.49 + 0.06	1.65 + 0.04	0.58 + 0.43
C20:4 n-6	0.44 + 0.22	0.42 + 0.08	0.50 + 0.04	0.11 + 0.01
C20:5 n-3	0.65 + 0.35	0.57 + 0.17	0.36 + 0.03	0.59 + 0.48
C22:5 n-3	0.24 + 0.08	0.16 + 0.05	0.31 + 0.01	0.08 + 0.01
C22:6 n-3	0.16 + 0.03	0.12 + 0.05	0.41 + 0.08	0.09 + 0.01
Total SFA	32.29 + 0.27	35.44 + 0.61	33.69 + 1.41	54.41 + 0.11
Total USFA	67.44 + 0.01	64.56 + 0.61	66.31 + 1.41	45.59 + 0.11
Total Monoenes	40.72 + 0.30	40.52 + 0.29	41.66 + 1.86	35.98 + 0.20
Total PUFA n-3	2.92 + 0.22	2.34 + 0.15	2.73 + 0.11	1.35 + 0.20
Total PUFA n-6	23.80 + 0.35	21.70 + 0.99	21.92 + 0.48	8.26 + 0.10
Poly:Sat Ratio	0.83 + 0.03	0.68 + 0.04	0.73 + 0.02	0.18 + 0.00
Unsat:Sat	2.08 + 0.03	1.82 + 0.05	1.97 + 0.13	0.84 + 0.00
n-6: n-3 Ratio	8.19 + 0.48	9.35 + 0.96	8.04 + 0.29	6.31 + 1.14

Value= mean + standard deviation, SFA= Saturated fatty acids, USFA=Unsaturated fatty acids, PUFA= Polyunsaturated fatty acids

Table 3. Effect of changing energy-to-protein ratio diet using Hermetia illucens on the fatty acid profile (%) in egg yolk.

	Dietary treatments				
Fatty acid profile	Control 0% *Hermetia illucens*	Low EPR 5% *Hermetia illucens*	High EPR 1% *Hermetia illucens*	SEM	*P* -value
14:0	0.48c	0.95a	0.56b	0.06	**
16:0	30.09a	26.94b	27.43b	0.47	**
16:1n-7	2.61b	2.42b	4.07a	0.29	*
18:0	2.66b	2.58b	4.33a	0.33	*
18:1 n-9	44.24b	53.08a	46.85b	1.20	**
18:2 n-6	11.42a	8.38b	9.89ab	0.47	*
18:3 n-3	0.63	0.65	0.57	0.08	ns
20:4 n-6	2.59a	1.63b	2.19ab	0.15	*
20:5 n-3	0.97	0.97	0.90	0.06	ns
22:5 n-3	0.64b	0.48c	0.71a	0.03	**
22:6 n-3	3.63a	1.88b	2.47b	0.29	*
Total SFA	33.24a	30.47b	32.33a	0.45	*
Total USFA	66.76b	69.52a	67.67b	0.45	*
Total Monoenes	46.85c	55.51a	50.92b	1.14	**
Total PUFA n-3	5.87a	3.99b	4.66ab	0.33	*
Total PUFA n-6	14.02a	10.0cb	12.08ab	0.56	**
Poly:Sat	0.60a	0.45c	0.52b	0.02	**
Unsat:Sat	2.01b	2.28a	2.10b	0.04	*
n-6 : n-3	2.48	2.55	2.79	0.16	ns

EPR= energy-to-protein ratio, SFA= Saturated fatty acids, USFA=Unsaturated fatty acids, PUFA= Polyunsaturated fatty acids

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Table 4. Effect of changing energy-to-protein ratio diet using *Hermetia illucens* meal on the cholesterol content (%) in egg yolk

Treatment	Cholesterol
Control (0% *Hermetia illucens*)	3.39
Low EPR (5% *Hermetia illucens*)	3.17
High EPR (1% *Hermetia illucens)*	3.51
SEM	0.33
P-Value	0.31

Discussion

In the analysis *Hermetia illucens* larvae meal, the higher total SFA content and the lower total USFA content were reported than those found in Raphia, Weevil, Cricket, Grasshopper, Termites, Imbrasia, UI caterpillar. (Womeni et al., 2009). Also, the total SFA content of *Hermetia illucens* larvae meal was lower and the USFA was higher than those reported in *Hermetia illucens* larvae oil by Kim et al. (2020). This could be because of the difference in the composition of larvae feed media. Ewald (2019) reported a significant difference in the fatty acid profile of larvae meal grown on different substrates. The contents of SFA and USFA in *Hermetia illucens* larvae meal may be altered regarding their contents in the larvae feed media and larvae weight on the harvesting day. Kawasaki et al. (2019) reported 22.9% of SFA and 3.2 PUFA in *Hermetia illucens* larvae meal raised on household organic waste. Liland et al. (2017) mentioned that the contents of PUFA, iodine and vitamin E in the *Hermetia illucens* larvae meal were increased by using seaweed in the feeding media. The larvae meal can be a dietary source of UFA by adding oils rich in UFA to the larva diet (Georgescu et al., 2022). Also, Tirtawijaya and Choi (2022) reported a good source of PUFA, DHA, and EPA in *Hermetia illucens* larvae meal by feeding the larvae on squid liver oil in an appropriate amount.

The findings of this study revealed fatty acid profile variation in egg yolk when changing the EPR diets using *Hermetia illucens* larvae meal. The hens fed a low EPR diet using *Hermetia illucens* at 5% laid eggs were slightly lower in total SFA, palmitic acid, and stearic acid, but higher in total UFA content. According to the previous study, the egg yolk of hens fed *Hermetia illucens* larvae diets contained more SFA and less PUFA than eggs laid by hens fed the control diet (Heuel et al., 2021). Also, in the study of Bejaei and Cheng (2020), it was reported that laying hens fed dry and crushed non defatted *Hermetia illucens* larvae had a high content of SFA, and MUFA compared with hens fed soybean meal. Also, the author mentioned that n-3 and n-6 fatty acid content were lowered by larvae treatments in the egg yolk compared to hens fed the basal diet. However, Secci et al. (2018) did not find a significant difference in the fatty acid profile of egg yolk laid by hens fed a defatted *Hermetia illucens* larvae diet. In the current study, the content of total SFA content in the egg yolk of hens fed the low EPR diet was lower than being used in the diet. In contrast, the total USFA content was higher in egg yolk than those consumed from the diet. This showed that more of SFA, particularly myristic acid and stearic acid were either divided up into other roles such as metabolism energy of the hen body or expansion in the hen metabolism (enterohepatic de novo lipogenesis) rather than being used for integration into the egg lipids as USFA. Also, the improvement in the fatty acid profile of egg yolk could be due to the including *Hermetia illucens* larvae meal in the diet, thus total UFA content was increased and total SFA content declined compared with hens fed the control diet. However, Chatzidimitriou et al. (2016) reported an increase in SFA content and a decrease in PUFA content when replacing soybean cake with *Hermetia illucens* larvae meal in Leghorn layers diets at 12% and 24%. In the fish study, St-Hilaire et al. (2007) mentioned that including the *Hermetia illucens* larvae meal as feedstuff in rainbow trout diets led to a decrease in omega-3 fatty acid content in fish fillets. The omega-3 (n-3) fatty acid content is fundamental for man and associated with health benefits for humans upon consumption (World Health Organization, 2003). Also, the content of palmitic acid in the egg yolk was higher than the amount consumed in the diet, this may be due to utilizing some dietary palmitic acid for active purposes and synthesis of palmitic acid through enterohepatic lipogenesis(Carta et al., 2017; Ravindran et al., 2016). Secci et al. (2018) reported double palmitic acid content in the egg yolk of laying hens fed a diet containing black solder fly larvae than those found in the consumed diet. In this study, changing EPR diets using *Hermetia illucens* larvae meal had a similar effect on cholesterol content in yolk eggs. This result did not agree with Razdan et al. (1997) who reported linkage between chitin-chitosan with bile acids led to a decrease cholesterol content in blood and liver tissue. Chitin-chitosan may decrease the content of bile acids with cholesterol which are available for reabsorption by enterohepatic circulation in the lower intestine. In conclusion, the fatty acid profile of egg yolk can be modified using *Hermetia illucens* larvae meal in the laying hen diet. The low EPR diet using *Hermetia illucens* larvae meal at 5% in the laying hen diet had a positive effect on the fatty acid profile of egg yolk.

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Potential Causes for Rice Plant Yellowing in "Maha" Cultivation Season in Year 2023 in Anuradhapura District, Sri Lanka

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Abstract

Rice (*Oryza sativa*) is the most consumed cereal food in the world and is mostly grown in Southeast Asia. It is a major staple food of Sri Lankans as well. Rice cultivation continues to occupy a vital place in the Sri Lankan economy. Yellowing of rice plants was a major challenge in the "Maha" cultivation season in 2023, and this condition was spread across significant rice-growing areas in Sri Lanka, including Anuradhapura, Polonnaruwa, and Hambantota. Although farmers have used different types of chemical fertilizers and pesticides, the problem has not been overcome. The main visible symptoms of this disease were yellowing, stunting, and inhibiting the growth of the rice plant. Some studies have revealed that the yellowing of rice plants is mainly due to nutrient deficiency, inadequate nutrient uptake, an increase in rice root knot nematode population, a decrease in soil microbial population, and soil acidity. In this study, the soils of Kawarakkulama and Nelumkanniya affected paddy fields from Anuradhapura district, and unaffected paddy fields in Yatihalagala and Barigama from Kandy district were sampled. Affected and unaffected soil samples of each paddy field located in Anuradhapura and Kandy districts were analyzed for nutrient status, nematode population, and microbial population to identify potential causes for rice yellowing. Nitrogen, phosphorus, and potassium contents of soil samples were significantly different in affected and unaffected sites. Phosphorous and potassium were limited in the affected sites of Anuradhapura paddy fields. Yellowing could be related to a deficiency of potassium and phosphorus.

Keywords: *Nutrient deficiency, nematode population, soil acidity, microbial population*

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Overview of Agroforestry and its Impact on Environment

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Abstract

Agroforestry is a conventional method of land use that could help to address agricultural environmental issues. In order to take advantage of the ensuing ecological and economic interactions, agroforestry is the technique of consciously integrating woody vegetation (trees or shrubs) with crop and/or animal systems. According to recent studies, the global agri-food industry may reach more sustainable methods of producing food and fiber by adopting agroforestry techniques and principles more widely. This would benefit farmers economically and would benefit society as a whole in terms of the environment. Agroforestry promotes eco-intensification based on resource efficiency and offers a wide range of provisioning, regulating, cultural, supporting ecosystem services, and environmental advantages. In this review, we discussed agroforestry with its advantages and developments.

Key Words: *Agroforestry, Ecosystem services, Sustainable agriculture, Development*

Id: 34

Arbuscular Mycorrhizal Fungi and Organic Amendments as alternatives for Inorganic Fertilizer on growth, yield and Vitamin C content of Chili (*Capsicum annum* L.)

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Abstract

This study was investigated to compare Biofertilizer (AMF), Biochar, Compost and Inorganic Fertilizer on Vegetative, Reproductive Properties and Vitamin C content of Chili (*Capsicum annum* L.) The pot experiment was conducted at the Faculty of Applied Sciences, Rajarata University of Sri Lanka. Control (without soil amendments) was consisted of 3000g of soil in pot with one chili plant. The treatments were arranged in a randomized complete block design (RCBD) with four replicates. Vitamin C content of chili fruits were tested after harvesting. Treatments were field soil only (T_0), field soil and 3% rock phosphate (T_1), field soil and arbuscular mycorrhizae (T_2), field soil and arbuscular mycorrhizae and 3% rock phosphate (T_3) field soil and 5% biochar (T_4), field soil, 5% biochar and 3% rock phosphate (T_5), field soil and 5% compost (T_6) field soil, 5% compost and 3% rock phosphate (T_7), field soil and inorganic fertilizer (T_8), field soil, inorganic fertilizer and 3% rock phosphate (T_9). According to Tukey's Pairwise Comparison test, the application of mycorrhizae and compost with or without rock phosphate significantly ($p<0.05$) improved the relative growth rate of chili compared to T_0 T_4, T_5 and T_8. However, number of fruits were significantly high ($p<0.05$) with mycorrhizae, biochar and compost with rock phosphate. Vitamin C content was significantly ($p<0.05$) high in all the treatments except T_0,T_1 and T_5. Organic and biofertilizer (AMF) with rock phosphate could be used as effective substitutes for inorganic fertilizers for chili cultivation in Sri Lanka.

Keywords: *Arbuscular mycorrhizae, Organic fertilizers, Inorganic fertilizers, Capsicum annuum L.*

Introduction

The present- day agricultural crop production is highly dependent on inorganic fertilizer and some other agro-chemicals. However, the application of inorganic fertilizers to soil are known to affect adversely on the soil microorganisms and therefore, the soil fertility and crop productivity will be affected in the long run (Seneviratne, 2009). Furthermore, it is also found that inorganic fertilizer contaminate soil with several toxic metals which could be accumulated in living systems and human bodies through the food chains, and cause health problems (Chandrajith *et al.*, 2010). Therefore, use of inorganic fertilizer cannot be continued as a sustainable practice of crop production. As a result, there is a renewed interest on the reduction of inorganic fertilizer applications by alternatives (Jayawardhane and Yapa, 2018; Kulasooriya *et al*., 2018). Traditionally, natural organic manure such as animal droppings, green manure, and compost, etc. used as alternatives for inorganic fertilizer. Also, beneficial microorganisms, biochar, and rock phosphate (RP) found to be currently trending in organic agriculture (Pathirana and Yapa, 2020).

Chili pepper (*Capsicum annum* L.: solanaceae) is popular throughout the world due to its nutritional, medicinal as well as the economic value (Rahmanet *et al*., 2013). Chili is rich in vitamins (A, B_5, C, and E), minerals (K, Mg, Fe, Ca, and P), antimicrobial, and anticancer compounds (Saleh *et al*., 2018). Arbuscular mycorrhizal fungi (AMF) are important soil microorganisms which form a symbiotic association with most of the higher plant roots. Through these mutualistic associations, AMF provide several benefits to crop plants including nutrient and water supply (Siddiqui and Pichtel, 2008), disease resistance (Siddiqui and Pichtel, 2008), Heavy metal tolerance (Davies *et al.*, 2002), and improve soil properties (Gaur and Adholeya, 2004). Biochar is a type of soil amendment prepared by a variety of biomass feedstocks, including wood, crop, manures, and yard wastes via the pyrolysis under limited oxygen and below 700 ^{0}C temperature. Biochar can enhance soil moisture and nutrient availability (Lehmann and Joseph, 2009), remediate contaminated lands (Woolf *et al.*, 2010), and provide habitat for soil microorganisms (Baldock and Smernik, 2002). Rock phosphate is a good

alternative phosphorous source for synthetic Triple super phosphate (TSP) and is recommended for organic farming due to its less solubility (Wanninayake *et al*., 2021).
Therefore, the present study was conducted to assess the effects of selected biofertilizer and organic amendments, which are the potential substitutions for synthetic fertilizer on the growth, yield and vitamin C content of green chili.

Material and Methods

Treatment application

A pot experiment was conducted inside a planthouse under natural light conditions at Rajarata University of Sri Lanka in Mihinthale (80 21′ 0" North, 800 30′ 0" East), Sri Lanka, during 2017-2018. The day temperature in the planthouse during the trial was 31°C -35°C and night temperature was 30°C with the 68% relative humidity. Annual precipitation in the area is between 1000-1500 mm. The experiment was designed as complete randomized block design with four replicates. There were five different manure treatments including the control, and depending on the addition of rock phosphate (RP), there were total of ten treatments: field soil only (T_0), field soil and 3% rock phosphate (T_1), field soil and arbuscular mycorrhizae (T_2), field soil and arbuscular mycorrhizae and 3% rock phosphate (T_3) field soil and 5% biochar (T_4), field soil, 5% biochar and 3% rock phosphate (T_5), field soil and 5% compost (T_6) field soil, 5% compost and 3% rock phosphate (T_7), field soil and inorganic fertilizer (T_8), field soil, inorganic fertilizer and 3% rock phosphate (T_9). Before adding treatments, each pot was filled with a potting mixture containing sieved field soil, obtained at the depth of 0-10 cm, from the fields with previously no added synthetic fertilizer. Composite soil samples containing AMF spores and fine corn root fragments obtained from the upper layer of a corn field were used as AMF inoculum. Biochar was produced by following double barrel method (Agegnehu *et al.*, 2016) using wood chips, paddy husks and paddy straw (3:2:2 ratio). Commercially available Eppawala rock phosphate and compost were used for desired treatments. AMF inoculum, biochar and compost were applied at the rate of 250g per pot, and rock phosphate was added at 90g per pot. Recommended doses of NPK were added in inorganic fertilizer treatments. The final weight of soil mixture per pot was adjusted into 3kg by changing the weight of initial potting mixture (Table 1). Seeds of variety chili pepper (*Capsicum annuum* L.) was grown in a tray and one plant was transplanted to each pot.

Data Collection

The agronomic parameters such as height of the plant (cm), relative growth rate, number of leaves per plant, leaf area index, number of branches per plant as the growth parameters and number of flowers per plant, number of fruits per plant and weight of fruits (g) as the yield parameters were measured. Furthermore, photosynthesis rate and ascorbic acid content of chili were measured.

Table 1. Treatment combinations of the pot experiment

Treatment		Amount of soil (g)	Amount of amendment (g)	Rock phosphate (3%) (g)
T_0	field soil only	3000	-	-
T_1	field soil and 3% rock phosphate	2910	-	90
T_2	field soil and arbuscular mycorrhizae	2750	250	-
T_3	field soil and arbuscular mycorrhizae and 3% rock phosphate	2660	250	90
T_4	field soil and 5% biochar	2750	250	-
T_5	field soil, 5% biochar and 3% rock phosphate	2660	250	90
T_6	field soil and 5% compost	2750	250	-
T_7	field soil, 5% compost and 3% rock phosphate	2660	250	90
T_8	field soil and inorganic fertilizer	2995	5	-
T_9	field soil, inorganic fertilizer and 3% rock phosphate	2905	5	90

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Agronomic data

Height of the plant (cm) was measured at harvesting stage and relative growth rate was calculated. Number of leaves, branches, flowers, and fruits per plant were measured from the date of transplanting to harvesting stage periodically. Fresh weight of fully-matured fruit was recorded after harvesting. Leaf area was determined by using leaf area meter and photosynthetic rate was measured by portable photosynthesis system (LI-6400XT).

Ascorbic acid content of chili

The ascorbic acid content of harvested fruits was determined by adopting the procedure of Orobiyi *et al*., (2015). Chili pepper fruits (0.5g) were washed with water and homogenized with 5 ml of 4% oxalic acid using mortar and pestle. The homogenates were centrifuged at 5,000 rpm for 10 minutes and the supernatants were filtered. The residues were made up to 25 ml with 4% oxalic acid. The ascorbic acid content was estimated by spectrophotometry using 2, 4 dinitrophenylhydrazine reagent at 540 nm wave length and the absorbance was measured. The standard curve was used to measure the vitamin C content.

Results and Discussion

The application of mycorrhizae and compost with or without rock phosphate significantly ($p<0.05$) improved the relative growth rate of chili compared to control and other treatments (Figure 1). Chili plant height was increased from transplanting onwards, reaching its maximum height at 4th month. The maximum plant growth was observed in mycorrhizal applied chili plants. However, number of fruits were significantly high ($p<0.05$) with mycorrhizae, biochar and compost with rock phosphate (Figure 2). The growth and yield parameters of chilies were greatly influenced by phosphorus. The findings of the current study showed that rock phosphate applied plants showed the higher values for most of investigated growth parameters and yield parameters.

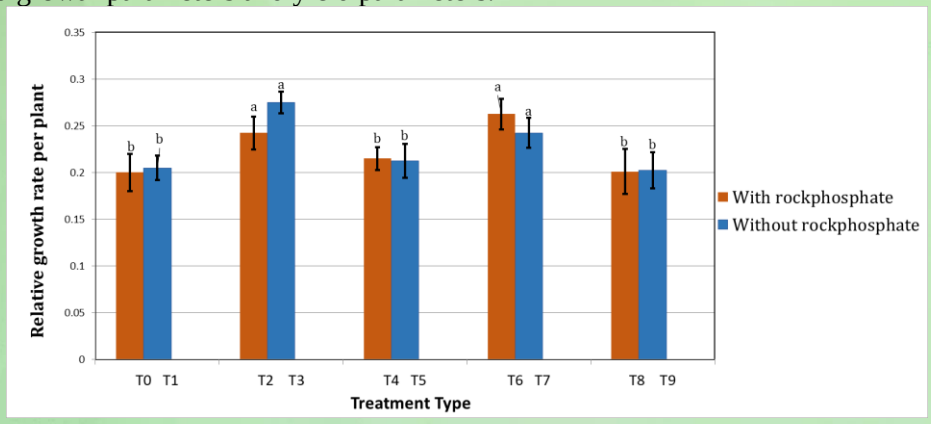


Figure 1. Effect of the different treatments for relative growth rate of chili plants. Means share a same letter denoted no significant difference at $p < 0.05$.

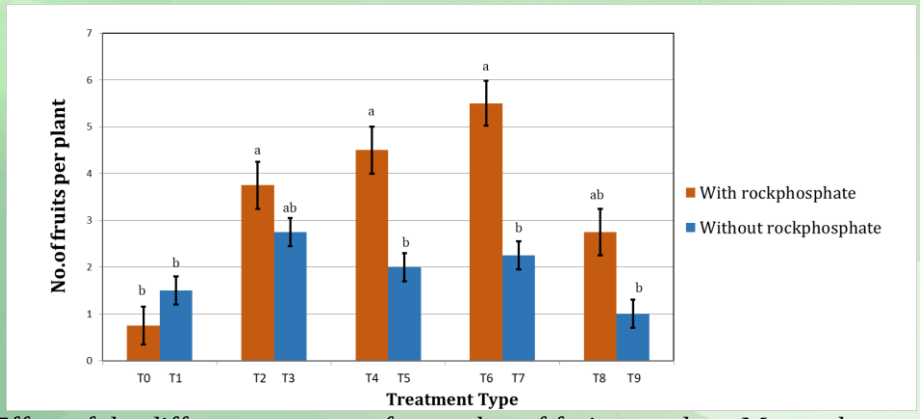


Figure 2. Effect of the different treatments for number of fruits per plant. Means share a same letter denoted no significant difference at $p < 0.05$.

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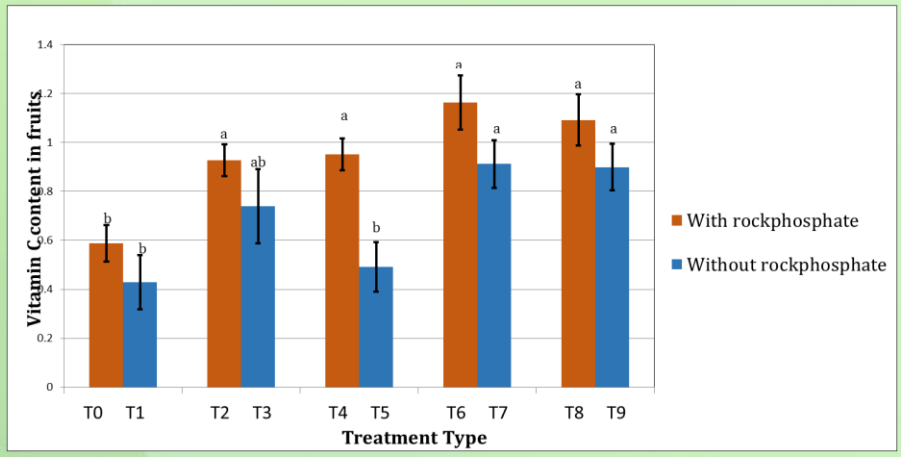


Figure 3. Effects of the different treatments for vitamin C content of fully matured fruits Means share a same letter denoted no significant difference at $p < 0.05$.

The vitamin C content of the sampled fresh fruits of *Capsicum annuum* L. varied from 1.72mg/cm 3 to 0.40 mg/cm 3 to fresh weight of 0.5mg. It was significantly ($p<0.05$) high in all the treatments except T_0, T_1 and T_5 (Figure 3). However, there was no significant difference ($p\geq0.05$) observed for final plant height (cm), number of leaves per plant, leaf area index, number of branches per plant, number of flowers per plant, and weight of fruits (g) and photosynthesis rate (Table 2).

Table 2. Mean values of growth parameters, yield parameters and photosynthesis rate for different treatments. Means share a same letter denoted no significant difference at $p < 0.05$.

Treatment No	Treatment type	Growth Parameters				Yield parameters		Photosynthesis rate ($\mu mol\ m^{-2}S^{-1}$)
		Plant Height (cm)	No. of leaves per plant	Leaf Area Index (cm^2)	No. of branches per plant	No. of Flowers per plant	Fruit weight (g)	
T0	Field soil only	23.68±1.7^a	18	140.57±15.3^a	12	3	1.51±.30^b	95.5±9.8^b
T1	Field soil and rock phosphate	18.90±0.9^b	17	107.04±15.9^b	13	3	1.62±0.25^b	95.5±11.8^b
T2	Field soil and AMF	27.03±1.^{a}	20	132.26±7.1^a	12	2	2.31±0.3^a	122.75±37.0^b
T3	Field soil, AMF and rock phosphate	27.13±1.8^a	18	123.55±11.2^a	15	5	2.09±0.26^{ab}	175.5±33.3^{ab}
T4	Field soil and biochar	23.37±2.^{b}	17	101.82±8.7^b	16	3	1.83±0.0^b	337±28.4^a
T5	Field soil, biochar and rock phosphate	25.32±1.3^a	12	107.94±7.7^b	13	4	2.84±0.28^a	106.25±24.3^b
T6	Field soil and compost	25.62±1.6^a	24	135.01±25.3^a	16	3	2.71±0.27^a	154.25±33.2^b
T7	Field soil, compost and rock phosphate	27.87±2.4^a	26	137.59±18.9^a	17	5	2.90±0.13^a	270.25±56.1^a
T8	Field soil and inorganic fertilizer	22.25±2.^{b}	14	108.46±11.^{b}	16	2	1.86±0.24^{ab}	263±32.5^a
T9	Field soil, ino. fer. and rock phosphate	26.75±2.7^a	26	136.99±5.4^a	17	5	2.76±0.18^a	151.75±41.2^{ab}

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Conclusion

Considering growth and yield parameters addition of standard compost, biochar and AMF, combination with rock phosphate separately can successfully replace the use of inorganic fertilizer in chili cultivation in dry zone, Sri Lanka. Organic fertilizer with rock phosphate positively influenced on vitamin C content of chili fruits.

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Evaluation of the Capacity and Sufficiency of Sakura Park in Selçuklu District of Konya Province as a Post-Disaster Assembly Area

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Abstract

After the earthquake disaster experienced by our country, the importance of open and green spaces has once again come to the agenda, just like the Covid-19 outbreak. Green areas are of great importance both because they can be used as assembly areas after disasters and because they can be transformed into temporary accommodation areas. Assembly areas are the areas where the public can assemble safely by preventing misunderstandings that may arise after a disaster and by creating a healthy exchange of information. Assembly areas are safe areas where people can assemble away from dangerous areas until tents and containers are ready after disasters and emergencies. Sakura Park, which became operational in 2023, is very suitable for being a post-earthquake assembly area with its location and design. In the park selected as the study area, a survey was conducted with 166 people selected according to the snowball method to exceed the population size in the central limit theorem on the basis of volunteerism at random times on weekdays and weekends. According to the results of the survey, Sakura Park was found to be very suitable as a post-disaster assembly area because it is located at the intersection of important transportation networks, close to hospitals, provides a plain settlement area, can be used as a support center with the surrounding schools, and has no thorny and poisonous plant material. The assembly capacity of the park is very sufficient considering that the neighboring Ecdat Park and the gardens of the schools can also be organized together.

Key Words: Assembly capacity of parks, *Post-disaster assembly area, Earthquake, Earthquake park, Konya*

Introduction

An earthquake is an event in which sudden vibrations caused by fractures in the earth's crust spread in waves and shake the environments they pass through. Earthquake is a natural phenomenon. Since the formation of the world, it is known that earthquakes have occurred consecutively in seismically active regions and many people and shelters have been destroyed as a result (İşçi, 2008).

Earthquake, which is one of the natural disasters, is synonymous with disaster in our country due to the fear, loss of life and property it causes. Earthquake, in the most comprehensive sense, is a natural event that takes its source from the depths of the earth and causes the earth's surface to shake with sudden vibrations caused by fractures in the earth's crust (Bilen and Polat, 2022).

Defined in terms of magnitude, it obeys a power law size distribution given by log N = a - bM , where N is the number of earthquakes greater than or equal to magnitude M and a and b are constants. The parameter a describes the total number of earthquakes and the parameter b, often referred to as the b value, describes the relative size distribution of earthquakes (Scholz, 2015).

They pose special risks to life safety because they are unpredictable, can occur in a sequence or series (e.g. a mainshock with hundreds to thousands of aftershocks, double earthquakes, etc.), and are temporally and spatially variable events that can vary in intensity. Even smaller magnitude earthquakes (M4.5+) can produce tremors significant enough to cause damage. This is particularly true in places with poor land-use planning and construction practices, weak building codes and standards, as well as aging or fragile building stock (McBride et al., 2022).

In our country, which is located in the earthquake zone, many earthquakes have occurred in which structural damages have reached serious dimensions and millions of lives have been lost. Especially with the recent earthquakes, it has been seen that our buildings do not provide the targeted strength, thus causing loss of life and property (Garip and Eren, 2022).

A country like Turkey is a natural laboratory for earth sciences, covering one of the most seismically active regions of the earth. Due to the complex plate interaction between Arabia, Eurasia and Africa, different fault systems exist in and around Anatolia.

The North Anatolian Fault System (NAFS) and the East Anatolian Fault System (EAFS) are the main strike-slip fault belts in Turkey. These fault systems facilitate the westward escape of the Anatolian microplate. Normal

fault systems dominate Western and Central Anatolia due to the north-south extension regime in the Aegean (Oduoye et al. ,2023).

In our country, buildings are generally composed of reinforced concrete structures and most of these buildings in the epicenter areas of earthquakes have collapsed and caused destruction. The performance of reinforced concrete buildings in recent earthquakes in Turkey is discussed. The failure modes include foundation collapse, soft floors, strong beams and weak columns, lack of column restraint, poor detailing practices and non-structural damage (Arslan and Korkmaz, 2007).

Earthquake Assembly Areas; Because the nature of earthquakes is unknown, there is often no advance warning and no time for evacuation to prevent damage, in which case emergency shelter placement often becomes a post-earthquake problem. Therefore, pre-disaster planning and preparation is critical to ensure a coordinated response in the siting of emergency shelters after a major earthquake. Gathering areas need to be identified (Aman and Aytaç, 2022). Assembly areas are safe areas that people can reach urgently during and after disasters and do not carry any risk in terms of disasters. For this reason, they should be selected from areas that are physically, geologically and geographically free from disaster risk and should be equipped to meet basic human needs such as toilets. Gathering areas are also centers where many activities are carried out during and after disasters such as informing individuals exposed to disasters, coordination with aid teams, and directing them to temporary shelter areas (Gerdan and Şen, 2019). Understanding the size of evacuees along specific routes after an earthquake can also help emergency managers understand population demand and capacity issues in pre-designated assembly areas. Having an idea of whether a assembly area will evacuate 100 or 1000 people will help emergency managers develop realistic response plans to help survivors and direct relief personnel (Wood et al. 2016).

Earthquake Assembly Areas Standards;

Distance and accessibility: Accessibility is a flexible, slippery and broad term. It is often defined as a measure of how close two places are to each other. Distance to building sites should be taken into account when identifying gathering areas. These areas should not be too close to buildings and not too far from walking distance. They should be as close as possible to the boundary of the evacuation area and accessible. Areas within 0-500 m walking distance should be considered.

Main road connections: Connections of gathering areas to main roads and alternatives to risky roads should be evaluated.

Multifunctionality and utilization: Multifunctionality and multi-use is a key strategy for making places more earthquake-sensitive. It promotes a culture of adaptability and helps build more resilient neighborhoods. The availability and usefulness of existing green spaces, playgrounds and parks, and public buildings with enclosed spaces such as schools or mosques that can be used as gathering spaces in the area/neighborhood should be assessed.

Public lands: Public lands should be considered as priority areas if they contain the features described above. The structural safety of public buildings, especially if they are designated as assembly areas in earthquake zones, should be considered.

Size: The JICA 2002 report recommends 1.5 m2 per person for evacuation areas. According to Tarabanis and Tsionas (1999), the standard is 2 m (Gerdan and Şen, 2019:967).

Responsibilities of Landscape Architects Before Earthquake; Public spaces such as squares, parks and sports fields are crucial for earthquake preparedness. They are the safest places to be during and after an earthquake due to building collapse, falling rubble, fire and gas leaks. Emergency and recovery needs such as evacuation, medical assistance, social gatherings, communication, and distribution of water and food are often taken care of in a city's urban open and green spaces (Alawi et al., 2023). These urban open and green areas (parks, children's playgrounds, recreation areas, sports facility areas, squares, marketplaces, educational and official facility areas) stand out when compared to other land uses. It is clear that the existing land use types and the land use types proposed in the current plans significantly affect the usability of urban open and green areas as first assembly areas (Partigöç, 2023).

Responsibilities of Landscape Architects after Earthquake; It is important to understand how the geological and geomorphological environment will continue to evolve due to earthquakes, and this is particularly important given that future climate change may alter the behavior of landscapes. However, it is necessary to predict how landscapes affected by earthquakes will respond and recover in the future (Congrong et al. 2020).

Open and green spaces can provide many functions in cities, such as park areas, recreation, natural environments, stormwater management. Open and green spaces have another potentially very important function. This is as a safe space during and after earthquakes. In earthquake-prone areas, open and green spaces become the place where people go during and immediately after seismic events. They don't want to be near buildings that could fall on them, so being in an open space often provides temporary safety. However, people often have to spend long periods of time there, potentially having to stay outdoors for days or weeks after an earthquake. An open and green space should be specifically designed for seismic resilience. Post-earthquake

landscape architects have identified six themes that should be considered when designing urban open and green spaces. These are
1-Multifunctionality
2-Connection
3-Site location and suitability
4-Dimension and function
5-Site elements
6-Social resilience (Brown and Corry, 2020).
The act of vegetative design can be part of recovery and resilience in communities. While green infrastructure is not an immediate post-disaster priority, improving and protecting green infrastructure is an important way to strengthen a community's recovery (Miller, 2020).

Materials and Methods

The main material of the research is Sakura Park located in Konya Selçuklu district. On February 6, 2023, the earthquake that affected 10 cities in Turkey, called the disaster of the century, caused a great loss of life and property in these cities and their immediate surroundings. One of the most important needs after the earthquake was earthquake gathering areas. For this reason, assembly areas have gained importance not only in these 10 cities but also throughout the country. With this research, it is aimed to investigate whether Sakura Park in Selçuklu district of Konya province meets the criteria of a gathering area in a possible earthquake. On the basis of volunteerism, a survey was conducted with 166 people using the snowball method in the park at different times on weekdays and weekends.

Results and Discussion

The distribution of the survey participants according to demographic characteristics is given in Tables 1, 2, 3, 4, 5. 65.7% of the participants were between the ages of 15-25, 26.5% between the ages of 26-35, 4.8% between the ages of 36-55, and 1.2% between the ages of 56-65. 25.3% of the participants were married and 74.7% were single. 2.4% of the participants attended secondary school, 7.2% high school, 12% associate's degree, 63.3% bachelor's degree and 12% master's degree. 62.7% of the participants were female and 37.3% were male. In terms of occupational status, 53% of the participants were students, 3.6% were housewives, 14.5% were civil servants, and 28.9% were self-employed.

Table 1. Distribution of participants according to age range

	N	(%)
15-25	112	%65,7
26-35	44	%26,5
36-55	8	%4,8
56-65	2	%1,2

Table 2. Distribution of participants according to marital status

	N	(%)
Married	42	%25,3
Single	124	%74,7

Table 3. Distribution of participants according to educational status

	N	(%)
Middle School	4	%2,4
High School	12	%7,2
Associate Degree	20	%12
License	110	%63,3
Master's Degree	20	%12

Table 4. Distribution of participants according to gender

	N	(%)
Woman	104	%62,7
Man	62	%37,3

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The relationship of the respondents to Sakura Park in the questionnaire study in this research is given in Tables 6,7,8,9,10,11 and 12. Accordingly, 7.2% of the participants are less than 250 m, 8.4% are within 500 m, 25.3% are within 1 km, 13.3% are within 1.5 km, and 45.8% are within 2 km of Sakura Park. 14.5% of the participants visit the park on weekdays and 85.5% on weekends. 4.9% of the participants prefer the park in the morning, 11% in the afternoon, 23.2% in the afternoon, 28% in the evening, and 32.9% at any time. 34.9% of the participants come to the park to get fresh air, 18.1% to relax, 30.1% to take a walk, 6% to let their children play, 10.8% to have a picnic. 22.9% of the participants walk to the park, 36.1% use public transportation, 33.7% use personal vehicles, and 7.2% use bicycles. 7.2% of the participants go to the park alone, 36.1% with their spouse and partner, 28.9% with their work/school social circle, 27.7% with their family/home/living circle. 27.7% of the participants prefer Sakura Park because they feel comfortable, 13.3% because the concept of using the park is interesting, 12% because they use the rubber walking path in the park, 6% because they use the bicycle path in the park, 38.6% because it meets their need for green space, and 2.4% because it is close to their home.

Table 5. Distribution of participants according to their occupations

	N	(%)
Student	88	%53
Housewife	6	%3,6
Officer	24	%14,5
Self-employment	48	%28,9

Table 6. Distribution of participants according to transportation distance to the park

	N	(%)
< 250 m.	12	%7,2
500 m	14	%8,4
1 km	42	%25,3
1,5 km	22	%13,3
2 km	76	%45,8

Table 7. Distribution of participants according to the days they visit the park

	N	(%)
Weekdays	24	%14,5
Weekend	142	%85,5

Table 8. Distribution of participants according to the times they prefer the park

	N	(%)
Morning	8	%4,9
Noon	18	%11
Afternoon	38	%23,2
Evening	46	%28
At any given time	54	%32,9

Table 9. Distribution of participants according to the purpose of choosing the park

	N	(%)
For clean air	58	%34,9
Resting	30	%18,1
For walking	50	%30,1
Play with kids	10	%6
For picnic	18	%10,8

Table 10. Distribution of participants according to the types of transportation they prefer to come to the park

	N	(%)
Walkink	38	%22,9
By public transportation	60	%36,1
With a personal vehicle	56	%33,7
By bike	12	%7,2

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The opinions of the participants regarding the use of Sakura Park after the earthquake through the survey conducted in this research are as follows;
Table 13,14,15,16,17,18,19 and 20. Accordingly, 10.8% of the participants preferred intercity travel, 3.6% preferred shopping centers, 75.9% preferred open and green areas, 8.4% preferred cafeterias/restaurants/tea gardens, and 1.2% preferred sports centers after the earthquake disaster.
51.8% of the participants answered, "definitely yes", 32.5% "yes", 13.3% "undecided", and 2.4% "no" to the idea that Sakura Park can be used as an earthquake assembly area. The participants answered 38.6% definitely yes, 37.3% yes, 21.7% undecided, 2.4% no to the idea that Sakura Park can provide sufficient service as an earthquake assembly area after a possible earthquake.
The participants responded as follows: 2,4% shelter, 30,1% general, 54,2% gathering area, 2,4% medical area, 6% food distribution area, 4,8% disaster administration management area to the idea of which service Sakura Park can provide in the best way. The participants answered 34.9% definitely yes, 38.6% yes, 22.9% undecided, 3.6% no to the idea of Sakura Park's compliance with the criteria of earthquake assembly area.
The participants answered 27.7% definitely yes, 32.5% yes, 28.9% undecided, 10.8% no to the idea that Sakura Park is sufficient as a tenting area. Participants answered 26.5% strongly yes, 36.1% yes, 28.9% undecided, 8.4% no to the idea that Sakura Park is sufficient to meet sanitary needs. Participants answered 26.5% strongly yes, 49.4% yes, 20.5% undecided, 3.6% no to the idea that Sakura Park's proximity to important transportation intersections is sufficient.

Table 11. With whom the participants come to the park

	N	(%)
Single	12	%7,2
With wife/husband	60	%36,1
With work/school social environment	48	%28,9
With family/home/living environment	46	%27,7

Table 12. Distribution of participants according to the reasons for choosing the park

	N	(%)
Because he feels comfortable	46	%27,7
He was interested in the concept of using the park	22	%13,3
For using the rubber walkway in the park	20	%12
For using the bicycle path in the park	10	%6
Because it meets the need for green space	64	%38,6
Because it's close to home.	4	%2,4

Table 13. Distribution of participants according to the activities they preferred after the earthquake disaster

	N	(%)
Intercity travel (Family visit)	18	%10,8
Shopping centers (to relieve stress)	9	%3,6
Open and green spaces (feeling safer in these areas)	126	%75,9
Cafeteria/restaurant/tea garden (Socialization needs)	14	%8,4
Sports centers (Healthy living)	2	%1,2

Table 14. Distribution of participants' agreement with the idea that Sakura Park can be used as an earthquake assembly area

	N	(%)
Absolutely yes	86	%51,8
Yes	54	%32,5
I am undecided	22	%13,3
No	4	%2,4

Table 15. Distribution of participants' agreement with the idea that Sakura Park can provide adequate service as an earthquake gathering area after a possible earthquake

	N	(%)
Absolutely yes	64	%38,6
Yes	62	%37,3
I am undecided	36	%21,7
No	4	%2,4

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Table 16. Distribution of participants according to which service they think Sakura Park can provide in the best way

	N	(%)
Housing	4	%2,4
General	50	%30,1
Assembly area	90	%54,2
Medical field	4	%2,4
Food distribution area	10	%6
AFAD administration management area	8	%4,8

Table 17. Distribution of participants' agreement with the idea that Sakura Park meets the criteria for earthquake assembly area

	N	(%)
Absolutely yes	58	%34,9
Yes	64	%38,6
I am undecided	38	%22,9
No	6	%3,6

Table 18. Distribution of participants' agreement with the idea that Sakura Park is sufficient as a tenting area

	N	(%)
Absolutely yes	46	%27,7
Yes	54	%32,5
I am undecided	48	%28,9
No	18	%10,8

Table 19. Distribution of participants' agreement with the idea that Sakura Park is sufficient to meet sanitary needs

	N	(%)
Absolutely yes	44	%26,5
Yes	60	%36,1
I am undecided	48	%28,9
No	14	%8,4

Table 20. Distribution of respondents' agreement with the idea that Sakura Park's proximity to important transportation intersections is sufficient

	N	(%)
Absolutely yes	44	%26,5
Yes	82	%49,4
I am undecided	34	%20,5
No	6	%3,6

In this study; the capacity and adequacy of Konya Sakura Park as a post-disaster gathering area and the possibilities of utilizing the area after a possible disaster were sought to be answered.

On the basis of volunteerism, a survey was conducted with 166 people according to the snowball method in the park at different hours on weekdays and weekends. According to the results of the surveys, people's need for open and green spaces (because they feel safe in this area) has increased after the earthquake, just like the Covid 19 outbreak.

It has been determined that Sakura Park has a very high possibility of being used as a gathering area after a possible earthquake and that it can provide this service adequately. It has been determined that the park is suitable for the size of the gathering area, as a tenting area and sufficient to meet sanitary needs. Its proximity to important transportation intersections has gained importance.

According to the results of the analysis, it is concluded that people feel the need to be in open and green areas more after the disaster and they consider the existing parks as the most important post-earthquake assembly areas.

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A Review On Biochemical, Nutritional and Medicinal Properties of Okra

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Abstract

Abelmoschus esculentus, commonly known as Bhindi, is a multi-usable vegetable crop whose whole part including roots can be consumed very effectively as a vegetable, fruit, juice and medicine. Almost 33k\al of energy can be gained on 100 gm consumption of okra. Due to the antioxidant, antidiabetic, antineoplastic, antitumor, antimicrobial and antiulcerogenic characteristics of the mucilage extract of okra, it has been extensively used in medical field. Sunsari is the biggest okra producing district followed by Dhanusha and Jhapa in terms of area and production per hectare. Being a high value vegetable crop, it hasn't been in popular in cultivation and use due to the lack of appreciate knowledge. Nepalese farmers are still on lack of information about the medicinal as well as dietary values of okra. If we use the cultivation practices in efficient way, it is pretty sure that a good prospect must be wait for our country.

Introduction

Okra (*Abelmoschus esculentus)*, commonly known as bhindi, is a mercantile vegetable crop that has been cultivated in different countries of the world. (Ambrose, 1956) Okra *(Abelmoschus esculentus*), a vegetable crop of Malvaceous family have many significant benefits.. It is grown widely in tropical, subtropical and warmer temperate regions including West Africa, South Asia, Southern Europe and North America (Gong et al., 2019). The optimum temperature for growth and development of okra is 24-28°C and it is very sensitive to drought, water logging, frost and cold (Das et al., 2018). When planting the temperature of soil should be warm enough for proper germination of seedling. Okra is cultivated commercially in USA, Japan, Thailand, India, Bangladesh, Turkey, Malaysia, Ethiopia, Pakistan, Myanmar, Brazil, etc. (Sorapong, 2012). It is an annual herb having slightly curved, six chambered pod of fibrous textured, 10-25 cm long fruit whose seeds are rich in protein and oil (Thoele et al., 2015). The leaves of the okra are polymorphous; heart shaped and three to five lobed and petioles upto 15 cm long. Flowers are attractive, yellow with crimson center (Islam, 2019). Different parts of the okra plant such as fresh leaves, buds, flowers, pods, stem, seeds and fruits can be use six-chambered board for several purpose (Durazzo et al., 2019). The fruits of okra are mostly consumed as vegetables, while some people use it to make salad, soup and stewed with meat. In food emulsion system Okra plant can be used as emulsifying agent (Ahmad & Norizzah, 2015). The mucilage of okra has medicinal properties like: antioxidant, antidiabetic, antineoplastic, antitumor, antimicrobial, antiulcerogenic capacities, binding cholesterol and bile acids and removing toxins from liver (Jha et al., 2018). Okra fruit is a good source of mineral, protein, fiber, folate, calcium, phosphorous, magnesium along with vitamin A, B, C and K1 (Tiamiyu et al., 2012)

Origin And Geographic Distribution

Okra is a trading crop owned by the Malvaceous family and its origin is supposed to be Ethiopia and other different Northeast African countries. (D S Kumar et al., 2013) was grown by the early Egyptian peoples by the 12th century (Singh, Chauhan, Tiwari, Singh Chauhan, et al., 2014) .Its distribution can be found all over the world with all the climatic regions(Singh, Chauhan, Tiwari, Chauhan, et al., 2014). In Nepal, it is seldom cultivated as a commercial crop but in some regions, such as Dhankuta, Bhairahawa, Pokhara, and Kathmandu District where okra is grown as a common vegetable up to 1400MASL. Because of high nutritive value species *A.esculantus* is vigorously cultivated all over the world, another one species i.e., *A.moschutus* is mainly grown for horticultural point of view i.e., mainly for aromatic seed production as well as grown as ornamental plants though its existence is in wild form (Keatinge et al., 2011)

Composition and Uses

Okra has been consumed in various ways throughout the history. Its fruits and leaves are consumed by human and could be fed to farm animals as a means of forage, respectively. Similarly, Okra is used as fuel, mucilage, paper pulp, coffee substitute, source of curd and oil and protein source.

- Leaves: In regions where a variety of leafy greens are included in the diet (such as western Africa and Southeast Asia), the soft leaves of okra are frequently eaten as a vegetable (Lamont, 1999). Along with the leaves, the delicate shoots, flower buds, and calyxes are frequently consumed (Irvine, 1952).

- Fruits: The pods have a distinctive flavor and mucilaginous texture when they are boiled, added to soups or cut up and fried. Boiling dried pods or okra powder makes them quickly palatable. Okra is predominantly consumed in the United States as food in its fresh and processed forms (canned, in ready-to-eat soups, frozen, and dehydrated as a powder). Okra's young, soft pods are great in soups and stews and are frequently used in creole cooking. They can be cooked, baked, or fried. Rapid cooking is desirable regardless of the technique since it maintains flavor and keeps the food from becoming mucilaginous.
- Fuel and Mucilage use: Okra stems that have been completely dried can be burned as a cheap fuel. It burns quickly and generates a lot of heat; however, it does not last long. Similarly, the pod turns extremely mucilaginous when it is boiled. Okra mucilage is the term for the thick, slimy substance that can be found in both fresh and dried pods. Potential applications for okra mucilage include food, non-food goods, and pharmaceuticals. Applications in food include using it to beat up reconstituted egg whites, as an ingredient in the creation of flour-based adhesives, and in India, to clarify sugarcane juice. In Malaysia, this mucilage has been utilized as a spreading agent in the production of paper. As a preventative food additive against irritative and inflammatory stomach disorders, Okra mucilage is utilized in Asian medicine (Lengsfeld et al., 2004).
- Oil and Protein source: Linoleic acid, a polyunsaturated fatty acid required for human nutrition, is abundant in Okra seed oil (S. Kumar et al., 2010). Okra seeds have a high (70%) amount of unsaturated fatty acids, particularly linoleic and oleic acids. Although the oil has a poor keeping quality, it may easily be hydrogenated to create a solid shortening that can be used as margarine. Also, okra contains a lot of protein—between i.e., 18% to 27%. Okra seed protein is comparable to many cereals (apart from wheat) in terms of protein efficiency ratio (PER) and net protein utilization (NPU), and its oil output is comparable to most oil seed crops, with the exception of oil palm and soybean (Onakpa, 2013).
- Paper Pulp: Okra plant fiber, like that of other members of the Malvaceous family, is ideal for use in the production of paper. The woody cores of okra stems have longer fibers than those of most other dicotyledonous plants (Nelson et al., 1961). The stems are used to produce a fiber that is used in place of jute. In addition, it is used to create textiles and paper. The fibers are 2.4mm length on average. The leaves are pulled off and the stems are heated till the fibers can be stripped off when used to make paper. The stems are harvested in late summer or autumn after the edible seedpods have been harvested. The fibers are lye-cooked for two hours before being ground for three hours in a ball mill (A. Kumar et al., 2013).
- Biopolymer: Natural binder called Abelmoschus esculentus can be used to create an inexpensive, ecologically sound biopolymer for the green pathway technique of silver nanoparticle production producing spherical silver nanoparticles. The green approach method for synthesizing nano silver material shown good antibacterial effectiveness against Candida, Staphylococcus aureus, and Escherichia coli (Pande, 2014).
- Livelihood Enhancement: Okra has enormous potential to improve livelihoods for many stakeholders, both in urban and rural regions. It provides a potential path to prosperity for both small- and large-scale farmers, as well as everyone else involved in the okra value chain, especially female farmers and traders. It provides nutritional and food security through high amount of dietary fiber, rich in vitamin B6, folic acid, A and C. Similarly, Okra can be value added; dried, mound and stored for long period unlike other perishable vegetables. Besides, it's potential for non-vegetable use are- paper pulp, bio-film etc

Nutritional Component of Okra

Okra provides vitamins and carbohydrates (Dilruba et al., 2009) and young, immature okra pods can be eaten in a variety of ways and are crucial to consume as fresh fruits (Ndunguru& Rajabu, 2004). Fruit of okra can be fried, boiled, or cooked (Akintoye et al., 2011). The primary elements included in okra pods are K, Na, Mg, and Ca which have a seed content of 17%. Fe, Zn, and Mn are present and Ni has also been mentioned (Moyin-Jesu, 2007). Fresh pods provide little calories (20 per 100 g), almost no fat, and almost no sodium, high in fiber, and include a number of essential nutrients, comprising around 30% of the advised levels of 10 to 20% of folate (46 to 88 g), and vitamin C (16 to 29 mg). Moreover, 5% of vitamin A (14 to 20 RAE) (Council, 2006). The seeds and pod skin (mesocarp) are both great sources of (80 g/g) zinc (Cook et al., 2000). Okra seeds and pods are abundant in phenolic compounds with significant biological effects, such as hydroxycinnamic derivatives, quartering derivatives, and catechin oligomers (Arapitsas, 2008). These qualities, combined with the high levels of proteins, carbohydrates, glycol-proteins, and other nutritional components, increase the significance of this meal in the human diet (Manach et al., 2005). The best vegetable source of viscous fiber, a crucial nutrient for lowering cholesterol, is found in fresh okra pods (Kendall & Jenkins, 2004). Fresh okra pods that are seven days old have the highest concentration of nutrients (Agbo et al., 2008).Okra stems and roots are used to clarify sugarcane juice, which is used to make gur or brown sugar (Kacha & Patel, 2015).

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Table 1. Nutritional value of raw Okra per 100g, Source:(A. Kumar *et al*., 2013)

Energy	33Kcal
Carbohydrate	7.45g
Sugar	1.48g
Dietary Fiber	3.2g
Fat	0.19g
Protein	2g
Water	90.19g
Vitamin A	36 µg (7%)
Thiamine(B1)	0.2 mg (17%)
Riboflavin(B2)	0.06mg (5%)
Niacin(B3)	1mg (7%)
Vitamin C	23 mg (28%)
Vitamin E	0.2 mg (2%)
Vitamin K	31.3 µg (30%)
Calcium	82 mg (8%)
Iron	0.62 mg (5%)
Magnesium	57 mg (16%)
POTASSIUM	299 mg (6%)
Zinc	0.58 mg (6%)

Chemical Composition of Okra

Okra pods contain 88.6 g of water, 144.00 kJ (36 kcal) of energy, 2.10 g of protein, 8.20 g of carbohydrate, 0.20 g of fat, 1.70 g of fiber, 185.00 g of beta-carotene, 0.08 mcg of riboflavin, 0.04 mcg of thiamin, 0.60 mcg of niacin and ascorbic acid 47.00 mg (Fekadu Gemede, 2014). Okra is rich in protein, carbohydrates, and vitamin C and is an essential part of the human diet (Saifullah & Rabbani, 2009). Okra fruit is primarily eaten raw or cooked, and it is a significant source of the vitamins A, B, and C, as well as minerals like iron and iodine and viscous fiber from vegetables. However, it is also said to be low in salt, saturated fat, and cholesterol (Kendall & Jenkins, 2004). Okra leaves contain the following nutrients per 100 g of edible portion: 81.50 g of water, 4.40 g of protein, 0.60 g of fat, 11.30 g of carbohydrate, 2.10 g of fiber, 532.00 mg of calcium, 70.00 mg of phosphorus, 0.70 mg of iron, 59.00 mg of ascorbic acid, 385.00 g of -carotene and 0.25 mg of thiamin (Gopalan et al., 2007). The majority of the carbohydrates are found as mucilage (R. Kumar et al., 2009). (Liao et al., 2012) observed that *Abelmoschus esculentus* L has a high usage value based on its high total phenolic and total flavonoid content and excellent antioxidant activity. The nutritional benefit of some chemical characteristics, such as crude protein, crude oil, and crude fiber, led to the importance of okra in human health (Çalışır et al., 2005).

Table 2. Chemical composition of okra seeds: Source:(Çalışır*et al*., 2005)

Properties	Values
Moisture (%)	6.35
Crude Protein (%)	19.10
Crude Oil (%)	8.21
Crude Fiber (%)	26.34
Ash %	4.63
Crude Energy (kcal/g)	25.4
Water soluble extract (%)	2.6
Ether-soluble extract (%)	8.7
Non–soluble HCL acid ash (%)	$0.41*10^{-2}$

Health Benefits of Okra

In recent years, people have become more aware about their health consciousness and preferred to live a healthy lifestyle with food enriched with high amounts of nutrients, vitamins, antioxidants and fibers. High consumption of plant products is linked to a lower risk of several chronic diseases, including atherosclerosis and heart disease (Gosslau& Chen, 2004). The chemicals with antioxidant activity have been partially responsible for these positive benefits. Okra is widely accepted as a healthy food because it is a source of calcium and potassium which also contains folate vitamin C and high dietary fiber. Carotenoids, and phenolic chemicals, especially flavonoids, vitamins C and E, are the main antioxidants found in vegetables especially okra (Oyelade*et al*., 2003). These antioxidants eliminate free radicals which prevent the start of chains, or stop chains from spreading

(the second defense line) (Fekadu Gemede, 2014). Carotenoids and vitamin E quench singlet oxygen, adding to the first line of defense against oxidative stress (Krinsky, 2001). Okra has been nicknamed "the perfect villager's vegetable" due to its hardiness, nutritional fiber, and unique seed protein balance of both lysine and tryptophan amino acids (unlike the proteins of grains and pulses) (Holser & Bost, 2004).
Okra seeds are well known for having a high concentration of high-quality protein, especially when compared to other plant protein sources due to their higher concentration of key amino acids (Oyelade et al., 2003). As a result, it is crucial to human diet (Farinde et al., 2007). Okra seed protein's amino acid profile is similar to that of soybean protein's, and it has a higher PER (Adetuyi et al., 2012). Similarly, the protein's amino acid composition makes it a suitable addition to diets based on legumes or grains (Ndangui et al., 2010). Protein and unsaturated fatty acids like linoleic acid are abundant in okra seeds. The thick, slimy polysaccharides found in okra pods are used to thicken soups and stews, as an alternative to egg whites, and as a fat substitute in chocolate bar cookies and frozen dairy desserts with chocolate (Sengkhamparn*et al*., 2009).

Medicinal Uses of Okra

Okra is an antispasmodic, diuretic, emollient, stimulant, demulcent, diaphoretic, and vulnerary food. Okra's medicinal benefits have reportedly included treating ulcers and providing relief from hemorrhoids (McCullough et al., 2002). Okra is renowned for having significant antioxidant activity with diverse portions of the plant (Shui & Peng, 2004).
The roots of okra have a potent demulcent effect due to their high mucilage content (Kumar *et al*., 2010) which can be used as plasma replacement. An infusion of the roots is used in the treatment of syphilis. Similarly, the juice of the roots is used external to treat cuts, wounds and boils in Nepal. The seeds are soothing, stimulating, and antispasmodic. The roasted seeds can be infused to have sudorific effects (Martin, 1982). Okra proves effective for lowering blood sugar levels in the body, helping with diabetes, due to fiber and other nutrients. The fiber also aids in maintaining stable blood sugar levels by delaying the absorption of sugar via the intestines (Ngoc et al., 2008). Okra contains a significant amount of folic acid, which is essential for the development of the neural tube in the baby between the fourth and the 12th week of pregnancy (Zaharuddin et al., 2014) Through the utilization of foliate, a crucial component for a healthy pregnancy, and critical B vitamins for forming and sustaining new cells, okra helps to support a healthy pregnancy.Okra is used to stabilize blood sugar by regulating the rate at which sugar is absorbed from the intestinal tract. Okra normalizes blood sugar and cholesterol levels in addition to being beneficial for asthma sufferers (Sengkhamparn et al., 2009). Polysaccharide of okra reduces blood cholesterol levels and may prevent cancer because of its capacity to bind bile acids (Lengsfeld et al., 2004). Furthermore, okra seeds have effects on diabetics' lipid profiles and blood glucose levels that normalize them (Sabitha et al., 2011) .

Cytogenetic Relationship

Regarding cytological evidences about the origin of cultivated okra, the statement says that A. esculentus (2n=130) is an amphidiploid of *A. tuberculatus* (2n=58) and an unknown species (2n=72), in all probability, most likely source of complementary genome has much acceptance.(Joshi & Hardas, 1956)and (Joshi & Hardas, 1956) studied chromosome homology during meiotic event of hybrids between *A. esculen*tus and A. tuberculatus concluded that out of 65 chromosomes of *A. esculentus* (n=65), 29 had complete homology with 29 of *A. tuberculatus* (n=29) and remaining 36 appeared considerable but incomplete pairing with 36 of *A. ficulneu*s (n=36). They suggested that one of the parents of A. esculentus (n=65) should have been *A. tuberculatus* (n=29) and among of the two Indian species, namely *A. ficulneus* and *A. moschatus* possibly show a role of complementary genome, yet to be established.

Production Status and Marketing in Nepal

For easy and maximum production of Okra in subsistence farming, the sack cultivation is most reliable in terai region of Neal during summer and spring days(Kandel & Puri, 2020). Though onion production technique had been satisfiable with new mechanization in different areas of Nepal, the daily vegetable consumption rate along with onion is very low (i.e., 56 gm) as compared to suggested amount (i.e., 300gm)(AVRDC, 1998).
According to the report of Nepalese Agriculture 2076/77(2019/20), the Okra production status in different districts of Nepal could be visualized as Table 3.
Thus, from the above statistical information, it could be claimed that the maximum production of Okra per hectare is in Lalitpur (20.10) and the minimum production per hectare is in Sarlahi (4.65).
Similarly, the Okra production of different provincial area of Nepal as per the report of Staatistical Information of Nepalese Agriculture 2077/78(2020/21) could be tabulated as Table 4.

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Table 3. The Okra production status in different districts of Nepal

S.N.	Districts	Area	Production	Yield
1	Taplejung	18	245	13.61
2	Sankhuwasabha	105.10	1167.0	11.10
3	Solukhumbu	4.5	23.00	5.11
4	Panchthar	28	209	7.46
5	Ilam	0	-	-
6	Terahthum	16.5	139.40	8.45
7	Dhankuta	23	119	5.17
8	Bhojpur	6	57	9.5
9	Khotang	4	38	9.5
10	Okhaldhunga	6	56	9.33
11	Udaypur	90	1080	12
12	Jhapa	575	8625	15
13	Morang	306	3367	11
14	Sunsari	715	8575	11.99
15	Saptari	325.25	4422.09	13.60
16	Siraha	93.05	1214.17	13.05
17	Dhanusa	606	5500.61	9.08
18	Mahottari	453	5174.72	11.42
19	Sarlahi	254.11	1181.67	4.65
20	Rautahat	49.81	478.37	9.6
21	Bara	458.11	6711.05	14.65
22	Persa	312	3726.19	11.94
23	Dolakha	6.5	52	8
24	Sindhupalchowk	41	477	11.63
25	Rasuwa	11	83	7.55
26	Ramechp	14	168	12
27	Sindhuli	130	870	6.69
28	Kavrepalanchowk	151	2273	15.05
29	Bhaktapur	-	-	-
30	Lalitpur	13.07	262.60	20.10
31	Kathmandu	15.08	129.28	8.58
32	Nuwakot	102	1338	13.12
33	Dharding	168	1512	9
34	Makwanpur	125	2750	22

Area on hectares, the production in metric tons and yield is on metric tons per hectare.

Table 4. the Okra production of different provincial area of Nepal as per the report of Staatistical Information of Nepalese Agriculture

S.N.	Province	Area	Production	Yield
1	Province 1	1914	25842	13.50
2	Madhesh	2566	29107	11.34
3	Baagmati	1135	14668	12.93
4	Gandaki	759	7335	9.66
5	Lumbini	1860	16941	9.11
6	Karnali	336	3833	11.41
7	Sudurpaschim	1013	12840	12.67

Area on hectares, the production in metric tons and yield is on metric tons per hectare.

Thus, from the above information, it could be concluded that the maximum Okra production in recent case is in Province 1 followed by Bagmati province. Meanwhile, the minimum Okra production is seen on Lumbini province followed by Gandaki province(Ministry of Agricultural Development, 2013).

Seed production of different vegetables including Okra could be the major source of economic and life quality upgrading phenomena among farmers(*Aggg2.Pdf*, n.d.), the seed production of okra and also other different spring vegetables are practiced in mid hills and high hills of Nepal due to favorable cool climate. Meanwhile, there exists lacking of roper research, mechanization and agricultural extension system in these areas(Timsina & Shivakoti, 2018).

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Conclusions

Okra (*Abelmoschus spp)* is a multipurpose vegetable crop whose whole parts from head of plant to the bottom i.e., (leaves, flower, stem, fruit, seed) can be used very effectively in different purpose such as vegetable, fruit, medicine, beauty and cosmetics, fiber industry, etc. Okra is very effective reagent in medical sector as it can perform as an antispasmatic, antidieuratic, emollient, stimulant, demulcent, diphoretic agent also useful in treating ulcer disease. The nutritional value of okra is also satisfactory, only 100 gm of okra fruit can give upto 33 k Cal of energy. But being a multipurpose vegetable crop Okra cultivation has not been so practical in context of our country, if we use the cultivation practices in efficient way, it is pretty sure that a good prospect must be wait for our country.

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Türkiye'de Buğday Üretimi ve Destekleme Politikaları

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Özet

Bu çalışmanın amacı, buğday üretiminin mevcut durumunu inceleyerek, yapılan destekleme politikaları hakkında değerlendirmelerde bulunmaktır. 2021 yılı verilerine göre, Türkiye 6.623.061 hektar alanda 17.650.000 ton buğday üretimi gerçekleşmiştir. Bu üretim dünyadaki toplam üretimin %2,29'una tekabül etmekte olup, dünyada en fazla buğday üretimi yapan 11. ülkedir. Ayrıca Türkiye, dünyada %26,26 ile en fazla buğday unu ihraç eden ülke olurken, makarna ihracatında %7,01 ile 4. ülke olmuştur. Üretim ve ihracat potansiyeline karşılık, dünyada toplam ithalatın yaklaşık %5'ini gerçekleştirerek en fazla ithalat yapan 3. ülkedir. Başka bir ifadeyle, Türkiye iç talebinin yanı sıra buğday unu ve makarna sanayisinde dünyada önde gelen ihracatçılardan biri olmasından dolayı arz açığı yaşamakta ve bu açığı kapatmak için her yıl önemli miktarda ithalat yapmaktadır. Öyle ki 2021 yılında buğday üretiminin kendine yeterliliği %87,26 seviyesinde kalmıştır. Türkiye buğday ve buğday ürünlerindeki üretim ve ihracat potansiyellerinin korunarak kendine yeterliliğin sağlanabildiği tarımsal politikalara yer vermelidir. Öncelikle Türkiye'nin (2.665 kg/ha) dünya ortalamasının (3.492 kg/ha) oldukça altında olan buğday verimliliği arttırılmalıdır. Buğday üretiminde sağlanan girdi destekleri ile son yıllarda birim fiyatları sabit bir seyir izleyen fark ödemesi (prim) desteklerinin; mevcut koşullara uygun, üretim maliyetlerini karşılayıcı ve olası fiyat değişimlerine paralel olarak düzenlenmelidir.

Anahtar Kelimeler: *Buğday Üretimi, Destekleme Politikası, Yeterlilik Derecesi, Türkiye*

Wheat Production and Support Policies in Türkiye

Abstract

The objective of this study is to examine the current status of wheat production and evaluate the support policies implemented in this regard. According to the data for the year 2021, Türkiye achieved a wheat production of 17,650,000 tons on an area of 6,623,061 hectares. This production corresponds to approximately 2.29% of the total global wheat production, making Türkiye the 11th largest wheat producer in the world. In addition, while Türkiye is the country that exports the most wheat flour with 26.26% in the world, it is the 4th country in pasta export with 7.01%. Despite its production and export potential, it is the 3rd largest importing country in the world by realizing 5% of total imports. In other words, due to its leading position as an exporter in the wheat flour and pasta industry, as well as domestic demand, Türkiye experiences a supply deficit and therefore relies on significant imports each year to bridge this gap. Indeed, in the year 2021, the self-sufficiency rate of wheat production in Türkiye remained at 87.26%. Türkiye should incorporate agricultural policies that preserve the production and export potentials in wheat and wheat products, enabling self-sufficiency to be achieved. Firstly, Türkiye's (2,665 kg/ha) wheat productivity, which is well below the world average (3.492 kg/ha), should be increased. Input supports provided in wheat production and difference payment (premium) supports, whose unit prices have followed a stable course in recent years; It should be arranged in accordance with current conditions, covering production costs and in parallel with possible price changes.

Keywords: *Wheat, Support Policy, Self-Sufficiency Level, Türkiye.*

Giriş

Tarım sektörü, insanların beslenme ihtiyaçlarını karşılamak için önemli bir rol üstlenir. Her ülke, beslenme açısından temel (stratejik) olan ürünlerde en azından yurt içi arzını karşılayacak düzeyde kendine yeterlilik sağlama amacı güder (Eraktan, 2001; Kızılaslan, 2004). Dünya genelinde ve Türkiye'nin hemen her bölgesinde üretilen buğday, hem büyük bir üretici kitlesini ilgilendirmesi hem de insanların temel gıdası olan ekmek gibi birçok unlu mamulün hammaddesi olması nedeniyle son derece önemli bir üründür (Kızılaslan, 2004).

Birleşmiş Milletler Gıda ve Tarım Örgütü (FAO)'nün 2020 yılı verilerine göre, buğday üretimi şeker kamışı ve mısırdan sonra dünyada en fazla üretilen üçüncü üründür. Aynı yılın verilerine göre buğday üretimi dünyadaki toplam bitkisel üretimin %8,17'sini, toplam tahıl üretiminin ise %25,40'ını barındırmaktadır (FAO, 2022).

Buğday önemli bir üretim faaliyeti olması nedeniyle girdi kullanımı, maliyet, karlılık ve üretim faktörlerini inceleyen ve ekonometrik analizlerini kapsayan çalışmalar bulunmaktadır (Gündoğmuş, 1998; Birinci ve Küçük, 2011; Sureshkumar ve ark., 2014; Karadaş 2016; Aydın ve ark., 2021)

Dünya genelinde ve Türkiye'de buğday üretimi ve buğdaydan elde edilen un, makarna gibi sanayiye dayalı mamullerin ekonomik ve sektörel açıdan önemini, üretim durumunu ve ticaretini inceleyen çalışmalar mevcuttur (Akay, 2005; Turhan, 2008; OAİB, 2010; Duru ve ark., 2019; OAİB, 2021; Ticaret Bakanlığı, 2023). Bununla birlikte literatürde buğday üretiminin kendine yeterliğin ön planda tutulduğu ve tarımsal destekleme uygulamaların yer aldığı politikaları kapsayan çalışmalar da yer almaktadır;

Kızılaslan ve Aktaş (2003) çalışmasında Türkiye'de buğday destekleme politikaları ve uygulamalarını irdelemiş ve bu politikaların üretimi, kaliteyi, verimi, pazarlamayı ve çiftçi gelirlerini iyileştirmede yeterli olmadığını belirtmiştir.

Konyalı ve Gaytancıoğlu (2007) çalışmasında Türkiye'de buğday üretimine sağlanan desteklerin dünya fiyatlarını dikkate alan, üretimi tüketime yetecek şekilde, daha çok yapısal ve sosyal politikalara ağırlık verecek şekilde olması gerektiğini belirtmiştir.

Gül Yavuz ve ark. (2016) araştırmasında buğday üreticilerine sağlanan tarım politikaları kapsamında fark ödemesi desteğini tercih etmelerinde prim miktarının etkili olduğu, prim miktarı arttıkça üreticilerin fark ödemesi desteğini tercih etme olasılıklarının da arttığı belirlenmiştir.

Shahzad ve ark. (2019) çalışmasında Pakistan için önemli bir ürün olan buğday üretiminde kendine yeterliğin sağlanması için üretimin arttırılması gerektiği vurgulanmıştır. Bunun içinde en iyi yöntemin girdilere sağlanan tarımsal desteklerin olduğu belirtilmiştir.

Kalabak ve Aslan (2021) çalışmasında alan bazlı tarımsal desteklerin buğday üretimi üzerinde oldukça sınırlı bir etkiye sahip olduğunu tespit etmiştir.

Badem ve Hurma (2021) araştırmasında Türkiye'de buğday taban fiyatlarına uygulanan desteklemelerin reel fiyatlar ile ve Amerikan doları cinsinden analizi yapıldığında buğday üreticilerinin kazançlarında bir azalma olduğu saptanmıştır.

Shikur (2022) Etiyopya'da yaptığı çalışmada, buğday üretimine uygulanan tarımsal politikaların buğday verimi ve üretimi üzerinde olumlu etkileri olduğu tespit edilmiştir.

Bu çalışmanın amacı, buğday üretiminin mevcut durumunu inceleyerek, yapılan desteklemeler ve uygulanan politikalar hakkında değerlendirmelerde bulunmaktır. Bu doğrultuda, dünya genelinde ve Türkiye'de buğday üretimi ve buğdaya dayalı sanayi sektörünün 2000'li yıllardan sonraki değişim seyri araştırılmıştır. Bu bağlamda, buğday üretimine uygulanan destekleme politikaları detaylı bir şekilde incelenmiş ve çalışmanın sonucunda, Türkiye'nin buğdayda kendine yeterlilik durumu ve uygulanan tarım politikaları göz önünde bulundurularak öneriler sunulmuştur.

Materyal ve Yöntem

Çalışmada kullanılan istatistiki veriler; Birleşmiş Milletler Gıda ve Tarım Örgütü (FAO), Uluslararası Ticaret Merkezi (ITC) ve Türkiye İstatistik Kurumu (TÜİK) verilerinden elde edilmiştir. Bununla birlikte çalışmada konu ile ilgili kurum ve kuruluşların yayınları, araştırma makaleleri, tez ve raporlardan yararlanılmıştır. Çalışmada, 2000'li yılların başından 2021 yılına kadar olan 20 yıllık dönemde dünya genelinde ve Türkiye'de buğday üretimi ile buğdaya dayalı sanayi ürünlerinin üretimine ve dış ticaretine ilişkin veriler çizelgeler halinde sunulmuş ve yorumlanmıştır. Ayrıca 2018'den 2022 yılına kadar Türkiye'de buğday üretimi detaylı olarak incelenmiş olup, buğday üretiminin kendine yeterliği ve uygulanan destekleme politikaları irdelenmiştir.

Bulgular ve Tartışma

Dünya'da Buğday Üretimi ve Türkiye'nin Durumu

2021 yılında dünyada toplam 220 milyon 760 bin hektar alanda buğday hasadı yapılmıştır. Aynı yıl dünya ortalamasında buğday üretiminin hektara verimi 3.492 kg olup, toplam üretim miktarı 770 milyon 877 bin ton olarak gerçekleşmiştir. Türkiye'nin dünyada hasat edilen toplam buğday üretim alanını içerisindeki payı %3,00 iken, üretim miktarında ise bu pay %2,29'dur. Dünya'da 2001-2004 yıllarından 2021 yılına kadar buğday üretiminde hasat edilen alanlarda %3,58 artış meydana gelirken, Türkiye'de %27,92 oranında düşüş yaşanmıştır. 2021 yılında bir önceki yıla göre ise dünyada %1,31 artış yaşanırken, Türkiye'de %4,22 düşüş gerçekleşmiştir. Üretim miktarı bakımından değerlendirildiğinde, dünyada 2001-2004 yıllarından 2021 yılına kadar %30,38 artış meydana gelirken, bu oran Türkiye'de %10,06 düşüş olarak gerçekleşmiştir. 2021 yılında bir önceki yıla göre dünyada %1,84 artış olurken, Türkiye'de ise %13,90 oranında düşüş meydana gelmiştir. Buğday verimi 2001-2004 yıllarından 2021 yılına kadar dünyada %25,88 artarken, bu artış Türkiye'de %24,77'dir. 2021 yılında bir önceki yıla göre ise dünyada buğday verimi (%0,52) neredeyse aynı kalırken, Türkiye'de %10,11 ile sert bir düşüş yaşanmıştır (Çizelge 1).

2021 yılı buğday üretiminde en fazla hasat edilen alan %14,38 ile Hindistan'a ait olup, bu üretimi %12,65 ile Rusya ikinci sırada, %10,68 ile Çin üçüncü sırada takip etmektedir. Türkiye'de aynı yıl 6 milyon 623 bin hektar alanda buğday hasat edilmekte olup, dünya genelinde %3,00 pay ile 10. sırada yer almaktadır. 2021 yılında

üretim miktarı en fazla %17,76 ile Çin'e ait olup, bu üretimi %14,22 ile Hindistan ikinci sırada, %9,87 ile Rusya üçüncü sırada takip etmektedir. Türkiye'de aynı yıl 17 milyon 650 bin ton buğday üretilmekte olup, dünya genelinde %2,29 pay ile 11. sırada yer almaktadır. 2021 yılı verilerine göre, Türkiye 2.665 kg/ha buğday verimi ile dünya ortalamasının altında seyretmektedir (Çizelge 2).

Dünya'da Buğday Dış Ticareti ve Türkiye'nin Durumu

Dünya genelinde 2021 yılında toplam 54 milyar 941 milyon ABD$ değerinde, 198 milyon 139 bin ton buğday ihracatı gerçekleşmiştir. Dünya'da 2001-2004 yılından 2021 yılına kadar ihracat miktarında %71,33 ihracat değerinde ise %237,39 oranında artış meydana gelmiştir. Buna karşılık, 2021 yılından bir önceki yıla göre, ihracat miktarında %0,21 düşüş yaşanırken, ihracat değerinde %22,49 oranında artış yaşanmıştır. Türkiye'de 2021 yılında toplam 97 milyon 554 bin ABD$ değerinde, 264 bin 520 ton buğday ihracatı gerçekleşmiştir. Türkiye 2001-2004 yılından 2021 yılına kadar ihracat miktarında %8,66 oranında düşüş yaşarken, ihracat değerinde ise %171,86 oranında artış yaşamıştır. Buna karşılık 2021 yılından bir önceki yıla göre, ihracat miktarında %112,22, ihracat değerinde ise %147,02 oranında artış gerçekleşmiştir. Türkiye buğday ihracatında 2021 yılı itibariyle dünya çapında üretim miktarının %0,13'ünü, üretim değerinin ise %0,18'ini barındırmaktadır (Çizelge 3).

Dünya genelinde 2021 yılında toplam 63 milyar 291 milyon ABD$ değerinde, 201 milyon 10 bin ton buğday ithalatı gerçekleşmiştir. Dünya genelinde 2001-2004 yılından 2021 yılına kadar ithalat miktarında %74,50, ithalat değerinde ise %246,83 oranında artış meydana gelmiştir. Dünya'da 2021 yılından bir önceki yıla göre, ithalat miktarında %3,28, ithalat değerinde ise %27,64 oranında artış gerçekleşmiştir (Çizelge 4).

Çizelge 1. Dünya'da ve Türkiye'de buğday üretiminin gelişimi

Yıllar	Hasat Edilen Alan (ha)		Türkiye'nin Payı (%)	Üretim Miktarı (ton)		Türkiye'nin Payı (%)	Verim (kg/ha)	
	Dünya	Türkiye		Dünya	Türkiye		Dünya	Türkiye
2001-2004	213.137.903	9.188.598	4,31	591.232.339	19.625.000	3,32	2.774	2.136
2005-2008	217.951.035	8.309.595	3,81	632.072.886	19.131.500	3,03	2.900	2.302
2009-2012	219.745.829	7.918.377	3,60	673.769.478	20.543.500	3,05	3.066	2.594
2013-2016	220.237.081	7.756.843	3,52	732.301.245	21.062.500	2,88	3.325	2.715
2017	218.288.892	7.662.273	3,51	772.305.496	21.500.000	2,78	3.538	2.806
2018	213.828.044	7.288.622	3,41	732.235.584	20.000.000	2,73	3.424	2.744
2019	215.693.643	6.831.854	3,17	764.063.333	19.000.000	2,49	3.542	2.781
2020	217.898.510	6.914.632	3,17	756.949.628	20.500.000	2,71	3.474	2.965
2021	220.759.739	6.623.061	3,00	770.877.073	17.650.000	2,29	3.492	2.665
İndeks (2001-2004=100)	103,58	72,08	-	130,38	89,94	-	125,88	124,77
İndeks (2020=100)	101,31	95,78	-	101,84	86,10	-	100,52	89,89

Kaynak: FAO, 2023

Çizelge 2. Buğday üretiminde önde gelen ülkeler (2021 yılı)

Ülkeler	Hasat Edilen Alan (ha)	Payı (%)	Üretim Miktarı (ton)	Payı (%)	Verim (kg/ha)
Çin	23.568.400	10,68	136.946.000	17,76	5.811
Hindistan	31.610.000	14,32	109.590.000	14,22	3.467
Rusya Federasyonu	27.916.725	12,65	76.057.258	9,87	2.724
ABD	15.039.490	6,81	44.790.360	5,81	2.978
Fransa	5.276.730	2,39	36.559.450	4,74	6.928
Ukrayna	7.099.400	3,22	32.183.300	4,17	4.533
Avustralya	12.643.216	5,73	31.922.555	4,14	2.525
Pakistan	9.168.249	4,15	27.464.081	3,56	2.996
Kanada	9.247.000	4,19	22.296.100	2,89	2.411
Almanya	2.939.000	1,33	21.459.200	2,78	7.302
Türkiye	6.623.061	3,00	17.650.000	2,29	2.665
Diğer	69.628.468	31,54	213.958.769	27,76	3.073
Dünya (Toplam)	220.759.739	100,00	770.877.073	100,00	3.492

Kaynak: FAO, 2023

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Türkiye'de 2021 yılında toplam 2 milyar 692 milyon 623 bin ABD$ değerinde, 8 milyon 877 bin 310 ton buğday ithalatı gerçekleşmiştir. Türkiye 2001-2004 yılından 2021 yılına kadar ithalat miktarında %716,54 ithalat değerinde ise yaklaşık %1.500 oranında artış meydana gelmiştir. 2021 yılından bir önceki yıla göre, ithalat miktarında %8,09 oranında düşüş yaşanırken, ithalat değerinde %15,34 artış görülmüştür. Türkiye 2021 yılı itibariyle dünyada yapılan toplam buğday ithalat miktarının %4,42'sini, ithalat değerinin ise %4,25'ini oluşturmaktadır (Çizelge 4).

2021 yılında buğday dış ticaretinde en fazla ihracat yapan ülke %13,29 ile Rusya olurken, %13,26 ile ABD ikinci ve %12,93 ile Avustralya üçüncü sırada gelmektedir. İthalat bakımından değerlendirdiğinde %5,61 ile Endonezya ilk sırada, %4,80 ile Çin ikinci ve %4,25 ile Türkiye üçüncü sırada gelmektedir. 2021 yılında Türkiye ihracatta %0,18 bir pay ile 33. sıradaki ülke olurken, ithalatçı ülkeler içerisinde %4,25 pay ile 3. sırada yer almaktadır (Çizelge 5).

Çizelge 3. Dünya'da ve Türkiye'de buğday ihracatı

Yıllar	İhracat Miktarı (ton)		Türkiye'nin Payı (%)	İhracat Değeri (bin ABD$)		Türkiye'nin Payı (%)
	Dünya	Türkiye		Dünya	Türkiye	
2001-2004	115.649.641	289.613	0,25	16.284.066	35.884	0,22
2005-2008	125.675.810	259.973	0,21	28.180.197	36.255	0,13
2009-2012	151.418.701	399.208	0,26	40.004.474	74.720	0,19
2013-2016	174.450.111	109.751	0,06	43.099.724	39.627	0,09
2017	196.599.970	42.014	0,02	39.013.851	14.828	0,04
2018	190.871.166	69.998	0,04	41.066.053	24.038	0,06
2019	186.304.880	135.157	0,07	40.198.714	48.212	0,12
2020	198.566.146	124.643	0,06	44.854.898	39.492	0,09
2021	198.139.346	264.520	0,13	54.940.688	97.554	0,18
İndeks (2001-2004=100)	171,33	91,34	53,31	337,39	271,86	80,58
İndeks (2020=100)	99,79	212,22	212,68	122,49	247,02	201,67

Kaynak: FAO, 2023

Çizelge 4. Dünya'da ve Türkiye'de buğday ithalatı

Yıllar	İthalat Miktarı (ton)		Türkiye'nin Payı (%)	İthalat Değeri (bin ABD$)		Türkiye'nin Payı (%)
	Dünya	Türkiye		Dünya	Türkiye	
2001-2004	115.191.029	1.087.180	0,94	18.248.762	173.933	0,95
2005-2008	124.974.383	1.557.645	1,25	31.958.240	532.809	1,67
2009-2012	151.474.498	3.605.024	2,38	44.575.597	1.076.454	2,41
2013-2016	172.109.774	4.478.462	2,60	48.042.745	1.207.729	2,51
2017	194.485.184	4.990.865	2,57	44.774.032	1.043.327	2,33
2018	187.160.533	5.781.712	3,09	46.132.495	1.289.386	2,79
2019	183.555.392	10.004.830	5,45	45.175.029	2.302.225	5,10
2020	194.620.895	9.659.186	4,96	49.586.247	2.334.510	4,71
2021	201.010.203	8.877.310	4,42	63.291.309	2.692.623	4,25
İndeks (2001-2004=100)	174,50	816,54	-	346,83	1.548,08	-
İndeks (2020=100)	103,28	91,91	-	127,64	115,34	-

Kaynak: FAO, 2023

Çizelge 5. Buğday dış ticaretinde önde gelen ülkeler (2021 yılı)

Ülkeler	İhracat			Ülkeler	İthalat		
	Miktar (ton)	Değer (bin ABD$)	Pay (%)		Miktar (ton)	Değer (bin ABD$)	Pay (%)
Rusya	27.366.371	7.301.689	13,29	Endonezya	11.481.353	3.548.356	5,61
ABD	24.014.160	7.286.461	13,26	Çin	9.711.387	3.038.667	4,80
Avustralya	25.563.035	7.105.524	12,93	Türkiye	8.877.310	2.692.623	4,25
Kanada	21.546.479	6.636.007	12,08	Cezayir	8.025.246	2.558.743	4,04
Ukrayna	19.394.935	4.722.745	8,60	İran	7.075.228	2.486.510	3,93
Fransa	16.090.549	4.483.928	8,16	Mısır	5.773.696	2.465.060	3,89
Arjantin	9.485.175	2.454.059	4,47	İtalya	7.298.488	2.270.478	3,59
Almanya	7.100.101	1.969.667	3,59	Bangladeş	6.982.449	2.149.530	3,40
Romanya	6.907.743	1.800.140	3,28	Nijerya	6.369.665	2.055.030	3,25
Hindistan	6.090.607	1.723.431	3,14	Filipinler	6.029.337	1.948.672	3,08
Diğer	34.580.191	9.457.037	17,21	Brezilya	123.386.043	38.077.640	60,16
Toplam	198.139.346	54.940.688	100,00	Toplam	201.010.203	63.291.309	100,00

Kaynak: FAO, 2023

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Türkiye'de Buğday Üretiminin Durumu

Türkiye'de 2022 yılında 6 milyon 601 bin 834 hektar alanda buğday hasadı yapılmıştır. Toplam hasat edilen alanların %8,70'ini Konya, %5,51'ini Ankara ve %4,43'ünü Şanlıurfa oluşturmaktadır. Bununla birlikte 19 milyon 750 bin ton buğday üretimi gerçekleşmiştir. Toplam üretim miktarının %9,77'sini Konya, %5,10'unu Şanlıurfa ve %4,54'ünü Ankara oluşturmaktadır. Türkiye'de 2022 yılında ortalama buğday verimi 2.976 kg/ha olup, üretimin başlıca yapıldığı illerde en yüksek verim Tekirdağ iline ait olurken, bunu sırasıyla Şanlıurfa ve Konya takip etmektedir. Toplam üretim içerisinde durum buğdayının payı hasat edilen alanlarda %18,10 olurken, üretim miktarında bu oran %18,99'dur. Buğday üretiminde 2018 yılından 2022 yılına kadar hasat edilen alanlarda %9,42, üretim miktarında ise %1,25 azalış yaşanırken, verim değerinde %9,02 oranında artış gerçekleşmiştir (Çizelge 6).

TÜİK tarafından yapılan bitkisel üretimler için denge tablosu çalışmasında, Türkiye'nin 2021 yılında kullanılabilir buğday üretimi, üretimde yaşanan kayıpların çıkarılmasıyla birlikte 16.679.250 ton olarak kayda geçmiştir. Aynı dönemde toplam 9.525.066 ton buğday ithalatı yapılmış ve ülkenin toplam arzı 26.204.316 ton olarak gerçekleşmiştir. Toplam arzın 7.898.297 tonu ihraç edilmiş ve 808.651 ton stok değişimi yaşanmıştır. Bu verilere göre, Türkiye'nin 2021 yılında yurt içinde kullanılan buğday miktarı 19.114.670 tondur. Bu kullanımın %79,44'ü tüketim, %11,22'si yemlik, %6,35'i tohumluk ve %2,99'u kayıplardan oluşmaktadır. Kişi başı buğday tüketimi ise 2021 yılında 179,30 kg olarak hesaplanmış ve yıllar itibariyle birbirine yakın seyretmiştir. Bu verilerin sonucunda, 2021 yılında buğday üretiminin kendine yeterlilik oranı %87,26 olarak gerçekleşmiştir. Bu oranın 2017 yılında %111,71 olduğu göz önüne alındığında, 2021 yılında önemli bir düşüş yaşanmıştır. Özellikle 2019 (%89,46) ve 2021 (%87,26) yıllarında arz açığı verdiği görülmektedir (Çizelge 7).

Türkiye'de Buğday Üretimine Dayalı Sanayinin Durumu

Buğday hasat edildikten sonra işlenmek üzere değirmenlere sevk edilir. Buğday; unlu mamuller, makarna, irmik, bisküvi, bulgur gibi insan hayatındaki temel besinlerin hammaddesini oluşturmaktadır (OAİB, 2021). Türkiye elde etmiş olduğu buğdayın önemli bir kısmını işlemekte olup, 2021 yılı verilerine göre buğday unu üretimi yaklaşık 10 milyon ton, makarna üretimi ise 2 milyon 108 bin ton olarak gerçekleşmiştir. Bununla birlikte 2005-2007 yıllarından 2021 yılına kadar buğday unu üretiminde %94,78, makarna üretiminde ise %265,95 artış meydana gelmiştir. 2021 yılından bir önceki yıla göre, buğday unu üretimi %0,70 oranında azalırken, makarna üretimi %2,10 artmıştır (Çizelge 8).

2022 yılı verilerine göre dünyada toplam 5 milyar 704 milyon ABD$ buğday unu ihracatı gerçekleşmiş olup, Türkiye %26,26 ile dünyada en fazla buğday unu ihraç eden ülke olmuştur. Türkiye'yi, %8,67 ile Almanya ikinci sırada, %4,71 ile Özbekistan üçüncü sırada takip etmektedir. Dünya genelinde buğday unu ihracatında 2018 yılından 2021 yılına kadar %16,24 artış meydana gelirken, bu artış Türkiye'de %48,85 olarak gerçekleşmiştir (Çizelge 9).

Çizelge 6. Türkiye'de buğday üretim bilgileri

Kriter	İller	Yıllar					Payı (%)	İndeks (2018=100)	Durum Buğdayın Payı (%)
		2018	2019	2020	2021	2022			
Hasat Edilen Alan (ha)	Konya	677.486	621.536	620.261	573.203	574.546	8,70	84,81	31,78
	Ankara	464.015	416.301	361.168	367.219	363.558	5,51	78,35	8,41
	Şanlıurfa	277.969	213.092	404.365	298.866	292.233	4,43	105,13	52,66
	Yozgat	309.462	288.408	262.956	276.244	288.442	4,37	93,21	36,14
	Diyarbakır	323.389	313.165	270.677	280.981	276.517	4,19	85,51	29,68
	Diğer	5.236.301	4.979.352	4.995.206	4.826.549	4.806.538	72,81	91,79	13,34
	Toplam	7.288.622	6.831.854	6.914.632	6.623.061	6.601.834	100,00	90,58	18,10
Üretim Miktarı (ton)	Konya	2.037.936	1.886.131	1.920.700	1.579.839	1.929.537	9,77	94,68	31,94
	Şanlıurfa	860.601	677.390	1.538.904	1.182.655	1.007.891	5,10	117,11	54,42
	Ankara	1.093.264	1.053.032	974.528	609.592	896.418	4,54	81,99	8,26
	Tekirdağ	637.685	857.020	769.915	1.026.611	811.950	4,11	127,33	0,00
	Diyarbakır	1.038.026	1.030.268	1.007.508	578.274	799.210	4,05	76,99	31,75
	Diğer	14.332.488	13.496.159	14.288.445	12.673.029	14.304.994	72,43	99,81	15,78
	Toplam	20.000.000	19.000.000	20.500.000	17.650.000	19.750.000	100,00	98,75	18,99
Verim (kg/ha)	Tekirdağ	3.396	4.513	3.915	5.335	4.212	-	124,04	-
	Şanlıurfa	3.096	3.179	3.806	3.957	3.449	-	111,40	-
	Konya	3.008	3.035	3.097	2.756	3.358	-	111,64	-
	Diyarbakır	3.210	3.290	3.722	2.058	2.890	-	90,04	-
	Ankara	2.356	2.529	2.698	1.660	2.466	-	104,65	-
	Yozgat	2.167	1.920	2.307	1.583	2.320	-	107,06	-
	Diğer	2.737	2.710	2.860	2.626	2.976	-	108,73	-
	Toplam	2.744	2.781	2.965	2.665	2.992	-	109,02	-

Kaynak: TÜİK, 2023a

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İthalat açısından değerlendirildiğinde, dünya genelinde 5 milyar 519 milyon ABD$ buğday unu ithalatı gerçekleşmiş olup, Irak %11,10 ile dünyada en fazla buğday unu ithal eden ülke olmuştur. Irak'ı %5,34 ile Hollanda ikinci sırada, %5,33 ile ABD üçüncü sırada takip etmektedir. Türkiye ise 29 milyon 530 bin ABD$ ithalat ile %0,53 pay alarak 43. ülke olmuştur. Dünya genelinde buğday unu ithalatı 2018 yılından 2021 yılına kadar %6,25 artış göstermiştir (Çizelge 9).

Çizelge 7. Türkiye'nin buğday denge tablosu

Yıllar	2017	2018	2019	2020	2021
Üretim (Ton)	21.500.000	20.000.000	19.000.000	20.500.000	17.650.000
Ekilen alan (Hektar)	7.668.879	7.299.271	6.846.327	6.922.237	6.744.666
Üretim kayıpları (Ton)	1.182.500	1.100.000	1.045.000	1.127.500	970.750
Arz=Kullanım (Ton)	26.427.069	25.367.562	28.748.317	27.610.481	26.204.316
Kullanılabilir üretim (Ton)	20.317.500	18.900.000	17.955.000	19.372.500	16.679.250
İthalat (Ton)	6.109.569	6.467.562	10.793.317	8.237.981	9.525.066
AB 27-28 İthalat (Ton)	709.650	617.368	956.986	484.971	398.111
Yurt içi kullanım (Ton)	18.186.979	18.804.861	20.069.822	18.934.082	19.114.670
Tüketim (Ton)	14.107.643	14.714.796	16.034.511	14.782.565	15.184.041
Tohumluk kullanım (Ton)	1.380.398	1.313.869	1.232.339	1.246.003	1.214.040
Yemlik kullanım (Ton)	2.093.098	2.212.504	2.267.299	2.338.951	2.145.110
İşlenen kısım (Ton)	-	-	-	-	-
Endüstriyel kullanım (Ton)	-	-	-	-	-
Kayıplar (Ton)	605.840	563.693	535.673	566.563	571.479
İhracat (Ton)	7.489.664	7.873.454	7.530.767	7.583.765	7.898.297
AB 27-28 İhracat (Ton)	180.462	252.792	200.630	193.782	229.989
Stok değişimi (Ton)	750.426	1.310.753	1.147.728	1.092.634	808.651
Kişi başına tüketim (Kg)	174,60	179,40	192,80	176,80	179,30
Yeterlilik derecesi (%)	111,71	100,51	89,46	102,31	87,26

Kaynak: TÜİK, 2023b

Çizelge 8. Türkiye'de buğday unu ve makarna üretimi (ton)

Yıllar	Buğday Unu Üretimi	Makarna Üretimi
2005-2007	5.132.003	576.024
2008-2010	6.173.279	654.594
2011-2013	7.952.074	957.341
2014-2016	9.023.494	1.236.078
2017	9.409.911	1.667.267
2018	9.260.962	1.762.492
2019	9.649.942	1.902.039
2020	10.066.668	2.064.619
2021	9.996.270	2.107.960
İndeks (2005-2007=100)	194,78	365,95
İndeks (2020=100)	99,30	102,10

TÜİK, 2023c

Çizelge 9. Dünya'da buğday unu dış ticareti

Kriterler	Ülkeler	Yıllar					Payı (%)	İndeks (2018=100)
		2018	2019	2020	2021	2022		
İhracat Değeri (bin ABD$)	Türkiye	1.006.290	1.051.757	951.074	1.106.563	1.497.903	26,26	148,85
	Almanya	344.887	354.111	345.579	389.197	494.581	8,67	143,40
	Özbekistan	70.085	104.576	218.610	281.012	268.530	4,71	383,15
	İtalya	126.120	144.229	153.320	200.886	251.904	4,42	199,73
	Hindistan	100.405	105.415	138.978	188.138	209.495	3,67	208,65
	Diğer	3.259.685	3.339.589	3.070.225	3.103.399	2.982.232	52,28	91,49
	Toplam	4.907.472	5.099.677	4.877.786	5.269.195	5.704.645	100,00	116,24
İthalat Değeri (bin ABD$)	Irak	578.973	482.266	453.833	489.496	612.636	11,10	105,81
	Hollanda	220.329	195.246	206.526	238.621	294.525	5,34	133,68
	ABD	207.352	192.682	202.087	213.446	294.098	5,33	141,84
	Afganistan	764.475	563.618	562.266	587.942	281.688	5,10	36,85
	Suriye	108.646	126.155	83.974	145.719	186.887	3,39	172,01
	Diğer	3.314.331	3.564.079	3.334.652	3.482.123	3.849.094	69,74	116,13
	Toplam	5.194.106	5.124.046	4.843.338	5.157.347	5.518.928	100,00	106,25

Kaynak: ITC, 2023

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Çizelge 10 incelendiğinde, 2022 yılında dünyada toplam 13 milyar 766 milyon ABD$ makarna ihracatı gerçekleşmiştir. 2022 yılı makarna dış ticaretinde en fazla ihracat yapan ülkelerin başında %30,34 ile İtalya ilk sırada, %8,68 ile Çin ikinci ve %7,11 ile Güney Kore üçüncü sırada yer almaktadır. Türkiye ise 964 milyon 539 bin ABD$ ihracat ile %7,01 pay alarak en fazla ihracat yapan 4. ülke olmuştur. Dünya genelinde makarna ihracatı 2018 yılından 2021 yılına kadar %36,10 artış meydana gelirken, bu artış Türkiye'de %74,60 olarak gerçekleşmiştir (Çizelge 10).
Çizelge 10 göre, 2022 yılında dünyada toplam 13 milyar 463 milyon ABD$ makarna ithalatı gerçekleşmiştir. 2022 yılı makarna dış ticaretinde en fazla ithalat yapan ülkelerin başında %12,47 ile ABD ilk sırada, %8,00 ile Almanya ikinci ve %7,64 ile Birleşik Krallık üçüncü sırada yer almaktadır. Türkiye ise 11 milyon 828 bin ABD$ ithalat ile %0,09 pay alarak 104. ülke olmuştur. Dünya genelinde makarna ithalatı 2018 yılından 2021 yılına kadar %39,76 oranında artış göstermiştir (Çizelge 10).
Çizelge 10 ve 11 ait veriler kısaca değerlendirildiğinde; Türkiye buğday unu ve makarna ihracatında dünyada önde gelen ülkelerden birisidir. Buna karşılık, ithalat oranları diğer ülkelere nazaran oldukça düşüktür.

Türkiye'de Buğday Üretimi Destekleme Politikaları

Türkiye'de buğday üretimine sağlanan desteklerin ayrıntıları Çizelge 11'de yer almaktadır. 2022 yılında buğday üretimi için dekara 75 TL mazot desteği, 46 TL gübre desteği ve 0,10 TL fark ödemesi (prim) desteği sağlanmıştır. Aynı şekilde, bireysel olarak başvuru yapan üreticilere dekara 40 TL, üretici gruplarına ise 20 TL organik tarım desteği verilmektedir. Katı organik-organomineral gübre kullanan üreticilere dekara 20 TL destek sunulmaktadır. Buğday üretiminde sertifikalı tohum kullanımına 50 TL/da destek verilirken, sertifikalı tohum üretimine de 0,10 TL/kg destek sağlanmaktadır. Buna ek olarak, orijinal ve üstü tohumluk üretimi için 0,12 TL/kg destekleme yapılmaktadır. Toprak analizi destekleme ödemesi ise her 50 dekarlık alan için analiz başına 50 TL olarak uygulanmaktadır. Küçük aile işletmesi desteği kapsamında tarımsal işletmelere dekara 200 TL destek sağlanmaktadır.

Çizelge 10. Dünya'da makarna dış ticareti

Kriterler	Ülkeler	Yıllar					Payı (%)	İndeks (2018=100)
		2018	2019	2020	2021	2022		
İhracat Değeri (bin ABD$)	İtalya	2.913.072	3.022.504	3.587.774	3.620.116	4.176.852	30,34	143,38
	Çin	923.430	929.427	979.752	1.052.196	1.195.235	8,68	129,43
	Güney Kore	556.001	612.139	792.304	891.151	978.361	7,11	175,96
	Türkiye	552.416	608.508	761.284	777.397	964.539	7,01	174,60
	Tayland	501.951	547.352	595.460	632.013	663.258	4,82	132,14
	Diğer	4.668.164	4.789.166	5.448.290	5.840.767	5.787.942	42,04	123,99
	Toplam	10.115.034	10.509.096	12.164.864	12.813.640	13.766.187	100,00	136,10
İthalat Değeri (bin ABD$)	ABD	986.322	1.011.860	1.357.296	1.264.315	1.678.778	12,47	170,21
	Almanya	828.351	803.427	907.461	988.621	1.077.675	8,00	130,10
	Birleşik Krallık	562.988	658.723	754.859	849.140	1.029.118	7,64	182,80
	Fransa	716.459	715.080	787.803	886.719	986.442	7,33	137,68
	Kanada	378.049	420.122	504.877	499.853	617.393	4,59	163,31
	Diğer	6.160.595	6.359.666	7.202.266	7.699.024	8.073.569	59,97	131,05
	Toplam	9.632.764	9.968.878	11.514.562	12.187.672	13.462.975	100,00	139,76

Kaynak: ITC, 2023

Çizelge 11. Türkiye'de buğday ürününe verilen destekleme birim fiyatları

Destek Türü	Yıllar				
	2018	2019	2020	2021	2022
Mazot Desteği (TL/da)	15,00	19,00	19,00	22,00	75,00
Gübre Desteği (TL/da)	4,00	8,00	8,00	20,00	46,00
Fark Desteği (TL/kg)	0,05	0,10	0,10	0,10	0,10
Organik Tarım Desteği (Bireysel) (TL/da)	10,00	10,00	10,00	10,00	40,00
Organik Tarım Desteği (Üretici Grubu) (TL/da)	10,00	5,00	5,0	10,00	20,00
Katı Organik-Organomineral Gübre Desteği (TL/da)	-	10,00	10,00	20,00	20,00
Sertifikalı Tohum Kullanım Desteği (TL/da)	8,50	8,50	16,00	16,00	50,00
Sertifikalı Tohum Üretim Desteği (TL/kg)	0,10	0,10	0,10	0,10	0,10
Orijinal ve Üstü Tohumluk Üretim Desteği (TL/kg)	0,20	0,20	0,12	0,12	0,12
Toprak Analizi Desteği (TL/Analiz)*	40,00	40,00	40,00	-	50,00
Küçük Aile İşletmesi Desteği (TL/da)	100,00	100,00	100,00	100,00	200,00

Kaynak: Resmî Gazeteler, 2018 –2022. (*): Her 50 dekar alana analiz başına Tarım ve Orman Bakanlığı tarafından akredite edilen toprak analiz ve tahlil laboratuvarlarına ödeme yapılmaktadır.

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Türkiye'de üreticilerin en çok yararlandığı desteklerin başında alan bazlı tarımsal destekler yer almaktadır (Erdal ve ark., 2013; Abay ve ark., 2017). Buğday üretimine sağlanan alan bazlı destekler kapsamında 2018 yılından 2022 yılına kadar mazot desteğinde %400, gübre desteğinde ise %1.000'in üzerinde artış yaşanmıştır (Çizelge 11). Tarımsal destekler içerisinde önemli başka bir destek kalemi de fark ödemesi (prim) desteğidir (Semerci ve Durmuş, 2021). Fark ödemesi desteği öncelikle arz açığı olan ürünleri kapsamaktadır (Tarım Kanunu, 2006). Türkiye'de 2022 yılında buğday üretimine verilen destek birim fiyatı 10 kuruş olup, buğday üretiminin 2022 yılı ortalama verimi dikkate alındığında birim alana (ha) (2.992 kg x 0,10 krş) 299,20 TL destek ödemesi düşmektedir.
Çizelge 12 incelendiğinde, 2018-2022 yılları arasında buğday prim desteğinin birim fiyatlarında herhangi bir artış yaşanmadığı görülmektedir. Buna ek olarak, fark ödemesi (prim) desteği sağlanan bazı temel ürünlerde en yüksek birim fiyata sahip ürün kütlü pamuk olurken, en düşük birim fiyat ise dane mısıra aittir.

Çizelge 12. Türkiye'de bazı temel ürünlerin fark ödemesi desteği birim fiyatları (krş/kg)

Ürünler	2018	2019	2020	2021	2022
Kütlü Pamuk	80	80	110	110	110
Kanola (Kolza)	50	50	50	80	80
Soya	60	60	60	60	60
Aspir	55	55	55	55	55
Kuru Fasulye, Mercimek, Nohut	50	50	50	50	50
Yağlık Ayçiçeği	40	40	50	50	50
Buğday, Arpa, Çavdar, Tritikale, Yulaf	5	10	10	10	10
Çeltik	10	10	10	10	10
Dane Mısır	3	3	3	3	3

Kaynak: Resmî Gazeteler, 2018 - 2022.

Sonuç ve Öneriler

Buğday, dünya çapında ve Türkiye'de en çok üretilen ve insan beslenmesinde temel gıdalardan birisi olduğu için ülkeler tarafından stratejik ürün olarak kabul edilen önemli bir tahıldır. Bu nedenle ülkeler buğday gibi ürünlerde arz açığı yaşamamak için kendine yeterliliğin ön planda tutulduğu tarımsal politikalara öncelik verirler. Buğday üretiminin dünyada olduğu gibi Türkiye'de içinde önemi büyük olup, dünya genelinde toplam buğday hasat edilen alanların %3,00'ünü, toplam üretim miktarının ise %2,29'unu karşılamaktadır. Bu verilere ek olarak, Türkiye buğday sanayisine dayalı ürünlerde önemli bir ihracatçı olup, buğday unu ihracatının %26,26'sını karşılayarak en fazla ihracat yapan birinci ülke olurken, benzer şekilde makarna sanayisinde dünya ihracatının %7,01'ini karşılayarak dördüncü ülke olmuştur. Buna karşılık, Türkiye'nin 2000'li yılların başından itibaren üretim alanlarında yaklaşık %30, üretim miktarında ise %10 seviyelerinde gerileme yaşamıştır. Özellikle son beş yılda dünya buğday ithalatın yaklaşık %5'ini Türkiye oluşturmaktadır. Bu nedenle Türkiye'nin buğdayda kendine yeterliği 2021 yılında %87,26 seviyesine kadar gerilemiştir. Başka bir deyişle, Türkiye iç talebinin yanı sıra buğday unu ve makarna sanayisinde dünyada önde gelen ihracatçılardan biri olması nedeniyle önemli bir arz açığı yaşamakta ve bu açığı kapatmak için her yıl önemli miktarda ithalat yapmaktadır. Türkiye'de hem ihracattaki potansiyelini koruyucu hem de kendine yeterliliğini sağlayabileceği tarımsal destekleme politikalarına öncelik verilmesi gerekmektedir.
Türkiye'de buğday hemen hemen her yerde yetiştirilmekle birlikte özellikle İç Anadolu ve Güneydoğu Anadolu Bölgesinde yoğunlaşmakta ve çoğunlukla kuru tarım olarak yapılmaktadır. Bununla birlikte, Türkiye'nin (2.665 kg/ha) buğday verimi dünya ortalamasının (3.492 kg/ha) oldukça altındadır. Söz konusu arz açığını kapatılmasında öncelikli olarak buğday veriminin arttırılması elzemdir. Bunun içinde bölgenin koşulları dikkate alınarak planlı bir üretime gidilmeli, sulama imkânları arttırılmalı, yüksek verimli ve sertifikalı tohum kullanımı yaygınlaştırılmalı, gübreleme ve tarımsal mücadelenin uygun miktarda, koşulda ve zamanında yapılmalı, makine çekigücü ve işgücünün nitelikli şekilde kullanılmalı ve ıslah çalışmalarına önem gösterilmelidir. Bu konuda özel ve kamuya ait araştırma kurum ve kuruluşlarının gerek danışmanlık ve yayım faaliyetleri gerekse de ar-ge çalışmalarını destekleyici politikalara yer verilmelidir.
Tarımsal destekler üretici geliri ve arzın artmasını ya da üretim maliyetlerinin düşürülmesinde önemli rol oynar. Özellikle buğday üretiminde sağlanan girdi desteklerinin ve son yıllarda birim fiyatları sabit bir seyir izleyen fark ödemesi (prim) desteklerinin mevcut koşullara uygun şekilde üretim maliyetlerini karşılayıcı ve olası fiyat değişimlerine paralel şekilde sürekli olarak düzenlenmelidir. Bu şekilde, buğday üretimi teşvik edilebilir ve üreticilerin motivasyonunda artış sağlanabilir. Tüm bunlarla birlikte uygulanmakta olan tarımsal destekleme politikaları arzın talebi karşılayacak şekilde, dünya fiyatlarını dikkate alan, yapısal ve sosyal politikaları barındıran ve küresel şartlarda rekabet edebilecek düzeyde olmasına dikkat edilmelidir.

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Türkiye'de Yem Bitkileri ve Karma Yem Üretimi

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Özet

Hayvanların beslenmesi için kaba yem ve karma yem üretiminin yeterli düzeyde olması oldukça önemlidir. Bununla birlikte hayvancılık faaliyetinin %70 gibi büyük bir kısmını yem masrafları oluşturmaktadır. Türkiye'de yem bitkileri üretimi yıldan yıla artış göstermesine rağmen kaba yemin karşılanma oranı %60-70 seviyelerinde kalmaktadır. Karma yem üretiminde ise hammadde ihtiyacının önemli kısmı ithalat yoluyla karşılanmaktadır. Öyle ki 2022 yılında karma yem ve yem hammadde ithalatı 5 milyar ABD doları seviyesinde dış ticaret açığı vermiştir. Türkiye'nin hayvan varlığını besleyebileceği, yani kendine yeterliliği ön planda tutan politikalara öncelik verilmesi gerekmektedir. Kaba yem ihtiyacının karşılanması için yem bitkilerinin üretimi arttırılmalı ve bunun için son yıllarda birim fiyatlarında önemli değişiklerin yaşanmadığı tarımsal desteklerin gözden geçirilmesi gerekmektedir. Ayrıca, mera, yaylak ve kışlakların ıslah edilerek otlatma kapasitesi ve verimlerinin arttırılmasına ihtiyaç duyulmaktadır. Karma yem sektörünün dışa bağımlılığın azaltılması için önemli yem hammaddelerinden olan tahıl ve yağlı tohumlu bitkilerin üretiminin arttırılmasına öncelik veren politikalara yer verilmelidir. Bu politikaların oluşturulurken uluslararası rekabet koşulları göz önünde bulundurulmalı ve yem bitkileri ile diğer stratejik ürünlerin arzında sorunlar yaratmayacak üretim planlamaları ve destekleme politikaları benimsenmelidir.

Anahtar Kelimeler: *Hayvancılık, Yem Bitkileri, Kaba Yem, Karma Yem, Kendine Yeterlilik, Destekleme Politikası*

Forage Crops and Compound Feed Production in Turkey

Abstract

The sufficient production of roughage and compound feed is crucial for the nutrition of animals. Additionally, feed expenses constitute a significant portion, approximately 70%, of livestock farming activities. Although there has been an increase in the production of forage crops in Turkey over the years, the self-sufficiency rate for roughage remains at around 60-70%. In the production of compound feed, a significant portion of the raw material requirement is met through imports. In fact, in 2022, the import of compound feed and feed ingredients resulted in a trade deficit of 5 billion US dollars. It is essential for Turkey to prioritize policies that focus on self-sufficiency, enabling the country to feed its livestock population. In order to meet the need for roughage, the production of forage crops should be increased, and for this, agricultural supports that have not experienced significant changes in unit prices in recent years should be reviewed. In addition, there is a need to increase the grazing capacity and yields by improving the pastures, summer pastures and winter pastures. To reduce the dependency of the compound feed sector on imports, priority should be given to policies that aim to increase the production of important feed ingredients such as grains and oilseed crops. While formulating these policies, it is important to consider international competitive conditions and adopt production planning and support policies that do not create issues in the supply of feed crops and other strategic products.

Keywords: *Livestock, Forage Crops, Roughage, Compound Feed, Self-Sufficiency, Support Policy*

Giriş

Hayvancılık sektörü, hızla artan insan nüfusunun et, süt ve yumurta gibi biyolojik değeri yüksek besin maddesi ihtiyaçlarını karşılayarak, dengeli beslenmesinde önemli rol oynamaktadır (Ergün ve Bayram, 2021). Hayvansal ürünlerin üretimi ise hayvanların beslenmesini sağlayacak yemin tedarik edilmesiyle mümkündür (Ertuş, 2019). Bu bağlamda hayvancılık sektöründe girdilerin büyük bir kısmını yem giderleri oluşturmaktadır (Aydın ve Sakarya, 2012; Seki ve Biler, 2016; Özkan, 2020).

Tandoğan (2014) broyler (etlik) piliç üretim maliyetlerini incelediği çalışmasında yem masraflarının toplam masraflar içerisinde %67,44 pay aldığını tespit etmiştir. Yeni ve Dağdemir (2023) tarafından yapılan benzer bir çalışmada broyler piliç üretim masrafı içerisinde en büyük payı %82,76 ile yem masrafı oluşturduğunu saptamıştır.

Can (2015) tarafından Ankara ilinde sığır besiciliği faaliyetinde bulunan işletmelere yapılan çalışmada, toplam üretim masraflarının %23,53'ünü yem masrafının oluşturduğunu tespit etmiştir. Gözener ve Sayılı (2015)

tarafından Tokat ilinde yapılan benzer bir çalışmada üretim masraflarının %28,68'ini yem masrafları oluştururken, bu masrafın %47,82 kaba yemler, %52'18'ini ise karma (kesif) yemler oluşturmaktadır.
Semerci ve ark. (2015) Hatay ilinde süt sığırcılığı işletmelerini incelediği çalışmasında, yem masraflarının toplam masraflar içerisinde %51,77, değişken masraflar içerisinde ise %80,56 oranında pay aldığını saptamıştır. Aşkan ve Dağdemir (2016) tarafından TRA1 Düzey 2 Bölgesinde yer alan Erzurum, Erzincan ve Bayburt illerini kapsayan benzer bir çalışmada süt sığırcılığı işletmelerinin yem masrafları toplam üretim masraflarının %72,67'sini oluşturmaktadır. Alyeşil ve Gözener (2018) Tokat ilinde süt sığırcılığı yapan tarımsal işletmenin masraf unsurları arasında toplam masrafların %52,09'unu yem masrafları oluşturmakta olup, bu masrafın %50,16'sını süt yemi, %16,89'unu ise silajlık mısırın oluşturduğu tespit etmiştir.
Özalp ve Sayın (2018) tarafından Antalya ilinde küçükbaş (koyun ve keçi) hayvan işletmelerinin incelendiği çalışmada, yem masrafları değişken masrafların %80,11'ini, toplam masrafların ise %40,33'ünü, oluşturduğu tespit edilmiştir. İncelenen işletmelerde toplam yem masraflarının %60'ını karma (kesif) yemler, %40'ını ise kaba yemler oluşturmaktadır. Ayrıca araştırma alanında yem bitkileri üretimi yapan 41 işletmeden sadece 2 tanesi yem bitkileri desteğinden yararlandığı bildirilmiştir.
Literatürden anlaşılacağı üzere hayvancılık sektörü için yem üretimi önemli ve bir o kadar maliyetli bir unsurdur. Bu nedenle yem bitkileri, kaba yem, karma yem ve yem hammaddesi üretimleri ön plana çıkmakta olup, bu üretimlerin durumlarını, sorunlarını ve uygulanan destekleme politikalarını inceleyen çalışmalar bulunmaktadır (Tekerli, 2010; Saygı ve Alarslan, 2012; Aksu ve Dellal, 2016; Ağırbaş ve ark.,2017; Altıntaş ve ark., 2017; Çelikyurt ve ark.,2017; Özek, 2020) .
Bu çalışmanın amacı, dünya genelinde ve Türkiye'de hayvan varlığına dikkat çekilerek Türkiye'de yem bitkileri ve karma yem üretiminin mevcut durumunun incelenmesi ve uygulanan politikalar hakkında değerlendirmelerde bulunmaktır.

Materyal ve Yöntem

Çalışmada kullanılan istatistiki veriler; Birleşmiş Milletler Gıda ve Tarım Örgütü (FAO) ve Türkiye İstatistik Kurumu (TÜİK) verilerinden elde edilmiştir. Bununla birlikte çalışmada konu ile ilgili kurum ve kuruluşların yayınları, araştırma makaleleri, tez ve raporlardan yararlanılmıştır. Çalışmada, 2000'li yılların başından 2021 yılına kadar olan 20 yıllık dönemde dünya genelinde ve Türkiye'de hayvan varlığının durumu ortaya konmuştur. Bu doğrultuda Türkiye'de yem bitkileri ve karma yem üretiminin mevcut durumu incelenerek yeterliliği ve uygulanan destekleme politikaları tartışılmıştır.

Bulgular ve Tartışma

Dünya'da ve Türkiye'de Hayvan Varlığı

Dünya'da 2021 yılında 1 milyar 733 milyon 235 bin büyükbaş hayvan bulunmaktadır. Bu hayvan varlığının %1,04'üne Türkiye ev sahipliği yapmaktadır. Dünya'daki büyükbaş hayvan varlığı 2001-2004 yıllarından 2021 yılına kadar %14,77 artarken, bu oran Türkiye'de %74,18 olarak gerçekleşmiştir. 2021 yılından bir önceki yıla göre hem dünya genelinde hem de Türkiye'de büyükbaş hayvan varlığında önemli bir değişiklik olmadığı görülmektedir (Çizelge 1).
Dünya'da 2021 yılında 2 milyar 396 milyon 135 bin küçükbaş hayvan bulunmaktadır. Bu hayvan varlığının %2,40'ını Türkiye oluşturmaktadır. Dünya'daki küçükbaş hayvan varlığı 2001-2004 yıllarından 2021 yılına kadar %29,93 artarken, bu oran Türkiye'de %71,90 olarak gerçekleşmiştir. 2021 yılından bir önceki yıla göre küçükbaş hayvan varlığında dünya genelinde önemli bir değişiklik görülmezken, Türkiye'de %6,30 oranında artış yaşanmıştır (Çizelge 1).
Türkiye'de 2023 yılı başları itibariyle kayıtlı büyükbaş hayvancılık işletme sayısı 1.161.095 adet olup, küçükbaş hayvancılık işletme sayısı ise 388.802 adettir (TOB, 2023). TÜİK (2016) tarafından yapılan araştırmada Türkiye'de hayvanı olan tarımsal işletmelerinin, büyükbaş hayvan (sığır ve manda) sayısına göre işletme büyüklüğü grubu incelendiğinde, işletmelerin %44,50'si 1-4 baş, %24,80'ni ise 20-49 baş işletme büyüklüğünde yoğunlaşmaktadır. Küçükbaş hayvanlarda (koyun ve keçi) ise işletmelerin %28,50'si 50-149 baş, %36,30'sı ise 300 ve üzeri baş hayvanı olan işletme büyüklüğü grubunda yoğunlaşmaktadır.

Türkiye'de Yem Bitkileri Üretimi ve Kaba Yem

Kaba yem kaynaklarının önemli bir kısmını tarla tarımı içerisinde bulunan yem bitkileri oluşturmaktadır (Özkan ve Şahin Demirbağ, 2016). Türkiye'de 2022 yılında toplam 2 milyon 403 bin 801 hektar alanda 63 milyon 20 bin 905 ton yem bitkisi üretimi gerçekleşmiştir. Yonca, silajlık mısır, çayır otu, yulaf ve korunga başlıca üretilen yem bitkileridir (Çizelge 2).
Hayvan birimi, hayvan sayısının belli bir ağırlığa çevrilerek ifade edilen şeklidir. Genellikle yanındaki buzağısı ile beraber bir inek bir hayvan birimi olarak kabul edilir ve büyükbaş hayvan birimi (BBHB) olarak ifade edilir (Yüksek

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ve ark., 2003). Büyükbaş hayvan birimi (BBHB), 2019 yılında 18 milyon 725 bin 802 olarak tespit edilmiştir. Söz konusu hayvan biriminin yıllık kaba yem ihtiyacı yaklaşık 95,6 milyon ton olmasına karşın, Türkiye'nin 2019 yılında kaba yem üretimi 67,2 milyon ton olarak gerçekleşmiştir. Kısacası, çayır ve meralarla beraber yem bitkilerinin oluşturduğu toplam yem üretimi yıllık kaba yem ihtiyacını karşılamaya yetmemektedir. 2019 yılında kaba yem açığı yaklaşık 30 milyon tondur. Başka bir ifadeyle, yem üretiminin yıllık kaba yem ihtiyacını karşılama oranı %70 dolaylarında olup, 2015 yılından itibaren bu oranda önemli bir değişiklik yaşanmamıştır (Çizelge 3). TOB (2021) raporunda Türkiye'de kaba yem açığının sap-saman hariç tutulduğunda yaklaşık 25 ton olarak tespit etmiş olup, ihtiyacı karşılama oranı %68,71 olarak hesaplanmıştır. Yapılan benzer bir çalışmada, Türkiye'de yem üretiminin yıllık kaba yem ihtiyacını karşılama oranı %60,76 olarak bulunmuştur (Özek, 2022).

Türkiye'de Karma Yem Üretimi

Hayvanlarda beslenme kaba yemlerin yanında karma (kesif) yemlerle de karşılanmaktadır. Özellikle hayvanların verim paylarının karşılanmasında karma yemler önemli rol oynamaktadır (Alarslan, 2017). Türkiye'de 2022 yılında 27 milyon 129 bin 648 ton karma yem üretimi gerçekleşmiştir. Bu üretimin %25,32'sini sığır süt yemi, %22,20'sini etlik piliç yemi, %21,66'sını sığır besi yemi, %12,91'ini yumurta yemi ve %17,91'ini diğer karma yemler oluşturmaktadır. 2015 yılından 2022 yılına kadar karma yem üretiminde %34,94 artış olurken, en fazla artış %76,99 ile sığır besi yeminde yaşanmıştır (Çizelge 4).

Çizelge 1. Dünya'da ve Türkiye'de büyükbaş ve küçükbaş hayvan varlığı

Yıllar	Büyükbaş (baş)		Türkiye'nin Payı (%)	Küçükbaş (baş)		Türkiye'nin Payı (%)
	Dünya	Türkiye		Dünya	Türkiye	
2001-2004	1.510.171.722	10.354.865	0,69	1.844.121.714	33.461.054	1,81
2005-2008	1.578.139.736	10.724.497	0,68	1.980.894.945	31.910.434	1,61
2009-2012	1.611.168.249	11.423.975	0,71	2.041.641.367	29.545.847	1,45
2013-2016	1.647.379.134	14.256.984	0,87	2.169.319.099	39.425.398	1,82
2017	1.678.886.347	14.222.228	0,85	2.254.707.666	41.329.232	1,83
2018	1.687.499.294	17.220.903	1,02	2.275.495.767	46.117.399	2,03
2019	1.703.969.794	17.872.331	1,05	2.342.385.389	48.481.479	2,07
2020	1.724.475.508	18.157.971	1,05	2.379.372.922	54.112.626	2,27
2021	1.733.235.141	18.036.117	1,04	2.396.134.564	57.519.204	2,40
2001-2004=100	114,77	174,18	-	129,93	171,90	-
2020=100	100,51	99,33	-	100,70	106,30	-

Kaynak: FAO, 2023

Çizelge 2. Türkiye'de yem bitkileri üretim alanı (ha) ve üretim miktarı (ton)

Ürün	2020		2021		2022	
	Alan	Miktar	Alan	Miktar	Alan	Miktar
Yonca (yeşil ot)	660.015	19.290.519	666.974	19.310.959	641.129	19.064.213
Mısır (silaj)	520.250	27.186.949	524.369	27.309.962	524.565	28.558.983
Çayır Otu (yeşil ot)	44.628	293.848	165.138	804.681	492.903	3.683.405
Yulaf (yeşil ot)	323.987	3.850.475	369.518	3.752.850	360.268	4.649.051
Korunga (yeşil ot)	172.169	1.934.697	174.417	1.546.641	160.875	1.786.207
Tritikale (yeşil ot)	34.994	558.643	46.426	673.112	61.919	1.072.635
İtalyan Çimi (yemlik)	25.328	971.691	37.328	1.380.195	53.982	2.122.105
Arpa (yeşil ot)	31.319	537.066	27.941	443.553	29.223	482.665
Bezelye (yemlik)	24.315	452.776	26.798	486.233	25.877	475.005
Buğday (hâsıl/yeşil ot)	17.866	348.838	15.077	286.270	16.831	310.966
Çavdar (yeşil ot)	6.851	98.195	8.554	114.162	10.655	150.885
Mürdümük (yeşil ot)	8.769	82.026	7.713	63.074	6.699	55.208
Mısır (hâsıl)	5.666	126.142	5.828	128.704	5.061	114.672
Yem Şalgamı	4.657	237.491	4.316	217.567	4.946	268.890
Sorgum (yeşil ot)	2.327	87.920	2.768	113.179	2.918	117.076
Burçak (yeşil ot)	2.293	14.562	2.257	13.401	2.043	12.417
Hayvan Pancarı	1.664	83.763	1.347	67.060	1.149	56.360
Bakla, Kuru (yemlik)	1.384	4.133	895	2.623	817	2.452
Sudan Otu (yemlik)	-	-	225	10.605	242	9.169
Üçgül (yeşil ot)	6	96	7	119	7	117
Diğer *	-	-	1.523	19.591	1.693	28.424
Toplam	1.888.486	56.159.830	2.089.419	56.744.541	2.403.801	63.020.905

Kaynak: TÜİK, 2023; (*): Başka yerde sınıflandırılmamış diğer yem bitkileri (tahıl samanı ve kabuklar hariç)

Çizelge 3. Türkiye'de büyükbaş hayvan birimi (BBHB) değerleri ve kaba yem açığı

		2015	2016	2017	2018	2019
Büyükbaş Hayvan Birimi (BBHB)	Büyükbaş	11.178.680	11.291.268	12.769.122	13.784.042	14.238.254
	Küçükbaş	3.773.408	3.728.890	4.082.554	4.259.461	4.487.548
	Toplam	14.952.089	15.020.159	16.851.677	18.043.503	18.725.802
Yıllık Kaba Yem İhtiyacı (milyon ton)	Yeşil Ot + Silaj	54,6	54,8	61,5	65,9	68,3
	Kuru Ot	21,8	21,9	24,6	26,3	27,3
	Toplam	76,4	76,7	86,1	92,2	95,6
Toplam Yem Üretimi (milyon ton)	Çayır ve Meralar	11,7	11,7	11,7	11,7	11,7
	Yem Bitkileri	42,0	45,7	49,7	52,3	55,5
	Toplam	53,7	57,4	61,4	64,0	67,2
Kaba Yem Açığı (milyon ton)		22,7	19,3	24,7	28,2	28,4
Kaba Yemin İhtiyacı Karşılama Oranı (%)		70,3	74,8	71,3	69,4	70,3

Kaynak: Özkan, 2020

Çizelge 4. Türkiye'de karma yem üretimi (ton)

Yıllar	Sığır Besi Yemi	Sığır Süt Yemi	Etlik Piliç Yemi	Yumurta Yemi	Diğer Karma Yemler*	Genel Toplam
2015	3.320.221	5.384.586	4.779.916	3.417.209	3.203.051	20.104.983
2016	3.827.073	5.840.262	4.566.237	2.958.232	3.210.048	20.401.852
2017	4.594.552	6.171.275	4.753.989	3.369.665	3.528.862	22.418.333
2018	5.072.549	6.481.999	5.306.118	3.600.843	3.682.980	24.144.489
2019	5.406.167	6.550.258	5.363.210	3.828.441	3.791.041	24.939.117
2020	5.732.941	7.016.824	5.397.526	3.716.754	4.408.221	26.272.266
2021	5.961.009	7.171.666	5.542.974	3.661.780	4.666.569	27.003.998
2022	5.876.345	6.870.374	6.022.932	3.501.499	4.858.498	27.129.648
2015=100	176,99	127,59	126,00	102,46	151,68	134,94
Payı (%)**	21,66	25,32	22,20	12,91	17,91	100,00

Kaynak: TOB, 2023;(*) Diğer Karma Yemler: Küçükbaş yemleri, balık yemleri, at yemi, ev ve süs hayvanları yemleri, arı keki vb.; (**) 2022 yılında genel toplamdan aldığı pay

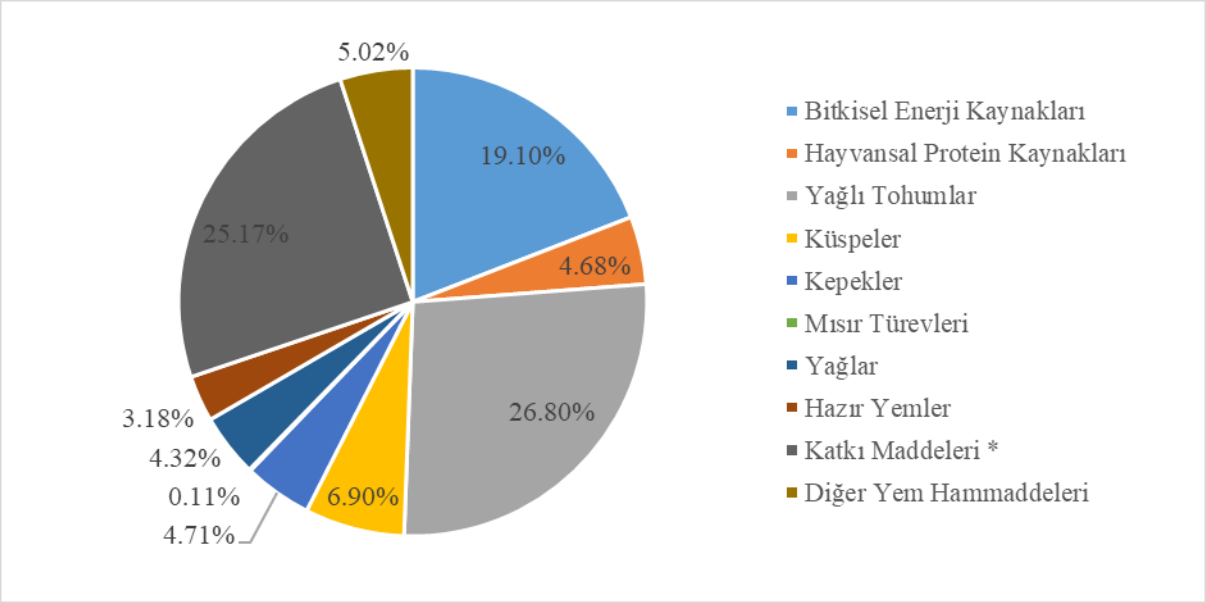
Çizelge 5. Türkiye'nin karma yem ve yem hammaddesi dış ticareti

Yıl	İthalat		İhracat		Dış Ticaret Dengesi (bin ABD$)
	Miktar (ton)	Değer (bin ABD$)	Miktar (ton)	Değer (bin ABD$)	
2015	8.821.449	3.926.437	1.232.193	714.472	- 3.211.965
2016	9.150.967	3.891.909	1.700.694	930.033	- 2.961.876
2017	12.575.129	4.646.073	1.858.879	897.696	- 3.748.377
2018	11.449.650	4.723.153	2.088.908	968.704	- 3.754.449
2019	13.123.482	4.818.599	1.523.519	989.055	- 3.829.544
2020	12.345.423	4.869.665	2.130.573	1.200.820	- 3.668.845
2021	12.835.547	6.408.330	2.862.134	1.557.528	- 4.850.802
2022	12.750.511	7.699.428	2.937.352	2.140.676	- 5.558.752
2015=100	144,54	196,09	238,38	299,62	173,06

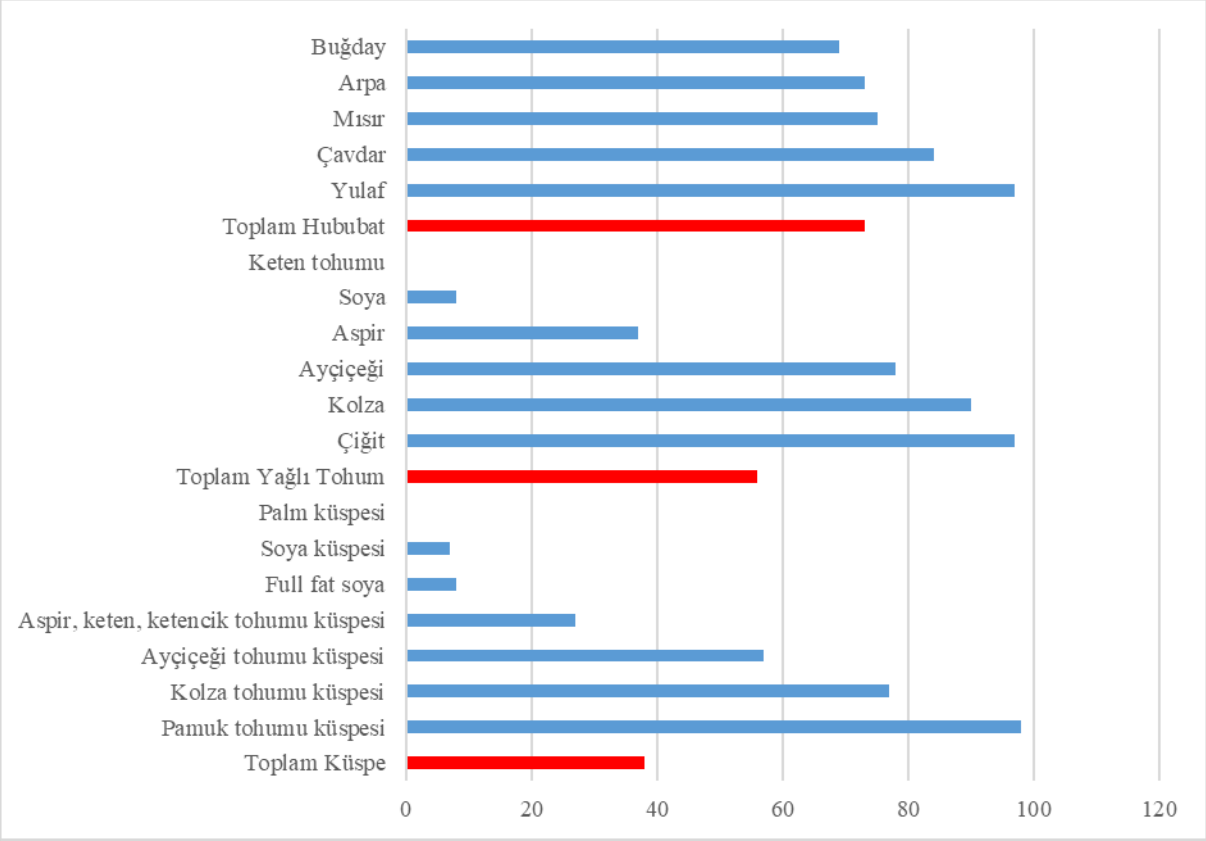
Kaynak: Türkiyem-Bir, 2023

Türkiye 2022 yılında 7 milyar 699 milyon 428 bin ABD$ değerinde, 12 milyon 750 bin 511 ton karma yem ve yem hammaddesi ithalatı gerçekleştirmiştir. 2015 yılından 2022 yılına kadar ithalat miktarında %44,54, ithalat değerinde ise %96,09 oranında artış yaşanmıştır. Bununla birlikte aynı yıl 2 milyar 140 milyon 676 bin ABD$ değerinde, 2 milyon 937 bin 352 ton karma yem ve yem hammaddesi ihracatı gerçekleşmiştir. 2015 yılından 2022 yılına kadar ihracat miktarında %138,38, ihracat değerinde ise %199,62 oranında artış meydana gelmiştir. Türkiye 2022 yılında karma yem ve yem hammaddesi dış ticaretinde 5 milyar 558 milyon 752 bin ABD$ dış ticaret açığı vermiştir. Bu açık 2015 yılından 2022 yılına kadar %73,06 oranında artmıştır. Kısacası Türkiye karma yem ve yem hammaddesinde önemli ölçüde dışa (ithalata) bağımlıdır (Çizelge 5).

Türkiye'nin karma yem üretiminde gerçekleştirdiği ithalatının tamamına yakını hammadde olarak yapılmaktadır. Başka bir deyişle, Türkiye hammaddeyi dışarıdan temin ederek yem üretimini yurtiçinde yapmaktadır. Karma yem hammadde grupları içerisinde ithalatta en büyük payı %26,80 ile yağlı tohumlu bitkiler (ayçiçeği, soya fasulyesi, kolza vs.) oluştururken, bu kalemi %25,17 ile katkı maddeleri, %19,10 ile bitkisel enerji kaynağı ürünler (buğday, arpa, mısır vs.) takip etmektedir (Şekil 1).



Şekil 1. Türkiye'de karma yem hammadde gruplarının ithalatta aldıkları paylar (2022 yılı)
Kaynak: Türkiyem-Bir, 2023; (*) Bu kalemde yer alan bazı ürünlerin ithalat ve ihracatları gıda ürünleri kapsamında yapılmaktadır.



Şekil 2. Türkiye'nin başlıca karma yem hammaddelerinde yeterlilik seviyeleri (%) (2021 yılı)
Kaynak: Türkiyem-Bir, 2022

Türkiye'de karma yem hammaddesi temininde ana ithalat kalemlerinin başında gelen tarımsal ürünlerin yurtiçi yeterlilik seviyeleri şekil 2'de verilmiştir. Buna göre, 2021 yılında hububatta kendine yeterlilik %70 seviyelerinde olup, bu oran yağlı tohumlarda %50 seviyelerinde, küspelerde ise %40 seviyesinin altına düşmektedir (Şekil 2).

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Şekil 1 ve 2 değerlendirildiğinde, Türkiye'de üretilen tahıllar ve yağlı tohumlu bitkiler doğrudan veya dolaylı olarak karma yem sanayisinin ana hammaddelerini oluşturmaktadır. Bununla birlikte tahıl ve yağlı tohumlu bitkiler doğrudan yem sanayisinde kullanılmasının yanında diğer birçok hammaddenin (kepek, küspe, mısır türevleri vs.) temelini oluşturmaktadır. Dolayısıyla bu ürünlerin üretiminde yaşanan arz açığı karma yem üretiminde ithalatın artmasına neden olmaktadır. Bu nedenle ithalatın azaltılması için bu ürünlerde en azından kendine yeterliliğin sağlanması elzemdir.

Türkiye'de Yem Bitkileri Desteklemeleri

Türkiye'de yem bitkileri üretimine sağlanan tarımsal desteklemeler çizelge 6'da yer almaktadır. Yem bitkilerine 2022 yılında alan bazlı tarımsal destekler kapsamında 94 TL/da mazot, 21 TL/da ise gübre desteği verilmektedir. Küçük aile işletmelerine 200 TL/da destek sağlanırken, organik tarım yapan üreticilere farklı kategoriler baz alınarak dekara 10-40 TL arasında değişen oranlarda destek sağlanmaktadır. Katı organik-organomineral gübre kullanan üreticilere dekara 20 TL destek sunulmaktadır (Çizelge 6).

Hayvancılık destekleri kapsamında yem bitkilerine verilen desteklerde ise yapay çayır-mera üretimine 150 TL/da, silajlık mısır (sulu) ekilişlere 100 TL/da, çok yıllık yem bitkileri (sulu) ve korunga üretimine (sulu/kuru) üretimine ise 90 TL/da destekleme sağlanmaktadır. Ayrıca tek yıllık yem bitkilerine 60 TL/da destek verilirken, kuru ekilişlere 40 TL/da destekleme ödemesi yapılmaktadır (Çizelge 6).

Yem bitkilerine sağlanan başka bir tarımsal destek ise sertifikalı tohum kullanım ve üretim desteğidir. 2022 yılında yonca üretiminde sertifikalı tohum kullanım desteği 60 TL/da iken, fiğ, yem bezelyesi ve korunga üretiminde bu tutar 45 TL/da'dır. Yonca için sertifikalı kademe tohum üretimi 4 TL/kg iken, yine yonca üretimi için orijinal/temel üstü kalitede olan tohum üretimlerine 5 TL/kg destek sağlanmaktadır. Benzer şekilde fiğ, yem bezelyesi ve korunga üretiminde sertifikalı kademe tohum üretimi 1,50 TL/kg iken, yine aynı ürünlerde orijinal/temel üstü kalitede olan tohum üretimlerine 1,60 TL/da destekleme yapılmaktadır. Ayrıca toprak analizi yapılan her 50 dekar alanda analiz başına Tarım ve Orman Bakanlığı tarafından akredite edilen kuruluşlara destekleme ödemesi yapılmaktadır. Yıllar itibariyle incelediğinde alan bazlı destekler kapsamında mazot ve gübre desteği hariç diğer destek kalemlerinde önemli düzeyde bir artış yaşanmamıştır.

Çizelge 6. Yem bitkilerine sağlanan tarımsal destekler

Tarımsal Destekler	Yıllar		
	2020	2021	2022
Alan Bazlı Tarımsal Destekler (TL/da)			
Mazot	17,00	19,00	94,00
Gübre	4,00	8,00	21,00
Katı Organik-Organomineral Gübre Desteği	10,00	20,00	20,00
Organik Tarım 2. Kategori (Bireysel)	40,00	40,00	40,00
Organik Tarım 2. Kategori (Üretici Grubu)	20,00	20,00	20,00
Organik Tarım 3. Kategori (Bireysel Grubu)	10,00	10,00	10,00
Organik Tarım 3. Kategori (Üretici Grubu)	5,00	10,00	10,00
Küçük Aile İşletmeleri Desteği	100,00	100,00	200,00
Hayvancılık Destekleri (Yem Bitkileri Desteği)* (TL/da)			
Korunga (Sulu/kuru)	90,00	90,00	90,00
Tek Yıllık Yem Bitkileri	60,00	60,00	60,00
Silajlık Ekilişler (Sulu)	100,00	100,00	100,00
Yapay Çayır Mera	150,00	150,00	150,00
Çok Yıllık Yem Bitkileri (Sulu)	90,00	90,00	90,00
Kuru Ekilişler	40,00	40,00	40,00
Diğer Tarımsal Amaçlı Destekler			
Sertifikalı Tohum Kullanım Desteği (TL/da)			
Fiğ, Yem Bezelyesi, Korunga	22,00	22,00	45,00
Yonca	30,00	30,00	60,00
Sertifikalı Tohum Üretim Desteği (Sertifikalı Kademe) (TL/kg)			
Fiğ, Yem Bezelyesi, Korunga	1,50	1,50	1,50
Yonca	4,00	4,00	4,00
Sertifikalı Tohum Üretim Desteği (Orijinal/Temel ve Üstü Kalite) (TL/kg)			
Fiğ, Yem Bezelyesi, Korunga	1,60	1,60	1,60
Yonca	5,00	5,00	5,00
Toprak Analizi Desteği (TL/Analiz)	40,00	-	50,00

Kaynak: Resmi Gazete, 2020-2022; (*) Yeraltı sularının yetersiz seviyede ve su kısıtı olduğunun Bakanlıkça tespit edildiği havzalarda ekimi yapılan yem bezelyesi, fiğ, macar fiği, burçak ve mürdümük için aldığı desteğe %50 ilave destek ödenir.

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Sonuç ve Öneriler

Hayvancılık sektörü, artan nüfus ve taleplerle birlikte insanların hayvansal gıdalara erişimi açısından oldukça önemlidir. Bunun sağlanabilmesi içinde hayvanların yeterli düzeyde beslenmesi öncelik haline gelmektedir. Bu doğrultuda yem maliyetleri hayvancılık işletmelerinde en önemli girdi kalemini oluşturmaktadır. Ancak Türkiye'de hayvanların beslenmesi için üretilen yem bitkileri ve çayır mera varlığı, mevcut hayvan varlığını yeterince beslemeye yetmemektedir. Ayrıca karma yem üretimi için de benzer sorunlar yaşanmakta olup, hammaddenin önemli bir kısmı ithalata dayalıdır. Söz konusu taleplere cevap verebilmek için, Türkiye'nin hayvan varlığını besleyebileceği, yani kendine yeterliliği ön planda tutan politikalara öncelik verilmesi gerekmektedir. Kaba yem ihtiyacının karşılanması için yem bitkilerinin üretimi arttırılmalı ve bunun için son yıllarda birim fiyatlarında önemli değişiklerin yaşanmadığı tarımsal desteklerin gözden geçirilmesi gerekmektedir. Ayrıca, mera, yaylak ve kışlakların ıslah edilerek otlatma kapasitesi ve verimlerinin arttırılmasına ihtiyaç duyulmaktadır. Benzer şekilde karma yem sektörünün dışa bağımlılığın azaltılması için yem hammaddelerinin üretim ve verimlilikleri arttırılmalıdır. Özellikle tahıl ve yağlı tohumlu bitki üretiminde kendine yeterliliğin sağlanması, karma yem sanayisindeki ithalatı azaltmak için önemli bir adımdır. Bu yapılırken, yem bitkileri ve diğer stratejik (temel) ürünlerin arzında sorun yaratmayacak şekilde üretim planlamaları ve destekleme politikaları benimsenmelidir.

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Patlıcan (*Solanum melongena L.*) Antosiyaninleri İçeren Akıllı İndikatör Filmler Kullanılarak Alabalığın (*Oncorhynchus mykiss*) Bozulmasının İzlenmesi

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Özet

Bu çalışmada evlerde ve gıda işletmelerinde atık olarak ayrılan patlıcan kabuklarından elde edilen antosiyanin ekstraktı kullanılarak pH değişimine duyarlı kitosan bazlı bir bozulma indikatörü filmi üretilmiştir. Geliştirilen filmlerin işlevi alabalık (*Oncorhynchus mykiss*) örneklerinde test edilmiştir. Örnekler indikatör filmler ile birlikte ambalajlanmış ve 0-4˚C'de 12 gün boyunca depolanmıştır. Depolamanın 0, 2, 4, 6, 8, 10 ve 12. günlerde raf ömrü analizleri yapılmıştır. Yeşil renkte olan indikatör film balıktaki bozulmayla doğru orantılı olarak sarı renk göstermeye başlamıştır. Elde edilen sonuçlara göre patlıcan kabuğu antosiyaninleri içeren kitosan bazlı filmin balıkta bozulma indikatörü olarak kullanılabileceğini göstermektedir.

Anahtar kelimeler: *pH indikatörü, akıllı ambalaj, alabalık, antosiyanin, kitosan, patlıcan antosiyaninleri,*

Giriş

Gökkuşağı alabalığı içerdiği mineraller, omega yağ asitleri ve yüksek protein içeriğiyle insan sağlığına oldukça faydalı bir gıda olmasının yanında hızlı bozulan gıdalar arasında yer almaktadır.

Antosiyaninler meyve, sebze ve bitkilere kendilerine özgü pembe, kırmızı, mavi ve mor tonlardaki çeşitli renkleri veren polifenolik bileşiklerdir. Antosiyaninler pH'a karşı duyarlıdırlar ve asit ortamında kırmızı, nötr ortamlarda mor, alkali ortamlarda ise mavi-yeşil renge sebep olurlar. Patlıcan en yüksek antosiyanin içeriğine sahip sebzelerden biridir (Gülçür Kaplan, 2019).

Akıllı ambalaj teknolojisi, gıdaların paketlendiği andan itibaren nakliyesi ve depolama süresi boyunca gıdanın kalitesi hakkında bilgi veren sistemlerin bütünüdür (Kocaman ve Sarımehmetoğlu, 2010).

Akıllı ambalajlar iç ve dış indikatörler sayesinde sıcaklık değişimleri, mikrobiyal bozulma ve ambalaj içi atmosfer değişimleri gibi ürünün tazeliği ve raf ömrü hakkında tüketiciye bilgi verirler (Gök vd., 2006; Özçandır ve Yetim, 2010).

Kitosan biyobozunurluğu yüksek ve toksik olmayan bir polimer olması sebebiyle balığa temas edecek olan bu indikatörün kitosandan üretilmesi uygun görülmüştür. Antosiyaninler farklı pH değerlerinde farklı renkleri yansıtması sebebiyle pH indikatörü olarak kullanılabilecek doğal pigmentlerdir. Patlıcan kabuğu birçok gıda işletmesinde gıda atığı olarak ayrılmaktadır. Patlıcan kabukları hem yüksek antosiyanin içermesi sebebiyle hem de gıda artıklarının değerlendirilmesi amacıyla kullanılmıştır.

Alabalık örnekleri geliştirilen pH indikatör filmler ile ambalajlanmış ve 0-4˚C'de 12 gün boyunca depolanmıştır. 0, 2, 4, 6, 8, 10 ve 12. günlerde balıkta kimyasal ve mikrobiyolojik analizler yapılmış ve filmlerin renk değişimi ölçülmüştür. İndikatör filmlerdeki renk değişimi ve alabalıkta bozulma arasındaki bağlantı yorumlanmıştır.

Materyal ve Yöntem

Materyal

Kitosan (C) (Sigma-Aldrich® 448877, orta molekül ağırlıklı, 200-800 Cps çözelti, 1% asetik asit, >75% deasetilasyon) Sigma-Aldrich (St. Louis, Missouri, USA)'den, diğer kimyasalların tümü ise analitik saflıkta olup, yine Sigma-Aldrich (St. Louis, Missouri, USA)'ten satın alınmıştır. Alabalık ve patlıcan örnekleri, Isparta'da faaliyet gösteren yerel bir işletmeden temin edilmiştir.

Yöntem

Antosiyaninlerin ekstraksiyonu

Antosiyaninler, patlıcan kabuğundan bazı değişikliklerle Choi ve diğ., (2017) tarafından tarif edilen yönteme göre ekstrakte edilmiştir. Patlıcan kabukları ince bir şekilde soyulmuş ve 65°C'deki etüvde 24 saat kurutulmuştur. Kuruyan kabuklar öğütülmüş ve kullanılacağı zamana kadar uygun koşullarda saklanmıştır. 6 g kurutulmuş patlıcan kabuğu tozu, asetik asit ile pH değeri 2'ye ayarlanmış 100 ml çözücü içerisine eklenip (%50 etanol, %50 su çözeltisi) oda sıcaklığında, manyetik karıştırıcıda karıştırılarak 24 saat boyunca ekstrakte edilmiş ve sonrasında 30 dakika boyunca ultrasonik banyoda ekstraksiyona devam edilmiştir. Sonrasında ekstratlar filtre edilmiş ve film içerisinde sıvı formda kullanılmıştır.

Ekstraktların Toplam Fenolik Madde Miktarının Ve Antosiyanin Konsantrasyonunun Belirlenmesi
Patlıcan kabuğu ekstraktlarının toplam fenolik içeriği Folin-Ciocalteu kolorimetrik yöntemi ile belirlenmiştir (Singleton ve diğerleri, 1999). Tüm ekstraktların uygun dilisyonları Folin-Ciocalteu reaktifi (Sigma-Aldrich, Missouri, ABD) (0.2 N) ve sodyum karbonatla (% 7.5 w/v) karıştırılır ve UV-vis spektrofotometre (Shimadzu, UV-1601, Tokyo, Japonya) kullanılarak 765 nm dalga boyunda örneklerin absorbans değerleri ölçülür. Sonuçlar, kg örnek/mg gallik asit eşdeğeri olarak ifade edilir.
Ekstraktların toplam antosiyanin içeriği, pH-diferansiyel metodu ile belirlenmiştir (Giusti ve Wrolstad, 2001). Kısaca, ekstrakte edilen çözeltinin (1 mL) pH'sı, biri potasyum klorür tamponu (10 mL), pH 1.0 ve diğeri sodyum asetat tamponu (10 mL), pH 4.5 ile ayarlandıktan 15 dakika sonra, her seyreltmenin absorbansı, 510 ve 700 nm'de saf suyla doldurulmuş boş bir hücreye karşı kaydedilir.

Ekstraktların (A) absorbansı aşağıdaki gibi hesaplanır:

$$A = (A510 - A700)pH\ 1.0 - (A510 - A700)pH\ 4.5$$

Orijinal örnekteki monomerik antosiyanin konsantrasyonu, aşağıdaki formül kullanılarak hesaplanır:

$$Toplam\ Monomerik\ Antosiyanin = \frac{(A \times MW \times DF \times 1000)}{(\varepsilon x 1)}$$

MW, moleküler ağırlık (siyanidin-3-glukozit için 449.2 g / mol), **DF**, seyreltme faktörüdür ve **ε**, molar absobanstır (siyanidin-3-glukozit için 26.900).

Film hazırlama
% 1 w/w kitosan (C), % 1 w/w sulu asetik asit çözeltisi içinde çözündürülmüştür. Ağırlıkça kitosanın %50 si oranında patlıcan kabuğu içerecek şekilde %6'lık patlıcan kabuğu ekstaraktı eklenmiş, manyetik karıştırıcıda 24 saat karıştırılmıştır. Ardından kitosanın ağırlıkça % 0,20'si oranında gliserol ilave edilerek bir kitosan film çözeltisi elde edilmiştir (Sanchez-Gonzalez ve diğ., 2010). Gliserol ilavesinin ardından film çözeltisi 5 dk. süre ile karıştırılmış ve 50 g çözelti, bir Teflon® kaplı plaka (Ø = 150 mm) üzerine dökülmüş ve çevre koşullarında 48 saat kurutulmuştur. Tüm film örnekleri analizden önce bir hafta boyunca 25 ° C'de ve % 50 bağıl nemde koşullandırılmıştır.
Film örneklerinin mekanik özellikleri
Elastik modül (EM), çekme dayanımı (TS) ve kopma noktasındaki uzama (E, %), ASTM standart yöntemi D882 (ASTM, 2018) ile belirlenmiştir. Filmler (2.5 cm x 5 cm), test makinesinin film uzatma tutamaçlarına (Lloyd LR5, AMETEK, Inc, Batı Sussex, UK) yerleştirilmiş ve kopana kadar 50 mm / dak'da gerilmiştir.
Su Buharı Geçirgenliği ve Film Örneklerinin Optik Özellikleri
Film örneklerinin su buharı geçirgenliği (WVP) E96-95 gravimetrik yönteme göre belirlenmiştir (ASTM, 2016). Tüm film numuneleri %100 bağıl neme maruz bırakılır ve geçirgenlik ölçümleri, kapları periyodik olarak (48 saat, bir 1.5 saatte bir) 25 ° C'de tartarak gerçekleştirilmiştir.
Filmlerin opasite değerleri, UV-spektrofotometre (Shimadzu, UV-1601, Tokyo, Japonya) kullanılarak 600 nm'deki absorbans değerlerinin alınması ve ardından filmlerin kalınlık değerlerine (mm) bölünmesi ile elde edilmiştir.
Film Örneklerinin Farklı pH Değerlerindeki Renk Değişimlerinin Belirlenmesi
Filmlerin farklı pH değerlerinde (1-10) renk değişimleri, film örneklerinin farklı pH tamponları içine daldırılarak bir Minolta Chroma Metre (CR-400, Konica Minolta, Inc., Japonya) ile ölçülmüştür. Filmlerin renk ölçümü için arka plan olarak beyaz standart bir kalibrasyon plakası (Y = 92.7, x = 0.3160, y = 0.3321) kullanılmıştır. Tüm ölçümler üç rastgele lokasyonda yapılarak, sonuçlar CIE L *, a * ve b * olarak ifade edilmiştir.
pH indikatör filmlerin alabalık örnekleri ile paketlenmesi ve raf ömrü çalışması
Üretilen pH indikatör filmlerin etkinliklerini test etmek amacıyla Alabalık (*Oncorhynchus mykiss*) örnekleri kullanılmış ve üretilen filmlerin balıkta tazelik pH indikatörü olarak kullanılmıştır. Balık örnekleri vakum poşeti içine pH indikatörleri ile birlikte konulmuş ve paketlenmiştir. Film ile birlikte paketlenen balık örnekleri 0-4°C'de depolanmıştır. Depolama boyunca alabalık örneklerinde 0, 2, 4, 6, 8, 10 ve 12. günlerde mikrobiyolojik ve kimyasal analizler yapılmıştır. Örneklerdeki pH değişimi izlenmiştir. Depolama sırasında balıklarda tiyobarbütirik asit (TBA) seviyeleri takip edilmiştir (FAO, 1986). Bu süreçte ayrıca indikatördeki renk değişimi de incelenmiştir. Balık örneklerindeki pH değişimi ile mikrobiyal gelişim arasındaki korelasyonu görmek amacıyla örneklerde mikrobiyolojik analizler gerçekleştirilmiştir. Bunun için toplam aerobik mezofilik mikroorganizmalar için PCA (Plate count agar), koliform bakteriler için VRBA (Violet Red Bile Agar) ve *Enterobacteriaceae* için VRBG (Violet Red Bile Glucose Agar) agarları kullanılarak mikroorganizma sayımı yapılmıştır.

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pH analizi
Balığın pH değeri dijital bir pH metre kullanılarak (Lab 860, Schott İnstruments, Almanya) 0, 2, 4, 6, 8, 10, ve 12. günlerde izlenmiştir. 5 g balık örneği 45 mL saf su ile (1:10 w/v) stomacher torbasında 3 dk homojenize edilmiştir. Homojenat filtre edildikten sonra pH değeri ölçülmüştür (Rastiani vd., 2019).
TBA analizi
Tiyobarbütirik asit analizi için 5 g örnek, 15 mL su ile homojenize edilmiş ardından filtre edilmiştir. Tüpe 2 mL filtrat, 4 mL trikloroasetik asit (TCA, % 20, w/v) ve 4 mL 2-tiyobarbitürik asit (TBA, 0.02 M) çözeltileri alınmış ve karıştırılmıştır. Aynı işlemler saf su içeren kör örnek için de uygulanmıştır. Tüpler vortekslendikten sonra 95°C'de 50 dk boyunca su banyosunda inkübasyona bırakılmıştır. İnkübasyondan sonra örnekler soğutulup 3500 rpm'de 15 dk santrifüj (Nuve NF800R, Türkiye) edilmiştir.
Örneğin 532 nm'deki absorbans değeri kör örneğe karşı okunmuştur (Shimadzu, UV-1601, Tokyo, Japan).
Elde edilen sonuç, 1,1,3,3-tetraetoksipropan standart kalibrasyon eğrisi kullanılarak mg malondialdehid (MDA)/kg et örneği olarak verilmiştir (Söğüt ve Seydim, 2018).
Mikrobiyolojik analizler
Depolama süresince balık örneklerindeki mikrobiyal değişim izlenmiştir. Toplam aerobik mezofilik mikroorganizmalar için PCA (Plate count agar), koliform bakteriler için VRBA (Violet Red Bile Agar) ve *Enterobacteriaceae* için VRBG (Violet Red Bile Glucose Agar) agarları kullanılarak mikroorganizma sayımı yapılmıştır. Balık örnekleri filtreli stomacher torbalarında homojenize edilmiş ve uygun dilüsyonlaraa seyreltilerek ekimler yapılmıştır. PCA için tek kat dökme yapılmış ve 35°C'de 48 saat inkübe edildikten sonra mikroorganizma sayımı yapılmıştır. VRBA ve VRBG için çift kat dökme yapıldıktan sonra 35°C'de 18-24 saat inkübe edildikten sonra sayımı yapılmıştır. Döküm yapılmış petri görselleri Şekil 3.2.12.1'de verilmiştir.

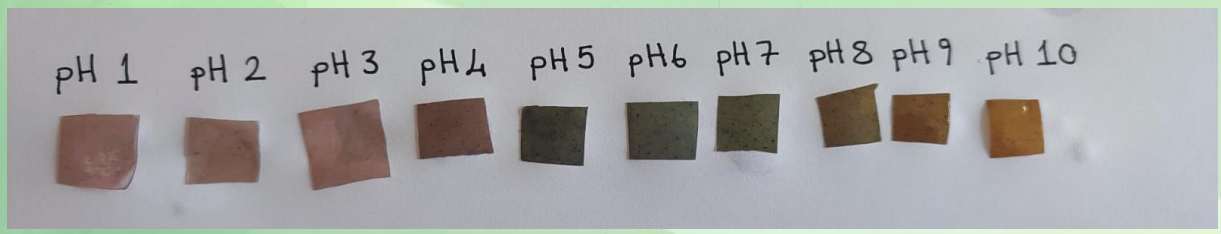
Araştırma Bulguları Ve Tartışma

Ekstraktların Toplam Fenolik Madde Miktarı ve Monomerik Antosiyanin Analizi Bulguları
Patlıcan kabuğundan elde edilen ekstraktlarda gerekli seyreltmeler yapılarak toplam fenolik madde miktarının belirlenmesi için 765 nm'de, monomerik antosiyanin miktarının belirlenmesi için 510 ve 700 nm'de spektrofotometre okumaları yapılmış ve denklemler ile sonuçlar hesaplanmıştır. Sonuç olarak patlıcan kabuğu ekstraktındaki ortalama toplam fenolik madde miktarı 1.654,05 kg örnek/mg gallik asit olarak bulunmuştur. Aynı şekilde ortalama monomerik antosiyanin miktarı 44,29 mg/100 g olarak bulunmuştur.

Film Örneklerinin Mekanik Özellikleri
Elde edilen sonuçlara göre ortalama olarak elastik modül (EM) sonucu 774,02, çekme dayanımı (TS)sonucu 19,29 ve kopma noktasındaki uzama (E, %) sonucu 16,38 olarak bulunmuştur.

Su Buharı Geçirgenliği ve Film Örneklerinin Optik Özellikleri
Sonuçlara göre filmin ortalama su geçirgenliği değeri 10,11 iken kalınlık değeri 0,03 ve opasite değeri 2,19 bulunmuştur.

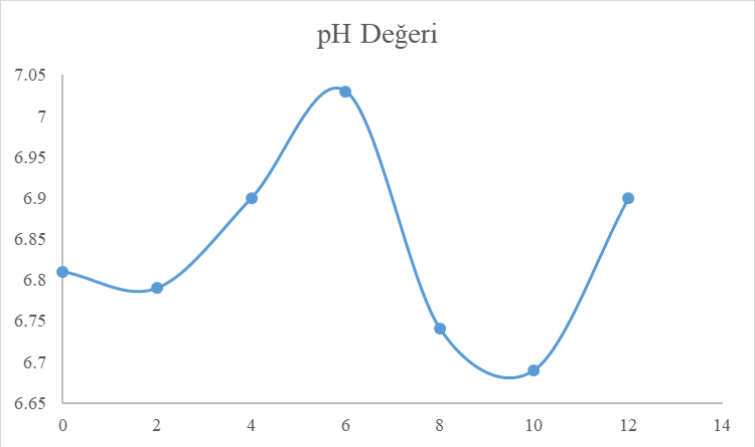
Film Örneklerinin Farklı pH Değerlerindeki Renk Değişimi Sonuçları
Üretilen indikatör filmlerin farklı pH'a sahip ortamlarda gösterdiği renk değişimini incelemek amacıyla eşit miktardaki indikatör filmler pH 1'den pH 10'a kadar olan eşit miktardaki tampon çözeltilere daldırılmıştır. Renk değişimleri aşağıdaki şekilde verilmiştir. İndikatör film pH 1-3 arası pembe-kırmızı renk alırken, pH 4-5 arasında mavi renk, pH 6-7 arası mavi-yeşil renk, pH 8-10 arası sarı renk almaktadır.



pH İndikatör Filmlerin Alabalık Örnekleri İle Paketlenmesi ve Raf Ömrü Çalışması
Alabalık örnekleri 40 g olacak şekilde ayrılmış ve indikatör filmler ile birlikte vakum poşet ile paketlenmiştir. Örnekler 12 gün boyunca 0-4°C'deki soğuk dolaplarda depolanmıştır. 0, 2, 4, 6, 8, 10, 12. günlerde alabalık örneklerinde kimyasal ve mikrobiyolojik analizler yapılmıştır. Filmlerde ise renk değişimi izlenmiştir.

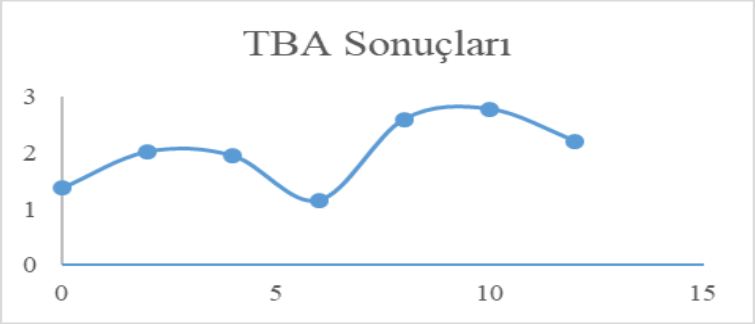
pH Analizi Sonuçları

İndikatör filmler ile paketlenen alabalıkların pH değerleri 0, 2, 4, 6, 8, 10 ve 12. günlerde analiz edilmiştir. Alabalığın pH değeri 6. güne kadar artarken 6. günden sonra düşmeye başlamış 10. günde tekrar artmıştır



TBA Analiz Sonuçları

İndikatör filmler ile paketlenen alabalıkların TBA değerleri 0, 2, 4, 6, 8, 10 ve 12. günlerde analiz edilmiştir. TBA değerleri 12 gün boyunca kabul edilebilir sınırın üstüne çıkmamıştır.



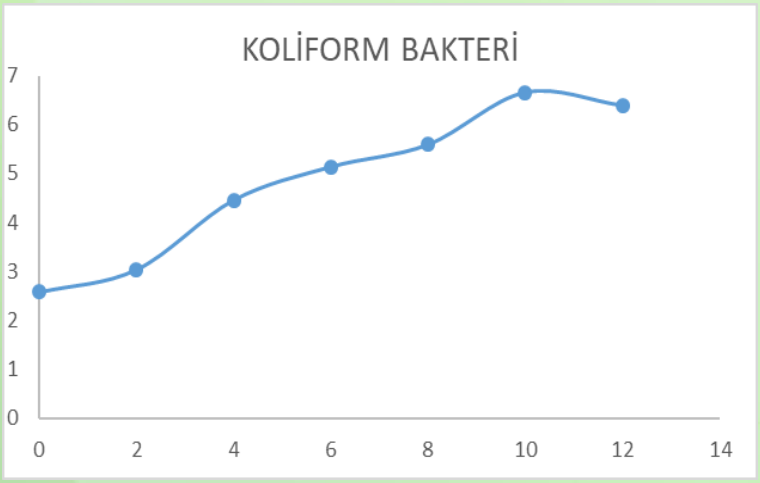
Mikrobiyolojik Analiz Sonuçları

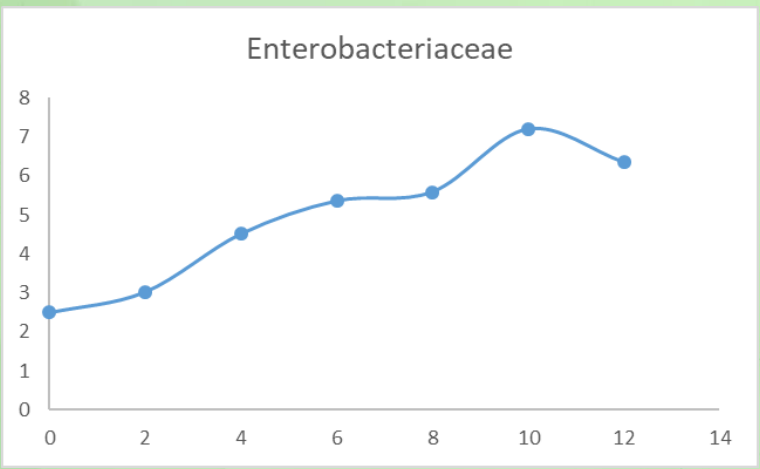
İndikatör filmler ile paketlenen alabalıklarda 0, 2, 4, 6, 8, 10 ve 12. günlerde mikrobiyolojik analizler yapılmıştır. Toplam aerobik mezofilik mikroorganizmalar için PCA (Plate count agar), koliform bakteriler için VRBA (Violet Red Bile Agar) ve *Enterobacteriaceae* için VRBG (Violet Red Bile Glucose Agar) agarları kullanılarak mikrobiyolojik analizler gerçekleştirilmiştir.

Toplam Mezofilik Aerobik Mezofilik Mikroorganizma sayısı 6. günde kabul edilebilir sınırı aşmasıyla örnek raf ömrünü tamamlamıştır.



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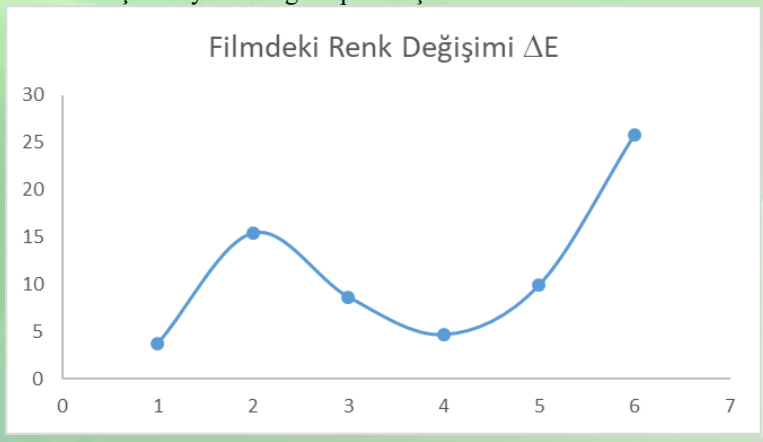


Depolama sırasında İndikatör Filmin Renk Değişimi

Filmlerin renkleri depolama süresi boyunca 0, 2, 4, 6, 8 ve 10. günlerde CIE L* a* b* sistemiyle ölçülmüştür.



0 ve 2. günlerdeki filmlerin renk değişimi orta, 6 ve 8. günlerde filmlerin renk değişimi büyük, 2-4,4-6, 8-10 ve 10-12. günlerdeki renk farkının çok büyük olduğu saptanmıştır.



Sonuç

Patlıcan kabuklarından elde edilen antosiyaninler ile pH'a duyarlı kitosan bazlı filmler başarı ile elde edilmiştir. Geliştirilen filmler ile birlikte paketlenen alabalıkların mikrobiyal analiz sonuçları ile indikatör filmlerin renk değişimi arasında anlamlı bir ilişki kurulmuştur. Yapılan analizler sonucunda geliştirilen patlıcan kabuğu antosiyaninleri içeren kitosan bazlı filmlerin taze alabalığın raf ömrü hakkında bilgi vermesi amacıyla kullanılabileceği sonucuna varılmıştır.

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A Workshop Example of Basic Design Education in Interior Architecture

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Abstract

Basic design is one of the common and introductory courses of design disciplines. It has great importance in interior architecture education as it forms the basis of design practice. Education that proceeds through abstract concepts creates difficulties for students to internalize this course. To avoid these difficulties, learning by doing has great importance. Learning by doing approach was carried out in the form of a workshop within the scope of the "Basic Design 1" course of the Department of Interior Architecture at Konya Technical University in the fall semester of 2022-2023 academic year. Students were asked to produce three-dimensional designs using basic design principles and elements. The class was divided into groups of eight people and studies were carried out with a workshop coordinator in each group. Duration of the workshop was planned as four weeks. During the workshop, students learned to use materials and colors, to design an original composition. At the end of the workshop, students learned to embody the abstract concepts they learned during the year by creating a composition that considers functionality and aesthetics. In order to evaluate the efficiency of the workshop, a survey study was carried out after the course period ended. As a result, it has been seen that the intelligibility of Basic Design 1, which is a course taught through abstract concepts, has increased thanks to the workshop.

Key Words: *Architectural education, Basic design, Interior architecture, Learning by doing, Workshop*

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Dikim Zamanı İle Sıklığının Basma Tipi Tütünlerin Verim, Gelir ve Kalitesine Etkileri

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Özet

Basma tipi tütünler sigara harmanlarının aromalarını düzenlemek için kullanılmaktadır. Araştırmada basma tipi tütününün verim ve kalite özelliklerine dikim zamanı ile sıklığının etkilerinin belirlenmesi amaçlanmıştır. Çalışma Tokat/Erbaa lokasyonunda 2021 yılında OZE B1 çeşidi ile yürütülmüştür. Araştırmada üç farklı dikim zamanı (16 Mayıs, 31 Mayıs ve 13 Haziran), üç sıra arası (30, 40 ve 50 cm) ve üç sıra üzeri (8, 12 ve 16 cm) mesafe kullanılmıştır. Çalışmada incelenen kuru yaprak verimi, randıman, bürüt gelir, indirgen şeker ve nikotin oranları istatistiki ($p<0,01$ ve $p<0,05$) olarak farklılık göstermiştir. En yüksek kuru yaprak verimi 16 Mayıs (2108,33 kg ha^{-1}) ve 31 Mayıs (2094,64 kg ha^{-1}) dikim zamanlarında, sıra arası 40 cm (2294,89 kg ha^{-1}) ve sıra üzeri 8 cm (2200,93 kg ha^{-1}) mesafeden elde edilmiştir. Randıman değerleri % 58,28 (13 Haziran, 8 cm sıra üzeri) ile %75,64 (16 Mayıs, 12 cm sıra üzeri) arasında nikotin oranı %0,93 ile %2,04 arasında, indirgen şeker oranı ise %4,48 ile %11,20 arasında değişim göstermiştir. Birim alandan elde edilen kuru yaprak verimi ve yaprak kalitesinin (randıman) oluşturduğu toplam gelir bakımından 8557.59 $ ha^{-1} ile en yüksek değer 16 Mayıs dikim zamanı, 8 cm sıra üzeri ve 40 cm sıra arası dikim sıklığında tespit edilmiştir.

Anahtar kelime: *Bitki yoğunluğu, İndirgen şeker oranı, Nicotiana tabacum L., Nikotin oranı*

The Effects of Planting Time and Density on Yield, Income and Quality of Basma Tobacco

Abstract

Basma tobaccos are used to improve the flavors of cigarette blends. In this study, it was aimed to determine the effects of planting time and density on yield and quality characteristics of basma type tobacco. The study was carried out in Tokat/Erbaa location in 2021 with OZE B1 variety. Three different planting times (16 May, 31 May and 13 June), three row spacing (30, 40 and 50 cm) and three intra-row spacing (8, 12 and 16 cm) were used in the study. Dry leaf yield, quality grade index, gross income, reducing sugar and nicotine ratios examined in the study differed statistically ($p<0.01$ and $p<0.05$). The highest dry leaf yield was obtained at planting times of May 16 (2108.33 kg ha-1) and May 31 (2094.64 kg ha-1), 40 cm row spacing (2294.89 kg ha-1) and 8 cm intra-row spacing (2200.93 kg ha-1). Quality grade index ranged from 58.28% (June 13, 8 cm inra-row spacing) to 75.64% (May 16, 12 cm intra-row spacing), while the nicotine ratio ranged between 0.93% and 2.04%, and the reducing sugar ratio varied between 4.48% and 11.20%. In terms of total income generated by dry leaf yield and leaf quality (quality grade index) per unit area with 8557.59 $ ha^{-1}, the highest value was determined at the planting time of May 16, planting density of 8 cm intra-rows spacing and 40 cm row spacing.

Keywords: *Planting density, Reducing sugar ratio, Nicotiana tabacum L., Nicotine ratio*

Giriş

Dünyada üretilmekte olan tütün tipleri genellikle sigara yapımında kullanılmaktadır. Sigara üretiminde virjinya, burley, oryantal tip tütünlerin yanı sıra diğer (recon, damar vb.) mamullerde kullanılabilmektedir. Oryantal tütünler sigara harmanlarına düzenleyici olarak katılmaktadır. Oryantal tütünler içerisindeki Basma tipinin ise en önemli özelliği yüksek aromaya sahip olmasıdır (Kınay ve ark., 2023). Harmanlardaki düzenleyiciliği ve aroma vermesi nedenleriyle tütün sanayinin vazgeçemediği bir tiptir.

Yunan basma tipi tütünler 2002 yılından günümüze kadar Tokat ve çevresinde farklı çalışmalara konu olmuştur. Çalışmaların çoğunluğu yörelere uygun yerel basma tütün tiplerinin geliştirilmesine yönelik yapılmış ve bölge için yeni çeşitler geliştirilmiştir (Kınay, 2020; Kurt ve ark., 2021). Yetiştiricilik ile ilgili uygulamalarda ise geçmişten gelen dikim desenleri kullanılmaktadır. Geçmişten günümüze üreticiler genellikle 43*15, 45*12, 50*10 cm dikim sıklığını kullanmakta ve fideleri araziye Nisan-Mayıs-Haziran aylarında şaşırtmaktadır. Yörede standart bir dikim zamanı ve sıklığının olmaması verim ve kalite kayıplarına neden olmaktadır. Bu çalışma yörede basma tipi tütünlerden ideal verim-kalitenin elde edilebilmesi için ne zaman ve hangi sıklıkta dikim işleminin yapılacağının belirlenmesi amacıyla yapılmıştır.

Tütünde verim ve kalite özelliklerini doğrudan etkileyen tarımsal uygulamalardan biri dikim sıklığı iken diğeri de dikim zamanıdır. Özellikle herhangi bir ekolojide yeni tütün tipleri yetiştirilmek istendiği zaman çeşit/çeşitlerin ne zaman ve hangi sıklıkta dikileceği belirlenmektedir. Bölgelerde en uygun dikim sıklığının ve zamanın belirlenmesi maksimum verim için en önemli faktör olabilmektedir (Kharazmi ve ark., 2014). Adıyaman'da yedi dikim sıklığı (110x38, 100x40, 100x35, 90x40, 80x40, 90x35 ve 80x35 cm) ile 2021 yılında yapılan araştırmada K 326 tütün çeşidi kullanılmıştır. En yüksek kuru yaprak veriminin 110x38, en iyi kalitenin ise 90x40 cm den elde edildiği belirtilmiştir (Vural ve Ekren, 2022). Başka bir çalışmada üç sıra arası (80, 100 ve 120 cm) ve dört sıra üzeri (30, 50, 70 ve 90 cm) sıklık çalışması Coker 347 tütün çeşidi ile yürütülmüştür. Araştırmada dekara 14285 bitki yoğunluğunun verim ve kalite açısından uygun olduğunu belirlemişlerdir (Kharazmi ve ark., 2014). Dekara 1515 ve 1665 bitki yoğunluğu ile flue-cured tipi tütünlerde yapılan araştırmada dekardan bitkilerin ne kadar azot kaldırdığı incelenmiştir. Çalışma sonucunda bitki yoğunluğu dekarda 1515 olduğu zaman 9,75 kg, 1665 olduğu zaman ise 11,3 kg olduğunu ve en iyi verim ve kalitenin 1665 da/bitki sıklığında tespit edilmiştir (Chao ve ark., 2021). Birim alandaki bitki yoğunluğun artması dekardan bitkilerin azot kaldırmasını ve dekara azot uygulamasının arttırılmasını gerektirmektedir. Ayrıca birim alanda bitki yoğunluğunun artması özellikle nikotin oranını azaltırken (Henry ve ark., 2019) indirgen şeker oranın ise artmasını sağlamaktadır. Ayrıca dikim zamanı da nikotin oranını etkilemekte, Miner (1980), de yaptığı çalışmada geleneksel dikim zamanından erken dikimlerde nikotin oranının azaldığını ancak geciktirildiğinde ise arttığını belirtmiştir. Wilkinson ve ark. (2008), iki lokasyonda (Clayton ve Oxford) iki çeşitle (K326 ve NC 297) yaptıkları çalışmada normal dikim zamanı ile normal dikim zamanından 2, 3, 4 ve 5 hafta sonra yaptıkları dikimleri karşılaştırmışlar. Araştırma sonucunda verim için en uygun dikim zamanın normal dikim zammından 2 hafta sonra yapılan olduğu özellikle 4 ve 5 hafta gecikmeli yapılan dikimlerde ise önemli derecede verim kayıplarına neden olduğunu belirlemişlerdir. Çalışmada randıman, toplam alkaloid ve toplam şeker değerlerinde değişimler olmasına rağmen net bir fark göremediklerini ifade etmişlerdir.
Araştırmada basma tütün tipinde en uygun dikim zamanı ve sıklığının verim ile kalite özelliklerine etkileri incelenmiştir. Çalışma sonucunda yöre çiftçilerinin üretim aşamasında kullanacağı agronomik verilerin üretilmesi hedeflenmiştir. En uygun dikim zamanı ve dikim sıklığının üreticiler tarafından kullanılması ile tütünün verim ve kalite parametrelerinin artırılarak gelir düzeyinin arttırılması diğer bir hedefimizdir.

Materyal ve Metot

Araştırmada OZE B1 basma tütün çeşidi kullanılmıştır. OZE B1; 2021 yılı ilk çeyreğinde Öz-Ege Tütün Sanayi ve Ticaret A.Ş. tarafından tescil ettirilmiş, orta geçci, bitki boyu 105-115 cm, yaprak sayısı 27-32 adet, yaprak verimi 165-175 kg/da, nikotin oranı %2,23-2,74, indirgen şeker oranı %9-10 arasında olan aroma içeriği yüksek bir çeşittir. Çalışma Tokat/Erbaa lokasyonunda tesadüf bloklarında bölünen bölünmüş parseller deneme desenine göre üç tekerrürlü olarak yürütülmüştür. Araştırmada üç sıra arası (30, 40 ve 50 cm), üç sıra üzeri (8, 12 ve 16 cm) ve üç dikim zamanı (16 Mayıs, 31 Mayıs ve 13 Haziran) kullanılmıştır. Deneme için gerekli fideler float sisteminde torf ortamında yetiştirilmiştir. Dikim öncesinde deneme alanına 6 kg/da N, 4 kg/da P ve 6 kg/da K uygulaması yapılmıştır (Kınay ve ark., 2022). Dikim işlemleri tamamlandıktan sonra yetiştiricilik süreci boyunca bakım işlemleri gerçekleştirilmiş, hasat olgunluğuna gelen yapraklar üç elde hasat edilmiştir. Kuruması tamamlanan yapraklar %15 nem oranına sabitlenerek verim değerleri hesaplanmıştır. Kuru tütün yapraklarından alınan örneklerde nikotin oranları "CORESTA Recommended Method No. 85" metodu, continuous flow analysis yöntemine (Coresta, 2017), indirgen şeker oranları ise "CORESTA Recommended Method No. 38" metodu, continuous flow analysis yöntemine (Coresta, 2010) göre Öz-Ege Tütün San. Tic. A.Ş. kimyasal analiz laboratuvarında yapılmıştır.
Çalışmada verim, randıman, gelir, nikotin ve indirgen şekerlere ait veriler JMP 13.0 yazılımı ile varyans analizine tabi tutulmuş ve ortalamalar arasındaki farklar Tukey HSD çoklu karşılaştırma testi ile gruplandırılmıştır (Kurt ve Kınay, 2021).

Bulgular ve Tartışma

Sigara harmanlarına özellikle aroma vermek için kullanılan basma tütünlerinden OZE B1 çeşidi ile yapılan çalışmada elde edilen verilerin tamamı istatistiki olarak önemli ($p<0,01$ ve $p<0,05$) bulunmuştur (Çizelge 1). Araştırmada incelenen verim, randıman, toplam gelir, indirgen şeker ve nikotin oranı parametreleri dikim tarihlerinden çok önemli ($p<0,01$) şekilde etkilenmiştir. Dikim tarihlerine bağlı olarak çevresel etkilerin değişmesi bitkilerin gelişimi ve kuru madde üretimi üzerinde etkili olmuştur (Senbayram ve ark., 2006). Dikim tarihlerinin gecikmesi bitkilerdeki asimilant madde birikiminin az olmasına neden olmuştur. Bitkilerin yaşam alanını belirleyen sıra üzeri mesafesi, incelenen tüm parametreleri, sıra arası mesafesi ise randıman hariç diğer parametreleri etkilemiştir. Genel olarak bitkilerin yaşam alanının genişlemesi besin, ışık, su gibi ihtiyaçlarını kolayca karşılayabilmesini sağlamakta (Kaydan ve ark., 2011; Şaman ve Öztürk, 2012) ancak her zaman birim alandan elde edilen verim ve geliri artırmamaktadır.
Çizelge 1. OZE B1 çeşidi dikim sıklığı ve zamanı varyans analiz tablosu

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Kaynaklar	SD	Verim			Randıman			Toplam gelir			İndirgen şeker oranı			Nikotin oranı			$Q_{0.05}$
		KO		SH	KO		SH	KO		SH	KO		SH	KO		SH	
Blok	2	81309		-	118.8		-	153865		-	1.978		-	0.059		-	-
DT	2	1279416	**	15.85	1195.8	**	0.83	10300000	**	46.21	95.16	**	0.113	0.781	**	0.021	3.564
Hata 1	4	6782.1		-	18.747		-	57650.80		-	0.345		-	0.012		-	-
SA	2	2354420	**	20.36	3.5	öd	0.55	27000000	**	52.10	21.41	**	0.059	0.713	**	0.015	2.668
DT × SA	4	747476.0	**	35.26	66.951	**	0.94	7453961.00	**	90.23	5.607	**	0.102	0.315	**	0.027	3.721
Hata 2	12	11187.90		-	8.03		-	73277.80		-	0.094		-	0.006		-	-
SÜ	2	1114461	**	23.59	72.33	*	0.90	8683600	**	72.27	3.32	**	0.111	0.475	**	0.019	2.444
DT × SÜ	4	147908.0	**	40.85	22.767	öd	1.56	1148362.0	**	125.18	3.431	**	0.193	0.028	*	0.032	3.297
SA × SÜ	4	77575	**	40.85	25.47	öd	1.56	1381855	**	125.18	2.715	**	0.193	0.010	*	0.032	3.297
DT × SA × SÜ	8	92998.6	**	70.76	76.744	**	2.71	801384.0	**	216.82	0.878	*	0.333	0.036	**	0.056	3.999
Hata 3	36	15021.0		-	21.95		-	141036.0		-	0.334		-	0.009		-	-

(**) önemlilik 1%, (*) önemlilik 5%, ÖD: önemli değil, SD: Serbestlik derecesi, DT: Dikim tarihi, SA: Sıra arası, SÜ: Sıra üzeri, KO: Kareler ortalaması, SH: Standart hata, Q: Tukey HSD Q değeri (α: 0.05)

Araştırmada 16 Mayıs itibariyle iki haftalık aralıklarla dikimler gerçekleştirilmiştir. Dikim zamanının gecikmesi kuru yaprak veriminde ve randımanda azalmaya neden olmasına rağmen ilk iki tarihe ait verim değerleri istatistiki olarak aynı grupta yer almıştır. Toplam geliri oluşturan verim ve randıman değerleri sonucunda en yüksek toplam gelir ilk dikim zamanında 6750.90 $ ha^{-1} olarak gerçekleşerek en yüksek değer olmuştur. Bitkilerin toprakta geçirdikleri süre uzadıkça kuru madde üretimi ve buna bağlı olarak verim artmaktadır (Bozbek ve Günay, 2005; Koca ve Turgut, 2012). Dikimler geciktikçe stres faktörlerinin artması bitkilerin ihtiyaçlarını yeterince karşılayamamasına neden olabilmektedir. Çevresel etkiler bitkiyi biyokimyasal ve morfolojik mekanizmalar ile performansını korumaya itmektedir (Senbayram ve ark., 2006). Tütün, bu farklı stres kaynaklarının olumsuz etkisinden kurtulmak için savunma oluştururken, verim kayıpları yaşamaktadır (Lambers ve ark., 2008). Tütün bitkisi oluşturduğu savunma mekanizması sonucunda yeterince besin elementi alamamış ve buna bağlı olarak şeker oranları dikim geciktikçe azalmıştır. Nikotin oranı ise önce artmış sonrasında ise azalmıştır. Dikim ile birlikte uygulanan besin elementlerinden azotu ikinci dikim zamanındaki bitkilerin daha iyi değerlendirdiği düşünülmektedir.

Çalışmanın faktörlerinden bir diğeri sıra arası mesafe olup en yüksek verimin 40 cm mesafeden elde edildiği görülmüştür. Birim alandaki bitki sayısının artmasına bağlı olarak randıman değerleri genellikle artmaktadır (Vural ve Ekren, 2022). Bu araştırmada randıman değerlerinin birbirine yakın gerçekleşmesi sonucu en yüksek toplam gelir yine 40 cm sıra arası mesafeden elde edilmiştir. En yüksek indirgen şeker oranı 30 cm sıra arası dikimde nikotin değeri ise 50 cm sıra arası dikimde tespit edilmiştir. Bitkilerin yaşam alanlarının azalması onları şekerli bileşikleri daha fazla ve azotlu bileşikleri ise daha az sentezlemeye itmektedir (Elliot, 1970; Miner, 1980; Henry ve ark., 2019). Buna bağlı olarak araştırmada nikotin ve indirgen şeker oranı birbirine ters orantılı olarak değişmiştir.

Sıra üzeri mesafede 8 cm sıklığın verim açısından 2200. 93 kg ha^{-1} ile en iyi sonucu verdiği belirlenmiştir. Randıman değerinde 12 cm sıklıktan en iyi değer alınmasına rağmen toplam gelir bakımından yine 8 cm sıra üzeri sıklığın öne çıktığı görülmüştür. İndirgen şeker ve nikotin oranında da sıra arası mesafenin etkisine benzer şekilde sıklık azaldığı zaman nikotin oranı azalmış indirgen şeker oranı ise artmıştır.

İlk iki dikim zamanında (16 ve 31 Mayıs) 40 cm sıra arası dikim mesafesinin en iyi sonucu verdiği, 16 Mayıs dikim tarihinde 40 cm sıra arasının ise öne çıktığı belirlenmiştir. Sıra üzeri mesafede 8 cm dikim mesafesinin yine ilk iki dikim zamanında ve 16 Mayıs dikim tarihinde öne çıktığı tespit edilmiştir. Dikim zamanının gecikmesi verim ve kalitede azalmalara neden olmuştur (Wilkinson ve ark., 2008). Dikim zamanı, sıra arası ve üzeri mesafelerin hepsinin bütün etkisi incelendiğinde 40 cm sıra arası, 8 cm sıra üzeri ve 16 Mayıs tarihindeki dikim zamanından en yüksek toplam gelir (8557.59 $ ha^{-1}) elde edilmiştir. Bunun yanı sıra 31 Mayıs dikim zamanında, 40*8 cm dikim sıklığında elde edilen gelir istatistiki olarak ilk grupta yer almasına rağmen randıman değerinin düşük olması nedeniyle toplam gelirde biraz geride kalmıştır.

Teşekkür
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Çizelge 2. Basma (OZE B1) çeşidinin verim, randıman, gelir ve kimyasal özellikleri

	DT	SA (cm)	SÜ (cm)	Verim (kg ha^{-1})		Randıman (%)		Toplam Gelir ($ ha^{-1})		İndirgen şeker oranı (%)		Nikotin oranı (%)	
Dikim tarihi (DT)	16 Mayıs			2108.33	a	73.25	a	6750.90	a	9.74	a	1.34	b
	31 Mayıs			2094.69	a	72.59	a	6333.75	b	8.53	b	1.61	a
	13 Haziran			1724.66	b	61.41	b	5536.16	c	6.05	c	1.29	b
Sıra arası (SA)		30		1920.71	b	68.97		6069.21	b	9.13	a	1.24	c
		40		2294.89	a	69.48		7268.79	a	7.52	b	1.43	b
		50		1712.08	c	68.80		5282.81	c	7.67	b	1.57	a
DT × SA	16 Mayıs	30		1843.09	c	71.45	ab	5916.31	cd	10.38	a	1.28	d
		40		2514.82	a	75.01	a	8072.56	a	9.72	b	1.44	c
		50		1967.09	bc	73.29	ab	6263.81	bc	9.10	c	1.31	cd
	31 Mayıs	30		1867.91	bc	75.09	a	5707.18	d	10.47	a	1.33	cd
		40		2532.94	a	69.61	b	7837.29	a	7.10	e	1.72	ab
		50		1883.23	bc	73.07	ab	5456.78	d	8.02	d	1.77	a
	13 Haziran	30		2051.14	b	60.37	c	6584.15	b	6.54	f	1.11	e
		40		1836.92	c	63.83	c	5896.51	cd	5.73	g	1.13	e
		50		1285.93	d	60.03	c	4127.83	e	5.89	g	1.62	b
Sıra üzeri (SÜ)			8	2200.93	a	67.24	b	6831.61	a	8.46	a	1.28	c
			12	1920.78	b	70.36	a	6064.74	b	8.10	ab	1.41	b
			16	1805.97	c	69.65	ab	5724.46	c	7.76	b	1.55	a
DT × SÜ	16 Mayıs		8	2348.83	a	71.05		7539.73	a	10.04	a	1.26	de
			12	2120.25	b	75.64		6806.01	b	10.00	a	1.31	cde
			16	1855.92	cd	73.06		5906.95	c	9.17	ab	1.46	bc
	31 Mayıs		8	2437.56	a	72.39		7124.45	ab	8.26	c	1.42	c
			12	1926.44	c	72.13		5880.94	c	8.59	bc	1.61	b
			16	1920.08	c	73.26		5995.87	c	8.74	bc	1.80	a
	13 Haziran		8	1816.40	cde	58.28		5830.66	cd	7.09	d	1.17	e
			12	1715.66	de	63.31		5507.27	cd	5.69	e	1.31	cde
			16	1641.92	e	62.63		5270.55	d	5.38	e	1.38	cd
SA × SÜ		30	8	2239.41	b	68.65		7105.49	a	9.42	a	1.13	f
			12	1868.82	c	69.71		5905.13	b	9.31	a	1.22	ef
			16	1653.91	d	68.55		5197.03	c	8.67	a	1.38	d
		40	8	2433.05	a	65.48		7516.63	a	7.30	b	1.32	de
			12	2282.76	ab	71.84		7327.65	a	7.66	b	1.43	cd
			16	2168.87	b	71.13		6962.08	a	7.60	b	1.54	bc
		50	8	1930.34	c	67.58		5872.72	b	8.67	a	1.40	cd
			12	1610.78	d	69.53		4961.44	c	7.32	b	1.58	ab
			16	1595.14	d	69.27		5014.26	c	7.02	b	1.72	a
DT × SA × SÜ	16 Mayıs	30	8	2103.13	c-i	68.45	a-f	6751.05	c-h	10.90	a	1.16	h-k
			12	1994.23	e-i	72.22	a-e	6401.48	e-j	10.73	ab	1.23	f-k
			16	1431.90	k-n	73.68	a-d	4596.41	l-o	9.52	a-e	1.46	d-h
		40	8	2665.92	ab	72.42	a-e	8557.59	a	8.96	c-g	1.38	e-i
			12	2479.46	bc	74.34	a-d	7959.05	abc	10.60	ab	1.44	d-i
			16	2399.08	bcd	78.26	ab	7701.05	a-d	9.61	a-e	1.49	d-g
		50	8	2277.43	b-f	72.26	a-e	7310.56	b-f	10.25	abc	1.24	f-k
			12	1887.07	f-j	80.36	a	6057.48	g-k	8.68	c-g	1.26	f-j
			16	1736.77	i-l	67.23	a-f	5423.38	i-n	8.38	c-h	1.43	d-i
	31 Mayıs	30	8	2245.72	c-g	75.88	abc	6959.71	c-g	9.97	a-d	1.19	g-k
			12	1551.44	j-n	73.59	a-d	4698.74	l-o	11.20	a	1.27	f-j
			16	1806.58	h-k	75.80	abc	5463.11	i-n	10.24	abc	1.53	c-f
		40	8	2899.90	a	66.43	a-f	8428.31	ab	6.57	h-l	1.65	b-e
			12	2461.16	bc	74.28	a-d	7900.33	abc	6.97	g-l	1.71	bcd
			16	2237.76	c-g	68.13	a-f	7183.22	c-g	7.78	e-j	1.81	abc
		50	8	2167.07	c-h	74.85	a-d	5985.32	g-k	8.26	d-i	1.41	d-i
			12	1766.73	ijk	68.51	a-f	5043.74	k-n	7.60	f-j	1.85	ab
			16	1715.88	i-m	75.85	abc	5341.28	j-n	8.19	d-i	2.04	a
	13 Haziran	30	8	2369.38	b-e	61.63	c-f	7605.70	a-e	7.38	f-k	1.04	jk
			12	2060.80	d-i	63.31	b-f	6615.17	d-i	5.99	j-m	1.16	h-k
			16	1723.23	i-m	56.16	f	5531.57	h-m	6.26	j-m	1.15	ijk
		40	8	1733.33	i-l	57.59	ef	5564.00	h-l	6.38	i-l	0.93	k
			12	1907.65	f-j	66.89	a-f	6123.56	f-k	5.40	lm	1.14	ijk
			16	1869.77	g-j	67.01	a-f	6001.96	g-k	5.40	lm	1.31	f-j
		50	8	1346.51	lmn	55.64	f	4322.28	mno	7.51	f-k	1.54	b-f
			12	1178.53	n	59.72	def	3783.09	o	5.68	klm	1.64	b-e
			16	1332.75	mn	64.73	b-f	4278.12	no	4.48	m	1.69	b-e

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ID: 58

Kurumsal Kimliğin Duvar Yüzeyi Tasarımıyla Eğitim Mekanlarına Yansıtılması

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Özet

Kurumsal kimlik kavramı, ticari olarak bir işletmenin isim, logo, amblem gibi bir takım grafiksel ögelerinden öteye geçerek daha geniş kapsamda kavramsal nitelikler kazanmıştır. Krallık döneminde savaş kalkanlarının üzerinde kullanılan simgeler, savaşanlara aidiyetlik duygusu vermek amacıyla yapılan ilk kurumsal kimlik çalışması olarak görülürken; günümüzde kurumsal kimliğin ticari işletmeler, kamu kurumları, eğitim kurumları, spor ve sanat kulüpleri gibi birçok platformda kullanıldığı görülmektedir. Bu çerçevenin genişlemesi, kurumsal kimlik tasarımının oluşumunda grafik tasarım, iç mimarlık, moda tasarımı, endüstri ürünleri tasarımı gibi birçok disiplinler arası etkileşimi arttırmıştır. Bu bağlamda kurumsal kimlik adına yapılan grafiksel semboller, zamanla geliştirilerek kurumların mekanlarında, personellerin kıyafetlerinde, eşyaların tasarımlarında kullanılmaya başlanmıştır. İç mimarlık disiplini üzerinden yapılan tasarımların, mekânın vizyon ve misyonuna uygun, kurumsal kimliği niteleyecek şekilde oluşturulması ilke haline gelmiştir. Yapılan çalışmada, iç mekân tasarımının kurumsal kimlik ilkesiyle nitelikli hale getirilmesi hedeflenerek eğitim mekânlarında, duvar yüzeyi tasarımının yapılması, uygulanması ve böylece belirlenen örneklem alanının iç mekân tasarımıyla kurumsal kimliği kapsayıcı şekilde kullanıcıya kazandırılması amaçlanmıştır. Çalışmada materyal olarak Selçuk Üniversitesi Sosyal Bilimler Enstitüsü ve Selçuk Üniversitesi Edebiyat Fakültesi'nin girişinde bulunan duvar yüzeyleri kullanılmıştır. Çalışmanın metodunda, literatür araştırması yapılarak grafik ve iç mimarlık disiplini üzerinden kurumsal kimlik ve eğitim mekânlarına odaklanılmıştır. Sonrasında örneklem alanlarını sürekli kullanan personel ve öğrencilerin görüş ve önerileri alınarak gözlem ve analizlerde bulunulmuştur. Buna bağlı olarak ele alınan eğitim mekânlarının girişlerinde kurumsal kimliği logo ile temsil eden, odaklayıcı aydınlatmalarla pekiştirilmiş, gelen misafir ve öğrencilerin fotoğraf çekinebilecekleri duvar yüzeylerinin olması gerektiği gözlemlenmiştir. Edinilen verilere göre, materyal olarak ele alınan eğitim mekanlarının kurumsal kimliğine göre duvar yüzeyi tasarımı yapılmış ve uygulanmıştır. Tasarımın uygulanmasından sonra, yerinde gözlem ve analizlere dayanarak personel ve öğrencilerin kuruma karşı aidiyetlik duygusunun geliştiği, gelen misafirlerin ve mezunların günümüzde yaygın olarak gerçekleştirilen fotoğraf çekme eyleminde bulunarak kurumun tanınırlığını arttırdığı, tasarımı yapılan duvar yüzeyinin ait olduğu mekâna kazandırılarak aktif hale geldiği görülmektedir.

Anahtar Kelime: *Kurumsal Kimlik, İç Mekân Tasarımı, Eğitim Mekânları, Yüzey Tasarımı*

Reflecting Corporate Identity to Educational Spaces with Wall Surface Design

Abstract

The concept of corporate identity has gone beyond a number of graphical elements such as the name, logo, emblem of an enterprise commercially and has gained conceptual qualifications in a wider scope. While the symbols used on war shields during the Kingdom period were seen as the first corporate identity work to give a sense of belonging to the warriors; Today, it is seen that corporate identity is used in many platforms such as commercial enterprises, public institutions, educational institutions, sports and art clubs. The expansion of this framework has increased many interdisciplinary interactions such as graphic design, interior architecture, fashion design, industrial product design in the formation of corporate identity design. In this context, the graphical symbols made on behalf of the corporate identity have been developed over time and started to be used in the spaces of the institutions, the clothes of the personnel and the designs of the goods. It has become a principle that the designs made through the discipline of interior architecture should be created in accordance with the vision and mission of the space and to characterize the corporate identity. In the study, it was aimed to make the interior design qualified with the principle of corporate identity, and to make and apply the wall surface design in the education spaces, and thus to bring the corporate identity to the user in an inclusive way with the interior design of the determined sample area. Wall surfaces at the entrance of Selçuk University Social Sciences Institute and Selçuk University Faculty of Letters were used as material in the study. In the method of the study, literature research was conducted and focused on corporate identity and educational spaces through the discipline of graphic and interior architecture. Afterwards, observations and analyzes were made by taking the opinions and suggestions of the staff and students who constantly use the sampling areas. Accordingly, it has been observed that there should be wall surfaces where the guests and students can take photos, reinforced with focusing lighting, which represents the corporate identity with the logo at the entrances of the educational venues discussed. According to the data obtained, the wall surface design was made and applied according to the institutional identity of the educational spaces considered as material. After the implementation of the design, based on on-site observations and analyzes, it is seen that the sense of belonging of the staff and students to the institution develops, the guests and alumni increase the recognition of the institution by taking photographs, which are commonly carried out today, and the wall surface of the design becomes active by bringing it to the place it belongs to.

Keyword: *Corporate Identity, Interior Design, Educational Spaces, Surface Design*

ID: 59

Üniversite Yerleşkesinde Müzecilik; Selçuk Üniversitesi Müzesi İç Mekân Uygulama Projesi Örneği

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Özet

Üniversiteler, çağımızın eğitim-öğretim, araştırma, bilgi aktarma ve geliştirme yönelik çalışmalara öncülük eden en önemli eğitim kompleksleridir. Üniversiteler içerisinde barındırdıkları farklı eğitim birimleri ve çeşitli sosyal olanakları ile üst düzey bilgi ve bulguları kamu hizmeti olarak gerçekleştirmeyi amaçlar. Bu kapsamda, üniversite yerleşkeleri içerisinde bilgiyi toplamak, korumak, sergilemek ve sonraki nesillere aktarmak görevi olan müze yapıları oldukça yaygınlaşmaya başlamıştır. Bu çalışmanın amacı, Selçuk Üniversitesi yerleşkesi içerisinde bulunan Müze binasının, bağlı bulunduğu kurum kültürüne uygun, müzenin amaç ve işlevlerini gerçekleştirebilen fuaye, geçici ve kalıcı sergileme alanlarından oluşan müze iç mekanlarının tasarım-uygulama süreçlerini kapsamaktadır. Çalışma kapsamında iki tür materyal kullanılmıştır. İlk materyal olarak teorik ve görsel bilgi ağırlıklı konuyla ilgili yayınlar, tez çalışmaları, ders notları, mimari ve iç mimari basılı yayınlar ile internet kaynaklarıdır. Taranan ve incelenen bilgiler, genelden özele doğru ele alınmıştır. İkinci materyal ise Selçuk Üniversitesi Alaeddin Keykubat Yerleşkesi içerisinde bulunan Selçuk Üniversitesi Müzesi binasının, yazarlar tarafından yerinde tespit aşamaları, ilgili kişilerle görüşmeler, müze fuaye, geçici, kalıcı sergileme alanlarının gereksinimleri ve var olan iç mekân fotoğraflarıyla analiz edilmesidir. Çalışmada izlenen metot ise gözlem ve tespittir. Konu ile ilgili yayınlar, tez çalışmaları, ders notları, mimari ve iç mimari basılı yayınlar ile internet kaynaklarından yararlanılarak yapılan araştırmalar ve gözlemler sonucunda, mevcut müze binası içerisinde tespit çalışması yapılmıştır. Araştırmanın sonucunda üniversite yerleşkesi içerisinde bulunan müzelerin, kuruma bağlı eğitim alanları dışında, halk ile üniversite arasında bir bağ kurulması açısından önemli yere sahip olduğu belirtilmiştir. Eğitim-öğretim yapıları dışında, farklı bir bakış açısıyla, ortak kullanılabilir çok amaçlı alanlar olduğu ve bağlı bulunduğu kuruma kattığı olumlu yönlerinden bahsedilmiştir. Müze yapısının belirlenen alanlarında yapılan iç mekân revizeleri, projelendirme süreci ve uygulama safhalarından bahsedilmiştir.

Anahtar Kelimeler: *Müze, Sergileme Alanları, Uygulama Projesi.*

Museum At The Unıversıty Campus; Example Of Interıor Applıcatıon Project In Selçuk Unıversıty Museum

Abstract

Universities are the most important educational complexes of our age, leading to education, research, knowledge transfer and development. Universities aim to realize high-level knowledge and findings as a public service with the different educational units and various social opportunities they house. In this context, museum structures, which have the task of collecting, preserving, exhibiting and transferring information to the next generations, have become quite common in university campuses. The aim of this study covers the design-implementation processes of the museum interiors, which consist of foyer, temporary and permanent exhibition areas, which are suitable for the institutional culture of the Museum building located in the campus of Selcuk University, and can fulfill the purpose and functions of the museum. Two types of materials were used within the scope of the study. As the first material, publications, thesis studies, lecture notes, architectural and interior design printed publications and internet resources are mainly theoretical and visual information. The scanned and analyzed information is handled from general to specific. The second material is the on-site determination of the Selcuk University Museum building located in Selcuk University Alaeddin Keykubat Campus by the authors. The museum building has been analyzed through interviews with relevant people, the museum foyer, the requirements of temporary and permanent exhibition areas, and existing interior photographs. The method followed in the study is observation and detection. As a result of researches and observations made using publications, thesis studies, lecture notes, architectural and interior architecture printed publications and internet resources on the subject, a determination study was made in the existing museum building. As a result of the research, it was stated that the museums located in the university campus have an important place in terms of establishing a bond between the public and the university, apart from the educational areas affiliated to the institution. Apart from the education-teaching structures, from a different point of view, it has been emphasized that there are multi-purpose areas that can be used in common and the positive aspects it adds to the institution it is affiliated with. Interior revisions made in the designated areas of the museum structure, project design process and application phases are mentioned.

Keywords: *University Museums, Exhibition Areas, Application Project.*

ID: 65

Effects of chronic Hydrogen Peroxide Exposure on mitochondrial Oxidative Stress genes and mitochondrial dynamics in HL60 Cells

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Abstract

Hydrogen peroxide (H_2O_2) is a reactive species also involved in the redox regulation of cells because of it is relative stability. In numerous pathological situations, a chronic increase in the production of reactive species is observed, which is related to oxidative stress and cellular damage. The aim of this study was to evaluate the effects of long-term exposure to different H_2O_2 concentrations on oxidative stress biomarkers and mitochondrial dynamics in HL60 cells. HL60 cells were treated with a sustained production (0.1, 1.0 and 10.0 nM/s) of H_2O_2 for one hour. H_2O_2 production and malondialdehyde (MDA) levels, as a lipid peroxidation marker, increased progressively in HL60 cells in accordance with higher H_2O_2 exposure, with significant differences between the 10nM/s H_2O_2 group to the control and 0.1 nM/s groups. Similarly, progressive increase in genes related with the mitochondrial antioxidant defences and mitochondrial dynamics were also observed. Significant increases in the 10 nM/s H_2O_2 with respect to the control group was observed for manganese superoxide dismutase (MnSOD), peroxisome proliferator-activated receptor gamma coactivator 1- transcription alpha (PCG1α), nuclear respiratory factor 2 (Nrf2), transcription of the transcription factor mitochondrial A (Tfam), mitofusins 1 and 2 (Mfn-1 and Mfn-2) and uncoupling protein 3 (UCP3), whereas no significant changes were observed in the COXIV gene expression. In conclusion, exposure to different sustained production of H_2O_2 is related to a progressive increase in mitochondrial dynamics gene expression and redox processes in HL60 cells but also to oxidative damage at the higher H_2O_2 production.

Key Words: *reactive species, antioxidants, mitochondria, gene expression*

ID: 66

Tasarımdan Uygulama Sürecine Eğitim Mekânı; Selçuk Üniversitesi, Güzel Sanatlar Fakültesi Projesi

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Akdeniz Üniversitesi, Mimarlık Fakültesi, Mimarlık Bölümü, Antalya

Özet

İnsanoğlu tarih boyunca mekanla karşılıklı bir ilişki içerisindedir. Devam eden bu ilişki süreci farklı birçok mekânı kapsamakla birlikte, eğitim mekanları ile bütünleşmiş ve değer kazanmıştır. Bunun temel nedeni eğitim mekanları; toplumsal, kültürel, teknolojik ve ekonomik gelişmeleri yakından takip eden, bilgileri gelecek nesillere aktararak hem birey hem de toplumun gelişmesinde önem arz etmektedir. Eğitim mekanları üzerine yapılan çalışmalarda fiziksel ortamın eğitim üzerindeki etkisinin ciddi oranda destekleyici veya engelleyici olduğunu söylemek mümkündür. Eğitim mekanları arasında özellikle üniversite yapılarının gerek mesleki gerekse de sosyal etkileşim yönünden insanların dış dünya ile olan ilişkilerinde kendilerini geliştirmesinde ayrı bir öneme sahiptir. Öyleki, sanat eğitimi verilen mekanların tasarımı, geleceğin sanatçılarının yetiştirilmesindeki katkısı göz ardı edilemez. Bu kapsamda Selçuk Üniversitesi, Güzel Sanatlar Fakültesi binasının tasarım ve uygulama süreçlerinde kullanıcı odaklı, sosyal etkileşime olanak tanıyan, sanatsal kimliği yansıtan yaklaşımlara bağlı olarak ele alınmakta, geliştirilen mimari proje ve uygulama sonrası mekânsal kimlik ile kullanıcılara sunulmaktadır. Çalışmada konuya ilişkin bilgi, belge ve raporların toplanıp, mimari programlama aşamalarının sürekli geri dönüşlerle doğru adımlarda ilerlediği inceleme ve gözlemlere dayalı nitel bir araştırma yöntemi izlenmiştir. Elde edilen bulgular neticesinde; Geleneksel Türk Mimarinin izlerine atıfta bulunarak projelendirilen Güzel Sanatlar Fakültesi, geleneksel ve modernin bütüncül bir yorumu olarak kullanıcıların hizmetine sunulmaktadır. Doğru kurgulanmış mimari programla ile eğitim binası mekânsal kimliğini yansıtarak diğer fakültelere örnek teşkil etmektedir. Araştırmada ortaya çıkan bir diğer önemli sonuç ise; söz konusu yapının bünyesinde yer alan bölümlere ait akademisyenlerin başlangıçtan itibaren tasarımcılar ile sürekli istişare halinde olup, tasarım haritasını birlikte oluşturmuş olmalıdır. Ancak ülkemizdeki sürekli değişen Yüksek Öğretim Kurumu (YÖK) kararları ile öğrenci kontenjan sayısının öngörülemeyecek seviyede artış göstermesi, projede ön görülen esnek öğrenme alan sınırlarını bile zorladığı çalışma ile tespit edilmiştir.

Anahtar Kelimler: *programlama, kullanıcı odaklı tasarım, mekânsal kimlik, Güzel Sanatlar Fakültesi*

Educational Space From Design To Implementation Process; Selçuk University, Faculty Of Fine Arts Project

Abstract

Mankind has been in a reciprocal relationship with space throughout history. Although this ongoing relationship process covers many different places, it has become integrated with education spaces and gained value. The main reason for this is education venues; It is important for the development of both the individual and the society by closely following the social, cultural, technological and economic developments and transferring the information to the next generations. In studies on educational spaces, it is possible to say that the effect of the physical environment on education is seriously supportive or obstructive. Among educational places, especially university buildings have a special importance in terms of both professional and social interaction, in terms of people's self-development in their relations with the outside world. In fact, the design of the places where art education is given and its contribution to the training of future artists cannot be ignored. In this context, Selcuk University, Faculty of Fine Arts building is handled in the design and application processes, depending on user-oriented approaches that allow social interaction and reflect the artistic identity, and presented to the users with the developed architectural project and spatial identity after the application. In the study, a qualitative research method based on examinations and observations was followed, in which information, documents and reports on the subject were collected and the architectural programming stages proceeded in the right steps with constant feedback. As a result of the findings obtained; The Faculty of Fine Arts, designed by referring to the traces of traditional Turkish Architecture, is offered to users as a holistic interpretation of traditional and modern. With its correctly designed architectural program, the education building reflects its spatial identity and sets an example for other faculties. Another important result of the research is; The academicians belonging to the departments within the body of the building in question should have been in constant consultation with the designers from the beginning and must have created the design map together. However, it has been determined by the study that the number of student quotas increased at an unpredictable level due to the constantly changing Higher Education Council (YÖK) decisions in our country, pushing even the limits of the flexible learning area foreseen in the project.

Keywords: *programming, user-oriented design, spatial identity, Faculty of Fine Arts*

ID: 68

Fertilizers and Inoculants Effects on Soybean Yield and Yield Components

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Abstract

Soybean (Glycine max L.) has been a significant source of plant origin proteins for both the livestock feed and humans industries for many years. Soybean yield is low in smallholder farms in Afghanistan. The objective of this study was to examine the impact of DAP, nitrogen fertilizer and Rhizobia on soybean yield and yield components performance. To achieve this objective, field experiments were conducted, using a randomized complete block design, with three replications, different levels of fertilizers, inoculant and control as well. Soybean responded remarkably to the added nitrogen, phosphorus sources fertilizers likewise bio fertilizer. The crop characters were significantly influenced by these treatments. Grain yields varied from 465 kg ha^{-1} to 2532.8 kg ha^{-1} in control treatment to 595 kg ha^{-1}. Analysis of variance was applied to find the effects of different levels of DAP, N and Rhizobia in yield and yield components of soybean. The results revealed that there was no significant differences in pod length, pods per plant, seeds per pod and 100 grain-weight at 5% level. The result of yield showed a significant difference at 1% level. Based on the results a positive correlation (0.15366) was between 100 grains weight and grain yield. There was a significant difference in days to flowering and plant height among treatments, the longest days to flowering was detected in Rhizobia treatments as well as the shortest days to flowering in DAP treatments. The amount of chlorophyll concentration was measured using SPAD 502, there was no a significant difference among treatments. It was ranged from 2.67 to 3 mg in all treatments. Cluster analysis using UPGAM was applied to determine the effects of different types of fertilizers on soybean agronomic relationship. Based on this analysis all treatments were classified in to three groups. This study's novelty is using rhizobia in Afghanistan.

***Key words**: Fertilizers, Inoculation, SPAD – 502, Yield, Yield Components, Chlorophyll Concentration, Soybean*

Introduction

Soybean (*Glycine max*) as well known as a 'miracle crop' with over 40% protein and 20% oil, originated in China. As early as in 2853 BC, the Emperor Sheng-Nung of China named it as one of the five sacred seeds. Thus, soybean has been cultivated in China for more than 4,000 years. It is believed that with the development of sea and land trades, soybean moved out of China to nearby countries such as Burma (Myanmar), Japan, India, Indonesia, Malaysia, Nepal, the Philippines, Thailand and Vietnam between the first century AD and 1100 AD. Soybean is grown in more than 50 countries and is the leading oilseed crop produced and consumed worldwide (Wilcox, 2004). Soybean has now become the largest source of vegetable oil and protein in the world and its large-scale cultivation is concentrated in a few countries such as Argentina, Brazil, Canada, China, India, Paraguay and USA which together produce about 96 per cent of the world's, 189 million tons annual soybean production.

Several studies on N in soybean-based systems reported that N removal at harvest may exceed biological fixation (Harper et al., 1989; Peoples & Craswell, 1992; Vanotti & Bundy, 1995). The combination of high rates of N removal with a potential reduction of biological N fixation due to soil compaction may make it necessary to balance N , either through N fertilizer application or by enhancing nodulation and N fixation. Most studies on the effect of fertilizer-N on soybean growth and N fixation by rhizobium conducted elsewhere concluded that fertilization reduces N fixation through a reduction in the number, weight and activity of nodules (Starling et al., 1998; Chen et al., 1992). Coating soybean seeds with rhizobial inoculants has been suggested as a way to improve N fixation but the success of inoculation was found to be highly variable (Peoples & Craswell, 1992). Starter N increased caused N accumulation in plants but seed yields usually remained unchanged (Salvagiotti et al., 2008). Poor nodulation and variable response to inoculation is mainly attributed to intrinsic characteristics of the host plant (Michiels et al., 1998). As a result, application of high amounts of inorganic-nitrogen fertilizers is becoming a common practice which has detrimental environmental consequences (Salton et al., 2008). Biological nitrogen fixation reduces costs of production.

The use of inoculants as alternatives to N fertilizer avoids problems of contamination of water resources from leaching and runoff of excess fertilizer. Utilizing biological nitrogen fixation (BNF) is part of responsible natural resource

management. Legume inoculants do not require high levels of energy for their production or distribution. Application on the seed is simple compared to spreading fertilizer on the field. Inoculants increase legume crop yields in many areas. Biological Nitrogen Fixation often improves the quality of dietary protein of legume seed even when yield increases are not detected. Through practices such as green manuring, crop rotations and alley cropping, N fixing legumes can increase soil fertility, permeability and organic matter to benefit non legume crops. Using BNF is part of the wise management of agricultural systems. The economic, environmental and agronomic advantages of BNF make it a cornerstone of sustainable agricultural systems. Grain yields varied from 1.0 t ha^{-1} to 1.7 t ha^{-1} in unamended control plots to 4.8 t ha^{-1} for common bean and 3.8 t ha^{-1} for soybean in inoculated plots with both P and manure addition (Rurangwa et al., 2018).Legumes comprise the most important plant families in agriculture. Many soils do not have sufficient numbers of appropriate rhizobia for maximum BNF. Rhizobial inoculants and legume crops must be properly matched. There are several methods of inoculating legumes. Inoculants require some special care to maintain their Viability Although BNF is a natural process, many soils do not have sufficient numbers of appropriate rhizobia for effective symbiosis (Denwar et al., 2012). Inoculating legume crops with compatible rhizobia ensures maximal BNF. Inoculation is especially important when introducing new legumes to an area (Dobbelaere et al., 2003; Zhang et al., 1997).

The main objective of this research was to compare different levels of Urea and DAP including Rhizobia treatments and their effects on soybean yield and yield components.

Materials and Methods

Variety of (Stine3400 - 2) was used as plant material

Different levels of chemical fertilizers (Urea fertilizer and DAP), and biological fertilizer (Rhizobia) were used to evaluate the effects of these fertilizers on yield and yield components of soybean. Inoculant and DAP were used at cultivation time, and N fertilizer was applied at different stages of plant growth.

Experimental site

Field trials were established in the experimental farm of Agriculture Faculty of Kabul University (34 `N 69`E) in 2016 and 2017. The soil physical and chemical properties were tested. Randomized complete block design was used with three replications and 36 plots. The area for each plot was prepared 3 x 2 m (6 m^2), the space between rows and plants considered 40 cm and 20 cm, respectively.

Germination test were applied to find germination capacity of soybean seeds, the result of germination test of this cultivar was more than 80%). The seeds were directly planted in the field.

Vernier clipper instrument was used to measure the length of pod and seed. SPAD (Soil Plant Analysis Development) used to measure the amount of N in the leaves.

Protein and oil analysis

DK Series Kjeldahl Apparatus Made in Italy (DKL 8 (8-position with 250 ml tubes, Ø 42 mm) was used to analyze the percentage of protein and oil of soybean (Figure 1). Statistical Tool for Agricultural Research (STAR), Version 2.0.1, January 2014 was used to analyse the data.

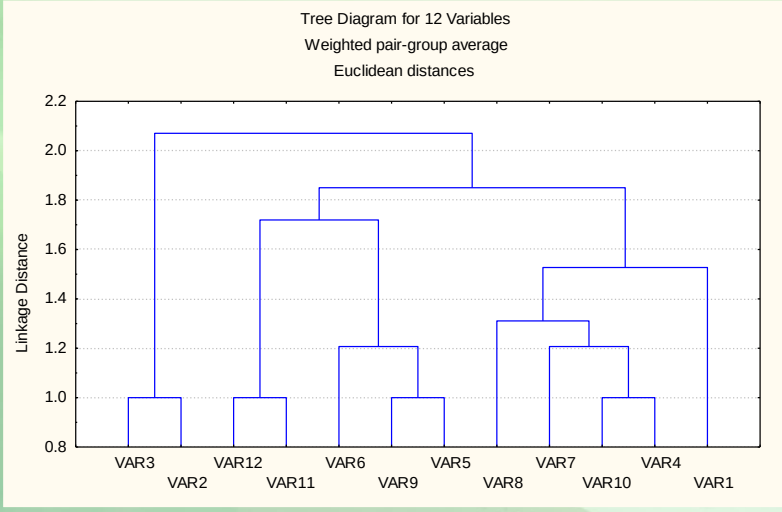


Figure 1. Tree diagram of different levels of DAP, N and Rhizobia and their effects on soybean yield, yield components and agronomic traits.

Results and Discussion

Yield and yield components evaluation

Seed is the starting point of agriculture. Hence, the seeds were tested for percentage of germination and the result of germination was more than 80%. Yield is one of the main objectives for researchers and farmers. All efforts are accomplished for quantity and quality of products. Therefore, yield and yield components were measured and analyzed in the present research. Pod length plays a key role in number of seeds per pod, as much as longer pod produce much more seeds than the shorter one. In using different levels of inoculants, exhibited longer pod length (more than 42 mm) (Table 1).

Number of pod per plant is also one of the important yield components. It means large number of pods per plant performs higher yield than less number of pods per plant. In this research large number of seeds per plot detected in DAP levels and 125 kg ha^{-1} N as well. Hence, we can conclude that P is an important element in somatic growth of crops. Number of seeds per plot were 72.87, 74.33 and 127.40 seeds per pod in 50 kg ha^{-1} and 100 kg ha^{-1} DAP, and 125 kg ha^{-1} N respectively (Table 1).

Seed number per pod, seed appearance, seeds color, and seed quality play a major role in yield per unit area. Thus, we decided to measure and analyze this useful parameter. Seeds per pod showed the same response to DAP, N and Rhizobia (Table 1).

South Dokota Agriculture Station reported 4.97 t ha^{-1} yield (Kleinjan et al., 2018), but in this research the highest yield obtained from DAP application, which is 2.5 t ha^{-1}. As was observed with early growth, no significant effect of either soybean cultivar or N treatment was present at EVS91 or WGS91, with an average yield of 34.9 and 31.4 bu/acre, respectively (wood & Weaver, 1993). In this study the highest yield using N fertilizer was 0.9 t ha^{-1} that has a coincidence with the result of the above mentioned authors (34.9 Bu $acre^{-1}$ is equal to 0.494 t ha^{-1}). Ntambo et al (2017) reported 0.5 t ha^{-1} of soybean yield using inoculant. When inoculated with Rhizobium sp. BARIRGm901, three of the four soybean genotypes tested (BARI soybean6 + R, MTD10 + R, and BGM02026 + R) showed significant increases ($p \leq 0.05$) in seed yields (3.60, 3.08, and 3.22 t ha−1, respectively) compared with plants of other treatments genotypes (Alma et al., 2015; Albareda et al., 2015). But in this study using different rates of inoculant, we obtained 1.008 t ha^{-1} of soybean yield that is two times higher than has been reported by Ntambo et al (2017).

100 grain-weight shows the healthiness of seeds. Because, wrinkled seeds are softer and smoother seeds are heavier. The smooth seeds are healthy and their yield performance is also

There is a strong coincidence between 100 grains weight and grain yield in this study. The different levels of DAP performed heavier grain weight as well as high yield than levels of N and Rhizobia. The yield of soybean in 125, 50, 75 and 100 kg ha^{-1} levels of DAP was 2532.8, 2061.8, 1567.2 and 1238.3 kg ha^{-1} respectively. The lowest yield was recognized in 120 kg h^{-1} level of N per hectare (Table 1).

Table 1. Evaluation of DAP, Nitrogen and Rhizobia treatments effects on yield and yield components of soybean.

Treatment	PL (mm)	PPP	SPP	100 GW (g)	GY kg ha^{-1}
125 DAP	39.16	66.93	3.00	11.23	2532.8 a
50 DAP	42.47	72.87	3.00	12.37	2061.1 b
75 DAP	40.58	55.47	2.67	12.27	1567.2 c
100 DAP	39.91	74.33	3.00	11.90	1238.3 d
125 N	41.18	127.40	3.00	12.37	900.6 ef
120 N	40.66	55.67	3.00	11.80	465 g
130 N	39.35	52.73	3.33	10.93	712.8 fg
135 N	39.11	53.07	3.00	10.90	1021.7 de
0 Control	41.91	41.27	3.33	12.03	595 g
0.2635 R (1X)	38.85	37.27	3.00	10.90	953.9 ef
0.527 R (2X)	42.09	54.87	3.00	11.33	903.3 ef
0.7905 R (3X)	42.37	58.60	3.33	10.63	1008.3 de
Mean	40.64	62.54	3.06	11.56	1163.3
F-test	ns	ns	ns	ns	**
SEM	1.11	17.19	0.23	0.62	94.9
SED	1.57	24.31	0.33	0.87	134.2
LSD (p= 0.05)	3.27	50.42	0.69	1.81	278.2
C.V	4.75	47.61	13.26	9.25	14.1

Pod Length (PL), Pod per Plant (PPP), Seed per Pod (SPP), 100 Grain Weight (100 GW), grain yield (GY), Means in a column with the same letter are not significantly different *, ** at P< 0.05 and P< 0.001, respectively, ns = Not significant, Di-Ammonium phosphate (DAP, Nitrogen (N), Rhizobia (R).

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Analysis of variance was applied to find the effects of different levels of DAP, N and Rhizobia among yield and yield components of soybean. The results revealed that there was no significant differences in pod length, pod per plant, seed per pod and 100 grain weight at 5% level. The result of yield showed a significant difference at 1% level (Table 1). Based on the results a positive correlation (0.15366) was between 100 grains weight and grain yield. Least significant difference test was applied to compare different treatments and there was similarity and differences among treatments (Table 1). Based on LSD 125, 50 and 75 kg ha^{-1} levels of DAP were different from the others. Coefficient of variation in pod per plant is larger but in the other parameters is lower than 20% and it shows the preciseness of the research (Table 1). Control exhibited the lowest yield (596 kg ha^{-1}) than DAP, N and Rhizobia treatments (Table 1).

Agronomic characters measurement and analysis

Agronomic characters play a useful role in increasing of crops yield. Days to flowering, nitrogen amount, plant height and branch per plant were measured and analyzed in this research. Based on the results, days to flowering were earlier in DAP treatments than N treatment and in N treatments earlier than Rhizobia treatments, respectively. Days to flowering in DAP different levels ranged from 65.33 – 70 days, in nitrogen different levels ranged from 67.33 – 70.67 days and in Rhizobia ranged from 70 – 73.33 days. Analysis of variance (ANOVA) was also applied to statistically compare the differences; the results of ANOVA were shown that there is a significant difference among treatments at 1% level. According to least significant difference test (LSD), Rhizobia treatments exhibited later flowering performance than DAP and N treatments (Table 2). We can conclude that it is the effect of N, which has been fixed by inoculants. Days to flowering adjustment are one of the important factors in breeding program as well as diseases and drought escape factors.

SPAD 502 chlorophyll meter made in Japan was used to measure chlorophyll concentration, in soybean plant. Application of this instrument helped the group to record chlorophyll concentration in different treatments. The results showed that the high level of chlorophyll recorded in DAP and Rhizobia treatments than N treatments. These results might be physiological expression between soil and atmospheric N. while the amount of N is low in the soil, chlorophyll concentration increases. Result of ANOVA revealed that there is no significant differences among treatments in chlorophyll concentration of different treatments. (Table 2).

Plant height is one of the key traits for obtaining high yield. Plant height has also been focused for measurement and analysis. The data were regularly collected and ANOVA applied to determine the differences among different levels of nutrients, which are important for plant growth. Outcome of ANOVA indicated that there is a significant difference among DAP, N and Rhizobia levels at 1% level. Least significant difference test LSD has also been applied and the results exhibited that the treatments were classified in different categories via this method (Table 2).

Desirable branching performs high yield, which is the main objective of researchers, specialists and farmers as well. The branching of soybean was measured in this study. Apparently, we can see some difference, but statistically there is no significant difference among treatments in branching of soybean plant (Table 2).

Table 2. Analysis the effects of DAP, N and Rhizobia on agronomic traits of soybean.

Treatments (Kg ha^{-1})	DTF	Chlorophyll concentration (mg)	PHT (cm)	BPP
125 DAP	68 bcd	39.00	58 a	3.80
50 DAP	65.33 a	41.00	65 a	5.27
75 DAP	66 ab	40.00	62 b	4.47
100 DAP	70 de	40.00	60 c	4.67
125 N	67.33abc	38.00	66 a	5.73
120 N	69.33 cde	38.00	47.3 g	3.33
130 N	70.67 e	38.00	53 e	3.47
135 N	68 bcd	39.47	50 f	4.07
0 Control	68 bcd	39.20	50 f	3.27
0.2635 R (1X)	73.67 f	40.00	51 f	4.13
0.527 R (2X)	73.33 f	41.00	57 d	4.40
0.7905 R (3X)	70.33 e	40.00	61 bc	4.87
Mean	69.17	39.47	0.68	4.29
F-test	**	ns	**	ns
SEM	0.75	0.74	56.69	0.72
SED	1.06	1.04	0.96	1.02
LSD (p= 0.05)	2.20	2.16	1.99	2.11
C.V	1.88	3.23	2.07	29.01

Days to Flowering (DTF),SPAD and plant height (PHT),Pod per Plant (PPP) , Means in a column with the same letter are not significantly different *, ** at P< 0.05 and P< 0.001, respectively; NS= Not significant, Di-Ammonium phosphate (DAP, Nitrogen (N), Rhizobia (R) .

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Cluster analysis

The term *cluster analysis* (first used by Tryon, 1939) encompasses a number of different algorithms and methods for grouping objects of similar kind into respective categories. The *EM* algorithm for clustering is described in detail in Witten and Frank (2001).

Cluster analysis using UPGAM was applied to determine the effects of different types of fertilizers on soybean agronomic relationship. Tree Diagram for 12 Variables Weighted pair-group average Euclidean distances was used to detect the relationship among 12 treatments, which were applied in this research. Based on the cluster results these treatments were classified into three main groups and each main group divided into some sub groups. Main group (I) was consisted of 50 and 75 kg ha^{-1} DAP, these variables exhibited similar effect on soybean different parameters. Main group (II) was consisted of 0.7905 and 0.5270 kg/ha of inoculant, 120 and 125 kg/ha N, and 0 levels (control), these variables had also the same effect on soybean growth. Main group (III) was consisted of 130 and 135 kg/ha N, 0.2635 kg/ha inoculant and 100 and 125 kg/ha DAP, these variables, classified in the same class, so performed the same expression on soybean life from different points of view (Figure 2). According to this cluster group, we can conclude that the treatments under the certain group had similar effects on yield, yield components and agronomic characters.

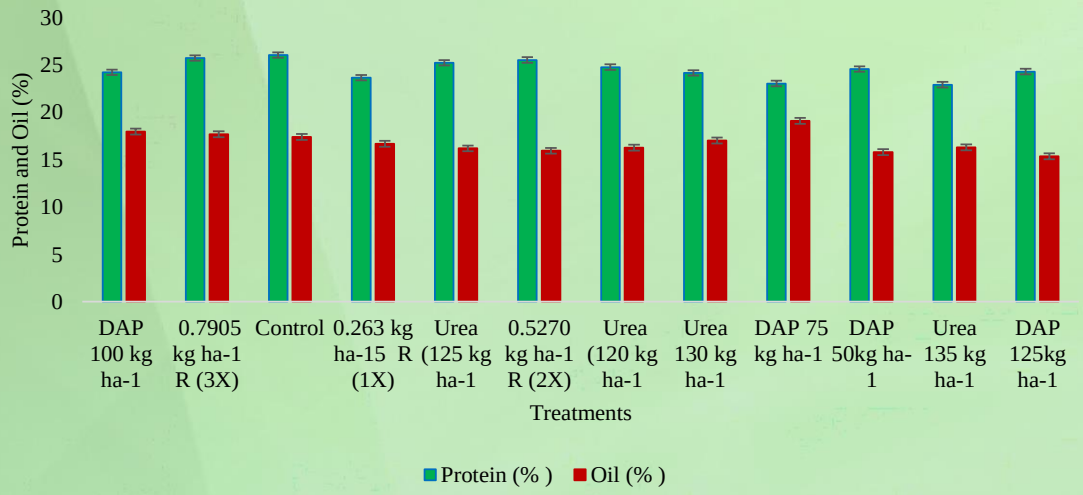


Figure 2. Effects of different levels of chemical and biological fertilizers on soybean Protein and Oil percentage.

Protein and Oil percentage analysis

Based on laboratory results using DKL 8 (8-position with 250 ml tubes, Ø 42 mm) instrument, the highest level of protein was detected in control and 3X Rhizobia treatments (26.03 & 25.71% respectively) and the lowest level of protein has been detected in 135 kg ha^{-1} Urea treatment (22.9%). The oil percentage has also been analyzed and based on the results, the highest level of oil was recognized in 75 kg ha^{-1} DAP treatment (19.08%) and the lowest level was found in 125 kg ha^{-1} DAP treatment (15.35%). Mainly there was no big differences of protein and Oil among treatments using the chemical and biological fertilizers.

Economic Return

Higher cost of cultivations are under inoculant rhizobium treatments (US $. 3504, 2450 & 1396 ha^{-1}) which it was because of the highest price of inoculant rhizobium (US $. 4 g^{-1}).

Maximum net return was obtained from 125 and 50 kg-DAP ha^{-1} in the value of (US $.1377.07 – 1243.33 ha^{-1}). As medium NR was obtained from treatments 75,100 DAP ha^{-1} and 100 Urea ha^{-1} ranging from (US $. 973.60, 812.40, 716.93 ha^{-1}) and the lowest NR ranging from (US $. 528.40, 474.53, 440.13, 276.93 ha^{-1}) was obtained from treatments 250 Urea, control, 200 Urea and 150 Urea ha^{-1} respectively (Table 3).

The economic analysis revealed that the highest net benefit of (US $.1377.07 ha^{-1}) was obtained from the application of 125 kg ha^{-1} DAP fertilizer whereas the rhizobium treatments gave the negative net returns (US $. -2406.67, -1453.73, -431.47 ha^{-1}) (Table 3) .

Therefore, with economic basis, the application of 125kg DAP ha^{-1} , 50 kg DAP ha^{-1} and in the case of Urea 100 kg ha^{-1} on soybean would be recommended in Kabul province of Afghanistan.

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Table 3. Cost benefit analysis of chemical and biological fertilizers application.

Treatments	Cost of Cultivation (US $/ha)	Gross Return (US $/ha)	Net returns (US $/ha)	Net returns per US $ invested
T1	425.33	1802.40	1377.07	3.24
T2	375.33	1618.67	1243.33	3.31
T3	392.00	1365.60	973.60	2.48
T4	408.67	1221.07	812.40	1.99
T5	382.00	1098.93	716.93	1.88
T6	402.00	678.93	276.93	0.69
T7	422.00	862.13	440.13	1.04
T8	442.00	970.40	528.40	1.20
T9	342.00	816.53	474.53	1.39
T10	1396.00	964.53	-431.47	-0.31
T11	2450.00	996.27	-1453.73	-0.59
T12	3504.00	1097.33	-2406.67	-0.69

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ID: 69

Genome-Edited Crops: A Hope To Mitigate Food Security Challenges In 23rd Century

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Genome editing is an emerging innovation of the current millennium that has potential to feed rapidly increasing population all over the world. This cutting-edge technology has successfully been employed for improved per hectare yield, better quality of the produce and stacking gene mutations for improved agronomic traits. Though ambiguities are there in the regulation and acceptance of genome-edited plants because most of the edited plants are produced through insertion of DNA sequences and their removal in the subsequent steps. This demands discrimination of edited plants from the transgenic ones and clarity in policy for the commercialization of genome-edited crops. European commission has recently released a proposal which suggests that plants developed through targeted mutagenesis or cisgenesis must be categorized separately from GMOs (Genetically Modified Organisms) and they should be treated as "conventional-like" category 1 plants. So, CRISPR-edited crops will not be taken as conventional GMOs and need not to get approval from the regulatory authorities. This highlights significance of this technology to develop improved crop varieties having potential to feed 298 million starved people of the world. Numerous crops plant have been developed for improved traits i.e. disease resistance (banana, cassava, maize, potato, rice, wheat), improved quality (cassava), nitrogen remobilization and insect resistance. Hence, genome editing is a great hope to mitigate food security challenges.

Keywords: *Genome-editing, GMOs, CRISPR-CAS, Food security, Targeted mutagenesis*

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Ultrasound assisted anthocyanin extraction from sumac and investigation of thermal degradation kinetics of the anthocyanins

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Abstract

In this study, an ultrasonic extraction method was used to extract anthocyanins from sumac. In order to maximize the yield of anthocyanins from the extraction, a three-factor Taguchi method with ethanol concentration (25, 50, 75%), sonication time (15, 30, 45 min), and solvent: solute ratio (10:1, 20:1, 30:1) was used. Under optimum extraction conditions, maximum anthocyanin yield (632.024 mg C3G/kg) was obtained by performing 15 min sonication of the mixture prepared with 75% ethanol at 10:1 solvent: solute ratio. The solvent: solute ratio was the parameter that most affected the extraction process. However, as a result of ANOVA analysis, the effect of the ethanol concentration variable on the extraction process was found to be significant ($p < 0.05$). In this study, the thermal degradation kinetics of sumac anthocyanins obtained under optimum extraction conditions as a result of 70, 80, and 90 °C heat treatment were also determined. The results showed that the thermal degradation process fit the first-order reaction kinetics. The kinetic rate constant (k) of thermal degradation of sumac anthocyanins varied between $1.69x10^{-3}$-$5.44x10^{-3}$ min^{-1} and the half-life ($t_{1/2}$) varied between 29.46-9.15 hrs. The activation energy (Ea) of thermal degradation of sumac anthocyanins was calculated as 60.28 kJ/mol. Taguchi method was successfully applied in the extraction of anthocyanins from sumac. There is an urgency to improve the stability of the extracted sumac anthocyanins by considering the food production conditions.

Key Words: *Sonication, kinetic rate constant, half-life, activation energy*

Introduction

Sumac (*Rhus coriaria*) naturally grows in the wild stretching from the Canary Islands across the Mediterranean coastline to regions in Iran and Afghanistan. The plant is indigenous to the Mediterranean area and southeastern Anatolia in Turkey. In the Middle East and Mediterranean regions, Sumac has been employed for a variety of traditional purposes, such as spice, dye, and medicinal herbs. Rhus coriaria is a valuable source of nutritional components, including organic acids, both essential and non-essential fatty acids, vitamins, carbohydrates, and minerals (K, Ca, Mg, Na, P, Fe). Additionally, it contains tannins, phenolic acids, anthocyanins, flavonoids, and terpenoids (Ozcan et al., 2021). Notably, extracts derived from sumac have exhibited antimicrobial, antifungal, and antiviral properties (Romeo et al., 2015).

Anthocyanins are widely utilized as natural colorants in the food industry. These natural pigments can exhibit a broad range of colors, ranging from orange to red, and purple to blue, depending on their molecular structure and pH levels. The interest in anthocyanins stems not only from their coloring effects but also from their health benefits. Due to increasing environmental concerns associated with synthetic dyes, natural dyes offer an environmentally friendly alternative for coloring in the food and pharmaceutical sectors (Ravanfar et al., 2015).

Nowadays, consumers are demanding the use of these natural colorants with beneficial health effects in food products. Anthocyanins, which are recognized as natural food colorants in the fruit and vegetable category in the US, are classified as e163 in the EU. Although there are many identified anthocyanin compounds, only pelargonidin, cyanidin, peonidin, delphinidin, petunidin, and malvidin are prevalent in fruits and cereal grains. These are active compounds with antioxidant activity and health-promoting properties owing to their anti-inflammatory and hypoglycemic effects. They also exhibit antimutagenic and anticarcinogenic activity (Loypimai et al., 2016).

It is well known that factors such as solvent type, liquid-solid ratio, and extraction time significantly influence the yield and bioactivities of active substances extracted from plants. However, the influence of these extraction parameters can vary depending on several factors, especially the specific plant material used in the extraction process. The conventional approach of one-factor-at-a-time experiments is both time-consuming and does not provide insight into the interactions between factors. Alternatively, Taguchi's methodology is highly effective in screening procedures to identify important factors whilst minimizing the number of experiments required (Ashengroph et al., 2013). A review of the existing literature shows that Taguchi modeling has not been applied to the extraction of anthocyanins from sumac. Additionally, there is a lack of data concerning the thermal degradation kinetics of anthocyanins obtained from sumac. Thus, this study has two main objectives: first to

determine the optimal conditions for extracting anthocyanins from sumac spice using ultrasonic extraction, focusing on three key process factors including ethanol concentration, sonication time, and solvent: solute ratio, through the Taguchi method. Second, to investigate the degradation kinetics of the extract with the highest anthocyanin content under optimal conditions when subjected to heat treatments at temperatures of 70, 80, and 90 °C. This investigation includes the determination of reaction rate constant (k), half-life ($t_{1/2}$), and activation energy (Ea).

Materials and Methods

Material

Sumac used in this study was obtained in spice form from a local supplier in Pamukova district of Sakarya. The chemicals used in the analysis were of analytical purity and were obtained from Merck (Germany).

Extraction procedure and Taguchi optimization

The sumac oil was extracted using petroleum ether in a soxhelet extraction unit for 8 hours (Kosar et al., 2007). Then, the required amount of the dried sample (solvent: solute ratio (10:1, 20:1, 30:1)) was taken and mixed with 100 ml of solvent containing different concentrations (25, 50, 75%) of ethanol. The sample mixture was extracted in an ultrasonic water bath at a frequency of 40 kHz for different times (15, 30, and 45 min). The temperature was kept below 30 °C during the extraction process. Ice sockets were used for this purpose. The sample mixtures were then firstly removed from the coarse elements using a fourfold cheesecloth and then the filtrate was filtered through a water trombe using Whatman no:1 filter paper. The clear extracts were kept at refrigerator temperature until analysis.

In this study, Taguchi L9 orthogonal experimental design was used to maximize anthocyanin extraction by minimizing the number of experiments. The factors and levels utilized in anthocyanin extraction from sumac are presented in Table 1. The effect of ethanol concentration (A), sonication time (B), and solvent: solute ratio (C) on maximum anthocyanin extraction was investigated. The anthocyanin extraction process was optimized using the Taguchi L9 experimental design in Table 2.

In the Taguchi optimization method, the effect of each extraction parameter on anthocyanin extraction is tested by signal-to-noise ratio (S/N). In general, S/N ratios are evaluated in 3 categories "nominal best", "smallest best" and "largest best" (Güldane, 2023). In this study, the S/N ratios analysis was performed by selecting the "largest best" (Equation 1) since it was aimed to maximize the anthocyanin content.

$$S/N = -10log\left[1/R \sum_{i=1}^{R} 1/y_i^2\right] \quad (1)$$

where R is the number of data points and y_i is the value of the ith data point.

Table 1. Factors and corresponding levels for design matrix

Factors	Unit	Symbol	Level 1	Level 2	Level 3
Ethanol concentration	%	A	25	50	75
Sonication time	min	B	15	30	45
Solvent: solute ratio	-	C	10:1	20:1	30:1

Table 2. Taguchi L9 design matrix for extraction of sumac anthocyanins, experimental results, and S/N ratios

Run	Ethanol concentration (%)	Sonication time (dak)	Solvent: solute ratio	Total anthocyanin (mg C3G/kg)	S/N (dB)
1	25	15	10:1	514.682	54.2308
2	25	30	20:1	367.953	51.3158
3	25	45	30:1	252.566	48.0475
4	50	15	20:1	434.672	52.7632
5	50	30	10:1	240.589	47.6255
6	50	45	30:1	577.631	55.2330
7	75	15	10:1	339.069	50.6058
8	75	30	30:1	619.379	55.8391
9	75	45	20:1	488.026	53.7689

Determination of total monomeric anthocyanin (TMA) content

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TMA content of sumac extracts was determined by pH differential method using a UV-VIS spectrophotometer (Shimadzu UV-1240, Japan). The clear anthocyanin extract was diluted with a pH 1.0 buffer solution (0.025M KCl) and pH 4.5 sodium acetate buffer solution (0.4M CH_3COONa-$3H_2O$) in separate test tubes. The absorbance of each sample was read at 510 and 700 nm against distilled water. The absorbance (Abs) value of the diluted sample was determined using Equation 2.

$$Abs = (A_{510\ nm} - A_{700\ nm})_{pH\ 1.0} - (A_{510\ nm} - A_{700\ nm})_{pH\ 4.5} \quad (2)$$

The TMA content of the samples was determined according to the following formula (Equation 3).

$$TMA\ \left(\frac{mg}{kg}\right) = \frac{Abs * M_w * DF * 1000}{\varepsilon * l} \quad (3)$$

where M_w is the molecular weight for cyanidin-3-glucoside (C3G) (445.2), DF is the dilution factor value, and ε is the molar absorbtivity constant for C3G (26,900) (Kirca et al., 2006).

Thermal degradation kinetics of sumac anthocyanins

Thermal degradation of sumac anthocyanins at 70, 80, and 90 °C was investigated by a slightly modified method proposed by Kirca and Cemeroğlu (2003). 10 ml of the extract liquid containing 632 ± 5.48 mg C3G/kg sample level of anthocyanins was transferred into 10 ml test tubes. After the test tubes were sealed, they were placed in heat-resistant tube spores and placed in a thermostatic water bath. At 30 min intervals, a random tube was taken and rapidly cooled in the ice water bath. Sample analysis times were 360, 360, and 270 min for 70, 80 and 90 °C. The cooled samples were kept at 4 °C until analysis.

Previous studies have shown that the degradation process of color pigments from various natural sources fits the first-order reaction model. In this study, the reaction degree fitting the degradation process of sumac color pigments was determined by regression analysis. In this study, the reaction rate constant (k, min^{-1}) (Equation 4) was used to calculate the time required for the degradation of half of the anthocyanins ($t_{1/2}$) (Equation 5). Furthermore, the temperature dependence of the degradation rate constant was determined by applying the Arrhenius equation (Equation 6). The activation energy (Ea) was calculated by plotting ln (kT) versus 1/T (Chen et al., 2019).

$$C_t = C_0 \exp(k.t) \quad (4)$$

$$t_{1/2} = -ln0.5/k \quad (5)$$

$$k_T = k_0 e^{\frac{-Ea}{RT}} \quad (6)$$

where C_0 is the initial anthocyanin content (AC) and C_t is the AC after t min of heating at a selected temperature. The kT is the kinetic constant at a given temperature, k_0 is the reaction rate constant (min^{-1}), R is the universal gas constant (8.314 J/mol.K), and T is the temperature (K).

Statistical analysis

Statistical analysis was performed with Minitab 19 software. Taguchi optimization results were analyzed by ANOVA. Significant extraction parameters in anthocyanin extraction were determined by F-value and corresponding p-value at a 95% confidence level. Statistical comparison of thermal degradation kinetic data was performed by Tukey's comparison test.

Results and Discussion

Taguchi optimization

In this study, the Taguchi optimization method was used to maximize TMA extraction. The average TMA results and the S/N ratios corresponding to each data are given in Table 2. According to the experimental results, the TMA content of the samples obtained by ultrasonic method ranged between 240.589 and 619.379 mg C3G/kg. In addition, the S/N ratios of the samples are between 47.63 dB and 55.84 dB. The results show that the extract with the highest TMA content was obtained when ultrasound was applied for 30 min to the mixture prepared in a 30:1 solvent: solute ratio in a solution containing 75% ethanol (A3B2C3). Similar results were obtained in the Taguchi L9 average S/N ratios table (Table 3). The highest value of each extraction parameter represents the

optimal level. The results revealed that the optimum extraction conditions were achieved by 10 min ultrasonic extraction of a sumac sample mixed with a solvent containing 75% ethanol at a solvent: solute ratio of 10:1 ($A_3B_1C_1$). The delta values in the table show the influence degree of the factors on the extraction process. Based on the data obtained, the order of influence of production factors on anthocyanin extraction is solvent: solute ratio (C) > ethanol concentration (A) > sonication time (B).

Table 3. Response table for S/N ratios

Level	A	B	C
1	51.20	*52.53*	*55.10*
2	51.87	51.59	52.62
3	*53.40*	52.35	48.76
Delta	2.21	0.94	6.34
Range	2	3	1

*italic characters indicate optimal levels of the process parameters.

The main effect graph of the S/N ratios for the Taguchi optimization method is provided in Figure 1. The graph indicates that the quantity of anthocyanins extracted from sumac increased as the concentration of ethanol in the solvent increased from 25% to 75%. Similar findings were obtained in anthocyanin extraction from jabuticaba peel (Rodrigues et al., 2015). The ANOVA table in Table 4 demonstrates that the effect of this extraction factor on the anthocyanin content was significant ($p < 0.05$). Another statistically significant effect was found for the solvent: solute ratio. The anthocyanin yield decreased with increasing solvent: solute ratio from 10:1 to 30:1 (Figure 1). Increasing solvent concentration in the extraction negatively affected anthocyanin diffusion from sumac powders. On the other hand, no significant effect of sonication time on anthocyanin extraction was observed (Figure 1). This effect was also not found statistically significant according to the ANOVA results in Table 4 ($p > 0.05$).

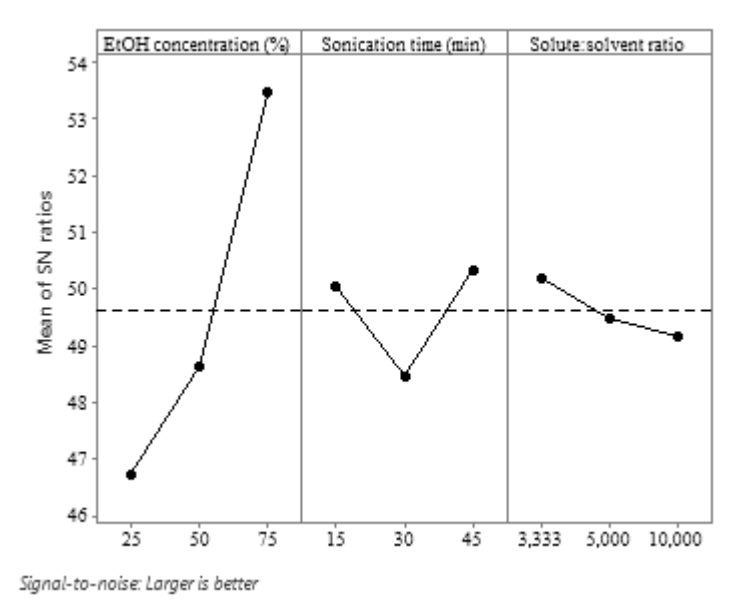


Figure 1. Main effects plot for S/N ratios

Table 4. ANOVA results for the extraction process of sumac anthocyanins

Source	DF	SS	MS	F-value	p-value
Ethanol concentration	2	16469	8234.3	23.90	0.040*
Sonication time	2	1411	705.7	2.05	0.328
Solvent: solute ratio	2	128988	64494.1	187.17	0.005*
Error	2	689	344.6		
Total	8	147557			

*significant; R^2= 99.53%, $R^2_{(adj)}$= 98.13%, $R^2_{(pred)}$=90.54%

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Validation tests were carried out to verify the optimum anthocyanin value obtained from the optimization process and to improve the anthocyanin extraction process. The anthocyanin content estimated by Minitab 19.0 software (630.071 mg C3G/kg) and the extraction yield obtained experimentally (632.024 mg C3G/kg) were found close to each other. Furthermore, an improvement of approximately 23% compared to the initial parameters ($A_1B_1C_1$) was achieved by applying Taguchi optimization.

Thermal stability of sumac anthocyanins

Thermal degradation of sumac anthocyanins was investigated at 70, 80 and 90 °C. The kinetic parameters of anthocyanin degradation by heat treatment are given in Table 5. It can be seen from Table 5 that the thermal degradation of sumac anthocyanins at each temperature level fits the first-order reaction model ($0.9945<R2<0.9986$). This result is in agreement with blackberry juice (Wang and Xu, 2007), blood orange juice (Kirca and Cemeroğlu, 2003), black carrot extract (Kirca et al., 2007), and wild blackthorn fruit extract (Moldovan et al., 2019) where a first-order reaction model for thermal degradation of anthocyanins was reported. The kinetic rate constant (k) is an indicator for predicting the thermal breakdown of color pigments. Lower k values indicate better color stability. The k values of sumac anthocyanins were determined as 1.69×10^{-3}, 2.65×10^{-3}, and 5.44×10^{-3} (min^{-1}) for 70, 80 and 90 °C, respectively (Table 5). The kinetic rate constant value of sumac anthocyanin extract increased significantly with increasing temperature from 70 °C to 90 °C ($p < 0.05$). This result indicates that anthocyanins subjected to heat treatment at 90 °C decomposed faster. The stability of sumac anthocyanins increased with decreasing half-life value ($t_{1/2}$). The $t_{1/2}$ value decreased significantly ($p < 0.05$) with increasing degree of heat treatment applied to the anthocyanin extract. Similar effects of kinetic rate constant (k) and half-life value ($t_{1/2}$) on anthocyanin stability were also reported for Juchara and Italian grape juices (Peron et al., 2017) and wild elm fruit extract (Moldovan et al., 2019). However, the activation energy (Ea) associated with the degradation of anthocyanins was 60.29 kJ/mol. Similar data were reported as 58.95 kJ/mol for blackberry juice (Wang and Xu, 2007), 62.5 kJ/mol for black carrot extract (Kirca et al., 2007), and 59.82 kJ/mol for purple sweet potato extract (Chen et al., 2019).

Table 5. Kinetic parameters of heat treatment stability of sumac anthocyanins

Temperature (°C)	$kx10^{-3}$ (min^{-1})	$t_{1/2}$ (hrs)	R^2	Ea (kJ/mol)
70	1.69^c	29.46^a	0.9945^a	60.28
80	2.65^b	18.75^b	0.9986^a	
90	5.44^a	9.15^c	0.9980^a	

a-c refers to the significant differences between the values in the same column (p <0.05).

Conclusion

In this study, ultrasound-assisted extraction of anthocyanins from sumac was successfully optimized using the Taguchi method. Under optimized parameter conditions, sumac anthocyanins were extracted with high extraction yields as a result of sonication with 75% ethanol-containing solvent at 10:1 solvent: solute ratio for 15 min. The decrease in the thermal stability of sumac anthocyanins with increasing temperature was proved by the first-order reaction model with increasing reaction rate constant (k) and decreasing half-life (t1/2) with increasing temperature. The thermal stability of sumac anthocyanins needs to be optimized considering food processing conditions.

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ID: 71

Perception of Employees in the Dairy Industry towards Digital-Smart Tracking Systems: A Case Study on Ezine Cheese Producers

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Abstract

In the digital era, food industry is facing to use digital-smart tracking systems for sustainable food quality and safety. By the increasing digital solutions during farm to fork processes, employees from each section should be a part of the digitalization and job definitions should be shifted to include digital process management. In this study, we aimed to determine current perception and resistance status of employees in dairy industry about digital-smart tracking systems. The empirical survey relies on a sample consisting of nearly 30 SMEs and 150 employees at different parts of farm to fork processes, including Ezine Cheese producer companies in Ezine region, Çanakkale, Türkiye. As we expected, most of employees knows digital-vehicle tracking systems. They believed that digital-tracking systems' necessity to transparency in food-value chain, quality systems, international trade and logistics. Due to heavy workload and hacking concerns, they resisted to digitalization and sustainability processes. Effective awareness and digital-security trainings should be done for food value-chain employees to reach expected digitalization targets in food industry.

Key Words: *Digitalization, Smart systems, Resistance, Dairy industry, Awareness*

ID: 72

Natural Preservative and Pesticide Potantial of White Cheese Isolated Lactic Acid Bacteria: Quorum Quenching, Antibacterial and Antitumor

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Abstract

The study aimed to determine the quorum quenching (QQ) and antitumor activity on short-chain AHLs from Quorum Sensing (QS) signals, which is the bacterial communication system, of metabolites obtained by using Lactic acid Bacteria (LAB) in the microbiota of white cheese, a fermented product. While *Chromabacterium violaceum* CV026 biosensor culture was used to determine the QQ effect on short-chain AHL QS signals; *Agrobacterium tumefaciens* A136 was used in potato disc studies used to determine its usability as a pesticide. While it was determined that the metabolites produced by all (21) isolates obtained and identified as lactic acid bacteria had a QQ effect on short-chain AHLs, the metabolites of 38.09% (8/21) of the same isolates were found to have antitumor properties. All metabolites were also found to have antibacterial properties against the bacteria *Esherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853, Staphylococcus aureus ATCC 6538 P, Micrococcus luteus ATCC 4698 and *Listeria monocytogenes* ATCC 7644. While it was determined that the metabolites produced by lactic acid bacteria have the potential to be used as a preservative and/or surface disinfectant in the food industry with their QQ and antibacterial effects; It has been determined that only 8 of the metabolites have antitumor properties and have the potential to be used as natural pesticides during agricultural practices.

Key Words: *Lactic acid bacteria, Metabolics, Quorum Quenching, Antibacterial, Antitumor*

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Beyaz Peynirden İzole Edilmiş Laktik Asit Bakterilerinin Doğal Koruyucu ve Pestisit Potansiyelinin Tespiti: Quorum Quenching, Antibakteriyel ve Antitümör

Özet

Çalışma, fermente bir ürün olan beyaz peynirden elde edilmiş, mikrobiyotasında bulunan Laktik asit Bakterileri (LAB) kullanılarak elde edilen metabolitlerin bakteriyel iletişim sistemi olan Quorum Sensing (QS) sinyallerinden kısa zincirli AHL'ler üzerine quorum quenching (QQ) ve antitümör etkinliğinin tespitini hedeflemiştir. Kısa zincirli AHL QS sinyalleri üzerine QQ etkisinin belirlenmesi için Chromabacterium violaceum CV026 biyosensör kültürü kullanılırken; pestisit olarak kullanılabilirliğinin tespiti için kullanılan patates disk çalışmalarında *Agrobacterium tumefaciens* A136 kullanılmıştır. Elde edilen ve laktik asit bakterisi olarak tanımlanan izolatların hepsinin (21) ürettiği metabolitlerin kısa zincirli AHL'ler üzerine QQ etkisinin bulunduğu tespit edilirken, aynı izolatların %38,09'unun (8/21) metabolitlerinin antitümör özelliğine sahip olduğu tespit edilmiştir. Tüm metabolitlerin, Esherichia *coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853, *Staphylococcus aureus* ATCC 6538 P, *Micrococcus luteus* ATCC 4698 ve *Listeria monocytogenes* ATCC 7644 bakterileri üzerine antibakteriyel özellikleri olduğu da tespit edilmiştir. Laktik asit bakterileri tarafından üretilen metabolitlerin QQ ve antibakteriyel etkileri ile gıda endüstrisinde koruyucu ve/veya yüzey dezenfektanı olarak kullanılabilme potansiyeli olduğu tespit edilirken; metabolitlerin yalnızca 8 tanesi antitümör özelliği ile tarım uygulamaları sırasında doğal pestisit olarak kullanılabilme potansiyelinin olduğu tespit edilmiştir.

Anahtar Kelimeler: *Laktik Asit Bakterisi, Metabolit, Quorum Quenching, Antibakteriyel,Antitümör*

Teşekkür: Bu çalışma, Türkiye Bilimsel ve Teknolojik Araştırma Kurumu tarafından desteklenmiştir (Tübitak 2209- 1919B012203844).

ID: 73

Urban Agriculture in Mogadishu: Opportunities and Constraints

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Abstract

Urban and peri-urban agriculture is crucial for improving food security among urban households and reducing the food mileage between urban and rural areas, especially with the unprecedented increase in urban populations. This study used a snowball sampling method to assess the opportunities and constraints faced by urban horticulture farmers in Deynile and Darusalam of Mogadishu. The findings of the study revealed that temperature, wind, pest and disease outbreaks, and water access for irrigation are the main constraints that urban farmers encounter. The study also found that the type of farming is another challenge that urban farmers face. Urban farmers who grow inside greenhouses have fewer challenges in terms of wind protection, which reduces crop evapotranspiration and improves crop quality, such as the appearance of fruits and leafy vegetables. Conversely, urban farmers who grow in the open fields encounter major challenges such as high irrigation and water requirements, frequent pest and disease infestations, and poor appearance of fruits and leafy vegetables, which are unattractive to buyers. The study discovered that farmers use two types of conventional protected farming: plastic greenhouses with net walls and houses that are entirely covered with net clothes. Farmers use undeveloped techniques to decrease the skyrocketing temperature during hot seasons. The study found that market availability, an increase in supermarkets in the city, an increase in displaced people from rural areas, the return of diasporas, and the shortage of fresh vegetables in the city due to regular droughts in rural areas had encouraged urban people in Mogadishu to begin farming in and around the city.

ID: 74

Zenginleştirilmiş Çevre Şartlarının Beç Tavuğunda Büyüme Dönemi Davranış, Performans ile Kesim ve Et Kalite Özelliklerine Etkisi

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*: *Bu makale birinci yazarın yüksek lisans tez çalışmasından özetlenmiştir*

Özet

Bu çalışmada beç tavuklarına kapalı yetiştirme şartlarında uygulanan çevresel zenginleştirme uygulamalarının büyüme performansı, kesim özellikleri, et kalite özellikleri ile bazı davranış özelliklerine etkilerinin ortaya koyulması amaçlanmıştır. Çalışma, Yozgat Bozok Üniversitesi BOZOKTUAM Yerköy Hayvancılık işletmesinde yürütülmüş olup, hayvan materyalini 200 adet günlük yaşta beç tavuğu oluşturmuştur. Bu çalışmada, çevresel zenginleştirme uygulanan ve çevresel zenginleştirme uygulanmayan iki farklı muamele grubu oluşturulmuştur. Beç tavukları her iki muamele grubunda da altlıklı yerde yetiştirme sisteminde üretilmişlerdir. Her muamele grubu 5 tekerrürden oluşmaktadır. Çevresel zenginleştirme grubunda tüneme tahtaları, yerde taş materyalleri ve yeşillik yemliği objeleri yer almıştır. Beç tavukları çıkıştan itibaren muamele gruplarına rastgele seçilerek ayrılmış, 13 haftalık kesim yaşına kadar aynı ortamda büyütülmüşlerdir. Çevresel zenginleştirme uygulanan yetiştirmede daha düşük kesim yaşı canlı ağırlığı tespit edilmiştir (Yemden yararlanma oranı (YYO) 10 ve 12. haftada kontrol grubunda daha iyi belirlenmiştir. Kesim ağırlığı, sıcak ve soğuk karkas ağırlığı çevresel zenginleştirme uygulanan grupta daha düşük bulunmuştur. Çevresel zenginleştirme uygulanan beç tavuklarında daha yüksek eşinme, koşma, yem yeme ve su içme, kabarma ve kanat çırpma ile tüy temizleme davranışı belirlenmiştir. Tüy gagalama davranışı ve yatma davranışı ise çevresel zenginleştirme uygulanmayan (kontrol grubu) beç tavuklarında daha yüksek bulunmuştur. Beç tavuklarında çevresel zenginleştirme uygulamalarının özellikle davranışlar üzerinde etkili olduğu görülmüştür.

Anahtar Kelimeler: *Canlı Ağırlık, Karkas, pH, Tonik immobilite, Davranış, Çevresel zenginleştirme*

The Effects ff Environmental Enrichment On Behavior, Performance, and Slaughter and Carcass Traits in Guinea Fowl

Abstract

In this study, it was aimed to determine the effects of environmental enrichment practices on growth performance, slaughter traits, meat quality traits and some behavioural traits of guinea fowls under confined rearing conditions. The study was carried out in Yozgat Bozok University BOZOK TUAM Yerköy Animal Husbandry Facility and the animal material consisted of 200 day-old guinea fowls. In this study, two different treatment groups with and without environmental enrichment were established. In both treatment groups, the guinea fowls were produced in the floor rearing system with litter. Each treatment group consisted of 5 replicates. In the environmental enrichment group, roosting boards, stone materials on the ground and foliage feeder objects were included. Guinea fowls were randomly allocated to the treatment groups from emergence and reared in the same environment until 13 weeks of age at slaughter. Lower live weight at slaughter age was determined in the environmental enrichment treatment (Feed conversion ratio (FCR) was better in the control group at 10 and 12 weeks. Slaughter weight, hot and cold carcass weight were lower in the environmental enrichment group. Higher level of mating, running, feeding, drinking, swelling, wing flapping and feather cleaning behaviours were determined in the environmental enrichment group. Feather pecking behaviour and lying down behaviour were found to be higher in the guinea fowl without environmental enrichment (control group). It was observed that environmental enrichment practices were especially effective on behaviours in guinea fowls.

Keywords: *Guinea fowl, Live weight, Carcass, pH, Tonic immobility, Behavior, Environmental enrichment.*

ID: 76

Extraction of bioactive compounds from yellow onion peels: Taguchi-SAW hybrid optimization

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Abstract

The aim of this study was to obtain an extract rich in bioactive components from yellow onion peels, which are generally considered waste material. Accordingly, a three-factor three-level Taguchi (L9) experimental design with three factors, namely ethanol concentration (A; 50%, 75%, 100%), extraction temperature (B; 30, 40, 50 °C), and sonication time (C; 10, 20, 30 min) was used to optimize the ultrasound-assisted extraction process of onion peel powders. Through Taguchi optimization, the optimum extraction conditions were determined as $A_2B_3C_2$ to obtain the extract with the highest total phenolic matter (TFM) content and antioxidant activity (DPPH (%)). In addition, the extract produced under $A_2B_1C_2$ conditions was found to be the richest in total monomeric anthocyanin (TMA) content with the highest level of color pigments. In order to determine the overall optimization conditions and to reduce the three-response optimization process to a single response, the simple sum weighting (SAW) method was used as a multi-criteria decision-making method. As a result of the optimization, it was concluded that an extract rich in bioactive components with optimal TFM and TMA contents and DPPH (%) value could be obtained as a result of sonication at 30 °C for 20 min to onion peel powders mixed with a solvent containing 75% ethanol ($A_2B_1C_2$). The extraction conditions of bioactive components from yellow onion peels were successfully optimized by the Taguchi-SAW hybrid optimization method.

Key Words: *Ultrasound, total phenolics, DPPH, total monomeric anthocyanin*

Introduction

Biomass waste is recognized as one of the significant global issues throughout the world and is becoming increasingly important in developing countries due to its detrimental impact on the environment. Fruit and vegetable waste and associated by-products are produced in substantial quantities through industrial processes, posing a serious environmental threat when not appropriately managed. However, these waste materials are rich in bioactive compounds known for their potential health benefits. In recent years, considerable efforts have been made to develop techniques for the efficient utilization of fruit and vegetable waste (Pal and Jadeja, 2019).

Onions (*Allium cepa* L.), a member of the Allium family, are not only known for their delicious taste but also serve as a valuable source of various beneficial compounds. Onions, particularly their peels, are rich in phenolic compounds and exhibit antioxidant properties (Bordin Viera et al., 2023). Red, yellow, and white onions contain significant amounts of anthocyanins, which are responsible for the coloration of onion peels. These anthocyanins have found applications in treating various diseases, including cancer, atherosclerosis, diabetes, and cardiovascular disease (JK et al., 2022).

Bioactive components are used as additives in foods due to their positive effects on human health. These functional compounds, which are already used in various applications such as pharmaceuticals, cosmetics, and textiles, are usually obtained by extraction from different parts of plants (stems, leaves, bark, bark, seeds, fruits, etc.). Studies on different extraction methods have focused on the separation of these components in order to increase extraction efficiency, reduce costs, and maximize profits. Ultrasound (US) technique is an alternative to supercritical fluid extraction and microwave-assisted extraction for the extraction of active substances from plant samples. This technique is economical, environmentally friendly, and time-saving compared to conventional extraction methods. The US disrupts cell tissues in a short time, accelerating mass transfer and thus increasing extraction efficiency (Alves Filho et al., 2021).

Taguchi method is one of the optimization techniques that can reduce the number of experiments, improve product quality, and determine design solutions. Taguchi method, which is generally used in single response optimization, can be integrated with multi-criteria decision-making methods and applied to obtain optimal conditions for multiple responses (Güldane, 2023). Taguchi-PROMETHEE (Crnjac et al., 2019), Taguchi-TOPSIS (Singh et al., 2011), and Taguchi-AHP (Salari et al., 2019) hybrid optimization techniques have been

applied successfully in various process operations. Pal and Jadeja (2019) applied the Taguchi method in single response optimization to maximize polyphenolic antioxidant extraction from onion peel.
In the literature, there is no study in which the Taguchi-SAW method was applied in multiple response optimization for the extraction of bioactive compounds from yellow onion peels. In this study, it was aimed to determine the optimal extraction conditions of yellow onion peels by ultrasonically assisted extraction method. Extraction conditions, ethanol concentration (A; 50%, 75%, 100%), extraction temperature (B; 30, 40, 50 °C), and sonication time (C; 10, 20, 30 min) were optimized by Taguchi-SAW hybrid optimization method to maximize total phenolic and total monomeric anthocyanin contents, and DPPH radical scavenging activity.

Materials and Methods

Materials

The waste onion peels used in this study were obtained from a local grocery store in Pamukova region of Sakarya. The chemicals used in the analysis were of analytical purity and were obtained from Merck (Germany).

Extraction of bioactive compounds from yellow onion peels

Onion peels were washed with distilled water and dried in an oven at 40 °C for 4 hours (Santos and Martins, 2022). After cooling the onion peels to room temperature, they were ground with a blender. Then, 1 g of the powdered samples was transferred to a beaker and 10 ml of 96% (v/v) ethanol was added at different concentrations (50, 75, and 100%). The pH of the mixtures was adjusted to 2.0 using 0.1N HCl (Santos and Martins, 2022). The samples were sonicated for different times (10, 20, and 30 min) in a 150 kW ultrasonic water bath (CALISKAN, LAB ULT 4045, China) set at various temperatures (30, 40, and 50 °C). The mixtures were then filtered through a water tromb using filter paper (Whatman no:1). The filtrates were stored at 4 °C until analysis.

Experimental design

Taguchi method was used in the optimization of bioactive component extraction from onion peel. Minitab 19.0 software was utilized in the planning of the study. Experiments were carried out according to Taguchi L9 experimental design which consists of 3 factors and 3 levels (Table 2). Ethanol concentration (50-100%), extraction temperature (30-50 °C), and sonication time (10-30 min) were selected as control parameters (Table 1). Literature data was used to determine the extraction factors and the levels of each extraction factor.

Table 1. Control parameters and levels

Symbol	Factors	Unit	Level 1	Level 2	Level 3
A	Ethanol concentration	%	50	75	100
B	Sonication temperature	°C	30	40	50
C	Sonication time	min	10	20	30

Table 2. Taguchi L9 orthogonal design, experimental results, and S/N ratio values

Run	Factors and levels			Responses					
				TPC (mg GAE/g)		TMA (mg C3G/100 g)		DPPH (%)	
	A	B	C	Mean	S/N	Mean	S/N	Mean	S/N
1	50	30	10	29.54	29.41	10.75	20.63	47.53	33.54
2	50	40	20	30.91	29.80	7.86	17.91	62.46	35.91
3	50	50	30	33.29	30.45	12.31	21.81	64.43	36.18
4	75	30	20	33.36	30.47	17.63	24.92	61.24	35.74
5	75	40	30	32.49	30.24	9.30	19.37	53.67	34.59
6	75	50	10	33.83	30.59	10.30	20.26	58.71	35.37
7	100	30	30	31.05	29.84	9.56	19.61	45.98	33.25
8	100	40	10	24.80	27.89	10.70	20.58	36.88	31.34
9	100	50	20	33.12	30.40	9.80	19.83	46.08	33.27

Taguchi Optimization method

Taguchi method is an optimization technique that is characterized by determining the optimum levels of extraction parameters with a minimum number of experiments. This procedure is specifically preferred for optimizing a single process characteristic. In Taguchi technique, optimal parameters are obtained by comparing the S/N ratios corresponding to each test parameter. In this study, the "bigger is better" (Equation 1), which

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corresponds to the maximum levels of S/N ratios for each of the responses was preferred since the aim was to obtain an extract rich in bioactive components (Roy, 2010).

$$S/_N = -10log\left[\frac{1}{n}\sum_{i=1}^{n}\frac{1}{y_{ij}^2}\right] \quad (1)$$

SAW method

Simple additive weighting (SAW) method was used for multiple response optimization in the extraction of bioactive components from onion peels. In this approach, the runs are scored between 0 and 1, and the sample equal to or closest to 1 is considered as the most ideal sample. The SAW method involves 4 steps (Muddineni et al., 2017):

- Construction of decision matrix (D_{mxn}) (Equation 2)

$$D_{mxn} = \begin{Bmatrix} x_{11} & x_{12} \cdots & x_{1n} \\ x_{12} & x_{22} \cdots & x_{2n} \\ \vdots & \vdots & \vdots \\ x_{m1} & x_{m2} \cdots & x_{mn} \end{Bmatrix}, \quad (2)$$

- Normalization of the parameters using Equation 3

$$n_{ij} = \frac{r_{ij}}{\max(r_{ij})} \quad (3)$$

- Calculation of the weighted decision matrix using Equation 4. The weighting value for each parameter was determined by principal component analysis (PCA). The details of this method are described by Guldane and Dogan (2022).

- $A_j = \sum w_i x_{ij}$ (4)

- The sample with the highest score is identified as the ideal.

Analysis

Total phenolic matter (TFM)

The TFM content of onion peel extracts was determined using the Folin-Ciocalteu spectrophotometric method described by Pal and Jadeja (2019). Firstly, 1 ml onion peel extract, 5 ml distilled water, and 0.5 ml Folin Ciocalteu reagent were added to the tubes and vortexed. After 5 minutes, 1.5 ml of 20% sodium carbonate (Na2CO3) and 2 ml of distilled water were added to the tubes and kept in the dark for 2 hours and the absorbance at 760 nm wavelength was measured in a spectrophotometer (Shimadzu UV-1240, Japan). The phenolic content of the samples was calculated using the calibration curve equation prepared using standard gallic acid solutions (25-500 mg/L). The total phenolic content of the extracts was calculated as mg GAE/g extract. These measurements were performed in 3 replicates and the results were given as the average.

Total monomeric anthocyanin (TMA)

The total anthocyanin content of onion peel extracts was determined according to the pH differential method reported by Stoica et al. (2020). This method is based on the absorbance values obtained spectrophotometrically at different pH ranges. Buffer solutions of pH 1.0 prepared with potassium chloride and pH 4.5 prepared with sodium acetate were used to prepare the dilutions of the prepared extracts. The absorbance values of the samples were measured in a UV-VIS spectrophotometer at 520 and 700 nm wavelengths. The TMA content of the samples was calculated by Equation 6 in terms of cyanidin-3-glycoside (C3G) equivalents based on the absorbance differences determined by Equation 5. Results are expressed as mg cyanidin-3-glucoside/ 100 g sample.

$$Abs = (A_{520\ nm} - A_{700\ nm})_{pH\ 1.0} - (A_{520\ nm} - A_{700\ nm})_{pH\ 4.5} \quad (5)$$

$$TMA\left(\frac{mg}{100\ g}\right) = \frac{Abs * M_w * DF * 10}{\varepsilon * l} \quad (6)$$

Antioxidant activity (DPPH(%))

The total antioxidant activity of onion peel extracts was determined by using the radical scavenging activity of the extracts against DPPH radical according to the method proposed by Viera et al. (2023). For this purpose, 0.5 ml of ethanolic extract was added to 2.5 ml of 0.1 mM DPPH solution. The mixture was shaken gently by hand and kept at room temperature in the dark for 30 minutes. The absorbance of the samples was determined by measuring at 517 nm wavelength. The percent radical scavenging activity values of the samples were expressed as DPPH (%). The results were calculated using Equation 7.

$$DPPH\,(\%) = \frac{(A_0 - A_{sample})}{A_0} * 100 \qquad (7)$$

Results and Discussion

Taguchi optimization

Experimental studies were carried out according to the L9 experimental design (Table 2) to determine the influence of extraction parameters on the responses in ultrasound-assisted extraction of onion peel. The studies were carefully conducted to determine the optimal extraction process for each response variable. Ultrasonic extraction aimed to maximize the total phenolic matter, total monomeric anthocyanin content, and antioxidant activity of the extracts. Therefore, the individual optimization of all three responses was based on the "larger is better" criterion to determine the optimal conditions.

Effect of process parameters on total phenolic matter (TFM)

The TFM content of onion peel extracts varied between 24.80 and 33.83 mg GAE/g (Table 2). Viera et al. (2023) stated that the TFM content of red onion peels varied between 117.50 and 822.87 mg GAE/g. JK et al. (2022) also reported that red onion was richer in bioactive compounds than yellow one. The main effect plot for total phenolic content during ultrasonic extraction of bioactive phenolic compounds is given in Figure 1. From the response plot, it can be seen that the phenolic content of extracts obtained with 75% ethanol is higher than those extracted with 50% and 100% ethanol. Also, it can be concluded from Figure 1 that the TFM contents of the samples extracted at 50 °C were higher than the others. The positive effect of temperature on TFM content can be attributed to keeping the extraction temperature at a moderate level. Short-term (10 min) ultrasound treatment had little effect on the phenolic content of the extracts. Increasing the sonication time to 20 min significantly increased the TFM content of the extracts. However, longer (30 min) ultrasound treatment had no significant effect on the TFM content of the extracts.

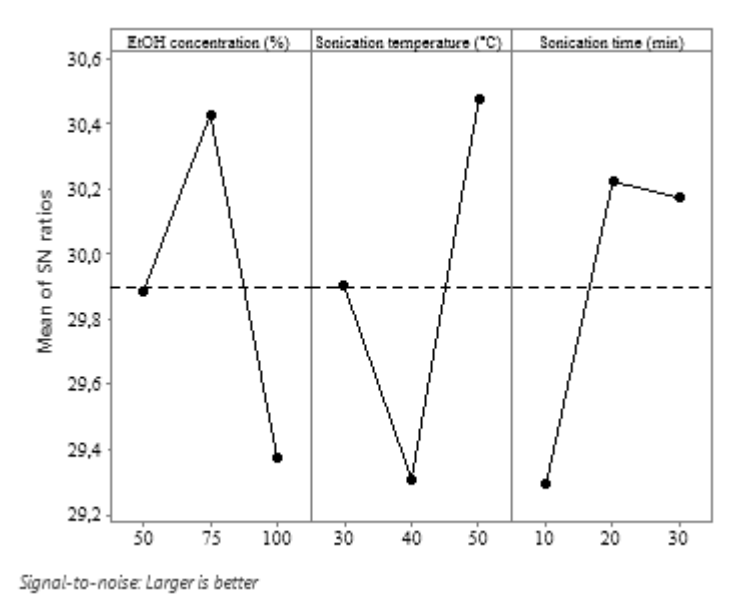


Figure 1. Main effect plot for total phenolic matter (TFM)

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The S/N ratios response table in the optimization study carried out to maximize the TFM content of onion peel extracts is given in Table 3. The optimal levels of each parameter are indicated in italics. As a result, the optimum process parameters for higher phenolic extraction were determined as $A_2B_3C_2$. This means that the optimal combination of process variables for better extraction performance is 75% for ethanol concentration, 50°C for extraction temperature, and 20 min for sonication time. Furthermore, extraction temperature was found to be the most effective parameter for phenolic extraction, followed by ethanol concentration and sonication time, respectively.

Table 3. S/N ratio response table for total phenolic matter

Level	A	B	C
1	29,89	29,90	29,29
2	*30,43*	29,31	*30,22*
3	29,38	*30,48*	30,17
Delta	1,05	1,17	0,93
Range	2	1	3

Effect of process parameters on total monomeric anthocyanin (TMA)

The TMA content of onion peel extracts varied between 7.86 and 17.63 mg C3G/100g sample (Table 2). Stoica et al. (2022) reported that the TMA content of red onion peels varied between 45-143 mg C3G/100g. It was observed that the anthocyanin content of yellow onion peels was lower than that of red onion peels. The main effect graph of TMA content in ultrasonic extraction of onion peel is given in Figure 2. According to the graph, it is clear that the anthocyanin content of extracts containing 75% ethanol is significantly higher than the other solvents. Viera et al. (2023) reported that the TMA content of red onion peel extracts increased as the concentration of ethanol in the solvent increased from 20% to 80%. They also reported that the maximum TMA content was obtained at 60% and 80% ethanol concentrations. This result is in agreement with our study. However, it can be concluded that TMA contents are low in samples extracted at higher temperatures. The effect of sonication time on the extraction of color substances from onion peel was similar to that of TFM extraction. The ultrasound application for 20 min resulted in the highest yield of TMA extraction.

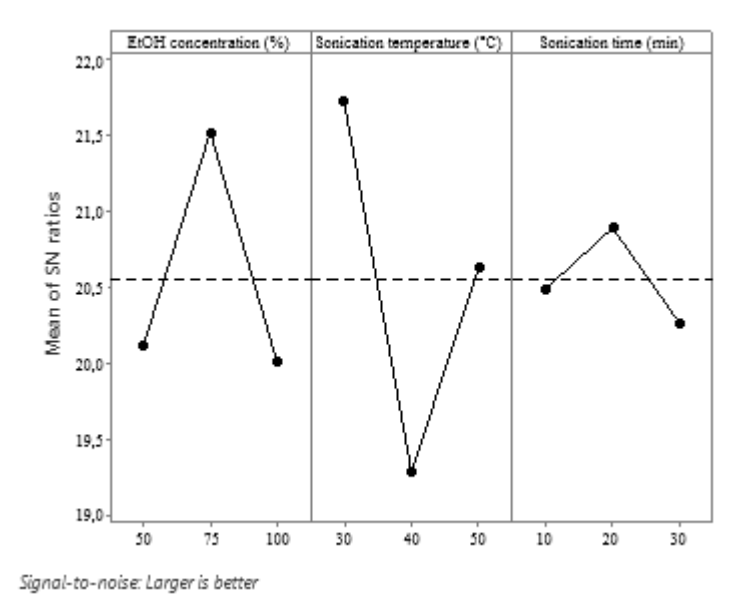


Figure 2. Main effect plot for total monomeric anthocyanin (TMA)

Taguchi method was performed for the TMA content extracted from onion peel and the S/N ratios response table is presented in Table 4. In the table, the optimal levels of each parameter are indicated in italics. Parameter levels with higher average S/N ratios can be expressed as optimum process parameters $A_2B_1C_2$ for TMA content. In terms of TMA content, it can be concluded that extracts sonicated for 20 min at 30 °C with 75% ethanol-containing solvent (Example 4) have the maximum TMA content. However, extraction temperature, which had the highest delta value (2.431) in TMA extraction, was found to be the most effective parameter in the extraction of color substances, followed by ethanol concentration and sonication time, respectively.

Table 4. S/N ratio response table for total monomeric anthocyanin (TMA)

Level	A	B	C
1	20.12	*21.72*	20.49
2	*21.52*	19.29	*20.89*
3	20.01	20.63	20.26
Delta	1.51	2.43	0.63
Range	2	1	3

Effect of process parameters on antioxidant activity

The total antioxidant activities of the extracts obtained from ultrasonic extraction of onion peel were determined based on the DPPH radical scavenging activity of the extracts and expressed as DPPH (%). The DPPH radical scavenging activities of the samples ranged from 36.88% to 64.43% (Table 2). The S/N ratios average plot for DPPH (%) values of the samples extracted according to Taguchi L9 experimental design is given in Figure 3. In the S/N ratios response graph, it was determined that the antioxidant activities of the samples extracted at 75% ethanol concentration were higher than the other samples. DPPH (%) values of the samples extracted at high temperatures (50 °C) were also higher. Increasing the sonication time to 20 min significantly increased the TFM content of the extracts. Also, there was no positive effect of a longer ultrasonication time on the antioxidant activity of the samples observed.

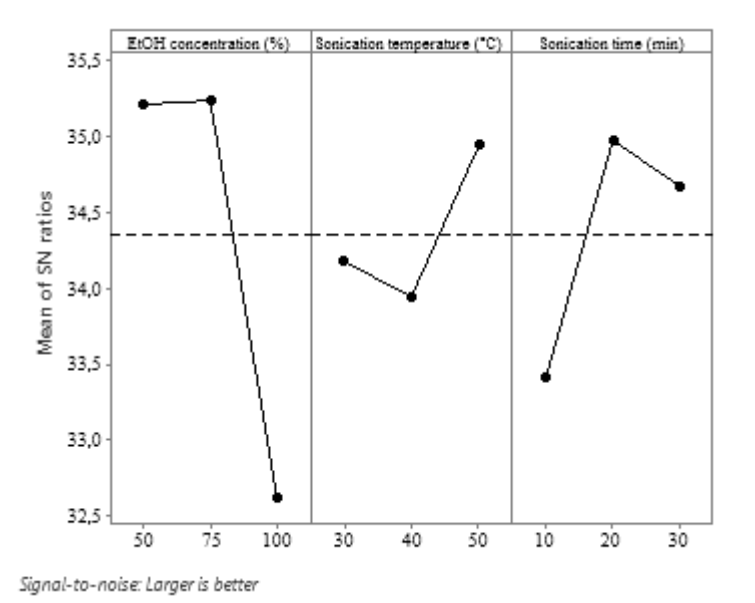


Figure 3. Main effect plot for DPPH (%)

The S/N responses of Taguchi optimization performed to maximize the antioxidant activities of onion peel extracts are given in Table 4. The data in the table shows that the extraction conditions for the maximum DPPH (%) value were found as A2B3C2. The optimum extraction variables for the extract with higher antioxidant activity were determined as 75%, 50 °C, and 20 min for ethanol concentration, extraction temperature, and sonication time, respectively. The most effective process parameter on DPPH (%) values was found to be ethanol concentration. This parameter was followed by sonication time and extraction temperature, respectively.

Table 5. S/N ratio response table for DPPH (%)

Level	A	B	C
1	35.21	34.18	33.42
2	*35.24*	33.95	*34.97*
3	32.62	*34.94*	34.68
Delta	2.62	0.99	1.56
Range	1	3	2

Multi-response optimization through SAW method

In the extraction of bioactive substances from onion peel, there were no common optimization conditions for the responses. $A_2B_3C_2$ for TFM, $A_2B_1C_2$ for TMA, and $A_2B_3C_2$ for DPPH (%) were found to be the optimum conditions. In these conditions, the sample providing the best-targeted properties among the available specimens was determined by the SAW method and the results are given in Table 5. The results show that sample 4 ($A_2B_1C_2$), which has the highest score (0.974) in the ranking, represents the optimal extraction process for all three responses.

Table 6. SAW results for optimization of bioactive component extraction

Sample	Normalized values			Weighted normalized values			Results	
	TPC	TMA	DPPH	TPC (0.419)*	TMA (0.146)*	DPPH (0.436)*	Score	Range
1	0.873	0.610	0.738	0.366	0.089	0.322	0.776	7
2	0.914	0.446	0.969	0.383	0.065	0.423	0.871	4
3	0.984	0.698	1.000	0.412	0.102	0.436	0.950	2
4	0.986	1.000	0.950	0.413	0.146	0.414	0.974	*1*
5	0.961	0.528	0.833	0.402	0.077	0.363	0.843	5
6	1.000	0.584	0.911	0.419	0.085	0.397	0.902	3
7	0.918	0.542	0.714	0.385	0.079	0.311	0.775	8
8	0.733	0.607	0.572	0.307	0.089	0.250	0.645	9
9	0.979	0.556	0.715	0.410	0.081	0.312	0.803	6

*Weight values determined by principal component analysis (PCA).

Conclusion

In this study, extraction conditions were optimized by the Taguchi-SAW hybrid method for an extract rich in phenolics and anthocyanins and high antioxidant activity from onion peel rich in bioactive components. Individual responses in the extraction process were successfully optimized by Taguchi optimization. Multiple response optimization was also performed successfully with the SAW ranking method. It is recommended to verify the success of this hybrid technique by comparing it with alternative optimization methods such as the response surface method, genetic algorithm, and fuzzy logic.

Acknowledgments

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ID: 79

The Effect of Different Pollen Sources on Colony Foundation Success of Bumblebees (*Bombus terrestris* L.)

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Abstract

In this study, different pollen sources used to investigate colony foundation success of bumblebees. 120 *Bombus terrestris* L. queens are used to form 6 feeding groups. Poppy pollen, chestnut pollen, cistus pollen and their difloral mixes (1 / 1 ratio) are used as feeding groups. The groups are also fed with ad-libitum sugar syrup (50% brix value). As a result of the research; pollen consumption ($P<0.01$), worker bee emergence time ($P<0.05$) and number of worker bees in the first brood ($P<0.01$ were statistically significant between the groups.

In conclusion; poppy – chestnut pollen mixture with highest number of worker bees in the first brood, can be recommended in commercial bumble bee breeding. New researches are needed to determine the most appropriate ratio of this mixture.

Keywords: *Bombus terrestris L., colony foundation success, feeding, pollen*

ID:81

The Influence of Feather Score on Some Blood Parameters of Laying Hens

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Abstract

The objective of the study was to investigate the effect of feather score on some blood parameters of laying hens. In the study, a total of 45 birds (Lohmann Brown strains) were randomly selected from a 60 weeks-old flock and grouped based on total feather scores obtained from scoring 6 different body parts of the birds: the head, neck, breast, back, wings, and tail. According to the total feather score, the experimental groups consisted of low (6-12, average 10, L), medium (13-17, average 15.40, M) and high (18-24, average 18.87, L). The number of lymphocytes, monocytes, heterophils, eosinophils, basophil cells and heterophil/lymphocyte ratio (H/L) were determined. The results indicated that feather score had a significant influence on and monocyte, heterophil ($P<0.001$), but the impact on H/L ratio, lymphocyte and eosinophil was not significant ($P>0.05$). While the H/L ratio and heterophil decreased with the increase in feather scores, the monocytes increased with the increase in feather score. The H/L ratio of the H group was lower compared to M and L groups however, the L group had the highest H/L ratio value of 0.51, which is considered as an indicator of moderate stress.
In conclusion, the findings of this study revealed that an average feather score of more than 10 was not very stress-inducing to the birds.

Keywords: *Laying hen, feather score, blood parameters, stress response*

ID: 82

Emerging trends in the utilization of hydrocolloids for the formation of oleogels

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Abstract

Chocolate, ice cream, butter, margarine, meat, and bakery products are examples of foods that contain solid fat in their structure. Solid fats are added to these foods, which are often preferred as part of daily nutrition, to make them more stable in terms of texture and oxidation. Studies have shown that these fats, which contain saturated and *trans*-fatty acids, cause cardiovascular diseases. Oleogelation creates structured solid-like materials by entrapping oil in a thermo-reversible and three-dimensional gel network. Oleogels made from functional oils have been the topic of recent studies into the minimization of saturated and trans fats in foods. Oleogelification gives oils semi-solid qualities without changing their chemistry. Gelling agents are necessary to give oleogels the structure of solid fat. Wax, monoglycerides, phytosterols, ceramides, and lecithin are some of the low molecular oleogelators used to structure edible oleogels. Low molecular oleogelators, on the other hand, may have limited commercial use because of their high sensitivity to temperature and shear, as well as the comparatively large concentrations required. In consideration of this, researchers have recently become interested in high molecular oleogelators (food hydrocolloids) as a possible alternative. Hydrocolloids can be used in biphasic systems to form oleogel, at the oil-in-water (emulsion type) or air-in-water (foam method) interface. The most used hydrocolloids for this purpose are gelatin, xanthan gum, arabic gum, citrus pectin, methylcellulose, and hydroxymethyl cellulose.

Keywords*: Solid fat, oleogels, hydrocolloids.*

ID: 83

Effect of Organomineral and Chemical Fertilizer Application on Available Phosphorus Content in a Soil With High Calcareous

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Abstract

Turkey's soils are generally alkaline and calcareous. Approximately 70-90% of the phosphorus applied to the alkaline and calcareous soils phosphorus (P) becomes unavailable forms by plants. Therefore, there is a need for forms of fertilizer that can provide greater uptake of phosphorus fertilizers by plants. However, there is not enough study about the effect of organomineral fertilizer and chemical fertilizer applications on the soil P content. The aim of this study was to determine the effect of chemical (DAP; 18% N, 46% P_2O_5) and organomineral (OMG; OM 15%, N 8%, P_2O_5 20%, SO_3 10%, 10% Humic + Fulvic acid) on available P in soils. The experiment was designed as a randomized plot design with three replications. Soil samples were taken on 1, 15, 3, 60, 90. Days, and the available P contents were determined in soils. According to the obtained data, the high average available P content of the soils was obtained in the samples taken on the 1st day and the lowest on the 90th day. The available P content in the soils decreased with by the time. The effect of fertilizer forms (OMG and DAP) on the average available P content of soils was statistically significant at $p < 0.01$ level. When DAP fertilizer and OMG fertilizer were compared, depending on time the available P contents of the soils were 16-21% higher in OMG fertilizer applications. However, detailed studies in different ecologies are needed.

Keywords: *Organomineral fertilizer, chemical fertilizer, phosphorus, calcareous soil.*

Yüksek Kireçli Bir Toprağa Organomineral Ve Kimyasal Gübre Uygulamasının Alınabilir Fosfor İçeriğine Etkisi

Özet

Türkiye toprakları genellikle alkalin ve kireçlidir. Alkalin ve kireçli topraklara uygulanan fosforun yaklaşık % 70-90 bitkilere alınamaz hale dönüşmektedir. Bu nedenle, fosforlu gübrelerin bitkiler tarafından daha fazla alımını sağlayabilecek gübre formlarına ihtiyaç vardır. Ancak organomineral gübre ile kimyasal gübrelerin topraklarda alınabilir içeriği konusunda yeterli çalışma yoktur. Bu çalışmanın amacı; topraklara uygulanan fosforlu kimyasal (DAP; % 18 N, %46 P_2O_5) ve organomineral (OMG; OM % 15, N % 8, P_2O_5 % 20, SO_3 % 10, % 10 Humik+Fulvik asit) gübrelerin zamana bağlı olarak topraklarda alınabilir fosfor içeriğine etkisini belirlemektir. Deneme tesadüf parselleri deneme desenine göre üç tekerrürlü olarak kurul muş olup, 1, 15, 30, 60 ve 90. günlerde toprak örnekleri alınarak alınabilir P içerikleri belirlenmiştir. Elde edilen verilere göre, toprakların ortalama P içeriği, en yüksek 1. günde, en düşük ise 90. günde alınan örneklerde elde edilmiş olup zamana bağlı olarak topraklarda alınabilir P içeriği azalmıştır. Toprakların ortalama alınabilir P içeriğine gübre formalarının (OMG ve DAP) etkisi istatistiksel olarak $p<0.01$ düzeyinde önemli bulunmuştur. DAP gübresi ile OMG gübresi karşılaştırıldığında, OMG gübresi uygulamalarında zamana bağlı olarak toprakların alınabilir P içeriği %16-21 daha yüksek bulunmuştur. Ancak bu konuda farklı ekolojilerde detaylı çalışmalara ihtiyaç vardır.

Anahtar sözcükler*: Organomineral gübre, kimyasal gübre, fosfor, kireçli toprak.*

Giriş

Türkiye'de tarımsal üretimi kısıtlayan en önemli toprak faktörleri yüksek pH, kireç ve düşük organik madde içeriğidir. Bitki besleme ve toprak verimliliği açısından ideal toprak pH'sı 6.0-7.5 arasında, kireç içeriği %5 'in altında, organik madde içeriği ise % 3'ün üzerinde olmalıdır. Toprakların pH ve kireç içeriğinin yüksek, organik madde içeriğinin düşük olması topraklarda fosforun ve mikro besin elementlerinin (Fe, Zn ve B vb) bitkiler tarafından alınamaz forma dönüşmesine, azotun ise gaz formuna dönüşerek uçmasına neden olmaktadır.

Türkiye topraklarının % 81'nin pH değeri 7.0'den fazla (Usta, 1995), % 63'nün pH değeri 7.5'ten büyüktür (Eyüpoğlu, 1999).Toprakların pH değerinin yüksek olması bitki besin maddelerinin bitkiler tarafından alımını azaltmakta makro (P) ve mikro bitki besin maddelerinin (Fe,Cu, Zn ve B vb.) topraklarda alınamaz konuma dönüşmesine neden olmaktadır.

Türkiye topraklarının % 25.14'nün kireç içeriği % 5-15, % 16.65'nin kireç içeriği %15-25 ve % 16.83'nün kireç içeriği >% 25'tir. Türkiye topraklarının % 58.6'nın kireç içeriği %5'ten yüksektir (Eyüpoğlu, 1999).

Toprakların kireç içeriği arttıkça bitki besleme sorunları başlamakta ve uygulanan besin maddelerinin bitkiler tarafında alınabilirliği azalmaktadır. Toprakların kireç içeriğini fazla olması azotlu gübrelerin amonyak formuna dönüşerek atmosfere gaz şeklinde uçmasına, fosforun ve mikro elementlerin ise kireç ile reaksiyona girerek bitkiler tarafından alınamaz konuma dönüşmesine neden olmaktadır (Turan ve Horoz, 2012).

Ülkemizde Toprak ve Su Kaynakları Arş. Ens. tarafından1990'lı yıllarda yapılan araştırmada, Türkiye topraklarının % 65'nin organik madde içeriği % 2'nin altında, % 88'nin organik madde içeriği ise %3'ün altında olduğu rapor edilmiştir (Eyüpoğlu, 1999). Yine 2011-2014 yılları arasında 10 bin adet toprakta yapılan analizlerde topraklarımızın % 99'nun organik madde içeriğinin %3'ten daha az olduğu bildirilmiştir (Güçdemir, 2006).

Toprakların pH ve kireç içeriğinin yüksek, organik madde içeriğinin düşük olduğu topraklara uygulanan fosforun ancak, % 10-30 bitkiler tarafından alınabilirken, % 70-90' ı bitkiler tarafından alınamaz konuma dönüşmektedir. Topraklarda fosfor fiksasyonunu azaltmak ve bitkiler tarafından topraklardan fosfor alımını artırabilmek için yüksek pH değerine sahip (pH>7.5) toprakların pH değerinin düşürülmesi, kireçli topraklara kükürt uygulanması ve toprakların organik madde içeriğinin artırılması gibi uygulamaların etkili olacağı vurgulanmaktadır (Güneş ve ark., 2000).

Karaca ve ark. (2006), gidya ve gübre (NP) uygulamasının toprakların mikrobiyolojik özelliklerinin üzerine etkisi konusunda yaptıkları inkübasyon denemesinde, gidya ve gübrenin birlikte verildiği uygulamalarda toprakların organik madde içeriğinin, mikrobiyal biyokitlenin ve enzim aktivitesinin olumlu yönde arttığını rapor etmiştir. Aynı çalışmada gidya ve gübre uygulaması ile üreaz, fosfataz, ß-glukosidaz enzim aktivitelerinin arttığı, bu artışların toprak kalitesini olumlu yönde etkilediği bildirilmiştir.

Çöteli ve ark. (2008), Elbistan linyitinden üretilmiş çeşitli humatlar ve organik kökenli organomineral gübrenin (8-6-1-8) sera koşullarında yetiştirilen mısır bitkisinin kök ve gövde gelişimine etkisi konusunda yaptıkları çalışmada, organomineral gübrenin bitki gelişimine daha etkili olduğunu bildirmişlerdir.

Edirne'de kuru koşullarda Selimiye kışlık ekmeklik buğday çeşidi kullanılarak yürütülen çalışmada, farklı kimyasal taban gübreleri ve değişik oranlarda NPK+S içeren organomineral gübreler kullanılmış ve hepsine ilkbaharda üst gübre olarak kardeşlenmede 15 kg/da üre, sapa kalkma devresinde de %33 N içeren 15 kg/da Amonyum Nitrat gübresi verilmiş, 12N:12P:0K+12S içerikli organomineral gübre uygulamasından 636 kg/da ortalamayla en yüksek tane verimi elde edilmiştir (Süzer ve Çulhacı, 2017).

Farklı organik gübre uygulamaları ile toprakta bulunan fosforun aktivitesi konusunda yapılan çalışmada; topraklara uygulanan organik maddenin ayrışması ile ortaya çıkan organik asitlerin; asit topraklarda bitkiler tarafından alınamaz konumda olan Al-P ve Fe-P bileşiklerini, alkalin topraklarda Ca-P bileşiklerini aktive ettiğini, böylece toprak çözeltisinde bitkiler tarafından alınabilir P miktarını artmasına neden olduğu ifade edilmiştir (Zhang ve ark., 2009).

Bitkilerin beslenmesinde mutlak gerekli olan besin maddesinden birisi fosfor (P)' dur. Fosfor bitkide cereyan eden sayısız fizyolojik ve biyokimyasal reaksiyonlarda görev almakta ve optimum bitki gelişimi için bitki kuru ağırlığının yaklaşık % 0.25-1.00'sini oluşturması gerekir (Alparslan ve ark., 1998). Bitkiler fosforu temelde orto fosfat anyonu şeklinde alırlar. Topraklarda pH 7,1'den düşük olursa bitkiler primer ortofosfat (H_2PO_4), pH 7,1'den yüksek olursa sekonder ortofosfat (HPO_4^{-2}) anyonları formunda alınırlar (Lindsay, 1979).

Toprakların organik madde içeriğini artırabilmek için koruyucu toprak işleme, anız artıklarının toprağa karıştırılması, çeşitli organik materyallerin (leonardit, hayvan gübresi, kompost vb.) uygulanması, yeşil gübrelemenin yapılması ve organomineral gübre kullanımının yaygınlaştırılması gereklidir.

Organomineral gübreler (OMG); kimyasal gübreler ile organik materyallerin (kompost veya leonardit) belli oranlarda tekniğine uygun olarak karışımı ile elde edilmektedir. Erdal (2018), organomineral gübrelerde bitki besin maddelerinin bir kısmının organik maddeye bağlanması nedeniyle besin maddesi kayıplarının ve topraklar tarafından alınamaz konuma dönüşme oranının azaldığını, böylece organik gübrelerin verim ve kaliteyi artırdığını rapor etmiştir. Aynı zamanda, ülkemizde organomineral gübrelerin etkinliği ve topraklardaki reaksiyonları konusunda detaylı çalışmalara ihtiyaç olduğunu vurgulamıştır.

Bu çalışmanın amacı, pH değeri 8.03, kireç içeriği %53 ve organik madde içeriği %1.7 olan bir toprağa; organomineral (OMG; OM % 15, N % 8, P_2O_5 % 15, SO_3 % 10) ve kimyasal gübre (DAP; N % 18, P_2O_5 % 46) uygulayarak zamana bağlı olarak topraklarda alınabilir P içeriğini değişimini incelemektir.

Materyal ve Yöntem

Araştırmada kullanılan toprak ve gübrelerin özellikleri

Bu çalışmada, alkalin (pH; 8.03), yüksek kireçli ($CaCO_3$; % 53) ve düşük organik madde (OM) içeriğine sahip toprak (OM; % 1.7) materyal olarak kullanılmıştır. Araştırmada Organomineral (OMG; 8-20) ve diamonyumfosfat (DAP) gübreleri kullanılmıştır. Organomineral gübresi % 15 organik madde, % 8 azot, % 20 P_2O_5, %10 SO_3, % 10 Humik+Fulfik Asit içermekte olup leonardit esaslı bir OMG gübresidir. DAP gübresi %18 azot ve %46 P_2O_5 içermektedir.

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Denemenin kurulması ve yürütülmesi

Denemede pH değeri 8.03, kireç içeriği % 53 toprak kullanılmıştır. Deneme için kullanılacak topraklar 2 mm elekten geçirildi, 1 kg toprak alabilen saksılara kondu. Topraklara 0, 5, 10 ve 20 kg fosfor (P)/da hesabına göre fosfor uygulandı. Denemede kullanılan kimyasal gübre DAP (P_2O_5 % 46, N %18 içerir) ve organomineral gübre (OMG; OM % 15, N % 8, P_2O_5 % 15, SO_3 % 10, % 10 Humik+ fulvik asit) 250 ml suda eritilerek topraklara uygulandı. Uygulama sırasında bütün toprağın su ile ıslanması sağlandı. Denemenin 1.,15., 30., 60. ve 90. günlerinde örnekler alınarak, topraklarda bitkilere alınabilir P belirlendi. Deneme tesadüf parselleri deneme desenine göre saksılarda üç tekerrürlü olarak yürütüldü.

Toprak örneklerinde yapılan bazı fiziksel ve kimyasal analizler

Toprak bünyesi bouyoucus hidrometre yöntemi ile belirlenmiştir (Bouyoucus, 1951). Toprak reaksiyonunu ve EC , saturasyon çamurunda pH metre ve EC cihazı ile yapılmıştır (Thomas, 1996). Toplam kireç miktarı; Scheibler Kalsimetresi ile Allison and Moodie (1965) tarafından önerilen yönteme göre yapılmıştır. Toprak organik madde içeri Walkley-Black yöntemine göre yapıldı (Nelson ve Sommers (1996) . Topraktaki yarayışlı fosfor içeriği, Olsen ve ark. (1954), tarafından önerilen yönteme göre belirlenmiştir.

İstatistik değerlendirme

Araştırmalar sonucunda elde edilen verilerin varyans analizinde ANOVA testi kullanıldı, elde edilen verilerin ortalamaları arasındaki farkların belirlenmesinde $p<0,05$ düzeyinde çoklu karşılaştırma testi olan Tukey testi uygulanmıştır. Analizlerde JMP 7.0 istatistik programı kullanılmıştır.

Bulgular ve Tartışma

Araştırma Kullanılan Topraklarının Bazı Fiziksel ve Kimyasal Özellikleri

Denemede kullanılan topraklarının bazı fiziksel ve kimyasal özellikleri Çizelge 1'de verilmiştir.

Çizelge 1. Denemede kullanılan toprakların özellikleri

	pH(SÇ)	%Tuz	işba	%Kireç	% OM	%Kil	%Silt	%Kum
Toprak	8.03	0.06	54	53	1.7	2639		35

Denemede kullanılan toprakların özellikleri çizelge 1'de görüldüğü gibi; toprakların pH değeri 8.03 olup orta alkalin, kireç içeriği % 53 olup çok fazla kireçli sınıfındadır. Denemede kullanılan topraklar organik madde içeriği (%1.7) bakımından sınıflandırıldığında ise az sınıfındadır (Güçdemir, 2006).

Kimyasal (DAP) ve Organomineral Gübre (OMG) Uygulamasında Toprakların Alınabilir P İçeriği

Araştırmada gübre formu olarak DAP (18-46, % 18 N, % 46 P_2O_5) ve OMG (8-20, % 8 N, % 20 P_2O_5, % 15 OM, % 10 SO_3) gübreleri kullanılmıştır. Farklı gübre form ve dozlarının zamana bağımlı olarak alınabilir P içeriğine etkisine ait istatistiksel değerlendirmesi ve önem düzeyleri Çizelge 2'de verilmiştir.

Çizelge 2. Farklı gübre form ve dozlarının zamana bağlı olarak alınabilir P içeriğine etkisine ait istatistiksel değerlendirme

Varyasyon Kaynağı	Doz**	Form**	Zaman**	Zaman x Doz**	Doz x Form**	Zaman x Form*	Zaman x Doz x Form*	Hata	VK
Serbestlik Der.	3	1	4	12	3	4	12	78	0.06
Kareler Ort.	2925.19	403.33	185.55	34.87	66.68	3.93	3.99	1.54	

*;p<0.05 düzeyinde, **;p<0.01 düzeyinde önemlidir.

Zaman x Form x Doz interaksiyonlarına ait ortalamalar ve Zaman x Form interaksiyonlarına ait ortalamalar Çizelge 5'de verilmiştir. Buna göre üçlü interaksiyon ortalamaları "a" değerinden "s" değerine kadar değişmektedir. Yine, ikili interaksiyonlar; Zaman x Form interaksiyonlarına ait ortalamalar "A" değerinden "G" değerine kadar değişmektedir. Bu da uygulama formları arasında önemli varyasyonların olduğunu göstermektedir. Genel olarak, OMG ve DAP gübresi uygulanan topraklarda alınabilir P içeriği, fosforlu gübre uygulanmayan kontrol topraklarına göre daha yüksektir ($P<0.01$). Toprakları alınabilir P içeriği uygulama dozuna bağlı olarak da artış göstermiştir ($p<0.01$).

Toprakların zamana bağlı olarak alınabilir P içeriği Çizelge 3'de verilmiştir. İki gübre formunun zamana bağlı olarak ortalama değerleri alındığında, topraklarda alınabilir P içeriği başlangıçta en yüksek olup zaman ilerledikçe azalmaktadır. Toprakların alınabilir P içeriğindeki azalma istatistiksel olarak $P<0.01$ düzeyinde önemli bulunmuştur (Çizelge 2 ve 3)

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Çizelge 3. Toprakların alınabilir P içeriğinin zamanla değişimi

Zaman (gün)	Fosfor (P)
1	21.85a
15	19.22b
30	17.73c
60	16.02d
90	14.74e

Zaman p<0.01. Aynı harfle gösterilen ortalamalar arasında fark yoktur (Tukey p<0.05)

Topraklarda fosforun farklı formlarda bulunmakta olup, topraklarda $NaHCO_3$ ile ekstrakte edilebilen fosforun yüksek ve düşük pH koşullarında farklı fosfat formlarını oluşarak zamanla azalmaktadır (Yusran, 2010; Saltalı ve Nedirli, 2021). Kashem ve ark. (2009), labil-P olarak nitelendirilen (Suda çözünebilir P ve $NaHCO_3$ ile ektrakte edilebilir P) P fraksiyonlarının zamanla azaldığını, buna karşın bitki besleme açısından daha az labil olarak değerlendirilen NaOH ve HCI ile ektrakte edilebilir P fraksiyonların ise arttığını saptamıştır.
Topraklara farklı gübre formunda P uygulamasının, toprakların ortalama alınabilir P içeriğine etkisi istatistiksel olarak p<0.01 düzeyinde önemli bulunmuştur (Çizelge 4).

Çizelge 4. Farklı formların, alınabilir P miktarı (mg kg^{-1}) üzerine ayrı ayrı etkileri

Form	Fosfor (P)
OMG	19.74a
DAP	16.08b

Form p<0.01. Aynı harfle gösterilen ortalamalar arasında fark yoktur (Tukey p<0.05)

Elde edilen verilere göre farklı gübre formların ortalama değerleri dikkate alındığında, gübre formları arasında alınabilir P farkı 3.66 mg kg^{-1}' olup iki form arasında % 18.5 fark vardır. Bu durum, DAP ile uygulanan P'un toprak bileşenleri ile zamanla reaksiyona girerek bitkilere alınamaz hale dönüştüğü, OMG uygulandığında ise bitkilere alınmaz hale dönüşme oranının daha az olmasından kaynaklanabilir. Aynı zamanda, OMG uygulamasında gübrenin toprak ile temas yüzeylerinde mikrobiyal aktivitenin artışına ve fosfor adsorbe yüzeylerin organik bileşikler ile maskelenmesi de etkili olabilir. Farklı organik kökenli materyallerden elde edilen organomineral gübrenin (8-6-1-8), kimyasal gübrelere göre daha etkili olduğu bildirilmiştir (Çöteli ve ark.,2008;), Ahmed et al. (2019), ise fosfor içeren kimyasal gübrelerin hayvan gübreleri ile kombine edilerek uygulanması sonucu topraklarda alınabilir P içeriğini arttığını bildirmişlerdir. Organik gübreler ile mineral gübrelerin deneme materyali olarak kullanıldığı farklı çalışmalarda; mineral gübrelemenin mikrobiyal populasyonu etkilemediğini (Cruz et al. 2009), organik kökenli gübrelerin ise mikrobiyal popülasyonu ve aktiviteyi artırdığını (Bünemann et al. 2004; Hamel et al. 2006). Topraklara gübreleme amaçlı olarak uygulanan fosforu hızlı bir şekilde fikse edebilen topraklara, organik maddenin uygulanması ya da fosforlu gübrelerin organik bileşikler ile karıştırılarak uygulanmasıyla, topraklarda bitkiler için alınabilir P içeriğinin arttığı rapor edilmiştir (Guppy and Menzeis, 2005). Farklı gübre formları ve dozları uygulamalarında, zamana bağlı olarak alınabilir P içeriğindeki değişim Çizelge 5'de verilmiştir.

Çizelge 5. Farklı gübre formları ve dozları uygulamalarında, zamana bağlı olarak alınabilir P değişim

Uygulama Dozları ($kgda^{-1}$)										
Zaman	OMG					DAP				
	0 $kgda^{-1}$	5 $kgda^{-1}$	10 $kgda^{-1}$	20 $kgda^{-1}$	Ort.	0 $kgda^{-1}$	5 $kgda^{-1}$	10 $kgda^{-1}$	20 $kgda^{-1}$	Ort.
1.	8.15s	15.8l-o	31.44c-e	40.32a	23.9A	8.15s	12.8n-r	21.54ı-k	36.54ab	19.8C
15.	11.8o-s	14.6m-p	28.33e-g	34.83bc	21.5B	8.15s	11.8o-s	18.91kl	28.91d-g	16.9DE
30.	8.04s	13.2n-q	25.05g-ı	32.49b-d	19.7C	8.04s	10.2q-s	18.87kl	25.86f-h	15.8EF
60.	8.15s	11.3p-s	21.31ı-k	29.47d-f	17.6D	8.15s	9.20q-s	16.54l-n	24.05h-j	14.5FG
90	8.03s	10.8p-s	18.57k-m	26.64f-h	16.0DF	8.03s	9.01rs	15.77l-o	20.96jk	13.4G
Ort.	8.83G	13.18E	24.94C	32.75A		8.10G	10.62F	18.33D	27.26B	

Küçük harfler interaksiyon gruplarını, büyük harfler ise grupların ortalamalarını ifade etmektedir. Aynı harfle gösterilen ortalamalar arasında fark yoktur. *; p<0.05 düzeyinde, **;p <0.01 düzeyinde önemlidir. Aynı harf ile gösterilen ortalamalar arasında fark yoktur (Tukey p<0.05).

Her iki gübre formu ve dozunda zamana bağlı olarak ortalama alınabilir P içeriği başlangıçta en yüksek olup zaman ilerledikçe azalmaktadır. Toprakların alınabilir P içeriğine farklı gübre formları, doz ve zamanın kombine etkisi Çizelge 5'de verilmiştir. Araştırmada, 3'lü interekasiyon bakımından yapılan istatiksel analizler sonucunda, zaman x doz x form interasiyonun p<0.05 düzeyinde önemli bulunmuştur (Çizelge 5). Toprakların alınabilir P içeriği en yüksek 1. günde alınan topraklarda (OMG;23.9, DAP;19.8 $mgkg^{-1}$) elde edilirken, en düşük P içeriği ise 90 günde alınan topraklarda (OMG;16.0, DAP;13.4 $mgkg^{-1}$) bulunmuştur. Gübre formları

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ortalamalarının zamanla değişimi incelendiğinde, 1. 15. 30. ve 60. ve 90. günlerde ortalamalar istatistiksel olarak birbirinden farklıdır.

Örnek alınan tüm zamanlarda, OMG gübre uygulamalarında topraklarda alınabilir P içeriği, DAP gübre uygulamasında elde edilen P içeriğine göre daha yüksektir. OMG gübre uygulamasında 30. günde toprakların alınabilir P içeriği ile DAP uygulamasında ise 1. günde alınabilir P içeriği istatistiksel olarak farksız olup aynı grupta yer almaktadır. Benzer durum, OMG uygulamasında 90. günde toprakların alınabilir P içeriği ile DAP uygulamasında 15 ve 30. günde alınan toprakların alınabilir P içeriği için de geçerlidir. Bu durum, OMG ve DAP gübre uygulamaları karşılaştırıldığında, topraklarda alınabilir P içeriğinin bitkilerin alamayacağı forma dönüşme olasılığının DAP gübresi uygulamasında hızlı, OMG gübre uygulamasında daha yavaş olduğunu göstermektedir. OMG uygulamalarında P adsorpsiyonun yavaş olması, OMG gübresinin %15 OM, %10 SO_3 ve % 10 Humik+ fulvik asit içermesi nedeniyle, toprak bileşenlerinin adsoprsiyon yüzeyleri için organik bileşiklerin fosfor iyonları ile rekabete girmesinden kaynaklanabilir.

Yüksek pH ve kireçli topraklarda serbest hale gelen P iyonları daha hızlı bir şekilde toprak bileşenleri (kireç, kil, oksit bileşikleri vb) ile reaksiyona girmekte ve zamanla çökelerek bitkiler tarafından alınamaz hale gelebilmektedir. Böylece topraklara uygulanan P'lu gübreleri bitkilerin kullanın etkinliği azalmaktadır. Farklı özelliklere sahip topraklara fosfor uygulanarak yapılan çalışmalarda, topraklarda zamanla alınabilir P içeriğinin azaldığı bildirilmiştir (Lindsay, 1979; Mengel ve Kirby, 2001). Topraklarda alınabilir P içeriğinin zaman bağlı olarak değişimi konusunda yapılan diğer bir çalışmada, uygulanan fosforun zamana (30., 60., 90., 120., 150. ve 180. gün) bağlı olarak azaldığı, 30. günde en yüksek, 180. günde en düşük olduğu saptanmıştır (Sharpley ve ark., 1989). Kireçli topraklara uygulanan fosforun topraklardaki reaksiyonlarının araştırıldığı bir çalışmada ise, uygulanan fosforun Ca-fosfatlar şeklinde çökeldiği, çökelme sürecinde önce di-kalsiyum-fosfat-dihidrat gibi çözünebilir formlara, zamanla daha zor çözünebilen okta-kalsiyum-fosfat ve tri-kalsiyum-fosfat formlarına, en sonunda ise hidroksi-apatit formuna dönüştüğü bildirilmiştir (Lindsay, 1979). Toprakların alınabilir P içeriği toprak pH'sı, Fe+Al oksitler, kireç içeriği, kil tipi ve miktarı gibi faktörler etkilemektedir. Yüksek pH değerine sahip topraklarda fosfor Fe+Al oksitler ve kireç ile reaksiyona girerek alınamaz konuma dönüşmektedir (Kuo, 1990).

OMG gübresi ile DAP gübresi uygulamasında zamana bağlı olarak topraklarda alınabilir P içeriğindeki değişim % olarak karşılaştırıldığında; OMG gübresi uygulanan topraklarda alınabilir P içeriği DAP gübresine göre; 1. günde %17.15, 15. günde % 21.4, 30. günde % 19.8, 60. günde % 17.6 ve 90. günde %16.2 daha yüksek bulunmuştur. Orta alkalin ve çok fazla kireçli topraklarda elde dilen bu verilere göre, P'lu gübreler OMG formunda uygulandığında DAP gübresine göre toprakların alınabilir P içeriği %16-21 arasında daha fazladır. Bu durum, yüksek kireçli ve alkalin topraklara uygulanan OMG gübresinin, DAP gübresine göre daha fazla alınabilir fosfor sağlayabileceğini yansıtmaktadır.

Diğer taraftan, hafif tekstürlü topraklarda ise alınabilir P, yüzey sulama suları yada toprak profilinde derine sızan sular ile yıkanma riski taşımaktadır (Hussain ve ark., 2021). Böyle risk durumlarında, bitkilerin fosfor ile beslenmesi açısından OMG gübre uygulamalarında, DAP gübresine göre yaklaşık %18 daha az gübre uygulaması alternatifi değerlendirilebilir. Daly ve ark. (2001), organik madde ile peat topraklarının P adsorpsiyon kapasitesi arasında negatif bir ilişkinin olduğunu, organik maddenin topraklardaki P adsorpsiyonunu engelleyebileceğini belirtmiş ve peat topraklarının düşük adsorpsiyon kapasitelerini bu toprakların sahip olduğu yüksek organik madde ile ilişkilendirmişlerdir.

Sonuçlar Ve Öneriler

Bu çalışmada, alkalin ve çok fazla kireçli topraklara kimyasal (DAP) ve organomineral (OMG) gübre formunda P uygulamasının, zamana bağlı olarak toprakların alınabilir P içeriğine etkisi araştırılmıştır. Toprakların ortalama P içeriği, en yüksek 1. günde, en düşük ise 90. günde alınan örneklerde elde edilmiş olup zamana bağlı olarak topraklarda alınabilir P içeriği azalmıştır. Toprakların ortalama alınabilir P içeriğine gübre formalarının (OMG ve DAP) etkisi istatistiksel olarak $p<0.01$ düzeyinde önemli bulunmuştur.

DAP gübresi ile OMG gübresi karşılaştırıldığında, OMG gübresi uygulamalarında zamana bağlı olarak toprakların alınabilir P içeriği %16-21 daha yüksek bulunmuştur. Orta alkalin ve çok fazla kireçli topraklarda elde dilen verilere göre; topraklara OMG formunda P'lu gübre uygulaması planlandığında, kimyasal gübrelere göre daha az P_2O_5 uygulaması önerilebilir. Ancak, farklı toprak koşullarında ve ekolojilerde bu oran değişebilir. Bu nedenle, farklı iklim ve toprak koşullarında tarla denemelerinin yapılması ve elde edilen sonuçlara göre önerilerin yapılması gerekir.

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Kreuzberg Koruyucu Kent Yenilemesi İlkelerinin Tepebağ-Kayalıbağ Özelinde İncelenmesi

Elife Büyüköztürk, Murat Oral

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Özet

Kentlerin çöküntü alanı haline gelmiş olan bölgelerinin yenilenerek yeniden kentle birleştirilmesi; kente tekrar geri kazandırılmasını sağlayan kentsel yenileme, günümüzde sıkça kullanılan bir terimdir. Çöküntü haline gelmiş bu alanların fiziksel ve sosyal olarak yenilenerek, yeniden canlandırılması gerekmektedir. Kentsel yenileme çalışmalarında asıl amaç; soyutlanmış olan yaşam alanlarının yeniden kent ile bütünleştirilmesidir. Bu bütünleşme sadece fiziksel ve ekonomik olarak değil, sosyal ve kültürel olarak da gerçekleştirilmelidir.

Almanya'da bulunan Kreuzberg Bölgesi, II. Dünya savaşında büyük hasarlar görmüş, zamanla çöküntü bölgesi haline dönüşmüştür. Bölgede 1961 yılından itibaren uygulanmakta olan "Koruyucu Kent Yenileme" yöntemi; 12 temel ilkesiyle kentsel yenileme çalışmalarında önemli bir yere sahiptir.

Adana ilinde bulunan tarihi kent merkezini teşkil eden Tepebağ-Kayalıbağ mahalleleri içerisindeki kentsel yenileme çalışmaları ise henüz sürecin çok başındadır. Alanda sokak sağlıklaştırma çalışmaları kapsamında birkaç proje yapılmıştır, ancak bunların yetersiz olduğu düşünülmektedir.

Bu çalışmada amaç; "Koruyucu Kent Yenilenme" yönteminin değerlendirmesi ve bu yöntemin 12 ilkesinin Adana'da korunması gerekli önemli bir tarihsel doku olan Tepebağ-Kayalıbağ kesimine nasıl uygulanabileceği hakkında bir deneme yapılmasıdır.

***Anahtar Kelimler**: Kentsel Yenileme, Kreuzberg Bölgesi, Adana Tepebağ-Kayalıbağ*

ID: 85

Economics of System of Rice Intensification Technology Usage among Rice Farmers in Nigeria

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Abstract

Rice production in Nigeria is produced using traditional methods, which made it more difficult for farmers to reach their full output capacity. Modern methods such as the system of rice intensification (SRI) was created in the rice-growing industry to increase productivity. However, there are limited studies on the economic viability of SRI technology and the factors influencing its usage among farmers in Nigeria. Therefore, this study examined the costs and returns, and factors influencing the adoption of SRI among rice farmers in Nigeria. We used a questionnaire to collect the relevant information needed for the study from 180 rice farmers that adopt SRI technology. Descriptive statistics, costs and returns analysis, and multivariate logistic regression were methods of data analysis. The results of the study revealed that the majority of the rice farmers using SRI technology in Nigeria were males who are within the economically active age. The rice farmers that adopted SRI technology made a profitability ratio of 0.41, a benefit-cost ratio of 1.68 and a gross margin of USD 370.55 per hectare of land cultivated. These imply that the use of SRI technology in rice farming is profitable. Furthermore, educational level, household size, association membership, farming experience, and the availability of extension services were the determinants of the use of SRI technology. This research call for the promotion of SRI technology through farmers' participation in training programs, extension demonstrations and knowledge exchange.

***Keywords**: Adoption, profitability, rice farming, system of rice intensification, technology*

ID: 86

Driving Factors for Agricultural Graduates' Involvement in Agribusiness Enterprise in Nigeria

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Abstract

Eradicating the high level of youth unemployment remains a global challenge, especially in sub-Saharan Africa. Despite a high volume of literature on youth involvement in agriculture, agricultural graduates have received little research attention. Therefore, this study assessed agricultural graduate involvement in agribusiness enterprises to fill the research gap. Data were collected from 200 agricultural graduates who were randomly selected. Descriptive statistics and logistic regression were methods of data analysis. The results revealed that, unlike other youths, agricultural graduates had a positive opinion about agriculture. Although just about half were involved in agribusiness, almost all of them were willing to engage in it if supplied with production resources, especially land and capital for start-ups. Family land, access to credit, perceived benefit, attitudes, location, and gender significantly influenced agricultural graduates' participation in agribusiness. To be self-employed and employer, to be financially independent, to be food secure, due to access to land, due to access to credit, parental influence, be an employer, satisfaction and personal growth, and to continue the family business were the reasons why agricultural graduates became involved in agribusiness enterprises. On the other hand, lack of capital, lack of access to land, the risk involved in agriculture, poor agricultural pricing, poor agricultural support from the government, seeking a white-collar job, and peer influence were reasons why some agricultural graduates were not involved in agribusiness. Hence, agricultural graduates should be encouraged and supported with resources, especially arable land and capital, by the government, development agencies, and financial institutions, to ensure effective participation in agribusiness.

Keywords: *Agribusiness enterprise, Agricultural graduates, Factors, Participation, Youth*

ID: 87

The Determinants of Livelihood Diversification among Rural Farming Households in Toungo Local Government Area, Adamawa State, Nigeria

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Abstract

To meet their food and other needs, rural households engage in livelihood diversification initiatives. The study looked at factors affecting people's decisions to diversify their sources of income in Toungo Local Government Area of Adamawa State, Nigeria. 250 respondents, were picked using multi-stage sample to provide data for the studies. Descriptive and inferential statistics like logit regression model and Simpson index of diversity were utilized as analytical tools. The study's findings showed that 76.40% of respondents were married and 80.40% were men. 76% of them were educated, and 72.40% had farming as their main occupation. The distribution of respondents based on livelihood activities, indicates that 86% of respondents were engaged in the farming of arable crops, followed by 56% in the sale of animals, 18% in the employment of civil service, and 77.20% in some sort of non-farm activity. In terms of the degree of livelihood diversification, only 6% were highly diverse, compared to 40% who had a low level of diversification. Results of the Logit regression reveals that there was positive relationship between six out of eight variables that are independent with dependent variable. The six variables were age, marital status, family size, formal education years, credit availability, and income were each statistically significant at varying levels. Strengthening livelihood diversification techniques in the research area is therefore necessary to increase household food and non-food security.

Key Words: *Livelihood, diversification, Simpson index of diversity, Logit regression model, Adamawa State*

Introduction

Diversification is a risk management technique of which the portfolio's investments are mixed. A portfolio made up of many investment types which produces higher returns on investment and offer a lesser risk than any other investment contained in the portfolio, according to theory behind the strategy. For rural residents in Africa and Nigeria in particular, diversification of their economic activities into a variety of productive areas, including acitivities that generate income from farm and non-farm has been identified as the single most important factor in reducing poverty (Idowu et al., 2014). Increasing the variety of economic activities a household engages in, whether willingly or inadvertently, in order to boost household income is known as livelihood diversification (Zhao & Barry, 2013). According to Dilruba and Roy (2012), productive resource were distributed among several activities that generating revenue from on-farm and off-farm which constitutes livelihood diversification. According to Drafor (2017), When income increases from different number of sources for households or stabilizing their various sources of income is known as income diversification. Rural farmers' in their effort to improve their living standard diversify their income sources in their households (Senadza, 2014). Additionally, Feliciano (2019) described income diversification as a way to stabilize or increase number of activities that generates income sources for a households. Ijaiya et al. (2010), defined diversification as an increase in the sources of revenue. Another description focuses on the transition from agriculture that produces food for subsistence to commercial agriculture. This also suggests that the farm's mix of income-generating activities is expanding. Thirdly, "livelihood diversification" frequently refer to an increase in significance of non-farm or non-crop revenue. Fourthly, according to Ibrahim and Onuk (2009), income diversification is moving away from subsistance agricultural production and moving toward better crops production, livestock production and other activities. Fabusoro et al. (2010), states that individuals that wants explore other ways in order to improve income of household and reduce their risks varied significantly in terms of choice to diversify or not.

Seera (2014), opined that households diversify to increase income and lower risk differ significantly in terms of choice. Historically, the bulk of rural producers have expanded the scope of their producing endeavors to include a variety of additional productive fields (Dilruba & Roy, 2012). Livelihood diversification for rural households involves activities that were conducted on-farm and off-farm to bring revenue to the family in addition to that from the core farm operations of the household. This could be done through the creation of commodities and services, both farm and non-farm, wage, businesses, and other techniques.

Nigeria has a large agricultural economy despite its high oil revenues. Labor force constitutes over 70% as a whole, which is significant to the economy in this regard (Chauvin et al., 2012). Small-scale, mostly

subsistence-oriented output, the use of basic, unrefined tools, and conventional farming practices are what define agriculture. Even still, according to Chauvin et al. (2012), these small-scale farmers in Nigeria produce 80% of the country's food.

Although farm and non-farm activities are becoming increasingly significant, little is known about how they fit into rural households' income generating plans in emerging nations like Nigeria (Ibekwe et al., 2010). Although is common knowledge that households in rural areas have a propensity to work several jobs, it is important to systematically relate diversification of income to food security strategies and rural poverty reduction. Little attention was also paid to decisions made at the household level, particularly the explanation of variations in income-source diversification methods among households.

By cultivating various crops, raising various livestock breeds, or engaging in activities that are resourceful, households can diversify their farm operations (Losch et al., 2012). Depending on the opportunities and limitations they encounter, some farmers may transition between different occupations over time (Djurfeldt & Djurfeldt, 2013). Diversification of income sources is usually an intentional household strategy to ensure more income, decrease poverty, fund agricultural production and other family expenses (Reardon et al., 2006). It can also be an unintentional household strategy. Rural households are increasingly relying on diversification as a means of generating income (Haggblade et al., 2007; World Bank 2007).

Diversifying rural livelihoods is usually regarded as desirable and a major goal of initiatives to fight poverty in developing nations (Bezu et al., 2012). Farm households in rural areas build increasingly broad portfolio of activities as a means of ensuring their survival and raising their standard of life (Dilruba & Roy, 2012). This process is known as rural livelihood diversification. The idea of livelihood diversification has quickly acquired popularity as a strategy to combat rural poverty in underdeveloped nations.

The phrase "economic diversification" refers to the production of a variety of commodities and services within a production boundaries. It also alludes to a region's inhabitants engaging in a variety of economic pursuit to produce diffirent goods and services. Income eventually flows from a variety of sources as a result of the diversity of human productivity and economic activity. When resources are used to produce goods and services from available alternative options, diversification is triggered (Mehta, 2009). According to Fiona et al. (2011), farming still remain the main sources of income for people in Adamawa State. However, despite the growing global and national concern about raising household income, the contributions of various livelihood income activities on rural farmers, particularly in this area was not documented well. Analysing the factors that determines livelihood diversification among rural farming households in Toungo Local Government Area of Adamawa State, Nigeria, is therefore essential in order to develop effective policies for promoting livelihood diversification.

Objectives of the Study

- describe the socio-economic characteristics of rural farmers
- identify reasons for diversifying income activities
- identify livelihood activities of respondents and their income generating capacity from their various livelihood activities
- assessing the level of livelihood diversification among the respondents
- identify determinants of diversifying livelihood activities of among rural farmers in the area

Materials and Methods

Study Area

The reseach was conducted in the Nigerian state of Adamawa's Toungo local government region. The Toungo local government area is located between Latitudes 7º 23' and 8º 23'N and between Longitudes 11º 20' and 12º 02'E of the Greenwich Meridian. 73,898 people are expected to live there in 2018 on a land area of 5,665.37 square kilometers. The two districts of Dawo and Toungo make up the Toungo local government area, which is surrounded by the Cameroon Republic to the east and south, Taraba State to the west and southwest, and Ganye to the north (Figure 1). The tropical climate in Toungo is characterized by dry and wet seasons. The wet season lasts from April until October. With a maximum temperature of 32.1 °C, a minimum temperature of 19.4 °C, and 1,326 millimetres of annual rainfall, the dry season lasts from November through April. The soils are classified as ferusginous tropical soil with abundant free oxides that often deposit as yellow or red concretions in their horizons. The vegetation is savannah in Southern Guinea. Majority of their occupation is farming, and the main food crops they grow include maize, sorghum, rice, groundnuts, and cowpea. Bambara: yams, cassava, sugarcane, cotton, and groundnuts. Cattle, sheep, and goats were the three main livestock species raised. Fishing, hunting, trading, civil service, barbering, carpentry, and pouring bricks are some more income-generating pursuits in the study region. (Adebayo & Zemba, 2020; Akosum et al., 2020; Ray, 2020;Zemba et al., 2020).

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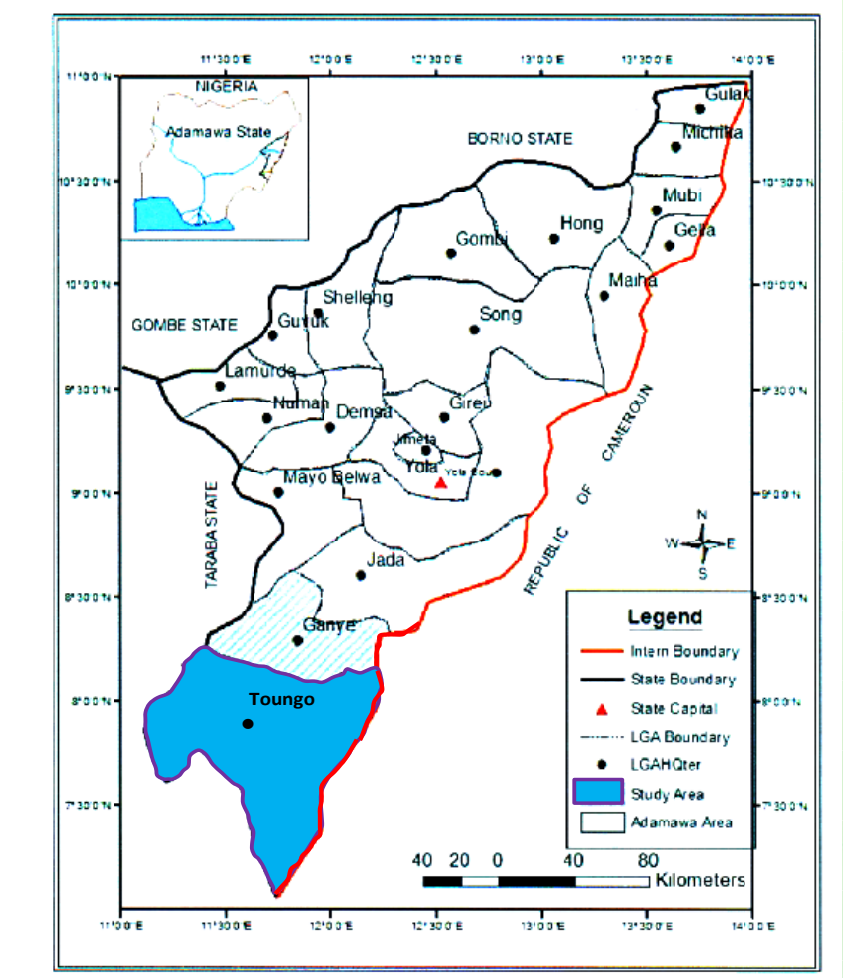


Figure 1: Map of Adamawa State Showing Toungo LGA
Source: Adebayo, 2020

Sampling Technique

250 respondents chosen at random from nine localities in the study region were surveyed using a two-stage sampling procedure for primary data. These settlements comprised Gurwati, Lainde-citta, Tipsan, Dawo, Gumti, Kiri, Yeliso, Kogin-Baba, and Sabon-gida. According to each community's size, a proportion of responders were chosen from there.

Analytical Technique

The objectives of the study were met by the use of descriptive statistics and inferential statistics. Socio-economic characteristics of respondents, causes for their diversification of means of subsistence, the types of livelihood they pursued, and their income were all described using descriptive statistics.

Diversification Index

In this study, the Simpsons Index of Diversity (SID) was used to calculate the level of income diversification among rural households. The SID considers both the number of income sources and how equally the money is distributed among them. The Simpson Index of Diversification was used to determine the respondents' level of livelihood diversification, following Amurtiya et al. (2016), Dia et al. (2022), and Sultana et al. (2015). The quantity of sources of income and their distribution were related to diversification. The index is mathematically expressed as:

$$SID = \sum_{i=1}^{n} P_i^2 \quad (1)$$

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Where: SID = Simpson Index of Diversity, *n* = number of income sources, P_i = Proportion of income coming from the source *i*, the value of SID is within the range from 0 and 1. When SID is less than 0.01 (No diversification), SID is equal 0.01 – 0.25 (Low diversification), SID is equal to 0.26 – 0.50 (Average diversification), SID greater than or equal to 0.51 (High diversification)

Binary Logit (BNL) Model

This study used the Binary Logit (BNL) Model. The dependent variable, which is the diversity of sources of income, has two possible outcomes: either the sources of income are diversified or not. In light of the decision variable's characteristics, the BNL model was used. The best analytical method for such a dichotomous result is the BNL model (Benedicta et al., 2010; Kristof, 2009; Pur et al., 2016). The model's implicit form is represented as follows:

$$Y = \ln\left(\frac{\emptyset_i}{1-\emptyset_i}\right) = \beta_o + \sum_{j=1}^{k} \beta_j X_{ij} + \varepsilon_i \quad (2)$$

Where:

Y = Dependent variable (i.e, the binary variable; Y = 1 for a household that diversified livelihood activities and Y = 0 for otherwise.

β_o Intercept

β_i = Estimated parameters

X_i = Explanatory variables

i = 1, 2, 3, ------ n number of explanatory variables

ε_i = the matrix of unobserved random effects, $\frac{\emptyset_i}{1-\emptyset_i}$ is "odd", and $ln\left(\frac{\emptyset_i}{1-\emptyset_i}\right)$ is the logarithm of "odds".

Equation (2) can be manipulated to give the odds ratio using equation (3):

$$\frac{\emptyset_i}{1-\emptyset_i} = \exp\left(\beta_0 + \sum_{i=1}^{k} \beta_i X_i\right) \quad (3)$$

The probability of the extent of access was calculated using equation (3):

$$\emptyset_i = \frac{exp\left(\beta_0 + \sum_{i=1}^{k} \beta_j X_{ij}\right)}{1 + exp\left(\beta_0 + \sum_{i=1}^{k} \beta_j X_{ij}\right)} \quad (4)$$

Equation (4) is intrinsically linear since the logit is linear in X_i (Gujarati, 2004); it indicates that probability $\emptyset_i$lies between zero and one and vary non-linearly with X_i. The equation for calculating partial effects of continuous variable is denoted by:

$$\frac{\partial \emptyset_i}{\partial x_i} = \emptyset_i(1-\emptyset)\beta_j \quad (5)$$

The partial effects of the discrete variables will be calculated by taking the difference of the mean probabilities estimated for the respective discrete variable, X_i = 0 and X_i = 1.

The marginal effects measure the expected change in probability of a particular choice being made with respect to a unit change in an explanatory variable (Greene, 2003).

The BNL model is explicitly expressed as follows:

$$Y = \ln\left(\frac{\emptyset_i}{1-\emptyset_i}\right) = \beta_o + \sum_{j=1}^{k} + \beta_1 X_1 + \beta_2 X_2 \ldots\ldots + \beta_8 X_8 + \varepsilon_i \quad (6)$$

Y = Dependent variable (i.e, the binary variable; Y = 1 for a household that diversified livelihood activities (Simpson index) and Y = 0 for otherwise.

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The independent variables were defined as follows:

Table 1: Exogenous variables in the binary logit regression to test diversity

Variable	Measurement	Expected sign
Age (X_1)	In years	$\pm$
Sex (X_2)	Binary (1=male, 0=otherwise)	$+$
Marital Status (X_3)	Binary (1=married, 0=otherwise)	$+$
Households Size (X_4)	Number	$+$
Formal Education (X_5)	Years	$\pm$
Total Annual Income (X_6)	Naira	$+$
Access to Credit (X_7)	Binary (1= yes, 0 = No)	$\pm$
Primary Occupation (X_8)	Binary (1 = farming, 0 = otherwise)	$\pm$

Results and Discussion

Socio-economic Characteristics of the Respondents

Information in Table 2 provides socio-economic characteristics of the rural farmers. The findings showed that, their mean age is 42.44 years, with many (72.40%) between the ages of 30 and 49. This shows that people in this age group were sufficiently active and can engage in different activities in order to make end meet. The study finds that married people (76.40%) make up the majority of those involved in activities that generate revenue, and that men made up a larger percentage of respondents (80.40%) in that area. Such households will undoubtedly profit from expansion of labour pool and supplemental income for the family. 76% of respondents had some sort of formal education, ranging from primary to university, and showed literacy. This suggests that there is a very high degree of literacy (the capacity to read and write) present in the studied area, allowing the entrepreneurs to more effectively and efficiently use the available resources and diversify income sources. With eight persons as mean family size and a farm size between one and five hectares, majority of respondents (72.40%) were farmers. In addition, 57.20% of them did not belong to a cooperative, and 71.60% had no access to financial facilities.

Reason for Diversification of Livelihood Activities

Table 3 presents the respondents' responses to the question of why they were broadening their sources of income. According to the findings, 48% of families diversified to lower their family's poverty level, 42.40% to ensure their family has access to healthy food, 27.50% to increase their income, 24% to move away from agriculture, and just 16% to take advantage of government grants. The conclusion is that more people want to be food secure and out of poverty, which is why they livelihood activities were diversify to generate more revenue to support both their personal and family needs. This supports the argument presented by Sekumade and Osundare (2014) that rural residents engaged in a variety of livelihood activities to increase their income, meet their needs, and promote their agricultural pursuits.

Distribution of Respondents According to Nature of Livelihood Diversification Activities

Farming households blend a number of activities to make a living since it was discovered that nearly no household relied solely on single activity but rather exploited a variety of possible activities identify on the farm and non-farm sectors. Table 4 displays the distribution of respondents depending on activities they carry out for a living and the average annual income from each occupation. According to research, 86% of agricultural activities involved growing arable crops, which generated an average yearly income of ₦264,003.48, while 56% were involved in selling livestock, which generated an average annual income of ₦126,615.08. Based on those who were employed in non-farm activities, it was discovered that 9.20% earned an average of ₦61,375.00 per year as wage laborers on other people's farms, 18% made an average of ₦230,327.86 per year in the civil service or the private sector, 8.80% made an average of ₦128,000.00 per year by leasing out land and renting out properties, 4.8% made an average of ₦277,633.33 per year as carpenters, and 7.2% earned an average of ₦170,864.15 per year as tailor, 9.60% of people were employed in butchery, earning an average of ₦177,086.96 per year, while 4.80% worked in grinding earning an average of ₦120,352.94 per annum, 6.20% of them worked as bricklayers, earning an average of ₦195,117.65 per year, compared to 6% who worked as mechanics, earning an average of ₦180,625.00 per year, and 3.20% who collected remittances from their relatives and children, earning an average of ₦102,000.00 per year. The findings demonstrated that for rural farming households, agriculture continues to be the main source of income. This study concurs with a study by Oyewole et al. (2015) states that for most of rural farmers they produce arable crops which are mostly subsistence-oriented and is mostly from one source of income.

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Table 2: Distribution of Socio-economic characteristic of the respondents (N=250)

Variable	Frequency	Percentage
Age (Years)		
20 – 29	40	16.00
30 – 39	68	27.20
40 – 49	113	42.20
50 – 59	22	8.80
60 and above	7	2.80
Mean = 42.44 Years		
Sex		
Male	201	80.40
Female	49	19.60
Marital status		
Single	30	12.00
Married	191	76.40
Widowed/Divorced	29	11.60
Educational Level		
Illiterate	60	24.00
Primary Education	75	30.00
Secondary Education	97	38.80
Tertiary Education	18	7.20
Primary Occupation		
Farming	181	72.40
Trading	29	11.60
Civil Servant	17	6.80
Artisan	23	9.20
Household Size		
1 – 5	77	30.80
6 – 10	137	54.80
11 and above	36	14.40
Mean = 8 People;		
Farm Size		
<1	40	16.00
1 – 5	159	63.60
6 – 10	51	20.40
Member of a Cooperative		
Yes	107	42.80
No	143	57.20
Access to Credit		
Yes	71	28.40
No	179	71.60

Source: Field Survey 2022

Table 3: Distributions of Respondents' Reasons for Diversification Livelihood Activities

Reason for Diversification	**Frequency***	**Percentage**
To generate more income	69	27.60
Availability of government grants	40	16.00
To diversify away from agriculture	60	24.00
To reduce poverty level in the family	120	48.00
To provide food security for the family	106	42.40

Source: Field Survey, 2022
*Multiple Responses were allowed, hence total frequency exceeded sample size (N250)

Table 4: Respondents' Distribution According to Nature of Livelihood Diversification and their Average Income Generating Capacity Per Annum

Livelihood Activities	Frequency*	Percentage	Average Annual income (₦)
Farm Activities			
Arable Cropping	215	86.00	264,003.48
Livestock Sales	140	56.00	126,615.08
Non-farm Activities			
Civil Service & Private Salaried	45	18.00	230,327.86
Wage on Agricultural labour on other people's farm	23	9.20	61,375.00
Revenue from leasing out land / rent	22	8.80	128,000.00
Trade	19	7.60	234,913.04
Carpentry	12	4.80	277,633.33
Tailoring	18	7.20	170,864.15
Remittances income	8	3.20	102,000.00
Grinding	12	4.80	120,352.94
Mechanic	15	6.00	180,625.00
Butchery	24	9.60	177,086.96
Barbing /hair dressing / platting	23	9.20	62,294.12
Brick laying	17	6.80	195,117.65

Source: Field Survey, 2022
*Multiple Responses were allowed, hence total frequency exceeded sample size (N250)

Level of diversification among the respondents

Only 4% of respondents, according to an analysis of their level of livelihood diversity in Figure 2, have a highly diverse source of income. 56% and 40%, respectively, of respondents had low or moderate levels of diversification. This should not be shocking given the enormous amount of capital needed to start and run a business. Noted that in the context of this study, diversification refers to getting different income streams in addition to your primary work. This result is agreeing with the study carried out Challa et al. (2019) in rural Ethiopia which revealed that the most of rural farmers have little economic diversity.

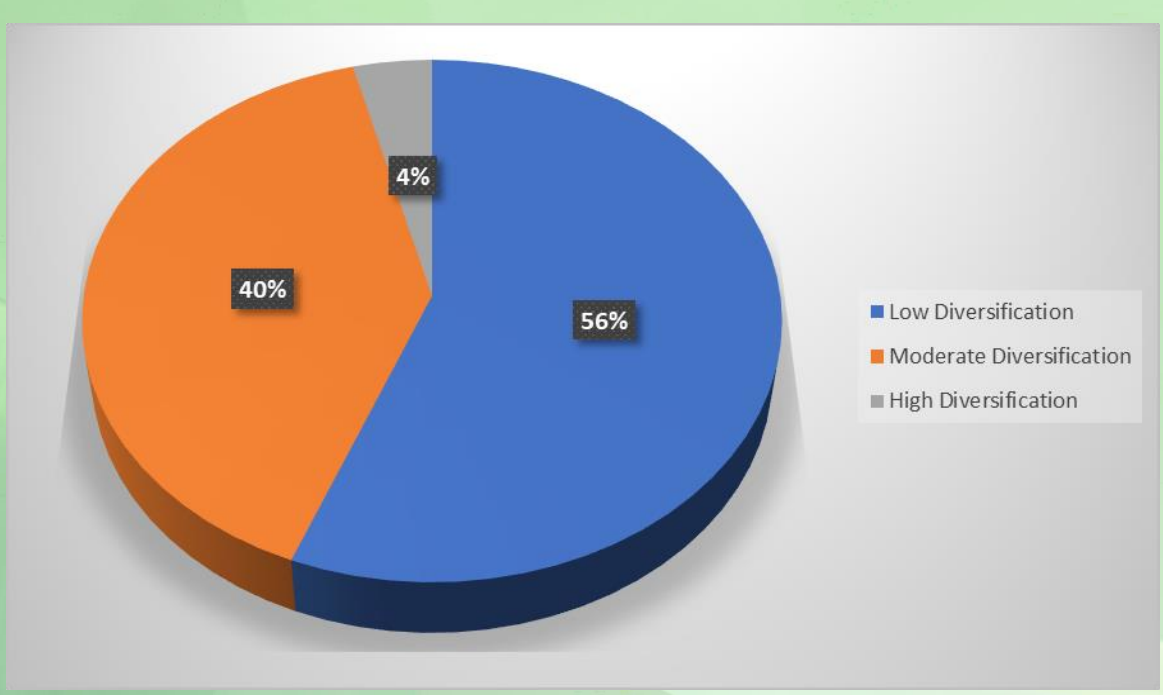


Figure 2: Distribution of respondents according to their level of diversification
Source: Field Survey 2022

Factors Affecting Rural Households' Diversification of Livelihood Activities

To examine the variables impacting the source of livelihood diversification among rural farming households in the research area, a logit regression model was used (Table 5). The fit of each individual observation was evaluated using the common regression diagnostics for binary logistic regression models. According to the findings of the study's goodness of fit test, an overall satisfactory fit is indicated by a non-significant Pearson Chi-square p-value of 0.9997. This shows that the information explains the relationship between the parties quite well. The p-value for the hat variable is 0.000, which is extremely significant, and the p-value for the hatsq variable is 0.613, which is non-significant, according to the model adequacy test. The absence of significance for Hatsq indicates that a sound model can be used.

The findings revealed that sex, married status, formal education, total annual income, credit availability, and major occupation all had a somewhat positive impact. The calculated model with a constant and the collection of explanatory factors fit the data better, according to the log likelihood function (-99.77). This suggests a more positive link between the odds ratio, the likelihood that different factors will have an impact on the Simpson index of diversity (dependent variable), and the explanatory factors included in the model as a whole. These elements work together to explain why farmers may choose to diversify their sources of income. The explanatory factors may account for around 52% of the variables in Y, based on the R-square value of 0.518285 (dependent variables).

The findings indicated that the heads of agricultural households had an adverse effect on diversifying their sources of income, and this effect was significant at $P<0.01$, according to the findings. According to this, the diversification of sources of income would decline as people's ages rose. The reason for this is that farmers' willingness to take risks decreases with increase in age. A rural household's likelihood of selecting a source of livelihood decreases by 81.5% for every extra year, according to the model's marginal effects estimates, which held all other factors constant. This could be because as people age increases, the likelihood that they would engage in several income-generating activities decreases, which may explain why older people may not have a larger tendency to do so. The possibility of respondents diversifying decreases as their age increases. Younger people have better opportunities to diversify their sources of income than older farmers do since fewer young people have access to land and because the service and construction sectors are growing (Kassie et al., 2017). The negative effect of age on diversifying a farmer's sources of income is an indication that older farmers who are more established, knowledgeable about agricultural output will be resistant to new information. They are less likely to diversify their sources of income as a result (Asfir, 2016).

The respondents' marital status was a crucial factor in the diversification of livelihoods in the studied area. With a marginal effect of 8.56 and significance at the $P<0.01$ level, it had a positive effect on diversifying sources of income. So, compared to respondents who were single, married respondents were around 8.56 times more likely to diversify. Married persons are more likely to diversify their sources of income for economic empowerment since they are responsible for meeting the requirements of their families at home (Tasie et al., 2012).

With a marginal effect of 0.8881 and statistical significance of $P<0.01$, the size of the household had a detrimental impact on the sources of income. This indicates that when family size increases, the likelihood of diversifying decreases by 88%. This might be because more resources are required for diversification as households grow larger. This supports a study by Fadipe et al. (2014) that found households with young dependents frequently make less effort to diversify their sources of income.

The formal education of the heads of agricultural households has a favorable impact on their sources of income and is statistically significant at $P<0.05$.The marginal effect of 1.103393 shows that the probability of diversifying one's sources of income increases by 110% for every additional year of education. The results show that a higher level of education among household members, such as completing secondary school or earning a university degree, had a positive effect on the diversification of sources of income. This showed that the income of the entire household increased in direct proportion to the family head's educational attainment. This suggests that those who are very litterate diversified more than those who are less litterate. This is likely a result of the fact that education raises human capital levels and provides the essential skills for entry into more lucrative job markets, particularly for non-farm activities. Individuals can access a variety of economic livelihood activities through education, either because it is a formal requirement for employment that pays a salary or because it aids them in starting their own small business (Idowu et al. 2011; Birhanu & Getachew 2017; Kassie et al. 2017).

The continuous variable that represented total annual income was calculated using the sum of the earnings from all sources of subsistence for each household. At the probability level $P<0.01$, income had a marginal effect of 4.6618 on the diversity of livelihoods. This suggests that respondents with higher incomes are around four times as likely to diversify than those with lower incomes. This suggests that sources of livelihood activities expanded as income increased for both agricultural households with male and female heads. This suggests that high income earners are more diverse and easily mobilize productive resources than low income earners.

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Access tocredit was found to have a marginal effect of 3.89, a positive and significant effect at the P<0.01 probability level on the level of livelihood diversification. The model's marginal effects findings showed that, other factors being equal, those who have access to credit are about four times (3.89) compared to their peers, they are more likely to diversify their income sources. This means that households' ability to diversify their income sources will be aided by farmers' access to loan facilities. The finding agrees with studies by Birhanu (2014), Adekoya (2014), and Ambachew and Ermiyas (2016), which showed that access to credit is a crucial element in enabling disadvantaged households to adopt a variety of livelihood options.

Table 5: Logit regression result on factors influencing Livelihood Diversification

Variable	Coefficient	Standard Error	Z-Statistics	Marginal effect
Constant	5.284543	1.434828	3.683049***	
Age (X_1)	-0.204219	0.030276	-6.745256***	0.8152848
Sex (X_2)	0.468661	0.547546	0.855931	1.597854
Marital Status (X_3)	2.147620	0.695270	3.088901***	8.564453
Households Size (X_4)	-0.118651	0.068718	-1.726629*	0.8881179
Formal Education (X_5)	0.098390	0.041200	2.388134**	1.103393
Total Annual Income (X_6)	1.08E-06	3.60E-06	0.301292***	4.61847
Access to Credit (X_7)	1.360176	0.400365	3.397336***	3.896878
Primary Occupation (X_8)	1.530063	0.393680	3.886597	1.000001
Diagnostic Statistics				
Chi-square 214.70***				
Log likelihood - 99.7757				
Pseudo R^2 0.5183				
Specification test				
Hat	1.005598	0.1197381	8.40***	
Hatsq	-0.0458902	0.0474774	-0.97	
Goodness-of-fit test				
Pearson $Chi^2(295)$ = 218.98***				
Correctly classified 99.97%				

Source: Computed Field Data, 2022
Note: *** = Significant at 1%, ** = Significant at 5%, * = Significant at 10%

Conclusion and Recommendation

According to the study's results, 76.40% of respondents were married, and 80.40% of them were male. They identified farming as their primary occupation, and 76.6% of them had a college degree. According to the distribution of respondents in this survey depending on their type of livelihood activity, the majority (86%) produced arable crops, earning an average of ₦264,003 each year, 56% were involved in selling livestock with an average yearly income of ₦126,615, 18% of the population working as civil servants, earning an average salary of ₦230,327.86 per year, while 77.20% of the population was involved in non-farm activities of some kind. Compared to 40% who had moderate diversification and 56% who had poor diversification, only 6% of respondents had extremely diverse occupations. The logit regression model shows that six independent factors, including age, marital status, household size, year of formal education, access to credit, and income, all had a positive impact on the dependent variable and were statistically significant at different levels. The study's conclusions led to the following recommendations:

- Intervention is required to empower and enable female-headed households to get involved in various livelihood activities.
- Government and non-governmental organizations should set up centers for rural farming households to learn new skills and diversify their revenue streams into non-farm enterprises. This will allow the money they make to flow back into agriculture.
- Encouraging farming households to participate in educational programs like adult education and workshops in order to improve their adoption behavior.
- Policymakers with managerial experience should develop and implement policies that will help in rural development in order to support the growth of the rural community.

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Recent Advances in Poultry Nutrition: Utilizing Phytobiotics as Alternatives to Antibiotics

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Abstract

In response to growing concerns over antibiotic resistance and consumer demand for antibiotic-free poultry products, recent years have witnessed significant advancements in poultry nutrition research, with a particular focus on exploring phytobiotics as viable alternatives to antibiotics. This abstract highlights the latest developments in utilizing phytobiotics to enhance poultry nutrition while addressing the challenges associated with antibiotic usage. Phytobiotics, derived from various herbs, spices, and medicinal plants, represent a diverse group of natural feed additives known for their bioactive properties. A primary area of investigation revolves around the impact of phytobiotics on gut health and microbiome management in poultry. These additives have demonstrated the ability to modulate the composition of gut microbiota, fostering the growth of beneficial bacteria while suppressing harmful pathogens. This shift in gut microbial balance contributes to improved nutrient absorption, enhanced immune responses, and a reduced incidence of gastrointestinal disorders, ultimately promoting the overall well-being of poultry flocks. By incorporating phytobiotics into poultry diets, researchers have observed a reduction in pathogenic colonization, leading to improved flock health and mitigated zoonotic risks. Beyond their antimicrobial effects, phytobiotics have been found to possess antioxidant and anti-inflammatory attributes, helping alleviate oxidative stress and support the immune system in poultry. By reducing the reliance on antibiotics, phytobiotics aid in minimizing antibiotic residues in poultry products, promoting environmentally friendly approaches to poultry nutrition. In conclusion, recent advances in poultry nutrition have demonstrated the potential of phytobiotics as effective alternatives to antibiotics. Their multifaceted benefits, including enhanced gut health, antimicrobial activity, and immune system support, contribute to improved productivity and sustainability in the poultry industry. As research continues to unveil the full potential of phytobiotics, they present a promising pathway towards safer, healthier, and antibiotic-free poultry production systems.

Keywords: *Phytobiotics, poultry, nutrition, alternative to antibiotics, herbs, feed additives*

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Effects of Leek Powder and Sunflower Oil in Guar Gum Edible Coating on the Preservation of Mushrooms (*Agaricus bisporus*)

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Abstract

This study investigated the effects of various guar gum edible coating formulations, incorporating different proportions of waste leek powder and sunflower oil, on weight loss, color parameters (L*, a*, b* values, and ΔE), texture, and shrinkage of Agaricus bisporus mushrooms during a 7-day storage period. The goal was to assess the potential impact of these coatings on preserving the mushrooms' quality over time. The results showed that the coatings had a significant effect on reducing weight loss compared to uncoated samples. The lowest weight loss was observed in the 0.5% leek powder and no sunflower oil, while the highest was in 2.5% leek powder and 0.1% sunflower oil. Shrinkage was also positively affected by the coatings, with 1.5% leek powder and no sunflower oil showing the most promising results. The L* values of the coated samples declined slightly, indicating better color preservation, while the a* values exhibited stable redness/greenness. On the other hand, b* values increased, indicating an increase in yellowness during storage. The ΔE values were lower for the coated samples, suggesting less color deviation compared to uncoated ones. Overall, the study indicates that these edible coatings have the potential to maintain the quality of mushrooms during storage, leading to better preservation and extended shelf life.

Key Words: *Edible coating, Mushroom, Leek powder, Sunflower oil*

Introduction

In Türkiye, the cultivation of edible mushrooms, particularly the Agaricus bisporus species, has shown significant growth in recent years. According to estimates, the production of cultivated mushrooms was around 65,000 tons in 2018, and it is projected to reach 100,000 tons by the year 2025 (Eren and Pekşen, 2019). Among the various mushroom cultivation practices, Agaricus bisporus remains at the forefront due to its popularity and economic significance in the country. This upward trend reflects the increasing interest in mushroom production as a viable and profitable agricultural activity in Türkiye. However, the short shelf life of mushrooms constitutes a major problem in the field of mushroom production and preservation. The short shelf life of mushrooms can be attributed to the absence of a protective cuticle, which leaves them vulnerable to damage and water loss, consequently leading to microbial attacks (Zhang et al., 2019). To solve the problem, edible packaging options can be applied to mushrooms to prolong the freshness. Edible films or coatings create a protective barrier for mushrooms, offering benefits such as gas conditioning, delayed gas transfer, reduced moisture and flavor loss, slower color change, and improved appearance (Nasiri et al., 2018). While films are the structures that can be wrapped around food after molding, coatings involve directly applying liquid edible coating material to protect the food (Ali et al., 2010; Thakur et al., 2021).

Research has focused on preparing edible films and coating by environmentally degradable materials that are derived from plants, animals, and even their by-products or waste. Up to date, xanthan gum, alginate (Jiang 2013), chitosan (Nair et al., 2020), aloe vera (Kumar et al., 2023), and tragacanth gum (Nasiri et al., 2018) are commonly used in the production of edible coatings due to their biodegradability, recyclability, and sustainability. Although biopolymers have advantages, they possess poor mechanical and barrier properties. To address this, certain natural materials can be incorporated to enhance their flexibility, gas barrier, and mechanical properties. Notably, oils can be added to inhibit the growth of microorganisms and improve water-vapor barrier capacity.

The outer leaves of leeks (Allium porrum) can be considered as waste since these parts are typically removed and discarded during the preparation process before cooking or using leeks in recipes. Due to their high phenolic content (262.66 ± 18.05 mg GAE 100 g−1 dry weight) and significant antioxidant activity (48.58 ± 3.84 %) coupled with antibacterial properties (Pellegrini and Ponce, 2020), leek leaves present a potential as an active ingredient in edible coating formulations. Sunflower oil in edible coatings may provide improved barrier properties, including enhanced water vapor resistance and flexibility, while also offering antioxidant benefits, antibacterial activity, and a mild flavor enhancement, making it a valuable addition for preserving and enhancing the quality of food products. Additionally, it serves as a source of essential fatty acids, contributing to the nutritional value of the coated food. In the literature, there have been no studies conducted on the application of

edible coating using waste leek powder for the preservation of mushrooms. Thus, in this study, the impact of various guar gum edible coating formulations containing different proportions of waste leek powder and sunflower oil on weight loss, color parameters (L*, a*, b* values, and ΔE), texture and shrinkage of mushrooms (Agaricus bisporus) during storage was investigated.

Materials and Methods

Materials

Leek and sunflower oil were purchased from a local store. Guar gum and glycerol was purchased from Sigma-Aldrich (Merck İlaç Ecza ve Kimya Tic. A.Ş., an affiliate of Merck KGaA, Darmstadt, Germany). Mushrooms (Agaricus bisporus) with consistent sizes, appearance, color, and ripeness level, devoid of any defects, were carefully chosen for the study. Immediately after harvest, the mushrooms were brought to the laboratory and subjected to washing with 0.1% sodium hypochlorite. Following the cleaning process, they were allowed to air dry before the application of the coating.

Edible coating preparation

The outer two layers of leek were peeled. Subsequently, the peeled leek material was subjected to drying in an electric oven (Nuve NO55, Ankara, Türkiye) and then finely ground using a grinder (Kiwi Coffee and Spice Grinder, Türkiye). The ground leek particles were further sieved through a 100-mesh sieve to achieve a consistent and uniform particle size. The guar gum edible coating formulation (Table 1.) was based on method described by Saha et al. (2016) with minor changes. Leek powder was added to the coating formulation at concentrations of 0, 0.5, 1.5, and 2.5 g per 100 ml of coating solution. Ethanol was included in the formulation to dissolve alcohol-soluble ingredients. Glycerol is commonly used in edible coatings as a plasticizer, enhancing the flexibility and mechanical properties of the coating. Its hygroscopic nature helps retain moisture, improving the barrier properties and extending the shelf life of coated food products. Glycerol was incorporated into the coating solution at a concentration of 0.4 g per 100 ml. To assess the impact of sunflower oil in the coating, 0.1 ml of sunflower oil was added to the formulation of samples L0S0.1, L0.5S0.1, L1.5S0.1, L2.5S0.1.

Table 1. Edible coating formulations

Coatings	Guar Gum (g)	Glycerol (g)	Leek powder (g)	Ethanol (ml)	Distilled water (ml)	Sunflower oil (ml)
L0S0*	0.9	0.4	0	0	100	0
L0.5S0	0.9	0.4	0.5	0.75	99.25	0
L1.5S0	0.9	0.4	1.5	2.25	97.75	0
L2.5S0	0.9	0.4	2.5	3.75	96.25	0
L0S0.1	0.9	0.4	0	0	99.9	0.1
L0.5S0.1	0.9	0.4	0.5	0.75	99.15	0.1
L1.5S0.1	0.9	0.4	1.5	2.25	97.65	0.1
L2.5S0.1	0.9	0.4	2.5	3.75	96.15	0.1

* the abbreviations L and S represent leek and sunflower oil, respectively. The subsequent numbers represent the percentage amount of each ingredient in the solution. For example, L0.5 indicates 0.5% (w/v) leek in the coating solution, and S0.1 indicates 0.1% (v/v) sunflower oil in the coating solution.

Guar gum, glycerol, leek powder, sunflower oil and distilled water were stirred at room temperature for 60 min to dissolve adequately. The mushrooms were randomly divided into eight different sections, and immersed in their respective coating solutions for a duration of 2 minutes at a temperature of 20°C. In contrast, the control group was submerged in distilled water.

Following the treatment, the samples were placed on plastic trays and exposed to a fan for 30 minutes to facilitate the drying process. Subsequently, the treated samples were placed on polystyrene trays using toothpicks. The samples were then stored under controlled conditions at 4 ± 1 °C and 85–90% relative humidity for a period of 7 days. Experimental assessments were performed on days 1, 3, and 7 to monitor the effects of the storage and coating on the samples. Each experiment was conducted in three replicates.

Weight loss (%) measurement

To assess weight loss, coated and uncoated mushrooms were initially weighed at day 1 and then weighed again at each storage period. Weight loss was calculated as the percentage of weight reduction relative to the initial mass. The experiment was performed in triplicate to ensure accuracy and reliability of the results. The mushrooms' weight was measured by an analytical scale (KERN PFB 1200-2A, Balingen, Germany). Weight loss was determined using the following equation where W1 represents the initial weight of the mushrooms, and W2 represents the weight after storage for 3 and 7 days.

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$$Weight\ loss\ (\%) = \frac{W_1 - W_2}{W_1} \times 100$$

Color measurement

Color of mushrooms on storage days 1, 3 and 7 were recorded using a handheld colorimeter (TES 135A Color Reader, TES, Taiwan). Color characteristics were evaluated and expressed using the CIE color coordinate system, which includes three components: L*, a*, and b*. The L* component represents lightness, ranging from 0 (black) to 100 (white). The a* component represents the position on the red-green axis, with positive values indicating redness and negative values indicating greenness. The b* component represents the position on the yellow-blue axis, with positive values indicating yellowness and negative values indicating blueness. By using this color coordinate system, the color of the samples could be precisely quantified and compared. Euclidean distance ΔE was obtained by Equation below by taking color data of fresh mushrooms as base (L* =99.6, a* = 3.5 and b* = 14.1)

$$\Delta E = \sqrt{(L_2^* - L_1^*)^2 + (a_2^* - a_1^*)^2 + (b_2^* - b_1^*)^2}$$

Hardness measurement

A texture analyzer (Lloyd Ins. TA Plus, Hants, UK) was employed to conduct a penetration test on the mushrooms' caps. A cylindrical probe with a diameter of 5 mm was utilized to determine the hardness. The texture analyzer was set with a loading head speed of 2.0 mm s−1, a trigger force of 50 g, and a probe travel distance of 5 mm. Average value of 6 different measurement for each batch was quantified as hardness value.

Shrinkage ratio (%)

The shrinkage ratio of mushrooms was calculated based on the measurement of cap diameter using a digital caliper, as described by Thakur et al. (2020). The formula for shrinkage ratio is as follows:

$$Shrinkage\ ratio\ (\%) = \frac{D_i - D_f}{D_i} \times 100$$

where Di represents the initial cap diameter of the fresh mushroom in millimeters (mm), and Df represents the cap diameter of the mushroom on 3rd and 7th days of storage. The average value of six different measurements was calculated for each batch of mushrooms.

Statistical analysis

The collected data was subjected to analysis of variance (ANOVA), and subsequently, the means were compared using Tukey Post Hoc Analysis. The statistical analysis was conducted in MINITAB Release 17.1 (Minitab Inc. State College, PA, USA), and a significance level of $p < 0.05$ was employed to determine the statistical significance of the results.

Results and Discussion

Effect of coatings on weight loss of mushrooms

Weight loss is a key parameter in assessing the efficiency of edible coatings, as it directly impacts the preservation and quality of food products. Minimizing weight loss is crucial in extending the shelf life of perishable items, ensuring they remain fresh and marketable for a longer period. Edible coatings can help reduce the rate of weight loss in coated food products. Moreover, weight loss is often associated with moisture loss in fruits and vegetables, leading to undesirable changes in texture, appearance, and taste. Edible coatings may act as a barrier, preventing excessive moisture loss and maintaining the overall quality of the coated food. The weight loss of coated mushrooms ranged from 39.079% ± 0.781% (coating L1.5S0) to 55.055% ± 1.437% (coating L2.5S0.1) between first and seventh days of storage (Table 2). The lowest weight loss was observed in mushrooms coated with L1.5S0, while the highest weight loss was in mushrooms coated with L2.5S0.1. In contrast, uncoated mushrooms exhibited a weight loss of 63.110% ± 5.200%. The coatings significantly reduced weight loss compared to the uncoated mushrooms, with the L1.5S0 formulation showing the most promising results because of the effect of waste leek powder. The addition of oil in the coatings was observed to lead to a significant increase in weight loss. The application of composite coatings consisting of carboxymethyl cellulose alone and in combination with garlic essential oil exhibited a significant delay effect on weight loss (Dong and Wang, 2017). In the study, %1 and %2 garlic essential oil added coatings reduced weight loss, while %3 garlic essential oil increased weight loss. In our research, the use of %0.1 sunflower oil in the coatings may have led to a less pronounced effect of sunflower oil in reducing weight loss.

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Table 2. Weight loss (%) and shrinkage ratio (%) in coated and uncoated mushroom samples between the 1st and 3rd days and the 1st and 7th days of storage

Coatings	Days	Weight loss (%)	Shrinkage ratio (%)
L0S0*	1-3	20.580±0.571^{ij}	11.468±0.0257^{bc}
	1-7	43.090±0.537^{def}	22.84±1.45^{abc}
L0.5S0	1-3	18.751±0.963^{jk}	13.329±0.288^{abc}
	1-7	41.287±0.460^{ef}	28.059±0.998^{a}
L1.5S0	1-3	14.860±0.567^{k}	8.873±1.082^{c}
	1-7	39.079±0.781^{f}	19.02±0.507^{abc}
L2.5S0	1-3	22.153±0.591^{hij}	8.739±0.732^{c}
	1-7	44.875±0.397^{de}	19.107±0.0108^{abc}
L0S0.1	1-3	23.120±0.460^{hij}	8.84±0.516^{c}
	1-7	46.670±1.498^{cd}	19.212±0.533^{abc}
L0.5S0.1	1-3	23.704±0.228^{hi}	9.25±1.94^{c}
	1-7	50.904±0.856^{bc}	21.76±3.06^{abc}
L1.5S0.1	1-3	26.127±0.964^{gh}	15.83±11.76^{abc}
	1-7	52.981±0.578^{b}	23.63±11.14^{abc}
L2.5S0.1	1-3	28.262±0.784^{g}	10.274±0.868^{bc}
	1-7	55.055±1.437^{b}	24.07±2.67^{abc}
Uncoated	1-3	29.125±0.902^{g}	15.95±1.58^{abc}
	1-7	63.110±5.200^{a}	25.838±0.434^{ab}

* the abbreviations L and S represent leek and sunflower oil, respectively. The subsequent numbers represent the percentage amount of each ingredient in the solution. For example, L0.5 indicates 0.5% (w/v) leek in the coating solution, and S0.1 indicates 0.1% (v/v) sunflower oil in the coating solution. Values are expressed as mean±standard deviation. Different superscripts show that values in the same column within each group are significantly different ($p \leq 0.05$)

Effect of coatings on shrinkage ratio of mushrooms

Some edible coatings have been shown to slow down the ripening and senescence processes in fruits and vegetables, which can contribute to reduced shrinkage during storage. Moreover, edible coatings prevent excessive moisture loss from the food. This can lead to reduced shrinkage, as moisture is retained within the product, maintaining its overall size and shape. The minimum shrinkage ratio was observed in sample L1.5S0, with a value of 19.02% ± 0.507%, while the maximum shrinkage ratio was found in sample L0.5S0, measuring 28.059% ± 0.998%. In comparison, uncoated samples exhibited a shrinkage ratio of 25.838% ± 0.434% (Table 2). The application of edible coatings, particularly L1.5S0, appears to have resulted in lower shrinkage ratios, indicating a potential positive effect in reducing the shrinkage of the coated mushrooms compared to the uncoated ones. So, there is approximately a 26.4% reduction in shrinkage ratio when using the coating L1.5S0 compared to the uncoated samples. 1.5% of waste leek powders showed promising results.

Effect of coatings on color values (L*, a*, b* and ΔE) of mushrooms

L*, a*, and b* values are color parameters used to characterize the color of a sample. L* corresponds to lightness, a* indicates the degree of redness (positive values) or greenness (negative values), and b* represents the extent of yellowness (positive values) or blueness (negative values). In many cases, edible coatings are formulated to preserve the natural color of the food, delay color changes, and maintain its visual appeal during storage (Medina-Jaramillo et al., 2020). As expected, L* values exhibited a declining pattern as the mushrooms were stored for longer period. During the 7-day storage period, the lightness (L*) of the uncoated sample decreased from 93.44±4.5 to 82.69±2.67. On the other hand, the best coating based on both weight loss and shrinkage data only slightly decreased from 98.115±1.407 to 94.2±0.933, resulting in a relatively lighter color, thus preserving its original appearance better (Table 3). In a previous study, alginate-based coatings were reported to effectively preserve the lightness of mushrooms, resulting in an L* value of approximately 82.5 (Louis et al., 2021), which is darker compared to the L* value observed in our study. The difference in L* values between the two studies could be attributed to variations in the formulation and application of the coatings, as well as differences in the storage conditions in each study.

Among the color parameters, the a* value exhibited the least change, indicating relatively stable redness/greenness, compared to other color components. Additionally, the coatings had a lesser effect on the a* value when compared to the uncoated samples, suggesting that the coatings had a minimal impact on the redness/greenness of the mushrooms during storage.

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The b* values, representing yellowness/blueness, increased during the 7 days of storage (Table 3). This indicates that the mushrooms became more yellow over time. The increase in yellowness may be attributed to various factors, such as the natural ripening process, chemical reactions, or changes in the structure and composition of the mushrooms during storage. An increase in b* values is often associated with browning reactions, which can occur during the storage of fruits and vegetables. Browning reactions, such as enzymatic browning and Maillard reactions, can lead to the formation of pigments that contribute to a more yellow or brown color in the food. The study by Rokayya et al. (2021) observed a similar increase in b* values of mushrooms, providing further evidence of the occurrence of browning reactions during storage.

ΔE represents the total color difference between two color samples in the CIE Lab color space. It quantifies the perceptual difference between the colors and is used to evaluate how much one color deviates from another. ΔE was calculated with respect to fresh mushrooms CIE Lab color. The least color deviation was observed in samples coated with L0S0, L0.5S0, and L1.5S0, with ΔE values of 8.2202±0.0442, 8.769±0.217, and 9.812±0.945, respectively. These coated samples showed minimal color change and maintained their original color more effectively. In contrast, the uncoated samples exhibited a higher ΔE value of 18.64±2.3, indicating a more significant color deviation and changes during the storage period.

Table 3. Color values (L*, a*, b* and ΔE) of coated and uncoated mushroom samples on the 1st, 3rd, and 7th day of storage

Coatings	Days	L* value	a* value	b* value	ΔE
L0S0*	1	98.85±0.438^{a}	3.296±0.185^{abc}	14.345±0.276^{efgh}	0.853±0.421^{g}
	3	95.845±0.757^{abc}	3.303±0.258^{abc}	17.76±2.39^{cdefgh}	5.32±2.19^{defg}
	7	93.635±0.0495^{abc}	5.325±1.103^{abc}	19.39±0.368^{bcdefg}	8.2202±0.0442^{bcdefg}
L0.5S0	1	99.37±0.368^{a}	1.14±1.054^{c}	13.635±0.134^{gh}	2.453±0.954^{fg}
	3	98.065±1.138^{ab}	5.06±1.77^{abc}	14.1±1.47^{fgh}	2.56±1.77^{fg}
	7	94.295±0.742^{abc}	5.658±0.463^{abc}	20.705±0.46^{bcdef}	8.769±0.217^{bcdefg}
L1.5S0	1	98.115±1.407^{ab}	2.692±0.272^{bc}	11.865±0.615^{h}	2.906±1.117^{fg}
	3	95.89±2.29^{abc}	4.305±1.047^{abc}	19.2±3.18^{bcdefg}	6.37±4.01^{cdefg}
	7	94.2±0.933^{abc}	5.898±0.357^{abc}	21.925±0.431^{abc}	9.812±0.945^{bcdefg}
L2.5S0	1	97.545±0.7^{ab}	3.5875±0.0247^{abc}	14.83±1.174^{defgh}	2.278±1.009^{fg}
	3	92.56±4.21^{abc}	6.32±2.32^{ab}	21.92±4.84^{abc}	10.9±6.79^{abcdefg}
	7	91.03±2.61^{abcd}	6.73±2.08^{ab}	24.915±1.096^{ab}	14.24±2.87^{abcde}
L0S0.1	1	95.76±0.863^{abc}	3.708±0.711^{abc}	14.165±0.219^{fgh}	3.879±0.888^{efg}
	3	93±2.43^{abc}	6.703±1.015^{ab}	22.46±1.81^{abc}	11.14±3.09^{abcdefg}
	7	87.465±0.997^{cde}	6.252±0.449^{abc}	25.535±0.502^{ab}	16.907±0.982^{abc}
L0.5S0.1	1	93.545±0.247^{abc}	4.883±0.456^{abc}	16.88±1.69^{cdefgh}	6.885±0.993^{cdefg}
	3	89.565±0.672^{bcd}	7.15±0.771^{ab}	23.31±1.58^{abc}	14.13±1.305^{abcde}
	7	87.99±0.665^{cde}	7.38±0.658^{ab}	23.22±0.382^{abc}	15.282±0.11^{abcd}
L1.5S0.1	1	94.07±3.99^{abc}	6.12±2.36^{abc}	16.9±0.495^{cdefgh}	6.84±4.33^{cdefg}
	3	91.755±0.728^{abc}	7.25±0.714^{ab}	22.68±0.467^{abc}	12.239±0.359^{abcdef}
	7	88.16±0.424^{cde}	8.023±0.237^{a}	27.79±1.72^{a}	18.41±1.6^{ab}
L2.5S0.1	1	91.94±0.976^{abc}	6.697±0.916^{ab}	20.3±1.032^{bcdefg}	10.37±1.62^{bcdefg}
	3	95.74±4.34^{abc}	5.72±2.3^{abc}	19.09±3.41^{bcdefg}	6.8±5.71^{cdefg}
	7	92.73±3.24^{abc}	5.367±0.916^{abc}	22.81±1.52^{abc}	11.36±2.97^{abcdefg}
Uncoated	1	93.44±4.5^{abc}	5.1±1.63^{abc}	17.77±1.344^{cdefgh}	7.42±4.75^{cdefg}
	3	80.07±2.23^{e}	7.6±2.47^{ab}	21.47±2.08^{abcd}	21.42±1.8^{a}
	7	82.69±2.67^{de}	6.212±0.929^{abc}	21.345±0.643^{abcde}	18.64±2.3^{ab}

* the abbreviations L and S represent leek and sunflower oil, respectively. The subsequent numbers represent the percentage amount of each ingredient in the solution. For example, L0.5 indicates 0.5% (w/v) leek in the coating solution, and S0.1 indicates 0.1% (v/v) sunflower oil in the coating solution. Values are expressed as mean±standard deviation. Different letters show that values in the same column within each group are significantly different ($p \leq 0.05$)

Effect of coatings on hardness of mushrooms

Monitoring the hardness of the coated mushrooms over the storage period is crucial to determine the effectiveness of the edible coating in preserving the desired texture. In general, edible coatings can help maintain the hardness or texture of the coated mushrooms during storage. The application of edible coatings forms a protective layer on the surface of the mushrooms, which can reduce moisture loss and prevent mechanical damage. This protective barrier helps retain the natural moisture content of the mushrooms, thereby minimizing softening or loss of firmness. The hardness values of both the coated and uncoated samples were observed to decrease significantly

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during storage. This reduction in hardness indicates that the mushrooms became softer over time, regardless of whether they were coated or uncoated. the short observation time of 7 days might have limited the ability to detect significant differences in hardness between the coated and uncoated samples. With longer storage durations, the positive effects of the coatings on hardness could become more pronounced. The findings from Mohebbi et al. (2012)'s study support the notion that the texture of mushrooms tends to deteriorate during storage, and this difference in texture becomes more pronounced over time. Therefore, the use of coatings is expected to help maintain the hardness and fresh texture of mushrooms. Initially, during the early days of storage, there might be minimal differences between the coated samples and the uncoated control in terms of preserving the initial texture quality. However, as the storage period extends, the positive effects of the coatings on hardness changes become more evident, particularly for mushrooms treated with gum tragacanth. This indicates that the coatings could provide protective benefits that effectively delay the degradation of hardness and texture in the mushrooms, especially when stored for longer durations.

Table 4. Hardness value of coated and uncoated mushroom samples on the 1st, 3rd, and 7th day of storage

Coatings	Days	Hardness value
L0S0*	1	2.05 ± 0.0866^{bcdefg}
	3	1.9333 ± 0.1528^{cdefg}
	7	1.56 ± 0.0529^{hijk}
L0.5S0	1	2.1333 ± 0.0289^{bcdef}
	3	2.243 ± 0.277^{abcd}
	7	1.57 ± 0.1127^{hijk}
L1.5S0	1	2.6 ± 0.265^{a}
	3	2.3 ± 0.1^{abc}
	7	1.8 ± 0.05^{efghijk}
L2.5S0	1	2.417 ± 0.176^{ab}
	3	1.9 ± 0.1^{cdefghi}
	7	1.5333 ± 0.0577^{hijk}
L0S0.1	1	2.25 ± 0.05^{abcd}
	3	1.8 ± 0.05^{efghijk}
	7	1.5 ± 0.1323^{ijk}
L0.5S0.1	1	2.0967 ± 0.0839^{bcdef}
	3	1.85 ± 0.05^{defghij}
	7	1.38 ± 0.0819^{k}
L1.5S0.1	1	2.2833 ± 0.0289^{abc}
	3	1.587 ± 0.201^{hijk}
	7	1.4667 ± 0.0577^{jk}
L2.5S0.1	1	2.1567 ± 0.0814^{bcde}
	3	1.717 ± 0.362^{fghijk}
	7	1.3833 ± 0.0289^{k}
Uncoated	1	$1.9167\pm0.0764^{cdefghi}$
	3	1.6333 ± 0.0289^{ghijk}
	7	1.4033 ± 0.138^{k}

* the abbreviations L and S represent leek and sunflower oil, respectively. The subsequent numbers represent the percentage amount of each ingredient in the solution. For example, L0.5 indicates 0.5% (w/v) leek in the coating solution, and S0.1 indicates 0.1% (v/v) sunflower oil in the coating solution. Values are expressed as mean±standard deviation. Different letters show that values in the same column within each group are significantly different ($p \leq 0.05$).

Conclusions

The study investigated the effects of different guar gum edible coating formulations, which incorporated varying proportions of waste leek powder and sunflower oil, on weight loss, color parameters (L*, a*, b* values, and ΔE), texture, and shrinkage of Agaricus bisporus mushrooms during 7 days of storage. The research explored how these coating formulations could potentially impact the preservation and quality of the mushrooms over time. Overall, the study suggests that edible coatings have the potential to play a crucial role in preserving the moisture, shape and color quality of mushrooms during storage, leading to better quality and extended shelf life.

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Identification of *Alternaria, Aspergillus, Fusarium* and *Penicillium* spp. on Onion Plant (*Allium cepa* L.) Growing in Hatay, Amasya and Tokat Provinces Using MALDI-TOF Mass Spectrometry

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Abstract

Plant fungal disease agents cause significant yield and quality losses in onion growing areas. In addition to yield losses, they cause negative effects that reduce the quality and export potential of the product, resulting in significant economic losses during harvest, post-harvest, processing and marketing stages. In recent years, Matrix-Assisted Laser Desorption/Ionization-Time Of Flight Mass Spectrometry (MALDI-TOF MS) has emerged as a rapid, cost-effective, reproducible, and powerful technique for identifying microorganisms, and its impact on microbiological diagnosis has transformed workflow in equipped laboratories. In this study, proteomic analyzes were performed on *Alternaria, Aspergillus, Fusarium* and *Penicillium* species isolated from onion growing areas in Hatay, Amasya, and Tokat provinces. After extraction of mycelium from single spore cultures of the isolates with ethanol-formic acid, the spectra of the individual fungal isolates were determined using the Flex control software program. These spectra were compared with Maldi Biotyper Real-Time Classification (RTC) and identification was performed. Of 519 different fungal isolates, 435 representative fungal isolates (83.8%) were identified by MALDI TOF MS. Eighty-four fungal isolates could not be identified because they were not in a satisfactory range of purity and identification. Of the 435 isolates, 269 (61.8%) were identified as *Fusarium* spp., 80 isolates (18.4%) were identified as *Alternaria* spp., 60 isolates (13.8%) as *Aspergillus* spp., and 26 isolates (6.0%) as *Penicillium* spp. Among the fungal isolates, 72.5% of the *Fusarium* isolates, 78.8% of the *Alternaria* isolates, 90.0% of the *Aspergillus* isolates and 84.6% of the *Penicillium* isolates were identified as "highly probable" species with score values between 2,000-3,000 (green color). The results clearly demonstrate that MALDI TOF MS biotyping may be used as a highly reliable and economical diagnostic method for routine diagnosis of diseases caused by *Alternaria, Aspergillus, Fusarium* and *Penicillium* species.

***Keywords**: Onion, disease agent, MALDI-TOF MS, diagnosis*

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Hatay, Amasya ve Tokat İllerinde Yetişen Soğan Bitkisinde (*Allium cepa* L.) Görülen *Alternaria, Aspergillus, Fusarium* ve *Penicillium* Türlerinin MALDI-TOF Kütle Spektrometresi Kullanılarak Tanılanması

Özet

Soğan tarımının yapıldığı alanlarda fungal hastalık etmenleri önemli verim ve kalite kaybına neden olmaktadır. Bu hastalık etmenleri verimdeki azalmanın yanında hasat sırasında, hasat sonrası, işleme ve pazarlama aşamalarında önemli ölçüde ekonomik kayıplara sebep olan ürünün kalite ve ihracat potansiyelini düşüren olumsuz etkiler oluşturmaktadır. Son yıllarda Matrix-Assisted Laser Desorption/Ionization-Time Of Flight Mass Spectrometry (MALDI-TOF MS), mikroorganizmaların tanılamasında, hızlı, ucuz, tekrarlanabilir güçlü bir teknik olarak ortaya çıkmış olup, mikrobiyolojik tanılamamadaki etkisi donanımlı laboratuvarlardaki iş akışını değiştirmiştir. Bu çalışmada Hatay, Amasya ve Tokat illerinde soğan yetiştirilen alanlardan izole edilmiş olan *Alternaria, Aspergillus, Fusarium* ve *Penicillium* türlerinin proteomik analizleri yapılmıştır. Bu amaçla, izolatların tek spor kültürlerinden elde edilen miselyumların etanol-formik asit ile ekstraksiyonundan sonra cihazın Flex kontrol yazılım programı ile spektrumları alınmıştır. Bu spektrumlar, Maldi Biotyper Real-Time Classification (RTC) ile karşılaştırılarak tanı işlemi gerçekleştirilmiştir. Temsili olarak seçilen 519 farklı fungal izolattan 435 adedinin MALDI TOF MS cihazı ile teşhisi (%83.8) yapılmıştır. 84 fungal izolatın ise sonucu tatmin eden saflık ve tanılama spektrumunda olmadığı için teşhisi yapılamamıştır. Tür tanılaması yapılan 435 izolattan 269'u (%61.8) *Fusarium* spp., 80'i (%18.4) *Alternaria* spp., 60'ı (%13.8) *Aspergillus* spp., ve 26'sı (%6.0) *Penicillium* spp. ait olduğu belirlenmiştir. *Fusarium* cinsine ait izolatların %72.5'i, *Alternaria* cinsinin %78.8'i, *Aspergillus* cinsinin %90.0'ı ve *Penicillium* cinsine ait olan izolatların %84.6'sı 2.000-3.000 (yeşil renk) arası skor değerleri ile "*yüksek olası*" tür olarak teşhis edilmişlerdir. Elde edilen sonuçlar MALDI TOF MS biyotiplemesinin, *Alternaria, Aspergillus, Fusarium* ve *Penicillium* türlerinin yol açtığı hastalıkların rutin tanısı için oldukça güvenilir ve ekonomik bir tanılama yöntemi olarak kullanılabileceğini açıkça göstermiştir.

***Anahtar Kelimeler:** Soğan, hastalık etmeni, MALDI-TOF MS, tanılama*

ID: 93

RNAi-Mediated Post-Transcriptional Gene Silencing Strategies in Honey Bees

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Abstract

Gene silencing technology (knock-down) via RNA interference (RNAi), a contemporary molecular method, represents an RNA-based, sequence-specific, post-transcriptional approach. RNAi has demonstrated its efficacy in reducing gene expression across a wide array of organisms, encompassing plants, mammals, and insects. Studies conducted on diverse organism groups have significantly contributed to comprehending both the operational mechanism of RNAi and the roles of genes within these organisms' biological processes. Among the organisms benefiting extensively from RNAi is the honey bee *Apis mellifera*. This technology, serving as a crucial natural antiviral defense mechanism in bees, has proven highly effective in probing genes associated with the immune system and in combatting pests and pathogens. Consequently, this study undertakes a review of the existing literature to delineate the potential applications, usage areas, and strategies of RNAi technology in honey bees.

Keywords: *Biotechnology, Gene silencing, Honey bee, RNAi*

Introduction

Honey bees play a critical role in plant pollination, thereby contributing to increased agricultural production and supporting the diversity and balance of natural ecosystems (Gallai et al., 2009). However, in recent years, several stress factors affecting honey bees have posed serious threats to hive health and productivity (Olate-Olave et al., 2021). Due to these challenges, scientists and beekeepers have displayed significant interest in developing new strategies involving molecular genetic techniques. Modern molecular biology and genetic research are indispensable for regulating gene expression and understanding gene functions in honey bees. Cells employ various mechanisms to control gene expression, and comprehending these mechanisms is pivotal for grasping the underlying causes of diseases and designing treatments. Among the array of mechanisms, RNA-mediated interference (RNAi) has emerged as a prominent post-transcriptional gene silencing strategy, gaining prominence in recent years. This approach provides valuable insights into gene regulation and holds potential for addressing diverse challenges in honey bee health and productivity.

RNA interference (RNAi)

RNA interference (RNAi) is a sequence-specific post-transcriptional gene silencing mechanism mediated by RNA molecules (Fire et al., 1998). The groundbreaking study conducted by Fire et al. (1998) provided the initial clear demonstration of the biochemistry underlying gene silencing inducers, achieved by directly introducing purified double-stranded RNA (dsRNA) into the body of Caenorhabditis elegans. The natural function of RNA interference encompasses the regulation of various genes and acts as a defense mechanism to safeguard the genome against mobile genetic elements, including viruses and transposons (Agrawal et al., 2003). RNAi has been extensively shown to efficiently reduce gene expression across a diverse spectrum of organisms, spanning plants, mammals, insects, and ticks (Hannon, 2002; Fuente et al., 2007). The silencing pathway initiates with the presence of endogenous or exogenous double-stranded RNA, leading to the generation of small (21-26 base pair) silenced RNA fragments known as small interfering RNAs (siRNA), which are cleaved by the Rnase III-like enzyme. These siRNAs are short dsRNAs characterized by two nucleotide overhangs at their 3' hydroxyl terminals and 5' monophosphate ends (Wilson and Doudna, 2013). Subsequently, the siRNAs are captured by Argonaute 2 (AGO2), an endoribonuclease and a catalytic component of the multiprotein RNA-induced silencing complex (RISC). One strand of the siRNA (the passenger strand) is liberated (the double strand is cleaved into a single strand by the RISC complex), while the other strand, known as the guide strand, targets homologous RNA sequences resulting in the silencing or cleavage of these homologous sequences (Wilson and Doudna, 2013). Notably, siRNAs possess the capability to direct RNA-directed DNA methylation or chromatin remodeling, alongside RNA degradation. They accomplish this by guiding protein complexes to RNAs carrying homologous sequences, thereby governing gene expression and inducing epigenetic modifications (Figure 1) (Hannon, 2002).

RNAi Applications in Honey Bees

RNA interference (RNAi) has emerged as a valuable method for enabling the screening and characterization of honey bee genes, facilitating the characterization of pathogen interactions and studying the functions of Acari genes (Fuente et al., 2007).

RNAi has been widely employed in honey bees to study gene functions. By selectively silencing specific genes through the introduction of double-stranded RNA (dsRNA), researchers can assess the impact of gene knockdown on various biological processes. Antonio et al. (2008) investigated role of vitellogenin in transition from within-hive activities to foraging behavior in honeybee workers, traditionally attributed to juvenile hormone (JH) regulation. By injecting vitellogenin double-stranded RNA (dsVg) into newly emerged Africanized worker bees, researchers observed that RNA interference-mediated silencing of vitellogenin gene function led to a shift in the onset of long-duration flights to earlier in life (by 3-4 days). Utilizing the RNA interference (RNAi), Barchuk et al. (2008) demonstrated the involvement of the Ultraspiracle (Usp) gene in the regulatory mechanism governing the progression of pupal development in *Apis mellifera*. This conclusion is supported by the observed pupal developmental delay in honeybees with Usp gene knockdown. Elias-Neto et al. (2010) characterized the Amlac2 gene responsible for encoding laccase2 in *A. mellifera*. They found that Amlac2 is prominently expressed in the adult integument of pharate adults and is present before cuticle coloring and sclerotization intensify. When the Amlac2 gene was post-transcriptionally knocked down, structural defects in the exoskeleton significantly impacted adult eclosion, the process of emerging from the pupal case.

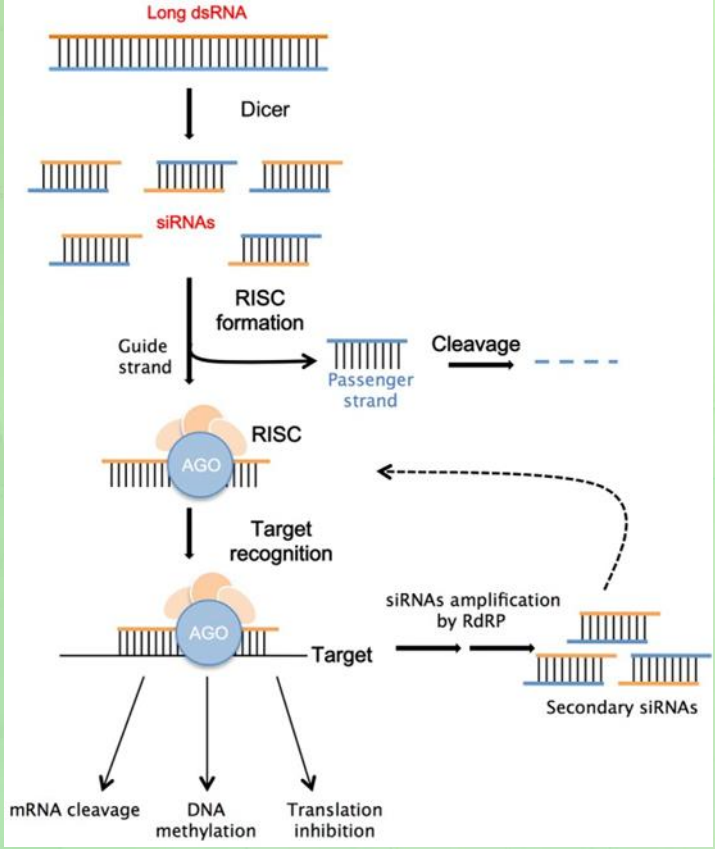


Figure 1. Mechanism of RNAi (Limera et al., 2017)

Understanding the interactions between honey bees and pathogens is crucial for mitigating the impact of diseases on bee colonies. RNAi has been instrumental in characterizing the mechanisms underlying honey bee-pathogen interactions. By targeting key genes in pathogens or the bee immune system, researchers can gain insights into disease susceptibility and immune responses. In their study, He et al. (2021) investigated the therapeutic potential of RNA interference (RNAi) for silencing two *Nosema ceranae* encoded spore wall protein (SWP) genes. The researchers found that oral ingestion of double-stranded RNAs (dsRNAs) corresponding to SWP8 and SWP12, either used separately or in combination, resulted in a substantial reduction in spore load, enhanced immunity, and extended the lifespan of *N. ceranae*-infected bees. Desai et al. (2012) aimed to reduce deformed wing virus (DWV) infection in honeybees (Apis mellifera) by feeding both first-instar larvae and adult bees with a specific double-stranded RNA (dsRNA) construct called DWV-dsRNA, which targets DWV in DWV-inoculated bees. The researchers mixed the DWV-dsRNA construct with the bees' food to deliver it. When the larvae were fed with DWV-dsRNA before being inoculated with the virus, it led to a reduction in DWV viral levels and a decrease in wing deformities compared to larvae fed with DWV or DWV mixed with green fluorescent protein-dsRNA.

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Surprising results have been obtained in recent years with the use of RNAi-mediated gene silencing in the struggle against Varroa and attracted great interest. In a pioneering study, Campbell et al. (2010) conducted the first-ever test of RNA interference (RNAi) feasibility in Varroa mites, targeting a mu-class glutathione S-transferase gene (VdGST-mu1). This research laid the foundation for exploring RNAi as a potential approach for controlling Varroa mite infestations, a major threat to honeybee colonies worldwide. Campbell et al. (2010) successfully achieved the suppression of the VdGST-mu1 gene in Varroa mites 48 hours after injection, and this gene suppression was observed to last for at least 72 hours. In their study, Campbell et al. (2010) also explored alternative methods for the transfer of dsRNA to Varroa mites, as they observed that the injection method led to high mortality rates. These researchers sought to find a less invasive and more practical approach to deliver dsRNA to the mites effectively. By investigating and comparing various delivery methods, they aimed to optimize the RNAi application and reduce any adverse effects on the mites' survival, thus advancing the potential use of RNAi as a safe and efficient method for Varroa mite control. When attempting to transfer dsRNA through topical application, Campbell et al. (2010) encountered difficulties due to the inability of dsRNA to penetrate the mites' cuticle effectively. However, the researchers found success with an alternative method by immersing the mites in a dsRNA solution. This immersion method proved to be effective in achieving gene silencing while causing the least damage to the mites during application. This significant finding demonstrates the importance of optimizing the delivery method in RNAi-based studies and highlights the potential of immersion as a practical and efficient approach for gene silencing in Varroa mites.

In a subsequent study conducted by Campbell et al. (2016), the researchers revealed that two neural genes, namely the B-type allatostatin gene and a crustacean hyperglycemic hormone (CHH)-like gene, could be targeted as potential candidates for mite control. By identifying and investigating these specific genes, the researchers aimed to explore their potential roles in mite physiology and develop new avenues for controlling Varroa mite infestations. This study further underscores the significance of RNAi as a valuable tool in understanding the molecular mechanisms involved in mite biology and its potential application for effective mite management strategies. They utilized the immersion method to avoid injection trauma while conducting double-stranded RNA interference (dsRNAi) experiments. By targeting the B-type allatostatin gene and a crustacean hyperglycemic hormone (CHH)-like gene through dsRNAi, they achieved significant knockdown effects on these neural genes in Varroa mites. The knockdown of the allatostatin gene resulted in an impressive 85% mortality rate among the mites, while the CHH-like gene knockdown led to a 55% mortality rate.

In their study aimed at investigating the potential use of RNAi to struggle Varroa mites, Huang et al. (2017) explored the effects of silencing various genes that play crucial roles in the survival and reproduction of Varroa mites. In the study conducted by Huang et al. (2017) using the micro-injection method, significant mortality was observed in Varroa mites when the Da and Pros26S genes were silenced. This result indicated that these genes played crucial roles in the survival and viability of the mites. Additionally, the researchers found that the silencing of RpL8, RpL11, and RpS13 genes did not impact the overall survival of Varroa mites. However, it was noted that the silencing of these genes resulted in a reduction in the number of offspring produced by the Varroa mites. This finding suggested that these genes were involved in regulating Varroa mite reproduction, and their manipulation through RNAi had an inhibitory effect on their reproductive capacity. The study's results shed light on specific genes that could be targeted to disrupt the life cycle and reproductive processes of Varroa mites, offering potential opportunities for the development of RNAi-based strategies for effective Varroa mite control in beekeeping practices.

RNA interference (RNAi) has emerged as a powerful tool in pest control strategies, with applications in various organisms, including insects and nematodes. One common approach is the transfer of RNAi molecules from genetically engineered plants to insects or nematodes that feed on these plants. This method involves the production of specific double-stranded RNAs (dsRNAs) in the plants, targeting essential genes in the pests. When the pests consume these plants, the ingested dsRNAs trigger the RNAi process, leading to the silencing of the targeted genes and eventually causing the pests' mortality or reduced reproductive capabilities (Steeves et al. 2006; Baum et al. 2007; Rechavi et al. 2011). The discovery that double-stranded RNA (dsRNA) can be systematically spread through ingestion in honey bees has sparked the idea that dsRNA can also be horizontally transmitted from honey bees to Varroa mites. This finding suggests the possibility of using bees as RNAi vectors, where bees can carry and deliver the dsRNA molecules to Varroa mites during their normal interactions (Hunter et al. 2010). The study conducted by Garbian et al. (2012) demonstrated that double-stranded RNA (dsRNA) ingested by honey bees can be efficiently transferred to Varroa mites and even to other bees that are subsequently parasitized by the mites. This dsRNA interchange between the bee and the Varroa mite resulted in the targeted silencing of vital genes in the mite, leading to a significant reduction of over 60% in the Varroa mite population. Furthermore, the researchers investigated the stability of dsRNA under hive conditions and found that it could remain viable in a sugar water solution for up to 6 days. This stability is crucial as it ensures the effectiveness of the dsRNA transfer method over a reasonable period. The study conducted by Cedeño et al. (2015) presented an innovative and cost-effective approach for dsRNA transfer into honey bee and Varroa mite tissues using bacteria. In this method, the

researchers engineered bacteria to express specific dsRNAs, eliminating the need for laborious RNA purification steps. The dsRNAs produced by the engineered bacteria were successfully delivered to both honey bee and Varroa mite tissues, offering an efficient in vivo alternative for gene silencing. They reported that this strategy could be used not only to control viral diseases and Varroa infestation in honey bees, but also for functional studies in bees by gene silencing.

Conclusion

In conclusion, the applications of RNAi in honey bees have significantly broadened our comprehension of gene functions, interactions with pathogens, and prospective strategies for managing parasites. The ongoing research in this domain holds the potential to further enhance honey bee health and make valuable contributions to the sustainable management of bee populations, especially in the face of persistent challenges like colony collapse disorder and Varroa mite infestations.

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ID:

How Does the Use of Natural Sugar Alternatives in Soft Candy Manufacturing Affect Product Properties?

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Abstract

Soft candy products are known as popular that can be preferred by consumers of all ages, especially children, due to their attractive appearance, pleasant taste and texture. In recent years, there has been a rapid increase in the number of studies proving that confectionery products, which are known to contain high-energy and low-nutrient additives, can be turned into healthier and more functional products. In order to produce these products with the desired properties, it is necessary to optimize the process parameters such as product formulation and ingredients, etc. In this study, it was aimed to investigate the effect of the use of alternative sugar sources (fruit concentrates and honey) on the product properties of soft sugars. It was also examined whether the aroma coming from the natural sugar sources used in the production of soft candy was liked by the panelists. Some chemical, sensory and textural properties of soft candies produced according to the optimized formulations were analyzed. According to the findings, , it was found that plain soft sugar (evaluated as control group in this study, which was produced from granulated sugar, had an extremely elastic, sticky and soft structure and required more energy to chew before swallowing, while soft candies produced from alternative sugar sources had a harder and less elastic structure than plain soft candy. On the other hand, although there was no statistically significant difference between the analyzed samples in terms of appearance (color) and aroma ($P>0.05$), it was observed that the aroma of the plain soft candy (2±1) was not liked by the panelists and negatively affected the purchase intention (2±1). The findings of this study show that parameters of production processes can affect the quality and consumer appreciation of the final product.

Key Words: *Gelatin, sugar, natural, chewable, purchase intention*

Yumuşak Şeker Üretiminde Doğal Şeker Kaynakları Kullanımı Ürün Özelliklerini Nasıl Etkiler?

Özet

Yumuşak şeker ürünleri, çekici görünümleri, hoş tadı ve dokusu nedeniyle başta çocuklar olmak üzere her yaştan tüketici tarafından tercih edilebilecek popüler ürünler olarak bilinmektedir. Son yıllarda yüksek enerjili ve düşük besleyici katkı maddeleri içerdiği bilinen şekerleme ürünlerinin daha sağlıklı ve fonksiyonel ürünlere dönüştürülebileceğini kanıtlayan çalışmaların sayısında hızlı bir artış yaşanmaktadır. İstenen özelliklere sahip ürün üretebilmek için ürün formülasyonu ve içeriği vb. işlem parametrelerinin optimizasyonunu gerekmektedir. Bu çalışmada alternatif şeker kaynakları (meyve konsantreleri ve bal) kullanımının yumuşak şekerlerin ürün özelliklerine etkisinin araştırılması amaçlanmıştır. Ayrıca yumuşak şeker üretiminde kullanılan doğal şeker kaynaklarından gelen aromanın tüketici tarafından beğenilip beğenilmediği de incelenmiştir. Belirlenmiş en iyi formülasyonlara göre üretilen yumuşak şekerlerin bazı kimyasal, duyusal ve tekstürel özellikleri analiz edilmiştir. Elde edilen bulgulara göre toz şekerden üretilen ve çalışmada kontrol grubu olarak değerlendirilen sade yumuşak şekerin son derece elastik, yapışkan ve yumuşak bir yapıda olduğu ve yutmadan önce çiğnemek için daha fazla enerji gerektirdiği, alternatif şeker kaynaklarından üretilen yumuşak şekerlerin ise sade yumuşak şekerden daha sert ve daha az elastik bir yapıya sahip olduğu bulunmuştur. Öte yandan, her ne kadar analiz edilen örnekler arasında görünüm (renk) ve aroma açısından istatistiksel açıdan önemli bir farklılık bulunmamışsa da ($P>0.05$), toz şeker kullanılan sade yumuşak şeker aromasının (2±1) panelistler tarafından beğenilmediği ve bu durumun satın alma niyetini (2±1) olumsuz yönde etkilediği gözlenmiştir. Çalışmanın bulguları üretim süreçlerindeki parametrelerin nihai ürün kalitesini ve beğenisini etkileyebileceğini göstermektedir.

Anahtar Kelimeler: *Jelatin, şeker, doğal, çiğnenebilir, satın alma niyeti*

ID: 97

Mercuric Chloride-Induced HepatotoxicityIn Female Wistar Rats

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Abstract

Mercury is one of the most hazardous environmental and industrial pollutants found in various chemical forms such as elemental, organic and inorganic mercury. It is a toxic chemical, its exposure leads to damage in a variety of tissues and organs. Mercury exposure also leads to gastrointestinal disorders and hormonal imbalance. A specific concern about mercury exposure in people is the need for efficient treatment to cope with poisoning. The central nervous system, gastrointestinal system, kidney and liver are the main target sites of mercury toxicity. Plant products and their active components are the sources of natural antioxidants that can protect tissues and organs from oxidative stress and thus play a significant role in metal detoxification. The present study was to determined the impact of *Morinda longissima* ethanolic extract(150 and 300 mg/kg body weight) on mercuric chloride (HgCl2)(1.5 mg/kg b.w.)-mediated hepatic oxidative toxicity in rats. Compared with antioxidant synthetic alpha-Tocopherol (100 mg/kg b. w). The experiment was carried out in female rats which was divided into five groups as follow: negative control, positive control (HgCl2), *ML* 150 mg/kg + HgCl2, *ML* 300 mg/kg + HgCl2 and Tocopherol 100 mg/kg + HgCl2. Animals were treated for 10 days; the rats were administered by single dose of HgCl2 (1.5 mg/kg b.w.) in physiological saline intraperitoneal. Twenty-four hours after the last treatment, all rats were sacrificed and liver tissues were isolated for histological parameters. The results showed that HgCl2 caused a marked damage in tissues HgCl2 changed histological integrity of liver. In contrast to this, *Morinda longissima* decreased histopathological alterations compared with standard and positive group.

Key Words: *Oxidative stress, mercuric chloride, liver damage, histological parametres,Morinda longissima.*

ID: 98

Mikrobiyal Gübreler ve Kullanım Alanları

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Özet

Bitkisel üretimde birim alan verimini ve ürün kalitesini artırmada kullanılan kimyasal içerikli birçok agronomik uygulama yapılmaktadır. Bu bakımdan en etkili uygulamalar arasında yer alan kimyasal gübrelerin aşırı kullanımı sonucunda toprakta kirlilik ve ağır metal birikimi artmaktadır. Son yıllarda bitkilerin gelişimleri teşvik etmek, hastalık ve zararlılara karşı toleranslarını artırmak, tuz, kuraklık ve don stresine toleransını yükseltmek ve toprakta bitkiler tarafından kullanılmayan formdaki bitki besin maddelerini yarayışlı hale getirmek amacıyla farklı mikroorganizmalar kullanılmaktadır. Böylece daha az kimyasal gübre kullanarak çevre kirliliğinin önüne geçilmesi, bitkisel üretimde verim ve kalitenin yükseltilmesi amaçlanmaktadır. Mikrobiyal gübre olarak adlandırılan bu ürünler farklı bitki türleri üzerine olumlu yöndeki etkileri çeşitli çalışmalar sonucunda ortaya konulmuştur. Bu nedenle, önümüzdeki yıllarda farklı amaçla kullanılacak mikrobiyal gübrelerin giderek artacağı ve kullanımının yaygınlaşacağı düşünülmektedir.

Anahtar kelimeler: *Mikrobiyal gübre, bakteri, bitki, verim*

Microbial Fertilizers and Usage Areas

Abstract

In crop production, many agronomic practices with chemical contents that will increase the yield per unit area and product quality are used. In this respect, soil pollution and heavy metal accumulation increase as a result of excessive use of chemical fertilizers, which are among the most effective practices. In recent years, different microorganisms have been used to promote the growth of plants, to increase their tolerance to diseases and pests, to support their tolerance to salt, drought, and frost stresses, and to make plant nutrients useful in the form that are not used by plants in the soil. Thus, it is aimed to prevent environmental pollution by using less chemical fertilizers and to enhance yield and quality in crop production. These products, called microbial fertilizers, have positive effects on different plant species as a result of various studies. For these reasons, microbial fertilizers should be extensively used for different purposes and their use will be widespread in the coming years.

Keywords: *Microbial fertilizer, bacteria, plant, yield*

Giriş

Son yıllarda, nüfus artışı ve buna bağlı olarak artan gıda ihtiyacı nedeniyle tarımsal üretimde önemli artışlar gerçekleşmiştir. Bitkisel üretimde gerçekleşen artışta verim potansiyeli yüksek yeni çeşitlerin ıslahı başta olmak üzere sulama, gübreleme, yabancı otlar, hastalık ve zararlılarla mücadele önemli rol oynamıştır. Ancak pestisitlerin ve kimyasal gübrelerin aşırı kullanılması tarım alanlarının kirlenmesine ve fakirleşmesine neden olmuştur. Özellikle gıda arzının sürdürülebilmesi, doğal dengenin korunması ve çevrenin kirletilmemesi açısından kimyasal gübre ve pestisit kullanımının azaltılması gerekliliği ortaya çıkmıştır (Szilagyi-Zecchin ve ark., 2016). Günümüzde uygun ekim nöbeti sistemleri, entegre pestisit yönetimi ve koruyucu toprak işleme yöntemleri gibi verimliliği ve karlılığı ön plana çıkaran uygulamalar yapılmakta ise de, toprak verimliliğinin korunması ve artırılması amacıyla mikrobiyal gübreler önemli bir alternatif olarak karşımıza çıkmaktadır.

04.06.2010 tarihli Resmi Gazetede yayımlanarak yürürlüğe giren Tarımda Kullanılan Organik, Organomineral Gübreler ve Toprak Düzenleyiciler ile Mikrobiyal, Enzim İçerikli ve Diğer Ürünlerin Üretimi, İthalatı ve Piyasaya Arzına Dair Yönetmelikte mikrobiyal gübre, "*bitki için gerekli olan bitki besin maddelerinin sağlanmasında ve biyolojik yolla yarayışlı hale gelmesinde rol oynayan canlı mikroorganizmaların ticari formülasyonları*" olarak tarif edilmektedir (Anonim, 2023). Yine aynı yönetmelikte, mikrobiyal gübreler iki ürün tipine ayrılmıştır. Birincisi, mikrobiyal gübreler, bitkilerle ortak yaşayarak makro ve mikro elementleri bitkiye taşıyan ve toprakta doğal olarak bulunan mantarlar, çeltikle ortak yaşayarak bitkiye azot sağlayan ve toprakta doğal halde bulunan *Cyanobacteria*lar ile algler, topraktan izole edilerek etkinliği tespit edilmiş bakteriler bu grubu oluşturmaktadır. Bu organizmaların tamamı toprakta mikrobiyal aktiviteyi artırmakta, enerji kaynağı olarak kullanmak için topraktaki kompleks organik bileşikleri parçalayarak toprakları makro ve mikro besin elementleri yönünden

zenginleştirmektedirler. Bu kimyasallar ayrıca, tohum çimlenmesini, çelik köklenmesini teşvik etmektir ve bitki büyümesine yardımcı olmaktadır. Bu organizmalar kültüre alınarak çoğaltılmakta ve standart hale getirilmektedir. İkinci ürün grubu olan karışım mikrobiyal gübreler ise bu sınıfta değerlendirilen materyallerin karışımından meydana gelen ürünleri ifade etmektedir. Mikrobiyal gübreler içerik olarak; bakteriler, *Cyanobacteria*, Algler, Funguslar, Mikorizalar ile Tek Hücreli Organizmalarda kuru hücre ağırlığı, klorofil a, canlı organizma sayısı, İpliksi Organizmalarda ise klorofil a ve kuru hücre ağırlığı olarak belirlenmektedir.
Dünyada ve ülkemizde tescillenerek piyasaya sunulan ve tarımda kullanılan mikrobiyal ürünlerin büyük bir kısmının içerikleri bakteri ve funguslardır. Dünya Sağlık Örgütü (WHO)'nün Mikroorganizma Risk Gruplandırması Listesinde riski olmayan grupta yer alan mikroorganizmalar kullanıldığı için mikrobiyal gübreler, insan sağlığı açısından risk taşımamaktadır (Avan ve Kotan, 2021). Ayrıca, kimyasal gübrelere göre çok daha az risklidir ve çevre kirliliğine neden olmadığı belirtilmektedir. Kimyasal gübrelere göre doğal dengeyi koruyucu özelliklerinden dolayı yaban hayatı koruma açısından önemli avantajları bulunmaktadır. Bununla birlikte, bazı hastalık ve zararlıların önlenmesinde de mikrobiyal gübreler içerdiği bakteri ve fungusların özelliklerine göre biyopestisit olarak da ön plana çıkabilmektedir (Avan ve Kotan, 2021). Bu sayede pestisitlerin neden olduğu kalıntı riskinin minimuma indirilerek insan ve hayvan sağlığı açısından neden olduğu olumsuzlukların azaltılması sağlanabilmektedir. Dolayısıyla hem bitki besleme hem de bitki koruma açısından önemli olan birçok mekanizmaya sahip olabilecek mikrobiyal gübreler geniş bir kullanım alanına sahiptir. Toprak patojenlerine karşı başarılı bir şekilde kullanımları, pestisitlerden daha ekonomik olmaları ve toprak düzenleyici özellikleri sayesinde uzun vadede toprağın verimliliğini ve mikrobiyal aktivitesinde artış sağlamaktadırlar. Böylece mikrobiyal gübre kullanımı bitkisel üretimde verim ve kalite artışı sağlarken aynı zamanda üretim maliyetlerini de azaltacaktır (Kotan, 2020).

Mikrobiyal Gübrelerin Kullanım Alanları

Mikrobiyal gübre olarak kullanılan faydalı bakteriler, funguslar ve diğer organizmalar, dünyada en yaygın kullanılan biyolojik çözümlerin başında gelmektedir (Avan and Kotan, 2021). *Pseudomonas* sp., *Bacillus* sp., *Rhizobium* sp., *Azotobacter* sp. ve *Azospirillum* sp. gibi mikroorganizmalar mikrobiyal gübre olarak kullanılmaktadır (Stamenković ve ark., 2018) Mikrobiyal gübre olarak kullanılan mikroorganizmaları kullanım alanlarına göre Li and Zhang (2001) tarafından şu şekilde sıralanmıştır.

- Nodül oluşturan bakteriler: Nodül bakteriyel gübre, en uzun kullanım geçmişine ve faydalı etkilere sahip mikrobiyal gübreler arasındadır (Olson, 1989; Song, 1994). Baklagil bitkileri tarafından simbiyotik azot fiksasyonu üzerine yapılan klasik araştırmalardan üretilmiştir. *Rhizobium* ve *Bradyrhizobium* cinslerinin fonksiyonel bakteri türleri baklagil bitkilerinin köklerini enfekte ederek atmosferik azotu (N) bitkinin kullanabileceği forma sabitlediği nodüller oluşturmaktadır. Bu grup içerisinde en önemli bakteri türleri *Bradyrhizobium japonicum* (*Sinorhizobium fredii*/*Rhizobium fredii*), *Bradyrhizobium* sp. (*Arachis hypogaea*), *R. huakuii*, *R. leguminosarum* bv. *viceae*, *R. meliloti*, *R. trifolii*, *R. leguminosarum* (Chen ve ark., 1981).
- Azotobakterler: Serbest yaşayan *Azotobacter*ler azot fiksasyonu gerçekleştirmektedir. *Azotojen*, *Rhizobium*'a göre daha düşük azot fiksasyon verimliliğine sahiptir. Bununla birlikte, azot bağlama faaliyetleri için mevsimsel bir sınırı bulunmamaktadır. Doğada çeşitli *Azotobacter* türleri bulunmaktadır. Bunlar arasında *Azotobacter chroococcum*, *Klebsiella pneunoniae*, *Alcali-genes faecalis* ve *Enterobacter cloacae* en yaygın türler arasındadır.
- Fosfobakteriler: *Bacillus megaterium*, *B. cereus*, *B. firmus*, *B. brevis*, *Thiobacillus thiooxidans*, *Pseudomonas* ve *Arthrobacter* türleri gibi bazı mikroorganizmalar fosfatı ayrıştırabilmektedir (Ge and Wu, 1996). Bu nedenle son yıllarda fosfat çözücü gübre olarak kullanımları hızla artmaktadır. (Zhang ve ark., 1994; Li ve ark., 1994; Liang, 1994; Lin ve ark., 1994).
- Silikat bakteriler: Biyopotas gübresi olarak da bilinen bu bakteriler (*Bacillus mucilaginosus*, *B. circulans* ve *B. macerans*) toprakta bulunan potasyum minerallerini çözünebilir potasyum iyonlarına ayrıştırmakta ve bitkilerde potasyum eksikliğinin giderilmesinde önemli katkılarının olacağı bildirilmektedir (Xiong ve ark., 1993; Peng and Ye, 1995).
- Antibiyotik bakteriler: Bu mikrobiyal gübre, toprak verimliliğini artırmanın yanı sıra bitkiyi hastalıklardan koruyarak büyümesini destekleyebilmektedir. Antibiyotik üreten bir bakteri türü *Actinomyces microflavus* bu özelliği nedeniyle kullanılmaktadır (Wu ve ark., 1994). *Pseudomonas* ve *Bacillus* de dahil olmak üzere birçok gram-negatif bakteri türü bu özelliğe sahiptir (Weller, 1988).
- Kompoze mikrobiyal gübreler: Son yıllarda birçok kompoze mikrobiyal gübre farklı özelliklere sahip mikroorganizmaların bir araya getirilmesiyle kompoze mikrobiyal gübreler elde edilmiştir. *Azotobacter* ve fosfobakterilerin karıştırılması veya silikat bakterilerinin diğer bakterilerle karıştırılarak kompoze mikrobiyal gübreler elde edilmiştir.

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Ticari biyogübreler: Hazırlama ve Tarla Uygulamaları

Sürdürülebilir teknikler kullanılarak bitki sağlığının iyileştirilmesi, birçok çevresel sorun nedeniyle günümüzde ihtiyacı haline gelmiştir. Bu bağlamda biyogübreler, bu tür sorunların üstesinden gelmek için en güçlü araçlar arasındadır. Artık biyogübrelerin, sürdürülebilir tarımın hayati bir bileşenini oluşturan ve çeşitli besinlerin, fitohormonların kullanılabilirliğini sağlayarak büyümeyi desteklemenin yanı sıra patojenlere karşı etki ederek bitkilerin sağlığının korunmasında kilit rol oynayan mikroplar olduğu açıktır. Bu formülasyonlar, toprağın verimliliğinin yanı sıra üretkenliği de aynı anda artırarak canlı kalacak şekilde hazırlanır. Çalışmalar, formülasyonların konukçu bitkiye aşılandıktan sonra topraktaki sayılarını ve aktivitelerini büyük ölçüde artırdığını göstermektedir (Arora ve ark., 2010). Ayrıca, biyogübrelerin fotosentezde, amino asit sentezine, pestisitlerin iyileştirilmesinde, biyofortifikasyonda, ve abiyotik stresin iyileştirilmesinde birçok etkileri vardır. Biyogübrelerin iyi formülasyonları aşağıdaki arzu edilen özelliklere sahip olmalıdır; çevre dostu olmalı, yani çevreyi kirletmemeli, toksik olmamalı ve biyolojik olarak parçalanabilir olmalıdır; Besin maddelerinin eklenmesine, pH ayarlamalarına olanak sağlamalı, yeterli arz ve erişilebilirlikte düşük maliyetli hammaddelerden oluşmalı, raf ömrü uzun olmalı ve olumsuz koşullarda metabolik olarak canlı yüksek sayıları sürdürebilmelidir. Sıvı biyogübreler, turba formülasyonları, granüller ve dondurularak kurutulmuş tozlar dahil olmak üzere farklı türde ticari formları vardır. Sıvı formülasyonlar son zamanlarda geliştirilmiş ve kolay işlenebilmeleri, tohumlara veya toprağa kolayca uygulanabilmeleri nedeniyle ilgi görmektedir (Herrmann ve Lesueur, 2013). Ayrıca, sıvı biyogübreler, 2 yıla kadar daha uzun raf ömrüne sahip olduklarından, geleneksel katı taşıyıcı bazlı aşılayıcılara göre daha uzun raf ömrü, saflık, kolay tanımlama vb. gibi birçok avantaj sunmaktadır. Bu formülasyonlar, üreticinin çeşitli hücre koruyucuları, oluşumuna yardımcı olabilecek belirli indükleyiciler ile yeterli miktarda besin eklemesine izin verir. Sıvı biyogübreler, taşıyıcı bazlı toza göre daha az dozda gereklidir ve yüksek ihracat potansiyeline sahiptir (Kour ve ark., 2020).

Mikrobiyal Gübrenin Bitkiler Üzerine Etkileri

Mikrobiyal gübreler granül, sıvı veya toz formunda üretilmekte ve pazarlanmaktadır. Bu gübreler toprağa uygulanabilir iken, aynı zamanda tohumlara kaplanarak uygulanabilir veya direk olarak bitkilerin yapraklarına püskürtülerek kullanılabilmektedir. Bu sayede kullanım kolaylığı sağladıkları gibi farklı gelişim dönemlerinde de uygulama olanağına sahiptirler. Örneğin, *Rhizobium* bakterileri hem tohuma hem de toprağa uygulanabilmektedir. Panasiewicz ve ark. (2023) soya fasulyesinde *B. japonicum* aşılaması ve azot gübrelemesinin, verimi artırmada önemli bir faktör olduğunu, Chen (1994) fiğ tohumlarının *R. leguminosarum* bv. *viceae* bakterisi ile aşılamanın verimi %20-%50 oranında arttırdığını tespit etmişlerdir. Cao (1997) tarafından elde edilmiş ve *Rhizobium*'u beş farklı yeşil gübre (*Trifolium incarnatum, T. repens, Astragalus sinicus, Vicia villosa, V. sativa*) bitkisinde verimlerin %18,1-%44,2 oranında arttığını ve toplam N miktarının hektarda yaklaşık olarak 30 kg artış gösterdiğini tespit etmiştir. Bununla birlikte farklı mikrobiyal gübrelerle yapılan çalışmalarda da olumlu sonuçlar tespit edilmiştir. Dusak (2021) toprak, yaprak ve tohuma uyguladıkları *Bacillus megaterium, Lactobacillus delbrueckli, Bacillus subtilis + Paenibacillus azotofixdt, Frateuria aurantia* bakteri içerikli mikrobiyal gübrelerin mısırda protein oranını etkilediği ve topraktan uygulanan *B. subtilis + Paenibacillus azotofixdt*'in en yüksek protein oranını verdiğini tespit etmişlerdir. Soysal ve ark. (2020) ekmeklik ve makarnalık buğdayda azot bağlayıcı *Bacillus atrophaeus* ve fosfor çözücü *B. subtilis* uygulaması ile tane veriminde önemli artışlar elde etmişlerdir. Altunlu ve ark. (2019) şeker mısır tohumlarına uygulanan *Endomycorrhiza*, *Trichoderma* spp., *B. subtilis* ve *B. megaterium* içerikli mikrobiyal gübrenin çimlenmeyi, bitki boyunu ve verimi arttırdığını, Öztüfekçi (2015) ise buğdayda *B. subtilis* içerikli ticari mikrobiyal gübrenin tohuma uygulanması ile bitki yaş ağırlığının %32,76 ve tane veriminin %16,24 oranında artış sağlandığını bildirmiştir. Ayrıca, mısırda yapılan araştırmalarda, *Bacillus* sp.'un yaprak alanı ve kuru biyomas ağırlığını arttırdığı (Kavamura ve ark., 2013), *Burkholderia cepacia*'ın bitki yaş ağırlığını (Bevivino ve ark., 1998), *Rhizobium tropici* ile zenginleştirilmiş *Azospirullum* spp. uygulamasının tane verimini (Marks ve ark., 2015), *Azotobacter chroococcum*'un NaCl'nin olumsuz etkilerini azalttığı (Rojas-Tapias ve ark., 2012), *Azotobacter chroococcum + A lipoferum* uygulamasının ise tane verimini arttırdığı (Hajnal-Jafari ve ark., 2012), *Pseudomonas fluorescenes P. putida, Azospirillum lipoferum* ve *A. brasilense* uygulamalarının da bitki boyu, bitki kuru ağırlığı, yaprak alanı, bin tane ağırlığı ve koçanda tane sayısını arttırdığı (Gholami ve ark., 2009) bildirilmiştir. Diğer birçok bitki türünde de mikrobiyal gübrelerin olumlu etkileri belirlenmiştir. Frezarin ve ark. (2023) *Azospirillum brasilense, Bacillus subtilis, Bradyrhizobium japonicum* ve *Trichoderma harzianum* tek ve kombine olarak uyguladıkları yer fıstığında en yüksek verimin *B. japonicum* aşılamasından elde etmişlerdir. Yine ülkemizde yapılan araştırmalarda *Rhizobium* bakterisinin tohuma aşılanmasıyla nohut (Takıl ve Kayan, 2023), fiğ (Ertekin ve Çakmakçı, 2020), fasulye (Altunkaynak ve Ceyhan, 2018) ve mercimek (Erman ve ark., 2012) bitkilerinde verim artışları belirlenmiştir. Bununla birlikte, kuraklık, yüksek ve düşük sıcaklık, su basması, ağır metaller ve tuzluluk gibi abiyotik stresler ile böcek, fungus, bakteri ve virüs gibi biyotik faktörlerin olumsuz etkilerini azaltmak, gidermek veya korumak amacıyla da mikrobiyal gübreler kullanılmaktadır. Agha ve ark.

(2023) *Bradyrhizobium japonicum* ile birlikte *Bacillus* MAP3 ve *Enterobacter* Delta PSK'nın iki NaCl seviyesinde (50 ve 100 mM) soya fasulyesi üzerindeki etkisini incelemiş, özellikle *B. japonicum* + *Enterobacter* Delta PSK ile birlikte aşılanmış bitkilerin sürgün uzunluğunda %49, yaprak alanında %78, kök uzunluğunda %20 ve klorofil a içeriğinde %57 oranında artış olduğunu tespit etmişlerdir. Son yıllarda, silikat bakterilerinin uygulama alanı giderek artmış, pamuk, tütün, pirinç, buğday, mısır, yer fıstığı, soya fasulyesi, tatlı patates, patates, elma, şeftali, üzüm, domates, lahana, biber ve fasulye bitkilerinde kullanılmıştır. Liu ve ark. (1996) silikat bakteri uygulaması ile ürün veriminde yaklaşık %13, endüstri bitki veriminde %10-25, kavun ve sebze de ise %20-30 oranında artış elde edilmiştir. Li ve ark. (1998) yaptıkları araştırmada, *Bradyrhizobium* sp. ve *Bacillus subtilis*'in birlikte mikrobiyal gübre olarak uygulanması ile yer fıstığında nematot görülme sıklığının %34,5 oranında azaldığını, verimin ise %23,4 oranında arttığı bildirmişlerdir. Takıl ve Kayan (2023) dört nohut çeşidine *Rhizobia*, *Azotobacter* ve *Rhizobia* + *Azotobacter* uyguladıkları çalışmada, fenolojik ve morfolojik özellikler açısından *Rhizobia* + *Azotobacter* uygulamasının en iyi sonuçları verdiğini bildirmişlerdir. Li ve ark. (2022) mikrobiyal gübre uygulamalarının topraktaki bakteri ve mantar yoğunlukları ile toprakta değişebilir Ca, organik madde içeriği, toplam N ve mevcut P'yi etkilediğini, toprağının mikrobiyotasında ve kimyasal özelliklerinde önemli iyileşmeler olduğunu ortaya koyarak mikrobiyal gübrelerin tarıma yeni açılan arazilerin toprak özelliklerini iyileştirmede kullanılabileceğini bildirmişlerdir. Bunun yanında Sharma ve Mathur (2020) pamuk yaprak kurdu zararına uğramış hardal bitkisinde fosfor çözücü bakteriler, mikoriza ve bunların kombinasyonunu uygulamışlar ve mikorizaların yalnız veya birlikte uygulanmasının SOD, CAT, POD ve APX enzim oranlarında artış sağlayarak bitkilerin dayanıklılık mekanizması güçlendirdiğini belirlemişlerdir.

Sonuç

Modern tarımın gelişmesiyle birlikte kimyasal gübrelerin kullanımı da hızla artmış ve bitkisel üretimde verim ve kalitenin artırılmasında önemli bir rol üstlenmişlerdir. Ancak kimyasal gübrelerin toprak reaksiyonu başta olmak üzere kimyasal yapısının bozulmasına ve topraktaki mikroorganizma dengesinin giderek bozulmasına neden olmuşlardır. Bu nedenle, organik, mikrobiyal ve organomineral gübreler hızla önem kazanmaya başlamıştır. Yapılan bir araştırmada, %10 NPK içeren kimyasal + organik gübreye faydalı mikroorganizmalar eklendiğinde, tek başına kimyasal gübreye kıyasla çeltikte ve yer fıstığında yaklaşık %22, karpuzda %34, çayda %14 kolzada %18 ve tütünde %12 oranında artış sağlanmıştır (Lin ve ark., 1997). Ayrıca, faydalı mikroorganizmalarla aşılanmış kimyasal + organik gübrenin önemli verim artışları sağladığı da gösterilmiştir. Mikrobiyal gübreler bitki hastalıklarının kontrolünde, bitki zararlılarının azaltılmasında ve bazı besin maddelerinin bitkiler için daha uygun forma dönüştürülmesinde önemli rol oynamaktadırlar. Bu nedenle toprak verimliliğini artırmada, atıkları ayrıştırmada ve kirli toprakları iyileştirmede kullanılmaktadır (Chen ve Hu, 1990). Günümüzde, faydalı mikroorganizmaların gübre ve inokulant olarak uygulanması dünya çapında büyük ilgi görmekte, üretimi ve kullanımları hızla artmaktadır. Mikrobiyal gübrelerin kullanımıyla bitki verimini ve toprak verimliliğini artırabileceği, biyoçeşitliliği korumaya yardımcı olacağı, organik atıkları geri dönüştürebileceği, kimyasal gübre ihtiyacını ve çevre kirliliğini azaltmaya yardımcı olacaktır. Güvenilir gıda ve organik ürün üretimi yanında ekolojik tarımı kolaylaştırmanın basit ve ekonomik yolu mikrobiyal gübreler olacaktır.

Kaynaklar

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Tiger Nut (*Cyperus esculentus*) Milk Powder: Effects of Preservatives on Quality Characteristics

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Abstract

Tiger nut milk *(Kunun aya)* is a traditional fermented non-alcoholic beverage widely consumed in northern parts of Nigeria especially during the dry season. The short lifespan of tiger nut milk beverage affects its large scale production and profitability. Big yellow tiger nuts were thoroughly washed with warm water, air-dried and then grinded into powder. The powder milk was then, divided into four portions and subjected to the following treatments; 0.05 g% sodium benzoate, 0.05 g% gelatin, a combination of 0.05 g% of gelatin and sodium benzoate and a fresh tiger nut powder as a control. The samples were stored at room temperature (28 ± 2 ºC) and the influence of added preservatives on nutrients and sensory quality of the samples were evaluated every week for a duration of six (6) weeks. The protein content increased slightly after storage, vitamin C & E contents of the treated milk samples were found to be significantly (P<0.05) different compared with the control sample after storage. The mineral elements of the treated milk samples were not significantly (P>0.05) different with the control sample at the respective storage time. The sensory quality characteristics and general acceptability of the tiger nut milk powder were not statistically affected by addition of preservatives and storage time. This study successfully processed tiger nut into milk powder with good acceptability.

Keywords: *Milk powder, preservation, quality, sensory score, tiger nut*

Introduction

Tiger nut (*Cyperusesculentus*) is a monocotyledenous plant that belongs to the family *cyperaceae* which is made up of over 4000 species (Ekeanyanwu *et al.,* 2010). It is locally called '*aya'* in hausa, '*akiawusa'* in igbo, and '*ofio'* in Yoruba. It is a perennial grass-like plant with spheroid tubers, pale yellow cream kernel surrounded by a fibrous sheath, it grows in wet areas and often occurs as a weed especially on farm lands used for cultivation of vegetables (Webster *et al.,* 2001). Its common names include; as yellow nut sedge, earth or ground almonds, "*souchet"* in French, "*ermandeln"* in German and "*chufa"* in Spanish (Abaejoh *et al.,* 2006). Tiger nut is found wild and cultivated in Africa, South America, Europe and Asia. Tiger nuts grow in the wild, along rivers and are cultivated on a small scale by rural farmers mostly in the northern states of Nigeria. Tiger nuts are edible, sweet, nutty, flavored tubers which contain protein, carbohydrate, sugars, and lots of oil and fiber (FAO, 2002). Grossman and Thomas (1998) reported that tiger nuts have been cultivated for food and drink for men and planted for hogs for many years in Spain and that the lovely milky elixir is served in health Spas, Pubs, and restaurants as a refreshing beverage (competing successfully with other soft drinks). Its tubers are said to be aphrodisiac, Carminative, diuretic, stimulant and tonic (Chopra *et al.,* 1986; Chevallier, 1996). Tiger nut has also been reported to be used in the treatment of flatulence, Indigestion, diarrhea, dysentery and excessive thirst (Chevallier, 1996). Unfortunately, despite these potentials in tiger nut it has been a neglected crop in Nigeria. This probably may be due to inadequate knowledge on its production, utilization and nutritional value. Tiger nut could provide a basis for rural industries in Africa. It is an important food crop for certain tribes in Africa, often collected and eaten raw, baked as a vegetable, roasted or dried and ground to flour. The grounded flour is mixed with sorghum to make porridge, ice-cream, sherbet or milky drink. It is mostly consumed raw as snack without knowledge of the food and nutritional quality (FAO, 2002). It has also been found to possess good therapeutic quality (Moore, 2004). Moore (2004) stated that "the expansion of tiger nut milky drinks will significantly help the research linking tiger nut milk to healthier cholesterol levels and other nondairy manufacturers. This could also gain a boost from an increased consumer interest in health foods. Tiger nut milk must be consumed within 2-24 hours at 4ºC-10ºC due to its poor shelf life (Akoma *et al.,* 2006), also the high water content coupled with crude method of production and packaging under improper sanitary conditions predispose tiger nut milk to microbial contamination. Although many women have developed the skills for commercial production of the milk (Musa and Hamza, 2013), preserving and extending the shelf life of tiger nut milk is a great challenge. Nwobosi *et al.* (2013) and Ibrahim *et al.* (2016a) have made an attempt to delay its spoilage by addition of some natural preservatives and by some physical methods such as short temperature long time pasteurization, refrigeration, sterilization, ultraviolent light, freezing and sodium benzoate treatments but with little success that could allow long distance transportation of the product and lengthened the storage time. This study was therefore aimed at processing tiger nut milk into powder form and determine the effects of addition of preservatives, and storage time on the nutritional and sensory characteristics of the tiger nut milk powder.

Materials and Methods

Chemicals and Reagents
All chemicals and reagents used were of analytical grades

Sample collection and preparation
Dry tiger nut (big yellow) was purchased from Sokoto central market, it was sorted and washed thoroughly with cooled boiled water, it was allowed to air dry and then grinded into powder.

Experimental design
Tiger nut milk powder was divided into four (4) portions and subjected to the following treatments:
Group 1: Tiger nut milk powder without preservative (TMP; Control).
Group 2: Tiger nut milk powder plus 0.54 g sodium benzoate (TMPS).
Group 3: Tiger nut milk powder plus 0.54 g of gelatin (TMPG).
Group 4: Tiger nut milk powder plus 0.54 g gelatin and 0.54 g sodium benzoate (TMPGS).
Each of the group was divided into six (6) places, and kept in an air tight container. These samples were analysed for six (6) weeks.

Milk preparation
One hundred and eighty gram (180 g) of the sample powder was placed in a plastic container and 540 ml of distilled water was added, the mixture was stirred gently and then sieved

Sensory evaluation
Undergraduate students of Usmanu Dan fodiyo University Sokoto who were familiar with the consumption of tiger nut milk assessed the sensory quality of the milk samples. A five points hedonic scale was used in the assessment, where 5 scores ‘extremely like’ and 1 scores ‘extremely dislike’ (Harry and Heymann, 2010). The judges rated the milk samples based on colour, odour, taste, mouth feel and general acceptability.

Determination of crude protein
The crude protein content of the powder samples were determined by the micro-Kjeldahl standard method of AOAC (2005).

Determination of vitamins
The vitamin C and E of the tiger nut milk powder preserved with preservatives and the control samples were determined by spectrophotometric method described by Rutkwoski *et al.* (2005).

Determination of mineral elements
Potassium and sodium ions were determined using flame photometer, calcium and magnesium ions were determined using EDTA titration method and phosphorus was determined using spectrophotometric method (Black, 1965).

Statistical analysis
All data were expressed as Mean ± Standard Deviation (SD). Data was analyzed using One-way analysis of variance (ANOVA), the comparisons between more than two groups was performed using Kruskal-Wallis one-way analysis of variance, followed by the Bonferroni multiple comparisons test. The graph pad software instant 3-software (San Diego, USA) was used to perform the statistical analysis. Differences in Mean were considered to be significant at ($P < 0.05$).

Results and discussion

The crude protein content of tiger nut milk powder as affected by addition of preservatives and storage time is presented in Table 1. The crude protein content of the powder milk significantly increased as the storage time increase. However, no significant differences in the crude protein content of the preserved milk powder with the unpreserved one at the respective storage time. The percentage crude protein content obtained in this study falls within the values reported from previous studies of Ukwuru and Ogbodo (2011); Ibrahim *et al.* (2016b).
Vitamin C and E content of tiger nut milk powder as affected by addition of preservatives and storage time are presented in Table 2. There was a significant decreased in the vitamin C content of the milk powder as the storage time progress. Likewise, the vitamin C content of the preserved milk powder significantly decreased as compared with TMP at the respective storage time. Except for the week 6 preserved milk powder, which have significantly

higher vitamin C content when compared with week 6 TMP. The vitamin E content of the preserved and unpreserved tiger nut milk powder significantly increased as the storage time increase. Likewise, there are significant differences in the vitamin E content of the preserved samples as compared to TMP.

Table 1: Effects of storage time on crude protein of preserved tiger nut milk powder

Samples	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
TMP	5.60±0.50	6.31±0.31	6.79±0.28	6.56±0.39	7.17±0.28	7.17±0.28
TMPS	4.90±0.70	5.69±0.39	6.62±0.28	6.74±0.28	7.24±0.37	7.24±0.37
TMPG	5.60±0.50	6.43±0.28	6.31±0.37	6.93±0.28	7.61±0.37	7.61±0.37
TMPGS	5.10±0.70	6.55±0.28	6.37±0.39	6.62±0.39	7.36±0.39	7.36±0.39

Values are expressed as mean ± SD of triplicate, there is no significant difference at α = 0.05 compared to TMP at the respective storage time. TMP= Tiger nut milk powder without preservative; TMPS= Tiger nut milk powder plus 0.54 g sodium benzoate; TMPG= Tiger nut milk powder plus 0.54 g gelatin; TMPGS= Tiger nut milk plus 0.54 g gelatin and 0.54 g sodium benzoate.

Table 2: Effects of storage time on vitamin C and E content of preserved tiger nut milk powder

	Samples	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Vitamin C (mg/dl)	TMP	7.60±0.02	3.64±0.13	3.60±0.01	4.12±0.08	4.27±0.06	3.24±0.03
	TMPS	7.30±0.03*	3.24±0.01*	3.35±0.02*	3.75±0.03*	3.72±0.01*	3.87±0.01*
	TMPG	6.80±0.02*	3.38±0.01	3.38±0.01*	3.67±0.02*	3.89±0.01*	3.71±0.02*
	TMPGS	6.40±0.04*	3.17±0.01*	2.98±0.02*	3.46±0.01*	4.70±0.01*	4.15±0.03*
Vitamin E (mg/dl)	TMP	53.4±0.7	125.27±0.97	115.71±2.14	106.67±1.74	154.89±2.26	114.93±0.75
	TMPS	47.30±1.70*	111.04±0.74*	121.67±1.49*	126.67±0.79*	148.37±2.64	84.33±0.75*
	TMPG	57.30±2.00	93.21±0.97*	126.43±1.89*	120.23±0.79*	119.05±4.28*	122.24±2.62*
	TMPGS	40.40±1.40*	65.39±1.32*	110.24±1.49*	115.86±1.82*	110.78±1.56*	114.93±0.75

Values are expressed as mean ± SD of triplicate, values with * indicate significantly difference at α = 0.05 compared to TMP at the respective storage time. TMP= Tiger nut milk powder without preservative; TMPS= Tiger nut milk powder plus 0.54 g sodium benzoate; TMPG= Tiger nut milk powder plus 0.54 g gelatin; TMPGS= Tiger nut milk plus 0.54 g gelatin and 0.54 g sodium benzoate.

Table 3 presents the effects of storage time on mineral content of preserved tiger nut milk powder as compared to tiger nut milk powder without preservative. There was no significant changes in the mineral content of the preserved milk powder as compared to tiger nut milk powder without preservative. Except TMPGS at week one which was significantly higher than TMP at the same storage time.

Table 3: Effects of storage time on mineral content of preserved tiger nut milk powder

	Samples	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Potassium (mg/kg)	TMP	1026.67±141.89	1590±185.20	1433.33±152.75	1500±100	1533.33±152.75	1500±100
	TMPS	1266.67±57.73	1573.33±303.53	1466.67±305.51	1543.33±128.97	1600.00±200.00	1543.33±128.97
	TMPG	1276.67±150.40	1596.67±136.50	1433.33±152.75	1676.00±112.39	1500.00±200.00	1676.00±112.39
	TMPGS	1640. 00 ±163.71*	1620. 00 ±100.00	1700.00±200.00	1483.33±175.59	1766.67±152.75	1483.33±175.59
Sodium (mg/kg)	TMP	100.00±5.73	103.33±8.78	105.42±5.05	95.42±3.82	100.83±3.82	95.42±3.82
	TMPS	105. 00 ±5.00	100.00±7.50	105.83±3.15	88.33±3.82	102.50±5.00	88.33±3.82
	TMPG	105. 00 ± 5.00	103.33±3.82	102.50±5.45	89.58±4.02	97.50±2.50	89.58±4.02
	TMPGS	100.00±5.00	99.17±7.64	102.50±3.75	98.33±1.91	97.5±5.00	98.33±1.91
Calcium (mg/kg)	TMP	0.60±0.10	0.37±0.08	0.43±0.08	0.47±0.13	0.35±0.05	0.47±0.13
	TMPS	0.50±0.05	0.43±0.03	0.43±0.03	0.55±0.13	0.43±0.03	0.55±0.13
	TMPG	0.80±0.08	0.35±0.05	0.37±0.10	0.53±0.10	0.43±0.08	0.53±0.10
	TMPGS	0.75±0.10	0.37±0.10	0.33±0.03	0.47±0.03	0.35±0.10	0.47±0.03
Magnesium (mg/kg)	TMP	0.88±0.08	0.80±0.05	0.90±0.05	1.17±0.10	1.05±0.05	1.17±0.10
	TMPS	1.13±0.13	0.98±0.08	0.95±0.05	1.25±0.10	1.12±0.08	1.25±0.10
	TMPG	1.07±0.13	1.00±0.10	0.92±0.08	1.20±0.05	0.98±0.08	1.20±0.05
	TMPGS	0.92±0.08	1.03±0.13	0.93±0.10	1.13±0.08	1.03±0.10	1.13±0.08
Phosphorus (mg/g)	TMP	3.60±0.03	4.09±0.30	3.94±0.03	3.28±0.05	3.99±0.02	3.28±0.05
	TMPS	3.50±0.07	4.05±0.02	3.89±0.02	3.28±0.05	4.03±0.02	3.28±0.05
	TMPG	3.70±0.09	4.03±0.04	3.86±0.02*	3.17±0.03	4.00±0.02	3.17±0.03
	TMPGS	3.60±0.04	4.00±0.04	3.91±0.03	3.19±0.02	4.01±0.02	3.19±0.02

Values are expressed as mean ± STD of triplicate values with * indicate significantly difference at α = 0.05 compared to TMP at the respective storage time. TMP= Tiger nut milk powder without preservative; TMPS= Tiger nut milk powder plus 0.54 g sodium benzoate; TMPG= Tiger nut milk powder plus 0.54 g gelatin; TMPGS= Tiger nut milk plus 0.54 g gelatin and 0.54 g sodium benzoate.

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The sensory score of the effects of addition of preservatives to tiger nut milk powder was presented in Figure 1. There was no significant difference in the sensory score of preserved and unpreserved samples at the respective storage time.

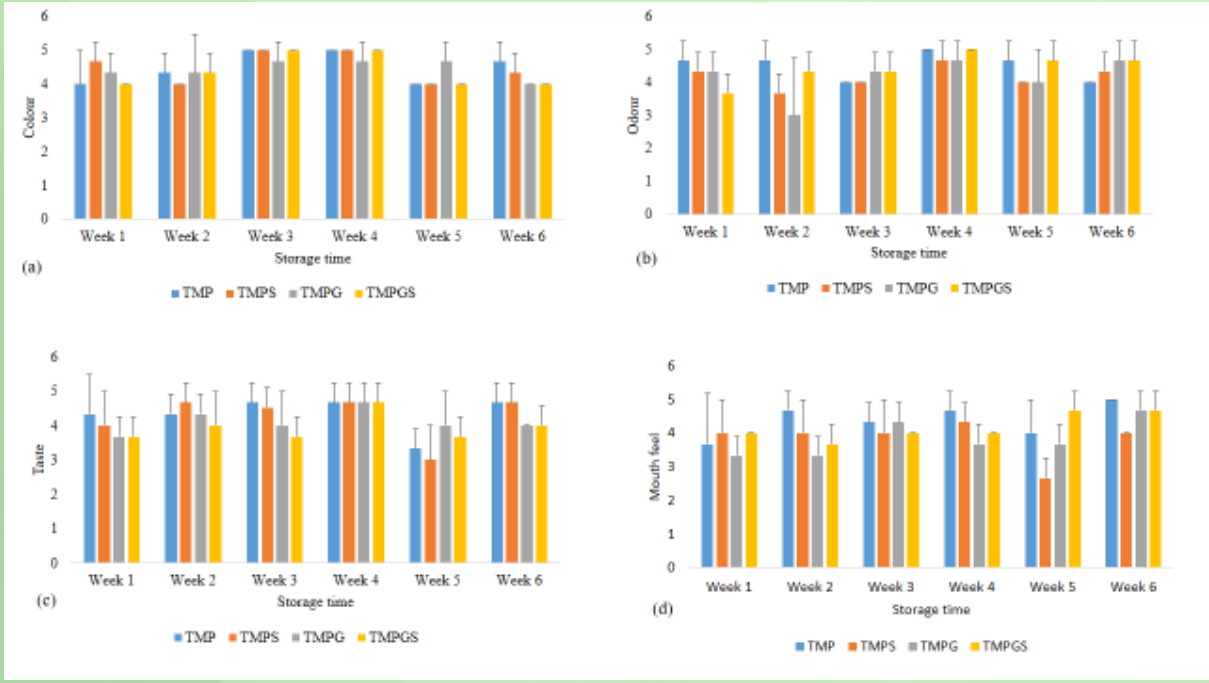


Figure 1: Effects of storage time on sensory score of preserved tiger nut milk powder.

Note: a): colour; b): odour; c): taste: d): mouth feel. Values are expressed as mean ± STD of triplicate. TMP= Tiger nut milk powder without preservative; TMPS= Tiger nut milk powder plus 0.54 g sodium benzoate; TMPG= Tiger nut milk powder plus 0.54 g gelatin; TMPGS= Tiger nut milk plus 0.54 g gelatin and 0.54 g sodium benzoate.

All the tiger nut milk powder had similar general acceptability score at their respective storage time as shown in Figure 2.

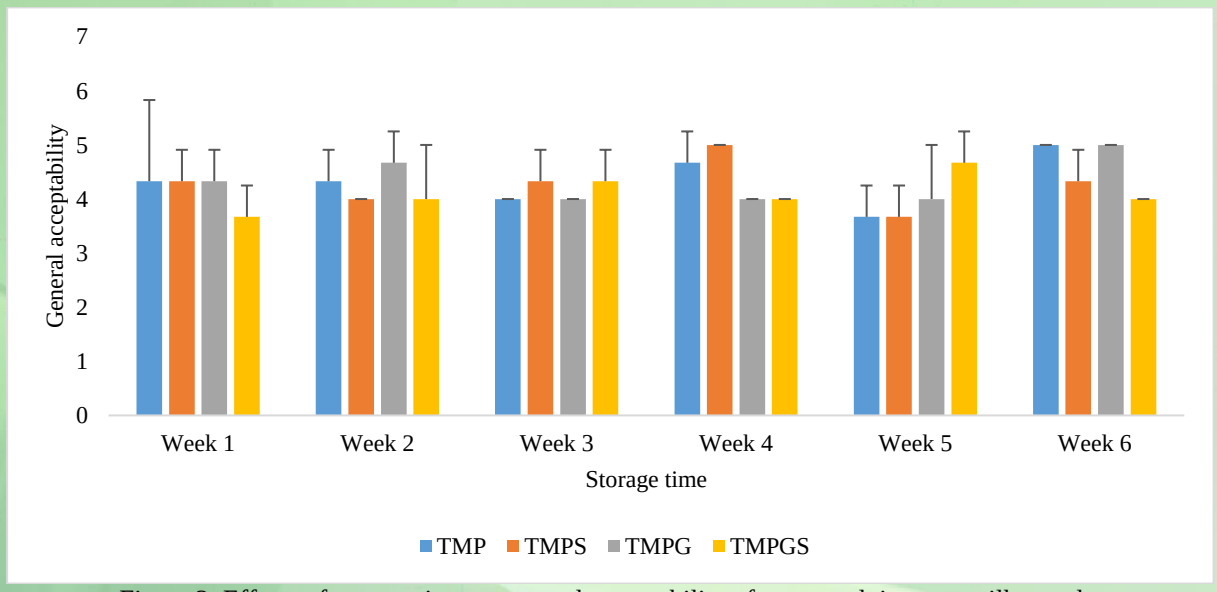


Figure 2: Effects of storage time on general acceptability of preserved tiger nut milk powder

The organoleptic properties of tiger nut milk produced from the treated samples and the control samples were found to be good and generally acceptable throughout the storage period. However, there was a significant difference at ($P<0.05$) on the general acceptability between the treated sample with a combination of 0.05% sodium benzoate and gelatin and the control sample after storage. This may be due to the combination of the two (2) preservatives which might have caused a deviation in the sensory attributes that the panelist are used to.

Conclusion

Tiger nut was successfully processed into tiger nut milk powder. Addition of preservatives to tiger nut milk powder have no significant effect on the crude protein, mineral elements and sensory quality. However, the vitamin C and E were significantly affected. Likewise, the storage time had more significant effect on the vitamin C and E of the milk powder.

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Effect of Oil Marination on Nutrient Content of Fresh Tomato

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Abstract

Tomato is one of the most widely consumed fresh vegetables in the world. This study was conducted to investigate the effect of oil marination on nutrient content of fresh tomatoes. The tomatoes were grouped into three. The group 1 served as the fresh (control), group 2 was the unblanched and group 3 was the blanched tomatoes. Both the groups 2 and 3 were oil immersed and stored for 6 weeks. The vitamins (A, C and E) contents of the fresh marinated tomatoes (75.14mg/100g, 15.14mg/100g and 154.34mg/100g) respectively were significantly (P<0.05) higher than the concentration found in the unblanched and blanched marinated tomatoes. The lycopene content of the fresh oil marinated tomatoes is 21.53mg/100g which was significantly (P<0.05) higher than the unblanched tomatoes (16.64 to 17.81 mg/100g) and the blanched (19.05 to 20.63 mg/100g). The sodium ion concentration on fresh sample is 122.01mg/kg, this value was significantly (P<0.05) higher than that of blanched and unblanched marinated tomatoes. There was no significant difference in the calcium ion and potassium ion concentration of the fresh tomatoes with that of blanched and unblanched samples. The magnesium ion content in the fresh sample was 1.4 mg/kg which was significantly (P<0.05) greater than that of the blanched marinated tomatoes (0.95 to 1.26mg/kg) and the unblanched (0.89 to 1.14mg/kg). The oil marinated tomatoes did not rotten for the entire six weeks under observation. This might be a better way for a long-term preservation of fresh tomatoes.

***Keywords**: Blanch, fresh, nutrient, oil marination, tomato*

Introduction

Tomatoes (*Lycopersicon esculentum*) are important fruits classified as a berry and commonly consumed for its red pigment due to lycopene content which has been reported as a source of antioxidant (Berry, 2004). Tomato fruits are extremely beneficial to human health due to their richness in folate, potassium, vitamin C, carotenoids and flavonoids (Agarwal and Rao, 2007). Blanching is a thermal treatment that is usually performed prior to food processes such as drying, freezing, frying, and canning (Arroqui *et al*., 2003). It is essential to preserve the product quality during the long-term storage because it inactivates enzymes and destroys microorganisms that might contaminate raw vegetables and fruits during production, harvesting and transportation (Cruz *et al.*, 2006; Mukherjee and Chattopadhyay, 2007).

A marination is a technique primarily used for enhancing the flavor, qualities and extending the shelf-life of foods by submerging the foods completely in edible oils or acids thus protecting them from aerobic spoilage organisms (Vallverdu – Queralt *et al*., 2013). Food preservation is aimed at maintaining the original state of food material by treatments, which will prevent its spoilage or deterioration (IFIS, 2005). Food preservation is also an obligation to sustain the wholesomeness of raw agricultural produce given their perishable nature (Andritsos *et al*., 2003). Fresh market tomatoes as obtained from the farm cannot keep fresh beyond five days at ambient conditions especially in the hot tropic regions like Nigeria (Andritsos *et al*., 2003). There is need therefore to advance alternative methods of preserving the shelf-life of tomato fruits that could be simple to adopt and practice at both household and commercial applications especially in areas with no access to electricity. Thu, this study aimed to determine the effect of processing; blanching and oil marination on nutrient content of tomatoes.

Sample Collection

Fresh sample of tomato (*Lycopersicon esculentum*) was purchased from the local market (Kasuwar daji), Sokoto State. The sample was randomized in uniform size, color, ripeness and free from defect or injury and then kept in a clean place.

Sample Preparation

The tomatoes were washed thoroughly under running tap water, rinsed with distilled water and then wiped with an absorbent paper. Nine kilograms of tomatoes were divided into 3 portions. Group1; fresh tomato (control), group 2; unblanched and group 3; blanched tomato. The blanching was done using steam blanching method as described by Xiao *et al.* (2017). Group 2 and 3 were further divided into 4 portions each, and then transferred into 200 ml preheated oil to 60°C. It was allowed to cool then packaged in sterile small bottles and was pasteurized at 90°C for 2 min. The product was stored at room temperature while being analyzed at day 1, 7, 14, 21, 28, 35 and 42 days.

Sample Analysis
Vitamin A, C and E were determined according to method of A.O.A.C (2010).

Determination of Lycopene
A well homogenized tomato juice was used for lycopene estimation; 100 µL of the juice was dispensed into a screw cap tube with the aid of a micropipette. Also blank sample was prepared with 100 µL water, 8 ml of hexane: ethanol: acetone (2:1:1) was also added. The tube was caped and vortexed immediately, then incubated out of bright light. After 10 min, 1.0 ml of water was added to each sample and vortexed again. The sample was allowed to stand for 10 min to allow phases to separate and all air bubbles to disappear. The cuvette was rinsed with the upper layer from the blank samples. It was discarded and fresh blank were used to zero the spectrophotometer at 503 nm. The absorbance was determined at 503 nm.

Determination of pH
The pH meter's electrode was lowered into a buffer solution. The instrument was then calibrated in a buffer of pH 7. The electrode was then removed from the buffer solution, rinsed and placed in the samples and the pH was read and recorded.

Data Analysis
The results are presented as mean ± standard deviation of mean of triplicate. Difference between Means are considered significant at $p<0.05$ using Dunnett One-way analysis of variance (ANOVA). This was carried out using SPSS version 16 statistical package.

Results

Pro-vitamin A
Figure 1 shows the effect of storage time on pro-vitamin A concentrations of fresh and oil marinated tomatoes. The fresh (control) has a mean value of 75.14 mg/100g. The vitamin A content of the blanched sample ranges from 70.66 mg/100g to 66.30 mg/100g. While that of unblanched sample ranges from 68.35 mg/100g to 47.73 mg/100g. There is a significant difference between the blanched and the unblanched with that of the control at $P<0.05$. The vitamin A content of oil marinated blanched and unblanched tomato decreases as the week's progresses.

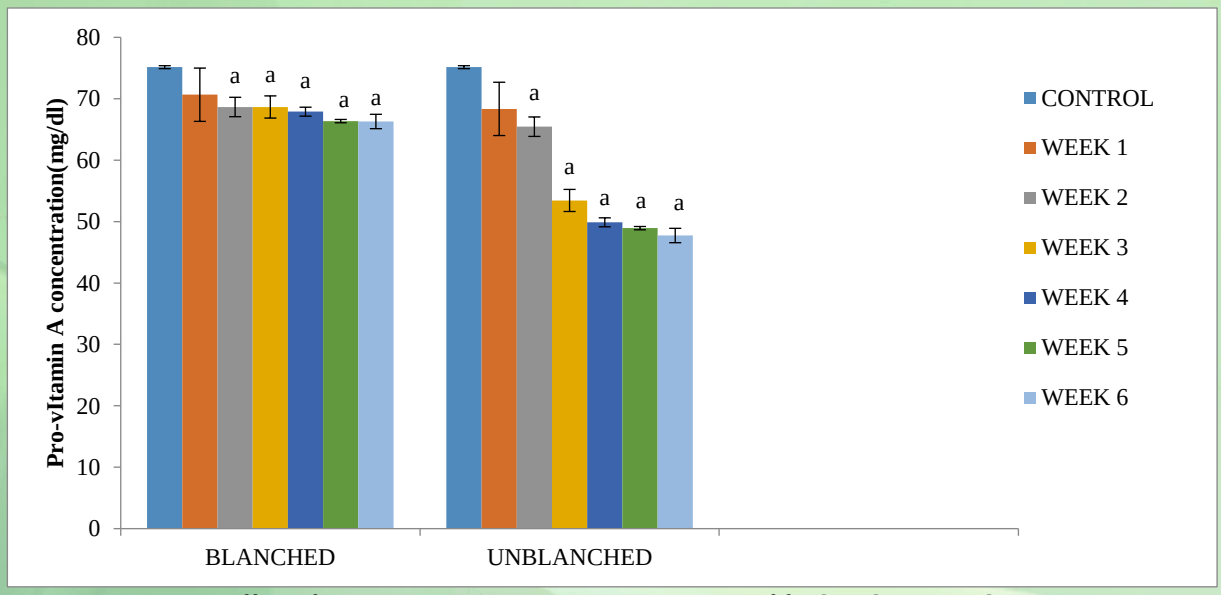


Figure 1: Effect of storage time on vitamin a concentration of fresh and marinated tomatoes.
Key: a = indicates significant difference with control

Vitamin C
The effect of storage time on vitamin C concentrations of fresh and marinated tomato are presented in figure 2. The fresh (control) has the highest vitamin C content (15.14mg/100g) while that of blanched ranges from 13.47 mg/100g to 11.43 mg/100g and unblanched ranges from 11.22 mg/100g to 9.82 mg/100g. There was a slight decrease in the vitamin C content of marinated tomatoes as the weeks progresses. There was a significant difference between the blanched and the unblanched with that of the control at $P<0.05$.

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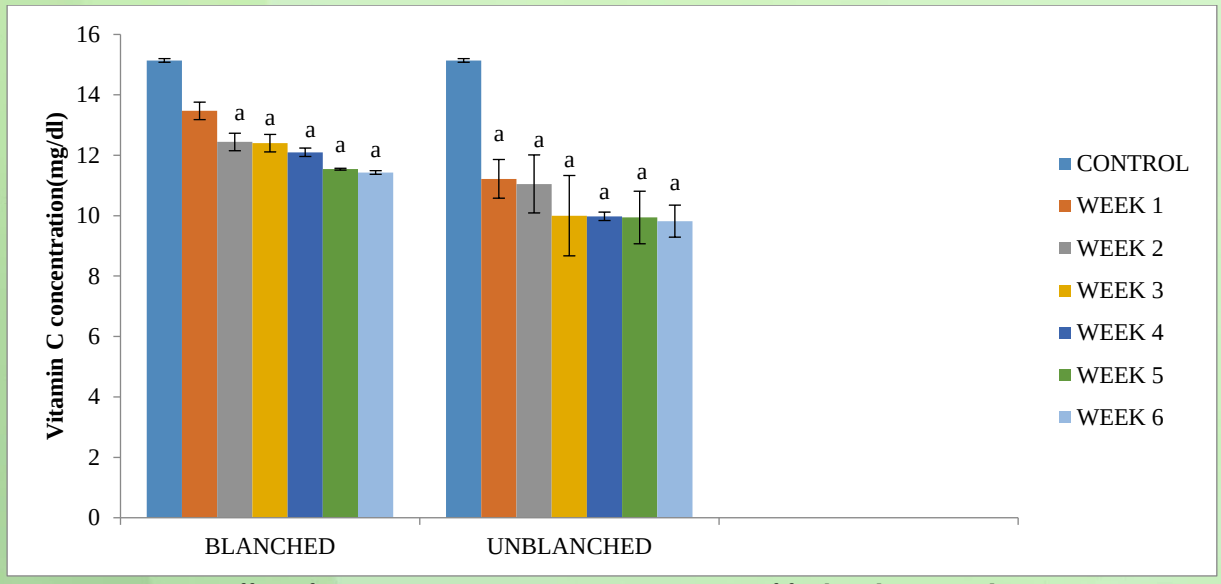


Figure 2: Effect of storage time on vitamin C concentration of fresh and marinated tomatoes.
Key: a= indicates significant difference with control

Vitamin E

The effect of storage time on vitamin E concentrations of fresh and marinated tomato are presented in figure 3. The fresh (control) has the highest vitamin E content (154.34 mg/100g) while that of blanched ranges from 152.34 mg/100g to 148.45 mg/100g and unblanched ranges from 150.34 mg/100g to 147.21 mg/100g. There was a significant decrease in the vitamin E content of marinated tomatoes as the weeks progresses. There was no significant difference between the blanched and the unblanched with that of the control at $P<0.05$.

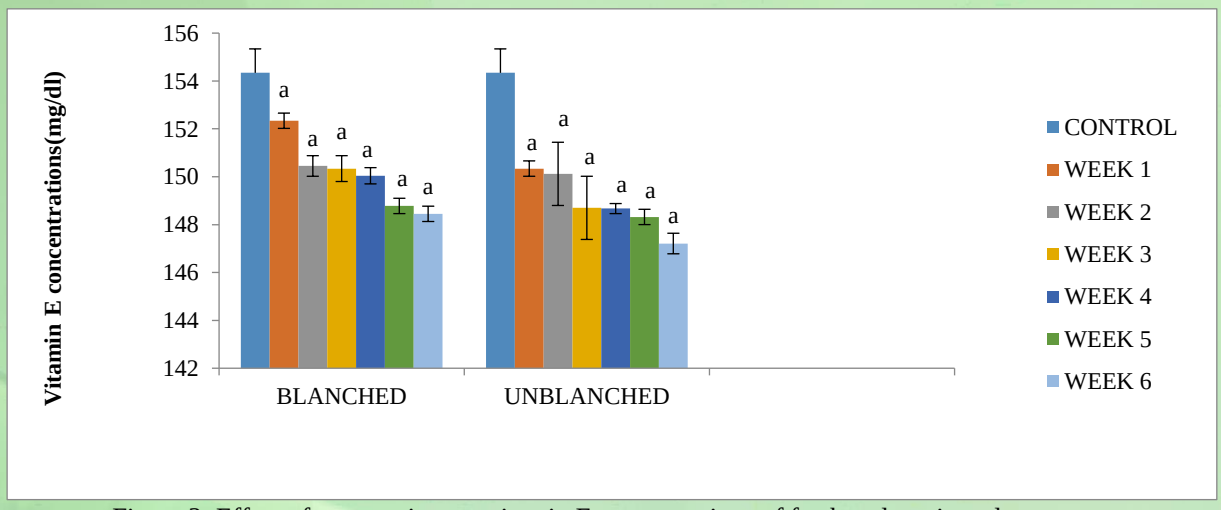


Figure 3: Effect of storage time on vitamin E concentrations of fresh and marinated tomatoes.
Key: a= indicates significant difference with control

Mineral Elements

Sodium Ion (Na^+)

Figure 4 presents the effect of storage time on sodium ion concentration of control (fresh), blanched and unblanched samples. The control has a mean value of 122mg/kg Na^+. The blanched sample has a mean value for week 1 to 6 110.33 mg/kg Na^+ which depreciated slightly across the 6 weeks to a final mean value of 98.33 mg/kg Na^+. Consequently, the unblanched sample has a mean value of 98.66 mg/kg Na^+ in week 1 which is significantly different with the control, but it was appreciably maintained across the 6 weeks.

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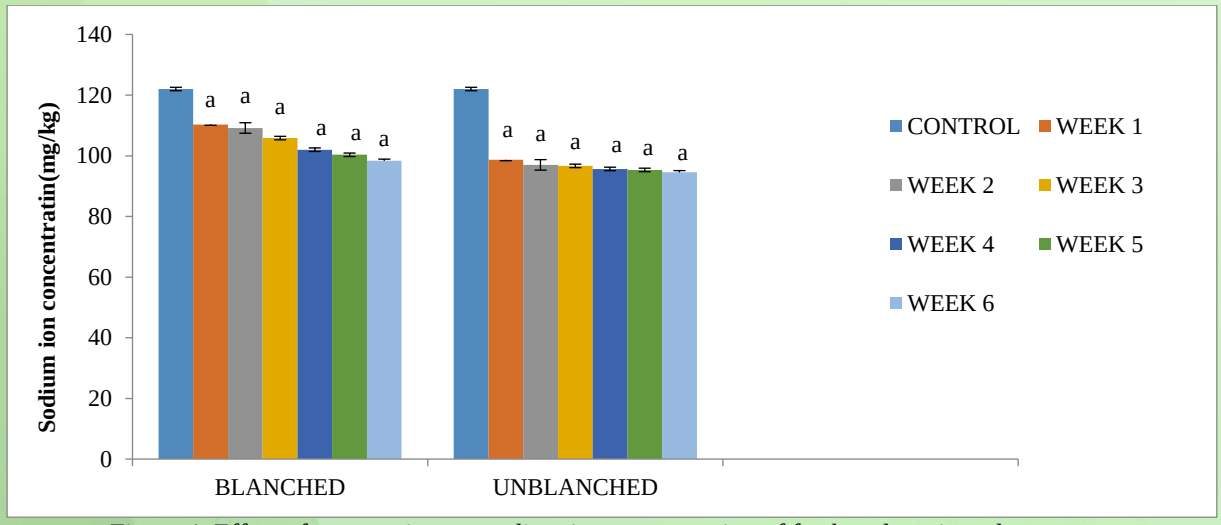


Figure 4: Effect of storage time on sodium ion concentration of fresh and marinated tomatoes.
Key: a= indicates significant difference with control

Potassium Ion (K^+)

Figure 5 explains the effect of storage time on potassium ion concentrations of control, blanched and unblanched samples. The control has a mean value of 590.31 mg/kg K^+. In the blanched sample, K^+ concentration depreciated significantly across the 6 weeks from 585.34 mg/kg in week 1 to 574.78 mg/kg in week 6. While the unblanched sample also has a significance difference with the control ranging from a mean value 583.00 mg/kg in week 1 to 570.34 mg/kg in week6.

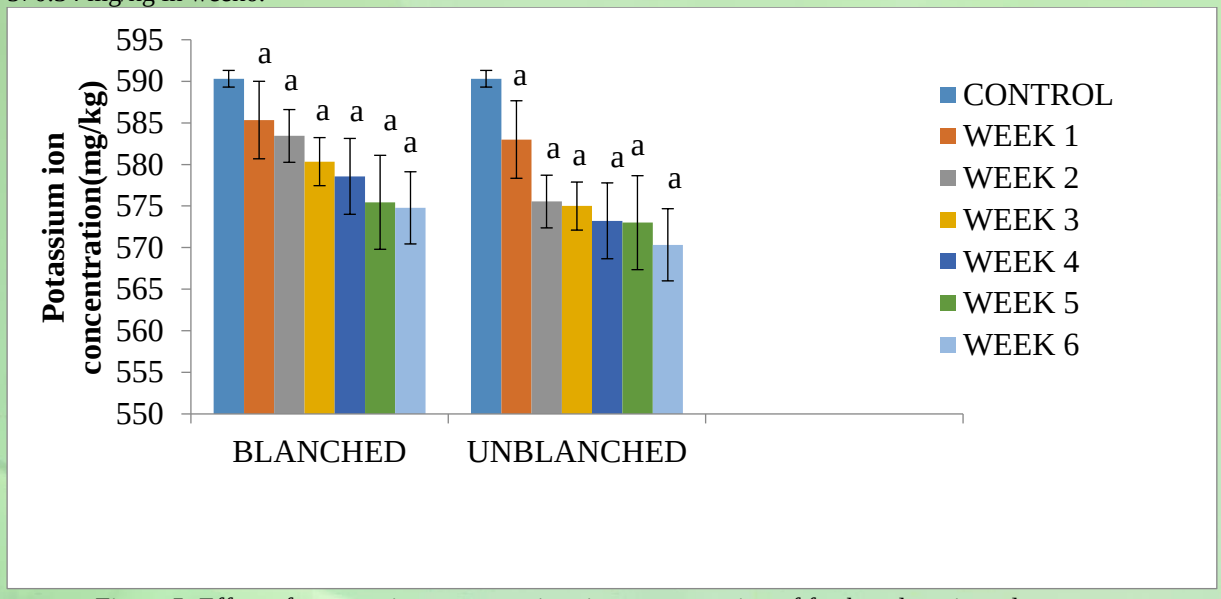


Figure 5: Effect of storage time on potassium ion concentration of fresh and marinated tomatoes.
Key: a= indicates significant difference with control

Calcium Ion (Ca^{2+})

Figure 6 shows the effect of storage time on calcium ion concentrations of control, blanched and unblanched samples. The control has a mean value of 1.11mg/kg Ca^{2+}. The blanched sample has a mean value of 1.00 mg/kg Ca^{2+} for week 1 which slightly depreciated across the 6 weeks to a mean value of 0.90 mg/kg Ca^{2+} for week 6. In the unblanched sample, where is no significance differences across the 6 weeks but it also depreciated from the control from a value of 1.02 mg/kg for week 1 to 0.90 mg/kg Ca^{2+} for week 6.

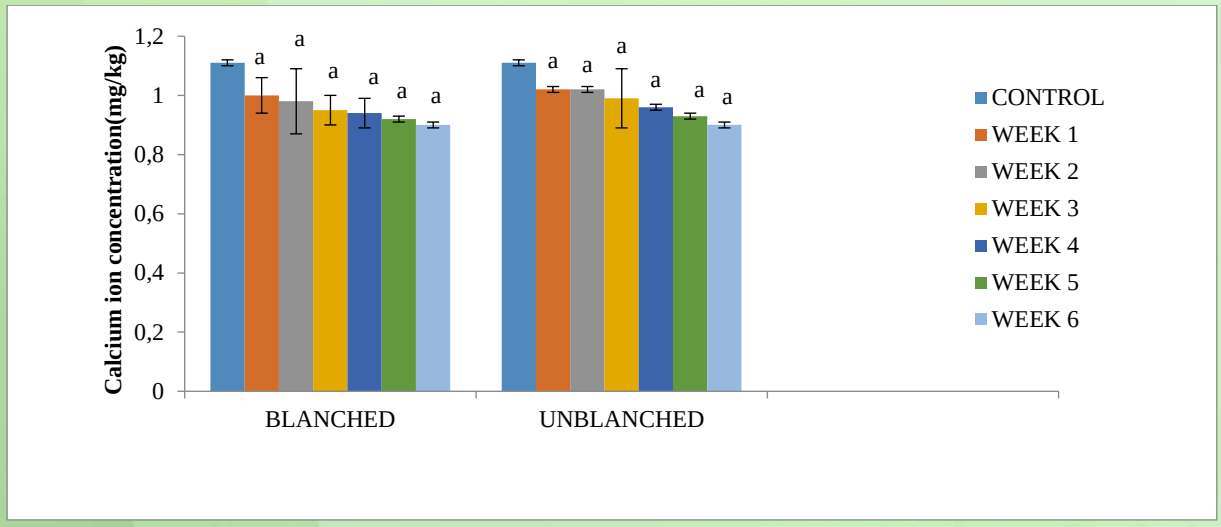


Figure 6: Effect of storage time on calcium ion concentration of fresh and marinated tomatoes.
Key: a= indicates significant difference with control

Magnesium Ion (Mg^{2+})

Figure 7 presents the effect of storage time on Magnesium ion concentrations of fresh and oil marinated blanched and unblanched samples. The fresh (control) has a mean value of 1.4 mg/kg Mg^{2+} while the blanched sample has a mean value of 1.26 mg/kg Mg^{2+} for week 1 and 0.95 mg/kg Mg^{2+} for week 6. A significance difference was seen in the unblanched sample from 1.13 mg/kg for week 1 to 0.89 mg/kg Mg^{2+} for week 6.

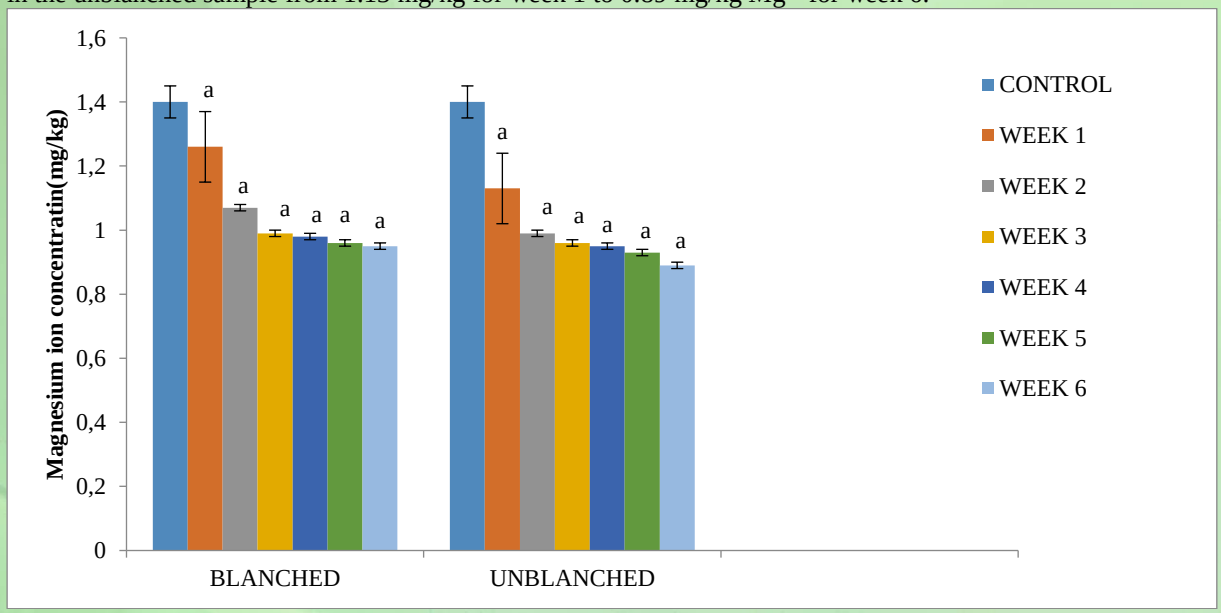


Figure 7: Effect of storage time on magnesium ion concentration of fresh and marinated tomatoes.
Key: a= indicates significant difference with control

Phosphorus Ions

Figure 8 shows the effect of storage time on phosphorus ion concentrations of fresh and oil marinade tomatoes. The control has a mean value of 4.76 mg/kg of Phosphorus ions. In the blanched sample, the phosphorus concentration reduced from 4.41 mg/kg in week 1 to 3.83 mg/kg in week 6. While the unblanched sample has a significance difference between the weeks. A large depreciation was observed from week 3 to week 6.

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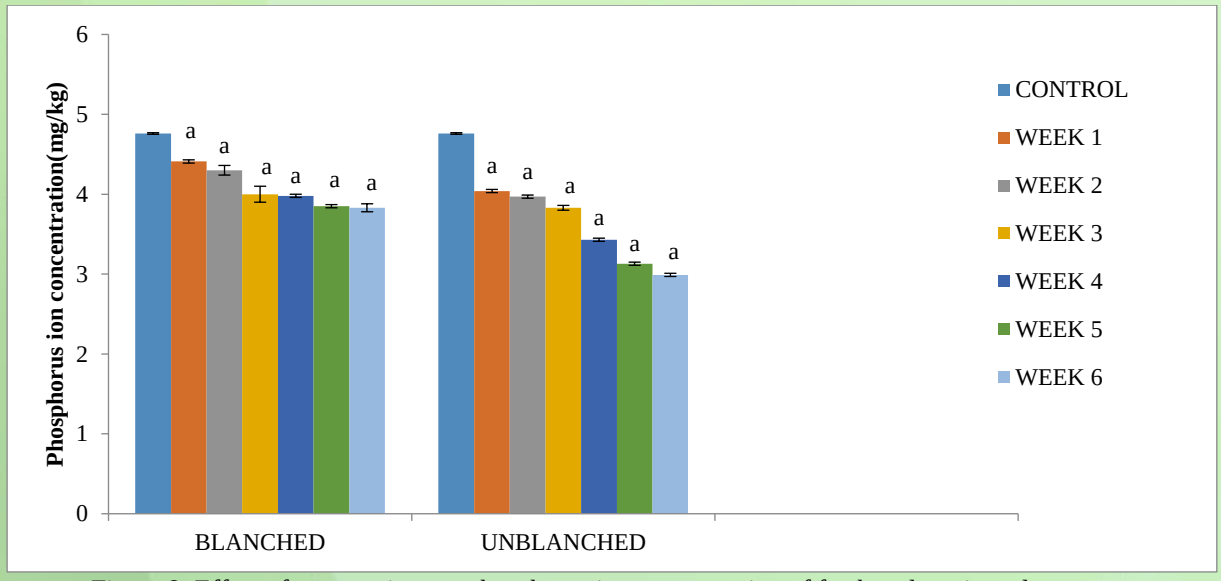


Figure 8: Effect of storage time on phosphorus ion concentration of fresh and marinated tomatoes
Key: a= indicates significant difference with control

Lycopene Concentrations

The effect of storage time on lycopene content of fresh and oil marinated tomato was presented in figure 9. The fresh (control) has the highest lycopene content (21.53 mg/100g), while that of blanched ranges from 20.63 mg/100g to 19.05 mg/100g and unblanched ranges from 17.81 mg/100g to 16.64 mg/100g. There was a decrease in the lycopene content of marinated tomatoes as the weeks progresses. There is a significant difference between the blanched and unblanched oil marinated tomatoes with the control at $P<0.05$.

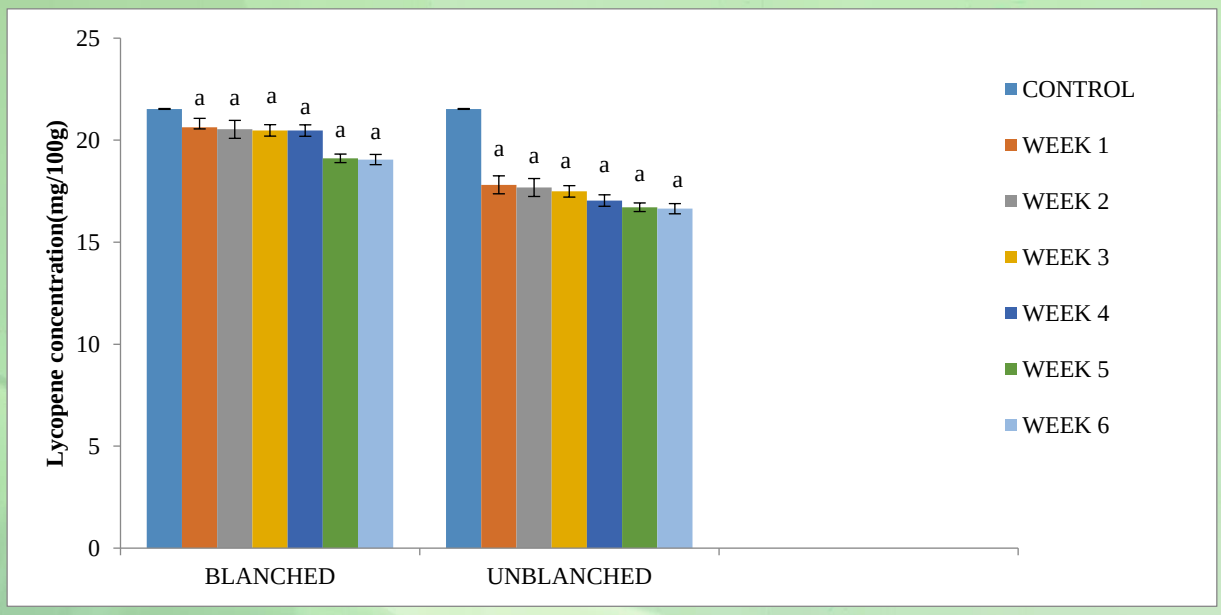


Figure 9: Effect of storage time on lycopene concentration of fresh and marinated tomatoes.
Key: a= indicates significant difference with control

pH Determination

Figure 10 presents the effect of storage time on the pH of fresh and oil marinated tomatoes. The control has a pH of 3.86 while the blanched sample has a pH of range from 3.88 to 4.12. While the pH of unblanched samples ranges from 3.88 to 4.10. There was an increase in the pH of marinated tomatoes as the weeks progresses. There is a significant difference between the blanched / unblanched with that of the control at $P<0.05$.

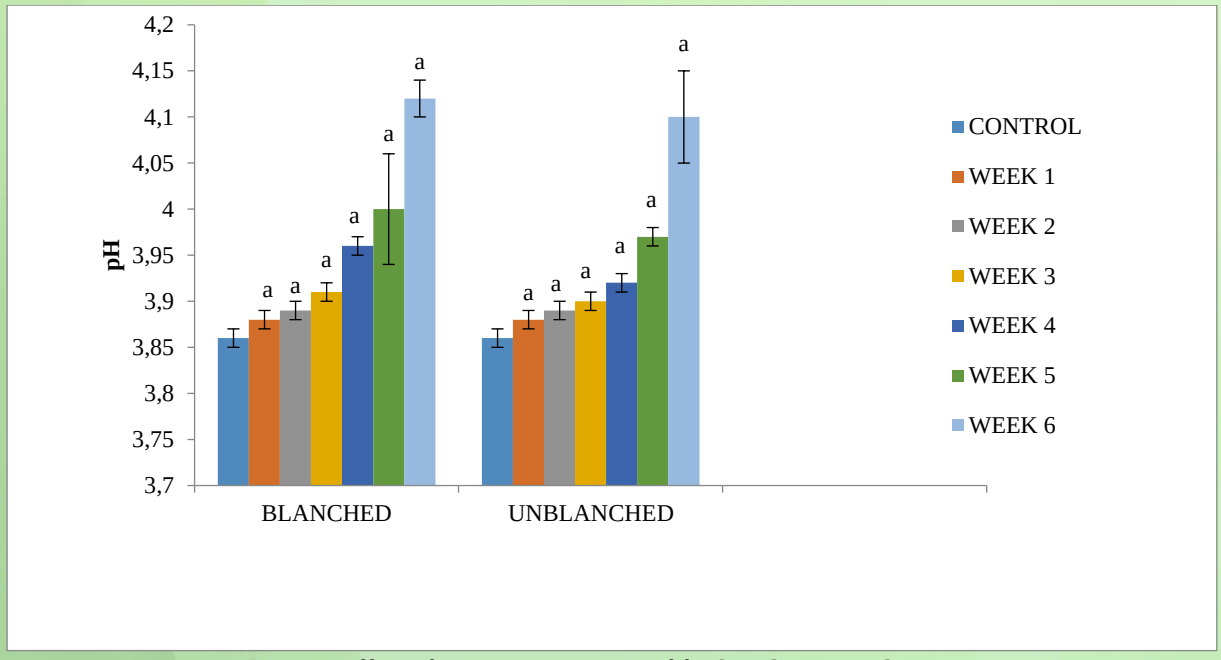


Figure 10: Effect of storage time on pH of fresh and marinated tomatoes.
Key: a = indicates significant difference with control

Discussion

Tomatoes are highly perishable and subject to surface and internal damage. There should be proper temperature and pH management during storage. Tomatoes, flavor should be preserved as much as possible. Hence, any means employed to preserve tomatoes should be able to maintain its flavor. In this study, the method used to preserve tomatoes proved to be very successful. This is because the tomatoes did not rotten for the entire 6 weeks of storage. The air-tight container was able to keep the tomatoes intact. Furthermore, fresh and marinated tomatoes (blanched and unblanched) were analyzed for their contents of major nutrients, vitamins, pH and essential minerals.

Effects of Pre-and post-processing treatments on vitamin contents of oil marinated tomatoes

The different levels of the three vitamins (A, C and E) were presented in Figure (1, 2 and 3) respectively. The significance difference in pro-vitamin A content between the blanched and unblanched samples might be due to the pre-processing undergone by the blanched sample. The pro-vitamin A content was above the RDA values (Institute of Medicine, 2005). Thus, may be a good source in supplementing the daily requirements. It is important to note that vitamin A is a good source for normal vision, gene expression, growth and immune function (Lukaski, 2004).

The significant high vitamin C content of the fresh (control) sample might be due to the fact that it did not undergo any pre -or-post processing treatments as the blanched sample. This explains the significant different between the blanched and unblanched samples in the vitamin C content. The low vitamin C content in the blanched sample was due to heating applied to the sample during pre-processing. Vitamin C is sensitive to thermal treatments. Similar results were found in the study of Mehmood *et al.* (2008) where ascorbic acid content was decreased with storage time in apple juice preserved with potassium sorbate and sodium benzoate. Preservation of ascorbic acid content during storage is a difficult task since it undergoes oxidation. The significant changes in the vitamin C content of blanched and unblanched oil marinated tomatoes might also be due to high temperature during the pre-processing treatments. According to Smith and Hull (2004), increase temperature normally results in high loss of ascorbic acid.

The significant high vitamin E content of the fresh (control) might be due to not undergoing pre-processing treatments of this sample. Subsequently there is no significant difference between the blanched and unblanched vitamin E content. The values recorded for these samples are within the recommended daily allowance for vitamin E which is 15mg/100g. This vitamin was known as a powerful antioxidant that assisted the cells against damage by free radical there by maintaining the normal function of red blood cells and muscles (Lukaski, 2004)

Effects of Pre-and post-processing treatment on mineral elements of oil marinated tomatoes

The minerals under study comprised of five major mineral elements (Ca, Mg, P, Na and K). Generally, fruits are not good sources of calcium. In this study it was found that in both blanched and unblanched marinated tomatoes

there was no significant amount of calcium detected. Generally, the daily allowance for calcium was 1000mg/day for adults and 700mg/day for children. According to Institute of Medicine (2005) it was reported that foods providing 20% or more of the daily values are considered to be high source of nutrients. Therefore, a supplementary source for calcium is necessary to augment this wide gap. Roth and Townsend (2003) reported that calcium and phosphorus are very important in the formation of strong bones and teeth, for growth, normal nerve and muscle action and in cell metabolism.

The phosphorus level was very low when compared to the RDA which is 700mg/day for adults and 1250mg/day for children between the ages of 9 and 18 years, because bone development and formation are rapid at this stage of life (Roth and Townsend, 2003). Consequently, the samples may not be good source of phosphorus. Tomatoes fruits are not good sources of phosphorous as reported by Gopalan *et al.* (2003).

Sodium content was found to be low. The required daily allowance for sodium was 1200mg for children and 2300mg for adult (Institute of Medicine, 2005). Thus, this sample cannot meet the daily allowance and must be supplemented from other dietary sources.

The potassium ion concentrations for control were relatively higher than the blanched and unblanched marinated tomatoes. This concentration was very low compared to recommended daily allowance which is 4700 mg/day for both male and female adults and children between the age of 9 and 13 years are recommended to ingest 4500mg/day, while the daily intake for pregnant women is 4700 mg/day and that of breast feeding women was 5100 mg/day respectively (Institute of Medicine, 2005). In this study, Mg^{2+} was found to be lower both in the fresh and also the oil marinated tomatoes compared to the recommended daily allowance which is 320 mg/day (Institute of Medicine, 2005).

Effect of Pre-and post-processing treatments on lycopene content of oil marinated tomatoes

The average lycopene content of a fresh tomato has been reported at 30 mg/100g (Konuru, 2005). In this study, lycopene was found to have a low content. This variation might be as a result of environmental factors (temperature, light, growing season and location) and the agricultural techniques used in lycopene accumulation (Duman *et al*., 2003; Toor *et al.*, 2006). The lower concentration of lycopene might be due to oxidation, as the main cause of lycopene degradation is oxidation which depend on temperature, moisture and so on (Smith and Hull, 2004). Lycopene content decreased the during storage period for all samples across the weeks for the very reason stated earlier. Lycopene is a powerful antioxidant in maintaining the strength, thickness and fluidity of cell membranes (Jackson, 2007). Lycopene lost is accelerated by high processing temperature. During hot break, the hotter the break temperature the greater the loss of lycopene, even when operating under a vacuum (Toor *et al.*, 2006). Since the tomato was blanched under a high temperature, degradation of lycopene might have occurred. Smith and Hull (2004) reported that heat concentration of tomato pulp can result up to 57% loss of lycopene.

Effect of Pre-and post-processing treatment on pH of oil marinated tomatoes

There was a significant increase in pH of blanched oil marinated tomatoes after week three and a significant increase in pH of unblanched oil marinated tomatoes after week four, this might be as a result of microbial load. High acidity makes the sample resistant to microbial spoilage, decrease in acidity as storage time progresses makes it liable to microbial spoilage (Smith and Hull, 2004). Similarly, the pH values obtained in figure 10 was found to be similar with the report made by Okoronkwo *et al.* (2016).

Conclusion

In this study, the effect of oil marination on nutrient content of fresh tomatoes was studied. Tomato was successfully processed and preserved by oil marination. Although, both the blanched and unblanched oil marinated tomatoes have significant reduction in lycopene, vitamins and mineral elements, except for calcium and potassium ions which were not significantly different from the control samples.

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ID: 101

Evaluating the Effect of Agricultural Credit Facility on the Volume of Rice Production in Selected Areas of Dinajpur District, Bangladesh

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Abstract

The study aims at determining the factors for influencing the agricultural credit adoption by the farmers as well as estimating the effect of agricultural credit received from either of formal or informal credit sources and all farmers on rice productivity. Socioeconomic characteristics of rice farmers are also explored. The study uses both secondary and primary data. The primary data was collected from 255 rice farmers by using field survey during December, 2022 by means of multistage random sampling design. Logit regression model and the Cobb-douglas production function are estimated to predict the effects of agricultural credit along with conventional inputs of production on rice productivity. In the regression outcome for all farmers, nine out of fourteen regressors viz, household size, land holding, credit amount, seed, pesticide, age, extension service and distance from the nearest market have a significant impact on rice productivity. While, in the regression result for formal source beneficiaries, seven independent variables viz, farming experience, credit amount, irrigation and distance, age, fertilizer and pesticide have a significant effect on rice productivity. In the regression result for informal source beneficiaries, four independent variables viz, household size, credit amount, seed and irrigation have a significant effect on rice productivity. In the regression result for no credit holders, six independent variables viz, seed, irrigation, fertilizer and pesticide, other cost and distance have a significant effect on rice productivity. Moreover, logistic regression shows that age, education, household size, experience, land size, SDI and average cost are the key significant determinants of the credit access for the farmers. Thus, this study emphasizes more on informal credit sources that is more proficient for the farmers to ensure high rice productivity in general.

Key Words: *Agricultural Credit, Rice Farmers, Productivity, Formal Credit, Production*

ID: 102

Agricultural Waste to Health, Safety and Environment: A critical review

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Abstract

The preservation of the environment is very important to the sustainability of all living things and must not be treated with levity because there are consequences, sometimes irreversible. This review focused on the conversion of agricultural waste products to biochar which is the solid carbon-rich product that remains after the pyrolysis process, it has a porous structure and a high surface area, which makes it useful for the adsorption of heavy metals from waste water. Man's daily activities for survival produces waste water some of which contain heavy metals, these metals contribute heavily to the destruction of the environment due to their toxic nature. Several research works have been consulted in this review and it was observed that biochar is easily accessible because of the abundance of agricultural waste and is very effective in the removal of heavy metals from waste water although the biochar from some waste products is more effective than the other. Further more the study revealed that in addition to the effectiveness of biochar it is a very safe practice and should be encouraged for the sustainability of the environment.

Key Words: *Wastewater, Treatment, Biochar, Environment, Preservation*

ID: 103

Urban Vegetable Production in Ghana: Investigating the Financial Viability and Key Drivers of Irrigation Techniques

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Abstract

Irrigation is an integral part of vegetable production in the cities of Ghana. Urban vegetable farmers therefore have to make a choice with regards their livelihood and the interests of consumers in their decision to adopt an irrigation technique. This study investigates the factors that influence vegetable farmers' decision to use various irrigation techniques for production in the Kumasi Metropolis of Ghana. A total of 150 vegetable farmers were selected using the simple random approach from three purposively selected sub-metros in the Kumasi Metropolis. The most common irrigation technique used for vegetable production in Kumasi was watering can irrigation (relatively less expensive). The revenue of vegetable farmers who use pump for irrigation was 18.23% more than those who use watering can for irrigation. Farm size, source of water, annual production cycles, seasonal revenue, household size, lettuce production and method of land acquisition influenced vegetable farmers' decision to use an irrigation technique. The labour intensive nature of watering can irrigation was identified as the key constraint associated with its use, whilst that of pump irrigation was the high cost involved. The study concludes that pump irrigation is cost-effective, less laborious and encourages relatively large-scale production. Therefore, the adoption of pump for irrigation is recommended.

Keywords: *Adoption decision, Farmers, Financial viability, Irrigation, Urban agriculture, Vegetable production*

Introduction

Urban agriculture entails all agricultural activities that are undertaken in the urban centres or cities. Mougeot (2000) broadly defines urban agriculture as the production, processing and distribution of foodstuff from crop and animal production, ornamental plants and flowers within and around urban areas. According to GSS (2013), 26.5% of the agriculture households in Ghana are located in urban areas and contributes significantly to the agricultural output.

The initiation of urban agriculture in Ghana started way back in the sixteenth century. In the sixteenth century, vegetables were grown in gardens around the castle and forts in the then Gold Coast. Vegetables produced under urban agriculture (Keraita et al. 2007) account for 50% to 90% of vegetables consumed in urban centres (Coffie et al., 2003). Although carried out informally, urban vegetable production has been an important means of attaining balanced diets and urban food security in Ghana (Obuobie *et al*. 2006). In general, urban agriculture comprises of livestock rearing, crop production, tree planting and aquaculture. Urban areas accounts for 26.5% of the agriculture households in Ghana [Ghana Statistical Service (GSS), 2013] and have contributed significantly to agricultural output.

Most agricultural producers involved in crop production in the urban areas have focused on the production of perishable produce such as vegetables, which have shorter shelf life, to meet the demand of urban consumers. More than 200,000 urban dwellers in Ghana consume vegetables daily from streets vegetable vendors and in canteens and restaurants (Obuobie et al., 2006), of which 50% to 90% of the quantity consumed are produced within or close to urban areas (Coffie et al., 2003). The high demand for vegetables in urban centres has necessitated the need to increase production. However, farmers are usually constrained with the resources, particularly water for vegetable production (Danso et al., 2002). According to Cornish and Lawrence (2001), vegetable production in Kumasi recorded more than 10,000 ha under seasonal vegetable farming. Vegetable production in the Metropolis is done all year round and mostly done on lands where construction is yet to begin, usually belonging to governmental institutions and departments or private developers. The Kumasi Metropolis is a city rich in water bodies such as the Wiwi, Owabi and Subin river. The inland valley areas surrounding the stream/rivers, especially where groundwater levels are low, are of high value for urban vegetable production.

According to Drechsel et al., (2013), vegetable production in the urban areas are predominant in the dry season where prices are high. This does not imply that irrigation is only done in the dry seasons. Irrigation is also needed in the rainy season on days without rain as exotic vegetables respond quickly to water shortage. Over the past, wastewater in urban areas serve as source of water for irrigating crops due to erratic rainfall pattern in the country. Wastewater irrigation has been the centre of many controversies surrounding urban agriculture. The use of

wastewater for irrigating in urban vegetable production is recognized as an effective source of water supply throughout the year [Food and Agriculture Organization (FAO), 2012] and also reduces the pressure on portable drinking water. However, the source of water can influence the irrigation technique used for vegetable production in the urban centres (Drechsel et al., 2011; Drechsel et al., 2010).

As compared to traditional crops, vegetables, especially leafy vegetables, have higher and more regular crop water requirement. Erratic rainfall conditions in Ghana have been one of the hindrances to urban vegetable production and mostly lead to a deficit in the crop water requirements of vegetables. The issue escalates in the dry seasons where, urban vegetable production is predominant due to the increase in price of vegetables. Most vegetables grown in Ghana, depending on the climatic conditions and crop species, have an irrigation water requirement between 300 and 700 mm (Agodzo *et al.*, 2003; Danso et al., 2002). As compared to more traditional crops, vegetables, especially leafy vegetables, have higher and more regular crop water requirement (Danso & Drechsel, 2003; Drechsel et al., 2010).

This means that most vegetables, especially exotic vegetables, are likely to wither and die off in the dry season where rainfall is insufficient to meet the water requirement of the crops. This comes as a cost to the farmer since money is spent on inputs but yields low output to generate returns to cater for the costs incurred. Also, this affects the supply of vegetables which causes an increase in its prices. Moreover, this causes a reduction in the consumption of vegetables and further leads to the non-attainment of the nutrient requirement of consumers.

Due to this, farmers have adopted various irrigation methods in order to improve production and increase productivity throughout the year. However, depending on the irrigation technique used, irrigation can take between 40% and 70% of the farmer's time throughout the season (Tallaki, 2005). Decisions made on factors such as investment of labour and irrigation technique employed can cause a variation in the income of farmers (Danso & Drechsel, 2003). However, these irrigation techniques adopted by farmers to cater for the water deficit comes with different cost and benefit. Irrigation takes between 40 and 70% of farmers' time and may be required in all seasons (Danso et al., 2002; Tallaki, 2005) and also contributes significantly to production cost. According to Drechsel et al., (2013), there is a variation in the income of farmers depending on factors such as investment of labour and irrigation technique employed. According to Castle et al. (2016), increasing production efficiency is aimed at the use of agricultural technologies being developed. A study by Muzari et al. (2012) also revealed that the adoption of technology by smallholder farmers in Sub-Saharan Africa is affected by factors such as the assets, income, labour and innovativeness of the farmer.

The main thrust of this study is to investigate the financial viability and key drivers of irrigation techniques for urban vegetable production so as to provide useful information to guide decision making on alternative irrigation methods used for urban vegetable production. We ask the following questions; 1) What are the common irrigation methods used for urban vegetable production? 2) What are the costs and benefits of the alternative irrigation methods employed for urban vegetable production? 3) Are the returns associated with various irrigation techniques different? 4) What factors determine the use of a particular irrigation method? 5) What are the constraints associated with each irrigation technique?

Materials And Methods

Study area

The study area for this research is the Kumasi Metropolis. The Kumasi Metropolis is one of the 30 administrative districts in the Ashanti region. It is located between latitude 6.35˚N and 6.40˚S and longitude 1.30˚W and 1.35˚E and also elevated to 250 to 300 meters above sea level. The Metropolis happens to be the second largest most populous city in the country, next to the national capital (Accra), with a population of 1,730,249 which represent 36.2% of the total population of Ashanti Region (GSS, 2014). It lies in the transitional forest zone, specifically the moist semi-deciduous South-East ecological zone. The Metropolis has 37,456 households (representing 8.5% of the households) involved in agricultural activities (GSS, 2014) and are usually located around their dwelling units often along the wetlands in the Metropolis. About 41 hectares of urban land in Kumasi are under vegetable production whiles more than 12,000 hectares of peri-urban lands are under irrigated vegetable production (Cornish & Lawrence, 2001).

Population

The population for this study includes vegetable farmers in the Kumasi Metropolis. This implies that any individual involved in the production of vegetables in the study area, with no regards to the farm size, age or location, qualified to be a respondent to the questionnaire in this study. As done by Abdulai et al, (2017), the population of the selected sub-metros in the Metropolis was used to represent the population. The population of vegetable farmers in the selected sub-metros of the study area was one hundred and fifty (150) (Table 1).

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Table 1. Population of selected sub-metros in the Kumasi Metropolis

Sub-metros	Towns	Number of farmers	Sample
Oforikrom	Boadi	43	30
	Kentinkrono	40	26
	Ayeduase (Engineering)	26	10
	Poku Sika	28	15
	Behind Brunei	19	8
Asawasi	Asokore Mampong	6	2
	Sawaba (New Site)	25	21
Asokwa	Kyirepatare	5	4
	Ahensan	11	8
	Gyinyase	38	26
Total		241	150

Source: Field Survey

Sampling technique

For the purpose of this study, multistage sampling technique was used to obtain the primary data. At the first stage of sampling, the Kumasi Metropolis was selected because it happens to be one of the urban centers noted for agricultural activities in Ghana. According to GSS (2014), 8.5% of the household in the Metropolis are involved in agricultural activities, specifically vegetable production. At the next sampling stage, the purposive sampling technique was used to select three sub-metros (Asawasi, Oforikrom and Asokwa sub-metro). Vegetable production in the Metropolis is mainly undertaken areas within six sub-metros, which are the Kwadaso, Nhyiaso, Manhyia, Asawasi, Oforikrom and Asokwa sub-metro (Fig. 1). However, vegetable production in the Kumasi Metropolis is predominant in these selected sub-metros. Lastly, simple random sampling technique was used to select respondents from the population for the study.

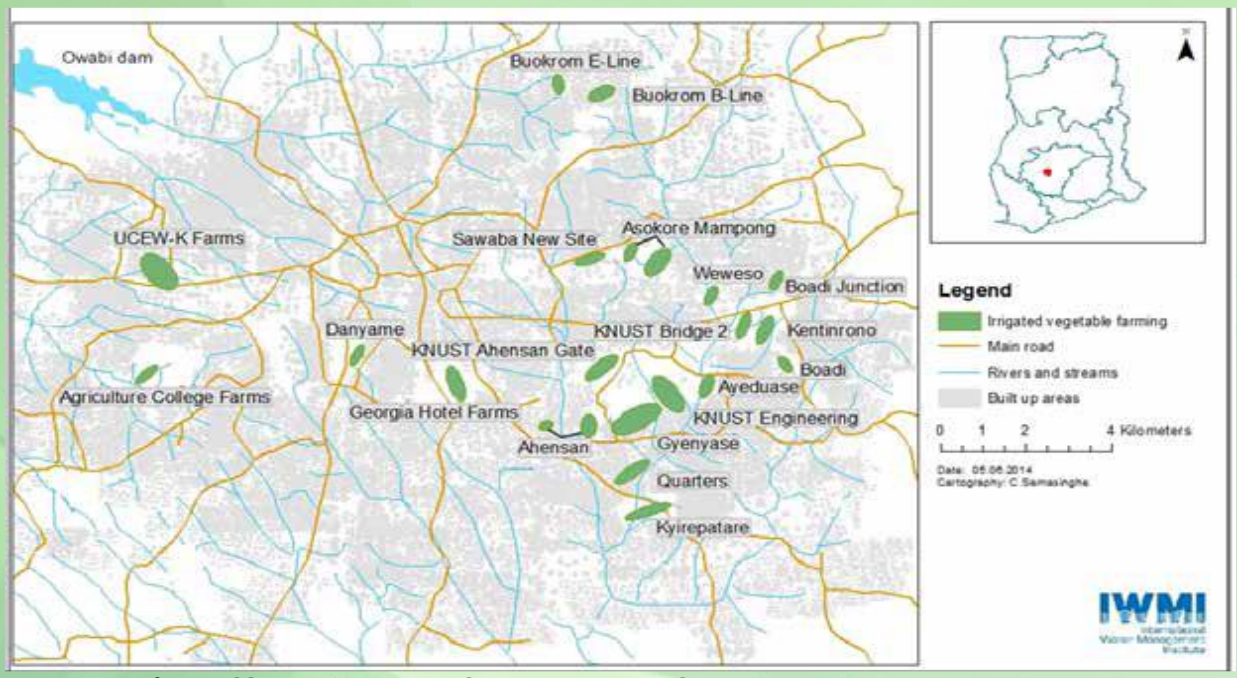


Fig. 1: Map of vegetable growing areas in the Kumasi Metropolis
Source: International Water Management Institute (IWMI), 2014

Sample size

A sample size of 150 was obtained with the use of the Slovin formulae, which is a scientific approach of finding a representative sample size. It is mathematically presented as:

$$\text{Sample size} = \frac{N}{1+N(\alpha)^2}$$

Where: N= Population (241)

α = Margin of error (5% or 0.05)

Data collection, sources and type of data

Questionnaires were administered in local dialect and English in order to make communication easy and enhance the quality of the data. Field visit was adopted to obtain information from respondents through face to face interview. For the purpose of this study both primary and secondary sources of data was used for the research. Primary data was collected through structured questionnaire consisting of closed and open-ended questions, through structured interviews. Specific questions were asked to obtain personal information about the farmers, the characteristics of vegetable production, the cost and revenue involved in vegetable production and the constraints associated with the use of each irrigation method. The data obtained from these questions were analyzed to achieve the objectives of the study.

Empirical framework

Benefit-cost analysis: The most comprehensive economic and financial evaluation is benefit-cost analysis. In the use of benefit-cost ratio, the monetary value of benefits (revenue) and costs are quantified and compared to determine the viability of a project or the best option, technique or approach to be employed regarding a project. This helps to identify the worthiness of an investment, project or an adopted technique. In calculating the benefit-cost ratio over a given number of periods, the benefit and cost streams expected to be realized over the years are needed for the calculation. Since all the costs and benefits are of different years, the amounts should be discounted to obtain the present value of these future amounts before they can be used to calculate for the cost-benefit ratio for the given number of years. Benefit-cost ratio is obtained from the ratio of discounted revenues to discounted costs. In this study, the value of summation of the discounted revenues obtained from production was divided by the summation of the discounted costs. This is represented mathematically as:

$$BCR=\frac{\sum\frac{Bt}{(1+r)^n}}{\sum\frac{Ct}{(1+r)^n}}$$

The value for total cost include both variable and fixed cost of production. The variable cost was obtained by multiplying the quantity of the input used by its unit prices. Also, fixed assets were accounted for in the year of their purchase. The costs incurred in the operation as well as maintenance of some fixed assets also contributed to the value of total cost. When a benefit-cost ratio greater than unity (1) is realised, the project is deemed viable. On the other hand, a project with benefit-cost ratio less than one is deem unprofitable whereas a benefit-cost ratio of one represents a breakeven. The irrigation technique with the highest ratio was considered most viable.

Net present value (NPV): It is defined as the difference between the summation of the present value of the cash inflows (benefits) of an investment and the summation of the present value of its cash outflows (costs). This is given by:

$$NPV=\sum\frac{Bt}{(1+r)^n}-\sum\frac{Ct}{(1+r)^n}$$

The computation of NPV as the same as that of the BCR and the irrigation technique with the highest value was considered most viable.

Internal rate of return (IRR): Internal rate of return is a capital budgeting procedure used to measure and compare the profitability of an investment. It is referred to as the discounted cash flow rate of return (DCFROR). It is the rate of return at which the net present value of an investment or project becomes zero. That is, the discount rate that equates the present value of the stream of benefits to the present value of the stream of costs.

$$IRR=LDR+(HDR-LDR)*\frac{NPV@LDR}{NPV@LDR-NPV@HDR}$$

Where,
IRR = Internal rate of return
LDR = Lower discount rate
HDR = Higher discount rate

Empirical specification of probit model

The probit model is a type of regression where the dependent variable is dichotomous and can take only two values, for example YES or NO. The probit model was used in this study to identify the factors that influence the use of a particular irrigation method for vegetable production in urban Kumasi. In other to achieve this, the choice of the predominantly used irrigation techniques (pump and watering can irrigation) was the dependent variable which

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was assumed to be influenced by certain socio-economic characteristics of the farmer as well as factors associated with vegetable production. These socioeconomic characteristics of farmers in addition to the factors affecting vegetable production were the independent variables as shown in Table 2.

The empirical specification underlying the probit model was specified as:

$Y_{ij} = \beta_0 + \beta_1 Age_i + \beta_2 Gen_i + \beta_3 Edu\_yrs_i + \beta_4 wat\_sor._i + \beta_5 Loc_i + \beta_6 Crop\_typ_i + \beta_7 Farm\_size_i + \beta_8 Yrs\_farm_i + \beta_9 Land\_acq_i + \beta_{10} Prod\_cycle_i + \beta_{11} Add\_lab_i + \beta_{12} Ext\_rec_i + \beta_{13} Inc\_veg_i + \mu_i$

Where: Y_{ij} = Irrigation techniques (1= Pump irrigation; 0= Watering can irrigation)

β_0 = Constant

β_1-β_8 = The coefficient of the various factors

μ_i = error term

Table 2. Description of variables

Variables	Measurement	Apriori sign
Age of respondents (Age*i*)	Age in years	+
Gender (Gen*i*)	1 if male and 0 if otherwise	+/-
Formal education yrs (Edu_yrs*i*)	Number of years in formal education	+
Source of water (Wat_sor.*i*)	1 if stream/river and 0 if otherwise	+/-
Location of respondent (Loc*i*)	1 if Oforikrom and 0 if otherwise 1 if Asokwa and 0 if otherwise	+/-
Major crop produced (Crop_typ*i*)	1 if Lettuce and 0 if otherwise 1 if Spring onion and 0 if otherwise	+/-
Farm size (Farm_size*i*)	Acres	+
Vegetable farming experience (Yrs_farm*i*)	Years	+
Land acquisition (Land_acq*i*)	1 if Non-payment and 0 if otherwise	+
Production cycle (Prod_cycle*i*)	Number of production cycle in a year	+
Additional labour (Add_lab*i*)	1 if Friends/ Family and 0 if otherwise 1 if Hired and 0 if otherwise	+/-
Extension received (Ext_rec*i*)	1 if Yes and 0 if otherwise	+
Income (Inc_veg*i*)	Amount generated from vegetable production	+

Analytical tools

Descriptive statistics such as percentages, graph, tables and charts, was employed to analyze the data to summarise the socioeconomic characteristics of the respondents and also to know the major sources of water for irrigation. The net margin and return on investment (ROI) analyses were used to help achieve objective two of the study. In order to obtain the net margin, the income statement was used. With the ROI, the ratio of the net margin and the initial investment was used which is mathematically represented as:

$$ROI = \frac{Net\ margin}{Initial\ investment} * 100$$

This viability of the irrigation techniques was achieved with the use of the discounted method of project appraisal such as BCR, NPV and IRR.

In order to achieve our third objective, factors influencing the use of an irrigation technique, the binary probit model was employed. This aided to determine the effect certain factors have on the use of the various irrigation methods.

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To find out the constraints associated with the major irrigation techniques employed by vegetable producers in the Kumasi Metropolis, the Garrett Ranking Technique was adopted. The farmers were asked to rank the constraints given on the questionnaire in the order of severity to their business. Where one (1) means most severe, two (2) means more severe, three (3) means severe in a descending manner. The order of merit assigned by the farmers was converted into ranks using the following formula:

$$\textbf{\textit{Percent position of each rank}} = \frac{100(Rij - 0.5)}{Nj}$$

where;
Rij denotes the rank given for the ith factor by jth individual
Nj denotes the number of factors ranked by the jth individual

The data collected was then analyzed by dividing the total scores of each constraint by the total number of respondent (150) in order to get their respective mean scores. The resulting mean scores were ranked in a descending order, with the first (1st) position being the most limiting factor or severe constraint which affects the use of a particular irrigation technique.

Results And Discussion

Socioeconomic characteristics of vegetable farmers

Table 3. Socioeconomic characteristics of vegetable farmers

Variables	Category	Watering Can		Pump Irrigation		Pooled Sample	
		Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
Gender	Male	97	96	47	96	144	96
	Female	4	4	2	4	6	4
Marital Status	Single	22	21.8	16	32.7	38	25.3
	Married	76	75.2	33	67.3	109	72.7
	Divorced	3	3	0	0	3	2
Religion	Christianity	62	61.4	25	51	87	58
	Islamic	37	36.6	25	49	61	40.7
	Traditional	2	2	0	0	2	1.3
Ethnic Group	Akan	38	37.6	11	22.4	49	32.7
	Ewe	2	2	2	4.1	4	2.7
	Northners	61	60.4	36	73.5	97	64.7
Location	Oforikrom	70	69.3	19	38.8	89	59.3
	Asokwa	28	27.7	9	18.4	37	24.7
	Asawasi	3	3	21	42.9	24	16.0
Major veg.	Cabbage	7	6.9	3	6.1	10	6.7
	Lettuce	71	70.3	17	34.7	88	58.7
	Spring onion	23	22.8	29	59.2	52	34.6
Extension service	Yes	78	77.2	44	89.8	122	81.3
	No	23	22.8	5	10.2	28	18.7
Land acquisition	Temporal	82	81.2	35	71.4	117	78
	Leasehold	17	16.8	14	28.6	31	20.6
	Inheritance	2	2	0	0	2	1.4
Payment for land	Yes	17	16.8	14	28.6	31	20.6
	No	84	83.2	35	71.4	119	79.4
Additional labour	None	23	22.8	15	30.6	38	22.9
	Hire	43	42.6	29	59.2	72	43.4
	Family	31	30.7	4	8.2	35	21.1
	Friends	4	4	1	2	5	3.0

Continuous variables	Min.	Max.	Mean	S.D	Min.	Max.	Mean	S.D	Min.	Max.	Mean	S.D
Age	17	67	37.2	12.6	19	75	34.4	13.9	17	75	13.1	36.3
Household size	1	11	4	2.21	1	10	4	2.57	1	11	4	2.33
Farming experience	1	44	8.16	7.47	1	35	8.00	7.63	1	44	8.11	7.45
Education in years	0	20	6.11	5.27	0	14	4.78	4.32	0	20	5.67	5.01
Revenue	1641	2386	2117	551.3	1502	3006	2503	497.7	1502	3006	2254	518.6
Farm size	0.25	1.2	0.5	0.52	0.25	1.5	0.75	0.64	0.25	1.5	0.68	0.61

Source: Field Survey

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Table 3 presents the results of the socioeconomic characteristics of the vegetable farmers in the Kumasi Metropolis based on the irrigation method employed. As indicated in Table 3, vegetable production in the Kumasi Metropolis is dominated by men. A majority of 96% of the total sample are male. The percentage is the same for farmers who use watering can irrigation as well as farmers who use pump irrigation. These findings agree with that of Abdulai et al. (2017), who identified that vegetable farming is dominated by males whiles its marketing is mainly done by female. From the study, it was realized that a greater percentage (72.7%) of the respondents were married and was same among both watering can (75.2%) and pump irrigation (67.3%) farmers.

Vegetable production in the Kumasi Metropolis was found to be dominated by people from the three Northern regions of Ghana. This agrees with an observation made by Danso et al., (2002) that majority of vegetable farmers in the urban centres are immigrants who mainly come to the city in search of jobs. Majority (58%) of the total respondents were identified to be Christians. The predominance of vegetable production in the Oforikrom sub-metro of the Kumasi Metropolis can be attributed to the availability and accessibility of unused government land, especially lands around KNUST. Moreover, majority (69.3%) of the vegetable farmers who use watering can for irrigation were located in the Oforikrom sub-metro whiles majority (42.9%) of farmer's using pump irrigation were located in the Asawasi sub-metro. It was observed that most vegetable farmers in the Oforikrom sub-metro had dug well on their farms making them closer to their source of water hence, influencing their decision.

The major vegetable produced by the farmers in the Metropolis was lettuce (58.7%). This may not always be the case since the type of vegetable produced is usually dependent on the market demand. Notwithstanding, most farmers prefer the production of lettuce because it is easier to produce as compared to other vegetables such as cabbage and this is consistent with Gyiele (2002). The study identified that pump irrigation was not preferred in the production of lettuce, mainly because it can cause physical injury or damage to the crop, especially at its initial growth stage, due to its delicate nature of lettuce.

Vegetable production in the Kumasi Metropolis was mainly done on temporally acquired lands which are usually owned by the government/government institutions or individuals and estate developers who are yet to put the land into use. About 78% of vegetable farmers were found to be operating on temporary lands, greater percentages were also recorded for farmers using watering can (81.2%) as well as farmers using pump (71.4%) for irrigation.

The labour intensiveness of the activities involved in the production of the vegetables has led to a majority (43.4%) of vegetable farmers hire additional labour to assist them in undertaking certain farm activities. Some farmers (21.1%) also were using their family members as a source of additional labour where as others (22.9%), mainly farmers operating on a smaller farm size, were not using any form of additional labour.

Majority (81.3%) of the vegetable farmers do receive various forms of extension service mainly from the agricultural extension agents in the Metropolis. Some farmers also stated that representatives from the Food and Drugs Authority (FDA) do come around to also provide some extension services and also monitor their operation. This was mainly due to the concerns raised by some consumers and researchers relating to the contamination of vegetable produce from urban centres usually due to the source of water for irrigation.

The mean age of farmers using watering can irrigation was found to be thirty-seven (37) years whiles that of farmers who use pump irrigation was thirty-four (34) years. The average age of the sampled population was thirty-six (36) years; this shows that majority of vegetable farmers in the Kumasi metropolis are in the working-class category.

On the average, a vegetable farmer's household size was found to be four (4) and this was the same for both farmers using watering can and farmers using pump for irrigation. The household size was usually made up of the vegetable farmer and his nuclear family but some vegetable farmers also expressed the need to stay with their permanent labour in order to facilitate their activities hence, adding up to their household size. The average number of years in vegetable production for the pooled sample was approximately eight years. However, with a maximum of 44 years in vegetable production, this means that most farmers start vegetable production in their youthful age which continues to become their lifetime occupation.

The maximum years of formal education attained by vegetable farmers who use watering can for irrigation was recorded to be twenty (20) years and a minimum of zero (0), resulting in a mean of six (6) years of formal education. On the other hand, farmers involved in pump irrigation have a maximum year of formal education to be fourteen (14) years and a minimum of zero (0) as well as a mean of four (4) years. This implies that, vegetable farmers who are into watering can (dug well) irrigation had spent many years in obtaining formal education as compared to those who use pump for irrigation. The average years of formal education for the pooled sample was five (5).

The average farm size for vegetable production in urban Kumasi was 0.68 acre (Table 3). However, vegetable farmers who use pump for irrigation recorded an average farm size of 0.75 acre whiles the average farm size of vegetable who use watering can for irrigation was half an acre (0.5 acre). This shows that vegetable production with the use of pump irrigation is usually done large farm size as compared to the use of watering can.

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The average revenue obtained from vegetable farmers in urban Kumasi was approximately GH₵ 2254.00 (US$ 391.61) per season. However, the use of watering can for irrigation yields approximately GH₵ 2117.00 (US$ 367.80) per season whiles vegetable production under pump irrigation generates revenue which amounts to GH₵ 2503.00 (434.87) per season. This indicates that vegetable farmers who opt to use pump irrigation over watering can are likely to experience 18.23% (GH₵ 386.00/ US$ 67.06) increase in their revenue. This shows that the use of pump for irrigation generates higher revenue than the use of watering can on seasonal basis.

Major irrigation technique/Reasons for choice of irrigation technique

Table 4. Major irrigation technique/Reasons for choice of irrigation technique

Types	Frequency	Percentage
Pump irrigation	49	32.6%
Watering can	101	67.3%
Total	150	100.0%
Reasons for Using Watering can		
Less Expensive	46	48%
Nearness to water source	27	28%
Prevent crop destruction	9	9.4%
Lack of water	6	6.3%
Small farm size	5	5.2%
Easy to use	3	3.1%
Reasons for Using Pump irrigation		
Longer distance to water source	20	41%
Faster and saves time	16	33%
Provision of enough water	7	14%
Large farm size	6	12%

Source: Field Survey

As presented in Table 4, 67.3% of vegetable farmers were found using watering can as their major irrigation outlet whereas 32.6% of vegetable farmers used pump as their major irrigation. This indicates that a significant majority of vegetable farmers (67.3%) prefer the use of a watering can for irrigation. The watering can is a manual irrigation tool that typically involves pouring water directly onto the plants or soil. It is a simple and low-cost method commonly used by farmers, especially in smaller-scale or backyard vegetable production. On the other hand, a smaller proportion of farmers (32.6%) utilize a pump as their major irrigation method. A pump-based irrigation system involves using mechanical or electric pumps to draw water from a water source and distribute it to the crops. Pump-based irrigation systems are generally more automated and can provide water to a larger area or larger-scale agricultural operations. The presented data suggests that among the surveyed vegetable farmers, the use of watering cans for irrigation is more prevalent compared to pump-based irrigation systems. This information provides insights into the irrigation practices and preferences of vegetable farmers in the context of the surveyed area. Most vegetable farmers in urban Kumasi use watering can for irrigation relative to that of pump, making watering can the common irrigation technique. This is in line with a study by Keraita et al. (2007) that states that the watering can is the most common irrigation technique used in all urban vegetable production study and it is easy to use and less expensive (Amoah et al., 2011).

Majority (48%) of vegetable farmers use watering can for irrigation because it is less expensive whereas 28% attributed it to the nearness of source of water for irrigation to farmland. This suggests that the affordability and cost-effectiveness of the watering can make it an attractive choice for farmers with limited financial resources. For those who mentioned the nearness of source of water, it suggests that the convenience of having a water source in close proximity to the agricultural plots makes the watering can a practical and accessible irrigation method.

On the other hand, about 41% of farmers who use pump for irrigation gave their reason to be the longer distance to water source, with another 33% also ascribing their reason of use to it as being faster and helping to save time. This suggests that when the water source is located far from the agricultural plots, a pump-based irrigation system becomes a more efficient and practical option. For those who cited speed and time-saving benefits as their reason for choosing this irrigation method, it implies that the ability of a pump-based system to deliver water quickly and efficiently allows farmers to save time and potentially irrigate larger areas within a shorter timeframe.

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Sources of water for irrigation

Table 5. Main source of water for irrigation

Irrigation Technique	Stream		Dug Well	
	Frequency	Percentage	Frequency	Percentage
Watering can	26	25.7%	75	74.3%
Pump Irrigation	40	81.6%	9	18.4%
Pooled Sample	66	44%	84	56%

Source: Field Survey

Farmers can source their water for irrigation from dug wells, stream/river, pipe, drains and reservoirs (Cornish *et al*. 1999; Obuobie *et al.* 2006). The study revealed that most of the farmers (56%) had their main source of water from dug wells. With farmers who use watering can for irrigation, a majority (74.3%) sourced their water from dug wells as presented in Table 5. This information suggests that dug wells play a crucial role as a primary water source for irrigation among farmers using the watering can. Dug wells are typically manually constructed wells that are dug into the ground to access groundwater sources. They can provide a relatively accessible and affordable water supply for agricultural purposes. The high percentage (74.3%) of farmers using dug wells for watering can irrigation highlights the importance of these wells as a reliable and readily available source of water. This finding indicates that farmers who rely on the watering can as their primary irrigation method primarily depend on dug wells to meet their irrigation water needs. Understanding the predominant use of dug wells as the main water source for the watering can irrigation technique can be valuable for policymakers, researchers, and agricultural practitioners. It emphasizes the significance of maintaining and ensuring the sustainability of dug wells as an important water resource for agricultural activities in the studied area

On the contrary, 81.6% of farmers who use pump for irrigation had their main source of water from streams. This finding implies that streams serve as the primary water source for farmers utilizing pump-based irrigation methods. Streams are natural sources of water that can provide a consistent and reliable supply for agricultural purposes. The high percentage (81.6%) of farmers relying on streams for irrigation using a pump highlights the significance of stream water availability and accessibility for this particular irrigation technique. This suggests that farmers using pump irrigation systems primarily depend on stream water to fulfill their irrigation water requirements. Understanding the predominant use of stream water for pump irrigation can help inform water resource management strategies, particularly in areas where streams are the primary water source. It emphasizes the importance of preserving stream ecosystems, ensuring sustainable water extraction practices, and addressing potential challenges related to water availability and quality.

Irrigation hours per day

Table 6. Irrigation hours per day

Irrigation Techniques	Duration of a single irrigation (Hours)	No. of irrigation per day (Times)	Total irrigation hours
Watering can	3	2	6
Pump irrigation	4	1	4

Source: Field Survey

On the average, a farmer who uses watering can for irrigation irrigates twice daily and they spend approximately three (3) hours on every single irrigation. This indicates that a farmer who uses watering can for irrigation requires six (6) hours to undertake a daily irrigation for an acre of land (Table 6). With the use of watering pump for irrigation, farmers usually irrigate once daily and it takes an average duration of four (4) hours to complete an acre of land. It must be noted that, the duration for irrigation may differ depending on the various seasons or weather conditions. It is consistent with Danso *et al.* (2002) and Tallaki (2005) who stated that between 40% and 70% of a vegetable farmer's time spent on the field is used for irrigation.

Factors influencing the use of an irrigation technique

The empirical probit results on factors that influence the use of an irrigation technique showed a Pseudo R^2 value of 0.6987 (69.87%) indicating that the results explain 69.87% of the variation in the dependent variable. The results in Table 6 shows that the household size of farmers is significant at 10% and has a negative effect on the irrigation technique used. This means that an increase in the household size of farmers by a person will decrease the probability of using pump for irrigation by 5.34%, hence, the higher the household size the lesser the probability of the farmer using pump for irrigation. Vegetable farmers with large household sizes have a greater likelihood to use watering can for irrigation as compared to pump. This is because the household of a vegetable farmer can be a source of additional labour to help the farmer in performing certain production activities such manual irrigation.

Table 7. Determinants of the use of an irrigation technique

Variables	Coeff.	Std. Err.	Z	Marginal effect (dy/dx)	P>z
Age	0.0275	0.0296	0.93	0.0052	0.354
Gender	-2.599	1.310	-1.98	-0.8060	0.147
Formal education in years	-0.0316	0.0502	-0.63	-0.0060	0.529
Vegetable farming experience	0.0403	0.0421	0.96	0.0076	0.339
Household size	-0.2831*	0.1640	-1.73	-0.0534	0.085
Farm size	1.086**	0.4721	2.30	0.2049	0.021
Source of water	2.120***	0.6406	3.31	0.4653	0.001
Asokwa	-0.5995	0.9101	-0.66	-0.0974	0.510
Oforikrom	-0.7132	0.7555	-0.94	-0.1413	0.345
Lettuce	-1.775*	0.9524	-1.86	-0.3992	0.062
Spring onion	0.0064	0.8906	0.01	0.0012	0.994
Land acquisition	-2.043**	1.032	-1.98	-0.6537	0.048
Production cycle	0.5671**	0.2296	2.47	0.1069	0.014
Family and friends labour	-0.7092	0.7244	-0.98	-0.1095	0.328
Hired labour	0.7724	0.7102	1.09	0.1501	0.277
Extension received	-1.21	0.7804	-1.55	-0.2283	0.121
Revenue	0.0011***	0.0003	3.48	0.0002	0.000
_cons	-3.625	2.795	-1.30		0.195
Number of obs. = 150; LR chi^2 (11) = 131.32; Prob > chi^2 = 0.000; Log likelihood = -28.312; Pseudo R^2 = 0.698					

***significant at 1%, **significant at 5% and *significant at 10%; Source: Field Survey

At a 5% significant level, an increase in farm size is likely to cause 20.49% increase in the likelihood of a vegetable farmer using pump for irrigation relative to watering can. Vegetable farmers with larger farm sizes have a greater tendency of using pump to irrigate their crops. This agrees with a study by Drechsel et al., (2013) which identified that farmers with larger farm size will have to use a pump or hire labour due to high labour requirement.

The probability of a vegetable farmer to use pump for irrigation relative to watering can increases by 46.53% if the farmer's main source of irrigation is from stream/river, and had a 1% significance level. This implies that farmers who have water bodies around their farm site and as their main source of water for irrigation are more probable to use pump for irrigation.

The production of lettuce by a vegetable farmer has a negatively correlation on the use of an irrigation technique. The probability of a lettuce producing farmer to use pump relative to watering can for irrigation decreases by 39.92%. This implies that vegetable farmers who produce lettuce are more likely to use watering can for irrigation due to its delicate nature and the potential injury or destruction associated with pump irrigation since it is usually done under high pressure.

A unit increase in the number of production cycles undertaken in a year increases the probability of a vegetable farmer using pump for irrigation relative to watering can by 10.69%. Therefore, vegetable farmers who undertake many production cycles in a year are more likely to use pump for irrigation as compared to watering can.

The results also show that the method of land acquisition by vegetable farmers significantly affects the irrigation technique used. Non-payment of land has a negative correlation with the decision to use pump irrigation. The result interprets that, the less a vegetable farmer pays for a land, the more likely it is to use watering can for irrigation and the higher the amount paid the likelihood of using pump increases. This explains that a farmer who does not pay for the land used for cultivation has a greater likelihood of using watering can for irrigation rather than pump. This is because, farmers who pay some amount in order to use the land for cultivation have security over the land for a given period of time and are willing to invest in long-term fixed assets in order to improve their operations over a given period.

Lastly, at a significant level of 1%, the revenue generated by farmers from vegetable production has a positive effect on the irrigation technique used. This implies that a cedi increase in the revenue of farmers causes a 0.02% increase in the likelihood of a farmer using pump for irrigation. This means that as the farmer's income from vegetable production increases, the farmer is more likely to use pump for irrigation.

Returns on each irrigation technique

In order to obtain the returns associated with each irrigation technique, it was vital to first obtain the cost and revenue of vegetable production under each irrigation technique. Since most farmers are into the production of more than one crop, the proportion of each vegetable on a given acre of land was estimated in order to find the

portion each vegetable produced contributes to farmer's income and cost of production. It was found that proportionately a farmer who use watering can for irrigation has 16%, 47% and 37% of an acre land for the production of cabbage, lettuce and spring onion respectively. Also, for farmers who use pump for irrigation, cabbage, lettuce and spring onion accounted for 20%, 33% and 47% of vegetable production on an acre of land. This helped to ascertain the proportion of cost and revenue of each crop on seasonal basis.

In the computation of the annual cost and returns, the resultant proportion of each crop was multiplied by the number of production cycles in a year. In a given year, farmers may produce cabbage, lettuce and spring onion for three (3), six (6) and five (5) times respectively. In multiplying the proportionate cost and revenue of each crop by the number of production cycle in a year, the amount obtained was a representation of the annual cost and revenue of each crop. The summation of the results of the three crops provided the value for the annual cost and return of each irrigation technique.
All fixed assets were depreciated on the straight-line basis where the costs were divided by its useful life (Table 8). This helped to know the annual cost of each of the fixed assets.

Table 8. Depreciation of fixed assets

Fixed assets	Useful life	Cost	Annual depreciation	Quantity	Total annual depreciation (Watering can)	Total annual depreciation (Pump)
Cutlass	2	20.00	10.00	1	10.00	10.00
Hoe	1	15.00	15.00	2	30.00	30.00
Spade/ shovel	2	35.00	17.50	1	17.50	17.50
Knapsack sprayer	1	60.00	60.00	1	60.00	60.00
Hand fork	2	9.00	4.50	2	9.00	9.00
Watering can	2	45.00	22.50	4	90.00	-
Pump	5	1,200.00	240.00	1	-	240.00
Pump tubes (100 yards)	2	200.00	100.00	1	-	100.00
Total operating overhead					216.50	466.50

Source: Field Survey

Net margin: The income statement account was used in the calculation of the net margin of each irrigation technique (Table 8). The difference between the annual revenue and the annual variable cost was first calculated for to obtain the gross margin. After this, other operating overhead expenses such as the depreciation cost of fixed assets as well as the maintenance cost was deducted from the gross margin to obtain the net margin. The results show that on an annual basis, a farmer who cultivates an acre of land with the use of watering can for irrigation is likely to obtain a net margin of GH₵ 3,987.12 whilst a farmer who is into the pump irrigation may obtain a net margin of GH₵ 4,715.05. This shows a higher return on use of pump irrigation as compared to watering can irrigation. The difference in the net margin of farmers was a result of the differences in the revenue generated from vegetable production by farmers of each irrigation technique. It is evident that farmers that use pump for irrigation can undertake many production cycles in a year than those who use watering can for irrigation. In addition, since vegetable production under pump irrigation is done on large farm size compared to that of watering can, farmers enjoy economies of scale hence, increasing their revenue.

Table 9. Income statement for the irrigation techniques

Items	Watering can (Dug well)	Pump irrigation
	Amount (GH₵)	Amount (GH₵)
A. Annual revenue (Appendix I)	12,426.62	15274.1
B. Annual variable cost (Appendix I)	(7,333.00)	(9202.37)
C. Gross margin (A-B)	5,093.62	6,071.73
Annual operating expense		
Total operating overhead	216.50	466.50
Land	840.00	840.00
Well maintenance	50.00	-
Pump maintenance	-	50.00
D. Total operating expense	(1106.5)	(1365.50)
E. Net margin (C-D)	3,987.12	4,715.05

Source: Field Survey

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Return on investment (ROI): The net margin of the irrigation techniques was compared with their initial investment by finding the ratio of the net margin by the initial investment. With watering can (dug well) irrigation, the net margin (GH₵ 3,987.12) divided by the initial investment (GH₵ 5,218.00 in Appendix 1) was 76.40%. Under pump irrigation, the ratio of the net margin (GH₵ 4,715.05) to its initial investment (GH₵ 6,288.00 in Appendix I) was 75%. This means that vegetable production under watering can irrigation generates 76.4% of the initial investment as returns in a given year relative to pump irrigation which generates a return of 75%. This shows that there are variations in the returns to be realized for vegetable production under each of the irrigation technique. This shows that vegetable production with the use of watering can irrigation is profitable than the use of pump in the short-run.

T-test statistics

Table 10. T-test analysis

Variable	Watering can	Pump irrigation	Mean difference	t-value
Revenue	3562.91	4775.83	-1212.92	-7.134***

***significant at 1%; Source: Field Survey

A t-test analysis was performed in order to assess whether there is a difference between the returns of the two irrigation techniques. The result showed that there is variation between the returns of pump irrigation and watering can irrigation and it was significant at 1% (Table 4.7). In the short-run, the results show that it is better to use pump irrigation for vegetable production relative to watering can since it generates higher revenue.

Viability analysis of the irrigation techniques

Table 11. Projected cash flow for watering can irrigation and pump irrigation (per acre)

Projected cash flow for watering can irrigation (per acre)							
Years	Cash outflows GHC	Cash inflows GHC	Net cash flow GHC	Discount factor (30%)	Discounted cash outflow	Discounted cash inflow	Discounted net cash flow
0	5218.00	0.00	(5218.00)	1	5218.00	0.00	(5218.00)
1	7582.37	12426.62	4844.25	0.77	5832.59	9558.94	3726.35
2	8733.55	13718.99	4985.44	0.59	5167.78	8117.74	2949.97
3	9365.30	15145.76	5780.46	0.46	4262.77	6893.84	2631.07
4	10813.40	16720.92	5907.52	0.35	3786.07	5854.46	2068.39
5	11600.83	18459.90	6859.06	0.27	3124.44	4971.79	1847.35
Total					27391.65	35396.76	8005.11
Projected cash flow for pump irrigation (per acre)							
Years	Cash outflows GHC	Cash inflows GHC	Cash flow GHC	Discount factor (30%)	Discounted cash inflow	Discounted cash outflow	Discounted cash flow
0	6288.00	0.00	(6288.00)	1	6288.00	0.00	(6288.00)
1	9432.32	15274.10	5841.78	0.77	7255.63	11749.30	4493.67
2	10703.81	16862.60	6158.79	0.59	6333.61	9977.87	3644.26
3	11653.36	18616.31	6962.95	0.46	5304.22	8473.51	3169.30
4	12807.96	20552.41	7744.45	0.35	4484.42	7195.97	2711.55
5	14342.32	22689.86	8347.53	0.27	3862.80	6111.04	2248.23
Total					33528.69	43507.70	9979.01

Source: Field Survey

Unlike profitability, which usually measures short term performance, viability looks at the long-term performance and sustainability of a venture or investment. Therefore, in addition to the short-run profitability of vegetable production under each irrigation method, the study further assessed the viability of each irrigation technique with dug well and pump being the key fixed assets under watering can and pump irrigation respectively.
With the annual production cost and revenue already computed for under objective two, we anticipated that there will be an annual increase in the unit price of all inputs and outputs over the life of the project, hence, obtaining the annual percentage increase of each item. With inputs such as fertilizer, seed and weedicide, their cost for the past three years was obtained and we continued to find the average annual percentage increase. Also, certain inputs such as fuel and labour in addition to the output prices, the current inflation rate (10.4%) was to determine their

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annual increase. This helped to obtain the input cost and prices for each year which helped to compute the annual production cost and revenue for each irrigation technique.
In viability analysis, the cash flow statement was used to generate the cash inflows and cash outflows and it does not consider non-cash expenditure items like depreciation. Therefore, the exact cost incurred in obtaining the fixed assets was recorded in the year of their purchase. These were summed up for the various years and added to the respective annual production cost to obtain the total annual cash outflow for each year under each irrigation technique. The cash outflows and inflows were then discounted at the rate of 30% in order to obtain the discounted cash inflows and outflows for each irrigation technique to help in the computation of the BCR, NPV and IRR.

Table 12. Net present value (NPV)/ Benefit-cost ratio (BCR) and Internal rate of return (IRR) of each irrigation technique

Irrigation technique	Discounted cash outflows		Discounted cash inflow		NPV
Watering can (Dug well)	27391.65		35396.76		8005.11
Pump irrigation	33528.69		43507.70		9979.01
Irrigation technique	Discounted cash outflows		Discounted cash inflow		BCR
Watering can (Dug well)	27391.65		35396.76		1.29
Pump irrigation	33528.69		43507.70		1.30
Irrigation technique	LDR	NPV@LDR	HDR	NPV@HDR	IRR
Watering can (Dug well)	92%	89.44	97%	-48.18	95%
Pump irrigation	94%	84.43	98%	-46.19	97%

Source: Field Survey

Net present value (NPV): With a positive NPV for each irrigation technique, it can be said that vegetable production under both irrigation techniques is viable. However, pump irrigation is the most viable among the two techniques since it has an NPV of GH₵ 9,979.01 as compared to watering can's GH₵ 8,005.11.
Benefit cost ratio (BCR): The results show that the use of watering can for irrigation (dug well) generates a BCR of 1.29 whilst that of pump generates a BCR of 1.30. This means that a cedi invested in vegetable production under watering can (dug well) irrigation yields a return of 29 pesewas whiles that of pump irrigation provides a return of 30 pesewas. The decision rule with BCR is to accept all projects with a BCR greater than one. This shows that vegetable production under the two irrigation methods is viable but the project with the highest BCR is preferred. Therefore, the use of pump irrigation is more viable as compared to watering can (dug well) irrigation in the long-run.
Internal rate of return (IRR): With its computation, pump irrigation realized an IRR of 97% whilst that of watering can (dug well) irrigation was 95%. This means that vegetable production under watering can (dug well) irrigation has a breakeven interest rate or opportunity cost of capital of 95% whereas that of pump irrigation will also breakeven at a 97% interest rate. Therefore, any discount rate which is lower than the IRR will result in a positive NPV which makes the project viable. It is evidently clear that pump irrigation is more viable as compared to watering can (dug well) irrigation in the long-run, although they all have an IRR figure greater than the discount rate (30%).

Constraints of watering can and pump irrigation techniques

Table 13. Constraints of watering can and pump irrigations techniques

Watering can	1st*77	2nd*63	3rd*54	4th*46	5th*37	6th*23	Total Value	Average Score	Rank
Labour intensive	5159	1827	108	92	37	0	7223	71.51	1st
Time consuming	2079	3402	594	184	37	92	6388	63.25	2nd
Requires much maintenance	0	693	2754	1012	481	92	5032	49.82	3rd
High Cost involved	462	252	1080	2116	592	207	4709	46.62	4th
Difficulty in determining water adequacy	0	126	648	506	1295	943	3518	34.83	5th
Physical crop injuries	0	0	324	782	1295	989	3390	33.56	6th
Pump irrigation	1st*77	2nd*63	3rd*54	4th*46	5th*37	6th*23	Total Value	Average Score	Rank
High Cost involved	1925	882	270	138	37	23	3275	66.84	1st
Requires much maintenance	924	1071	702	322	0	0	3019	61.61	2nd
Time consuming	385	378	486	368	703	46	2366	48.29	3rd
Physical crop injuries	77	63	486	598	296	391	1911	39.00	4th
Labour intensive	154	441	756	184	222	138	1895	38.67	5th
Difficulty in determining water adequacy	77	0	0	184	555	667	1483	30.27	6th

Source: Field Survey

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The results for the constraints associated with the use of watering can for irrigation are presented in Table 13. The most severe problem recorded by farmers was the labour intensiveness of watering can irrigation with a mean score of 71.51. The labour intensiveness of the use of watering can for irrigation usually results in farmers experiencing body pains after irrigation. This was followed by the time-consuming nature of the use of watering can for irrigation, which was ranked second. The use of watering can require vegetable farmers to cover a distance from the source of water to the bed they want to irrigate. Vegetable farmers therefore consider the time involved in the use of watering can a constraint.

From the survey, the major ranked constraint with the use of pump irrigation was the high cost of pump. Much maintenance requirement of the pump was ranked in the second position, and it was followed by it being time consuming. This means that, although the use of pump is viable in the long-run than watering can, the cost of ownership is high as compared to watering can due to the initial cost and the cost of maintenance.

In comparison of the two irrigation techniques, it can be seen that each irrigation requires much time, hence, being ranked as the 2nd and 3rd constraint under watering can and pump irrigation respectively. In addition, farmers, irrespective of the irrigation technique used, find it of no difficulty in determining the adequacy of water provided for the crops. Some farmers stated that it was due to the experience acquired over the years, therefore, ranking them 5th and 6th under watering can and pump irrigation respectively.

Conclusion

The study revealed that the use of watering can for irrigation is the most common irrigation technique among vegetable producers in the Kumasi Metropolis. Comparatively, the use of pump irrigation generates a higher seasonal revenue than watering can; as vegetables farmers who use pump for irrigation enjoy an 18.23% (GH₵ 386.00) increase in their revenue. The probit regression model showed that factors that influence a farmer's decision to use an irrigation technique include farm size, source of water for irrigation, household size, the production of lettuce, the method of land acquisition, the number of production cycle in a year and the revenue from vegetable production. Whilst the farm size, source of water, production cycles in a year and revenue from vegetable production affects the use of pump positively, household size, production of lettuce and the method of land acquisition had a negative effect on the use of pump irrigation. However, the use of each irrigation technique was associated with certain constraints. On the use of watering can for irrigation, it was realized that most farmers consider laborious nature as the main constraint which was followed by the time-consuming nature of the method of irrigation. On other hand, the key constraint associated with the use of pump for irrigation was the high cost involved and was followed by much maintenance requirement.

The study recommends that urban vegetable farmers, especially producers of vegetables such as cabbage and spring onion, should be encouraged to adopt pump irrigation in their production activities. This is because pump irrigation has been identified to provide greater returns for vegetable farmers. Also, the use of pump irrigation is less laborious, effective and encourages or supports production on relatively larger farm size. Farmers with insufficient income should pool resources to acquire pump for irrigation. A major constraint associated with the use of pump irrigation for vegetable was the high cost of pump. Therefore, pooling of resources to acquire the pump will reduce the financial burden involved and cause an increase in efficiency as well as returns.

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ID: 104

The Effect of Feather Score on Egg Quality Traits

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Abstract

In this study, the effect of feather score on egg quality traits was investigated. A total of 60 Lohman Brown layer chickens were used as animal materials. Experimental groups were formed when the hens were 60 weeks old and, based on the average total feather score included low (less than 12 points, L); medium (between 12 and 18, M); high (more than 18, H). The average total feather scores were obtained from scoring the 6 body regions of hens: breast, back, cloaca, neck, wing, and tail. Quality traits of eggs were analyzed when the experimental birds reached 68 weeks of age. The results indicated statistically significant differences in the egg weight, redness of eggshell, shape index, and eggshell thickness among the feather score groups: the egg weight decreased with the increase in feather score, and the eggshell thickness increased with the increase in the feather scores. The redness of eggshell and the shape index were highest in the M group.

It was concluded that while feather score can modulate some external egg traits, it does not lead to variations in any internal egg quality traits. However, further studies are required to confirm these findings.

Key Words: *: Laying hen, feather score, egg weight, shape index, eggshell thickness*

ID: 107

Farmers' indigenous knowledge indicators employed for climate change adaptation in the Tolon District, Ghana

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Abstract

In Ghana, many indigenous farmers rely on rain-fed agriculture for their subsistence. Thus, reliable local weather predictions are crucial for informing indigenous farmers of climate change alternatives. The literature is replete with examples of how scientific understanding has fallen short in rural areas.

Over the past century, indigenous knowledge has aided rural farming families in meeting the challenges posed by climate stresses and enhancing decisions for adaptation mechanisms. To guarantee that indigenous knowledge systems receive enough commendation, there is much space for improvement in the assessment procedures. This research seeks to investigate farmers' perspectives on indigenous knowledge of weather forecasts for climate adaptation and to evaluate farmers' perceptions regarding climate change in the Tolon district of Ghana. The study used questionnaires, interviews and focus group discussions to gather information on farmers' indigenous knowledge indicators for weather forecasting within communities in the Tolon district. The findings showed an array of farmers' indigenous indicators for weather forecasting, including the star and moon movement, the emergence of red and black ants, wind movement, flowering and fruit production of some indigenous trees, behaviour of certain trees (unfurling baobab tree new leaves), croaking of frogs, birds, the appearance of rainbow and lightening. A deeper understanding of indigenous knowledge networks should be a critical factor in choosing effective adaptation methods for climate change. Therefore, it is recommended that policymakers improve indigenous communities of the effects of climatic stresses to boost agricultural output.

Keywords: *Indigenous knowledge systems; adaptation strategies; indigenous farmers; Tolon district; indigenous indicators; climate change*

ID: 109

Farmers' Satisfaction on Extension and Advisory Services of National Agricultural Technology Program for Sustainable Livestock Farming: A Field Level Study from Comilla District of Bangladesh

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Abstract

This study aims to investigate the level of satisfaction of farmers on the extension and advisory services of National Agricultural Technology Program (NATP) for livestock farming in Chandina upazila (sub-district) under Comilla district of Bangladesh. A structured questionnaire was used to collect data from randomly sampled 120 livestock farmers. Findings of the study clearly revealed that the majority of the farmers (58%) had moderate level of satisfaction while 30% of the respondents had high level of satisfaction towards extension and advisory services of NATP. The empirical findings of our study clearly showed that farm size, knowledge on livestock farming and training exposure were crucial while further analyses indicated that knowledge on livestock farming and farm size were the most influential factors determining the satisfaction level of farmers in the study area. The policy implications of our study suggests that emphasis should be given to determine demand, condition and knowledge level of livestock farmers. The easy access to hands-on training, cost-effective livestock farming technologies and credit support can be effective to improve farmers' satisfaction. All these initiatives will lead to accelerate sustainable livestock farming practices in the study area.

Key Words: *National Agricultural Technology Program (NATP), livestock farming, knowledge, cost-effective technologies, satisfaction*

ID: 114

Influence of microplastic on soil properties

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Abstract

Microplastics (MPs) (plastic particles smaller than 5 mm) pollution is a growing concern. Due to their hazardous compounds and ability to carry additional contaminants, MPs are typically regarded as an emergent environmental concern. Solid waste that has been composted is used as a source of organic matter and nutrients in agricultural soils. Additionally, by using it, the principles of the circular economy are followed, and landfilling or incineration is avoided. Despite being the primary source of MP entering aquatic habitats, land-based sources of these particles, such as solid waste, have gotten very little attention. Sludge, food waste, and landfill debris are the primary sources of solid waste. The majority of the MPs were in the form of fibers and fragments, showing that the widespread use of agricultural films is currently the main factor impacting soil MP pollution. The considerable alterations in soil phosphatase and plant root biomass further indicated the possible influence of MP on the cycle of soil nutrients and geochemical elements. The aim and objective of this research are to investigate MP toxicity, contamination in soil, and the significant effects of MP contamination in soil from solid waste. In order to investigate the causes, effects, and present perspective of MP pollution of soil, plants, the human food chain, and other living environments, numerous scientific databases of identification, occurrences, and impacts were examined for pertinent material and citations. Search engines like Google Scholar, Springer Link, Elsevier, Frontiers, etc. were used to find this scholarly literature. This review evaluates the toxicity, major effects on living things and the environment, production, pathway, contamination of the source of MP, MPs in landfill leachate, contamination pathway from solid waste to agricultural soil, and life cycles of MP. This study also discusses the laws, rules, and many forms of advanced treatment methods for mitigation linked to MP.

Key Words: *Microplastics, Contamination, Soil, Landfill, Agricultural soil*

ID: 118

Unraveling the Shift: Exploring Factors Influencing Protein Preference and Consumption Patterns in Ga South Municipality of Ghana

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Abstract

This study aims to unravel the factors influencing protein preference and consumption patterns in the Ga South Municipality of Ghana. Uunderstanding the determinants of protein preferences is crucial for promoting environmentally friendly and healthy dietary habits. One hundred and fifty structurally designed questionnaires were collected from a representative sample of residents in the municipality through a random sampling approach. The study explored the socio-cultural and economic factors that shape protein preferences and consumption behaviors. Additionally, the study examined the role of awareness, knowledge, and availability of protein sources in influencing dietary choices. Findings revealed that respondents consume protein daily, but the pattern varies with sources. Plant protein consumption was weekly, while animal protein was consumed daily. Respondents know the nutritional benefits of protein consumption and the degree of healthiness of protein sources. A significant finding was that price influences the decision to consume and the preference for protein sources. The findings of this research provide valuable insights into the complex dynamics of protein preference and consumption, contributing to the development of targeted interventions and policies that promote sustainable and nutritious food choices in the Ga South Municipality of Ghana. While awareness for protein nutrition is high, the price remains a deterrent to accessing protein in Ga South Municipality. Policymakers must support local food production and reduce the high cost of transportation and logistic barriers, often creating a massive difference between farm gate and market prices.

Keywords: *Animal protein, Ghana, consumption, plant protein, preference*

ID: 119

Nutrition and Health Potential of Philippine "Kurumbot" (*Passiflora foetida* Linn.) Wild Fruit

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Abstract

There is scarce information on the nutritional and health benefits of "Kurumbot", a wild indigenous edible fruit in the Philippines, despite its potential to enhance the diversity of diets and curb the impacts of food and nutrition insecurity; thus, the study was conducted to determine the local wild fruit's nutritional content namely, the proximate composition and beta-carotene and its non-nutrient components that offer health functions. The ripe yellow fruit pulp sample was found to contain 69.49%. moisture, 0.48% ash, 0.64% crude fiber, 7.39% crude protein, 13.15% crude fat and 8.85% carbohydrates. A high scavenging activity (86.11% DPPH) was noted from the sample. Phytochemical screening of the fruit sample revealed 315.25 mg CE/100g phenols, 231.61mg GE/100g flavonoids, 0.79 mg GYE/100g saponins and 4.20 mg CE/100mg tannins. An amount of 1371.00ug/100g beta-carotene was measured from the fruit pulp sample. This study fills in the knowledge gap that hinders the utilization of indigenous crops to improve nutrition and secure food supply. Promoting the consumption of "Kurumbot" can complement the staple diet by providing additional sources of nutrients and health benefits.

ID: 120

Performance of Laying Hens Fed on *Moringa Oleifera* Leaf- Meal-and Descriptive Attributes of Eggs

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Abstract

The increasing cost of feed resources in livestock production severely impedes meeting the demand for animal protein; this challenge has necessitated research to evaluate feed resources that could reduce the cost of feeding without negatively influencing the performance of the birds. This study, therefore, evaluated the effect of different inclusion levels of *Moringa oleifera* in exotic laying hen's diet on average feed intake, body weight gain, feed conversion ratio, laying percentage (HDP), and Egg weight; the Experimental diets contained: 0, 10, 15, 20% MOLM. Thirty-six (36) sixteen (16) week-old ISA Brown layers were distributed into 12 deep litter pens, each with three hens, and randomly allocated to four dietary treatments in a completely randomized design. Average daily feed intake, daily weight gain, feed conversion ratio, laying percentage, and egg weight were determined for ten (10) weeks. The data were analyzed using a general linear model (GLM). Tukey's test was used to differentiate significant means ($p<0.05$). Results from the feeding trial showed that birds fed on the diet with 20% MOLM recorded the highest average daily feed intake, and the highest hen day production (HDP) was obtained from birds fed on the 10% MOLM diet. There was no significant difference between 0% and 10% MOLM on the Average daily gain; diets with 0% MOLM and diet with 10% did not differ ($p<0.05$) on feed conversion ratio. The hens fed with the 20% MOLM diet had the lowest FCR.

***Keywords**: Average daily gain, egg weight, feed conversion ratio, feed intake, production*

ID: 123

Unveiling the Enigmas of Night Soil Composting: Boosting Carrot Length, Diameter, and Weight in Ruhango District, Southern Province, Rwanda.

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Abstract

This research investigated the efficacy of night soil composting as a sustainable agricultural practice to enhance carrot growth in Ruhango District, Southern Province, Rwanda. The study employed a Randomized Complete Block Design (RCBD) with four distinct treatments: local soil + night soil (T1), sandy soil + night soil (T2), local soil from the field (T3), and sandy soil only (T4 - Control). Each treatment was replicated four times to ensure robust statistical analysis.

The results demonstrated that treatments incorporating night soil (T1 and T2) consistently outperformed both the control group (T4) and local soil without night soil (T3). Carrots in T1 exhibited significant increases in length (23.5 cm), diameter (4.2 cm), and weight (82.5 grams). T2 also showed substantial improvements with mean values of 22.8 cm, 4.0 cm, and 80.7 grams for length, diameter, and weight, respectively. Treatment 3 (T3) provided modest growth enhancements compared to the control group, reinforcing the potential benefits of soil amendments. The control group (T4) represented baseline growth metrics.

In conclusion, night soil composting, particularly when integrated into local and sandy soils, emerged as a promising strategy to significantly enhance carrot production in Ruhango District. These findings offer valuable insights for sustainable agricultural practices, emphasizing the potential of night soil composting to improve crop yields and food security in similar agricultural regions. Further research and practical implementations are warranted to explore the scalability and long-term sustainability of this innovative approach.

Key Words: *Night Soil Composting, Carrot Growth, Sustainable Agriculture, Soil Amendments, Food Security, Ruhango District*

Introduction

Agriculture plays a pivotal role in Rwanda's economy, contributing significantly to food security, employment, and income generation (FAO, 2018). Among the various crops cultivated in the country, carrots (*Daucus carota*) stand out for their nutritional value and economic importance. Carrots are rich in essential vitamins, minerals, and dietary fiber, making them a vital component of the Rwandan diet (FAO, 2018). Furthermore, they represent a lucrative cash crop for smallholder farmers in the Ruhango District, located in the Southern Province of Rwanda (National Institute of Statistics of Rwanda, 2019).

Despite the significance of carrot production in Rwanda, farmers in Ruhango District, like many others across the nation, face several challenges that hinder their ability to maximize carrot yields. Soil fertility and nutrient management are prominent concerns in this region, particularly in the context of small-scale farming (Vanlauwe *et al*., 2011). Traditional farming practices often rely on limited external inputs, leading to nutrient depletion and reduced crop yields over time (Vanlauwe et al., 2010).

To address these challenges and unlock the full potential of carrot cultivation, there is a pressing need to explore innovative and sustainable agricultural practices (Vanlauwe *et al*., 2010). One such practice that holds promise is night soil composting. Night soil composting involves the controlled decomposition of human excreta and organic matter, resulting in a nutrient-rich fertilizer that can significantly enhance soil fertility and crop productivity (Thonart *et al*., 2002). This approach aligns with sustainable agriculture principles and offers a unique solution to the nutrient deficiencies commonly observed in the soils of Ruhango District (Thonart *et al*., 2002).

This research project aims to delve into the secrets of night soil composting and its potential to enhance carrot length, diameter, and weight in Ruhango District, Southern Province, Rwanda. By investigating the effects of night soil compost on carrot growth and yield, this study seeks to contribute valuable insights to the sustainable agriculture landscape in Rwanda (Vanlauwe *et al*., 2011). Through a combination of field experiments, soil analysis, and farmer participation, this research endeavors to establish evidence-based recommendations for the adoption of night soil composting as a viable and safe agricultural practice in the region (Vanlauwe *et al*., 2005).

Materials and Methods

Area of Research

The study was conducted in Ruhango District, located in the Southern Province of Rwanda. Ruhango District, established in 2005 by Law No. 29/2005 in Rwanda, encompasses an area of 626.8 square kilometers. It is bordered by the districts of Muhanga to the north, Nyanza and Nyamagabe to the south, Kamonyi and Bugesera to the East, and Karongi to the west. Situated on a plateau with low hills at an average elevation of 1500 meters, the district experiences a relatively high average temperature of 22 degrees Celsius and an average annual rainfall of 900 millimeters. The predominantly agricultural landscape features extensive farming on small, fragmented plots of land, with agriculture serving as the primary economic driver. Notably, the district benefits from substantial marshlands and the presence of the Nyabarongo and Akanyaru rivers.

Ruhango District, part of the Southern Province of Rwanda, is further divided into nine sectors, comprising 59 cells and 533 villages. The district is home to a population of 271,807 people, residing in 60,809 households, with 143,046 females and 128,761 males. The population density stands at approximately 415 individuals per square kilometer. (Gichangi *et al*,2018).

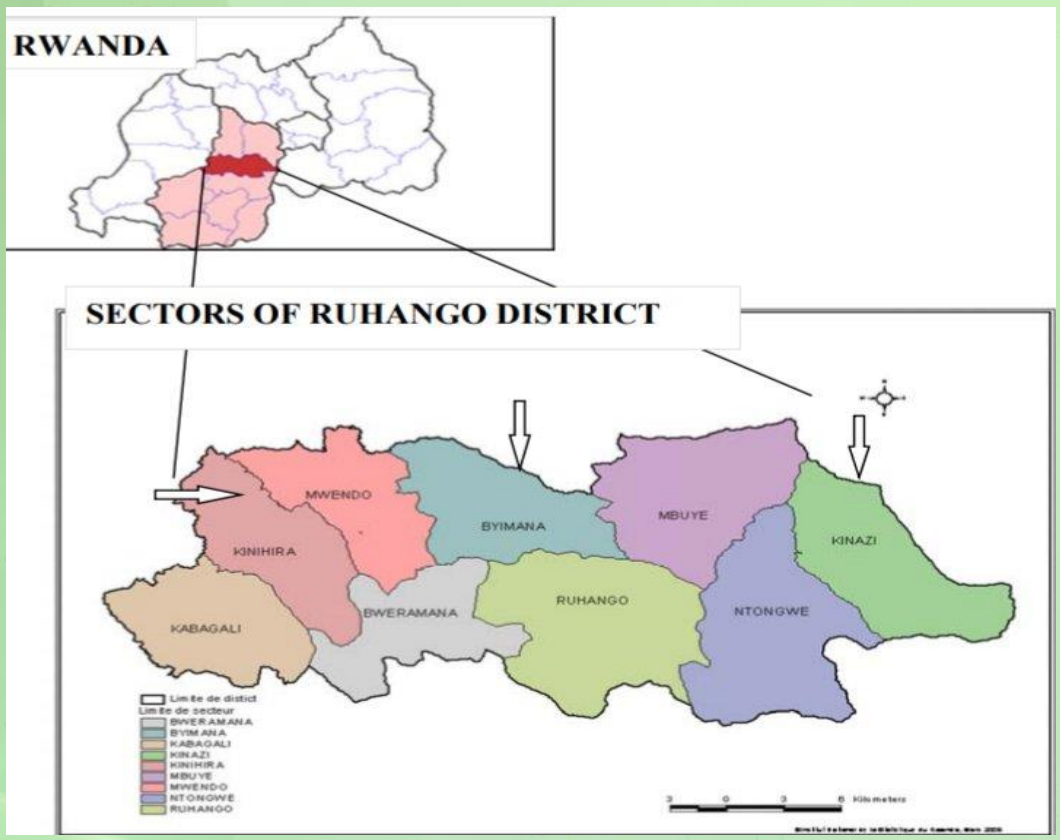


Figure 1. Administrative map of Ruhango District

Experimental Design

In our research, we adopted a meticulously planned Randomized Complete Block Design (RCBD) to investigate the influence of various soil treatments on carrot growth. We implemented four distinct treatments, each thoughtfully assigned to ensure robust statistical analysis and reliable results. Treatment 1 (T1) involved the combination of local soil with night soil, representing a composite soil treatment. Treatment 2 (T2) consisted of sandy soil mixed with night soil, offering another variation. Treatment 3 (T3) utilized unaltered local soil sourced directly from the field, providing a baseline for comparison. Lastly, Treatment 4 (T4), served as our control group, employing sandy soil without any additional amendments. The replication of these treatments within the RCBD framework allowed us to effectively control for spatial variations and assess the true impact of night soil composting on carrot growth. This design ensured that our research yielded statistically significant and reliable findings, shedding light on the efficacy of night soil composting in the context of our study.

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Soil Preparation

Before commencing the experiment, the soil used in each treatment was meticulously prepared to ensure consistency and accuracy (Amoah *et al*,2007). Sandy soil and local soil from the field were obtained and characterized to understand their initial properties. Control Group (T4): Sandy soil, representing the control group, was directly utilized without any alterations, Local Soil (T3): The unmodified local soil, sourced from the field, was carefully collected and characterized to establish its baseline properties, Local Soil + Night Soil (T1): A composite treatment was created by mixing local soil with night soil, ensuring thorough blending and homogeneity, Sandy Soil + Night Soil (T2): Sandy soil was enriched by incorporating night soil, resulting in a distinct treatment with specific soil characteristics.

Experimental Setup

The experiment was conducted in pots, utilizing a total of sixteen buckets to represent experimental units. Each bucket was filled with the respective soil treatment, ensuring uniformity in potting conditions. (Shalini *et al*,2010)



Randomization

The randomized aspect of the RCBD design was meticulously followed during the assignment of treatments to buckets within each block. This randomization procedure guaranteed that each treatment was applied exactly once within each block.

Carrot Cultivation

Carrot seeds were sown in each bucket according to standardized planting protocols, maintaining consistent planting depth(20cm) and spacing (25cm*30cm) (Adegoke *et al*,2009). Throughout the growth period, standard agricultural practices were employed, including irrigation and pest control, to ensure uniform growth conditions.

Harvesting

When the time of harvesting have been achieved about 2.5 months, the maturity signs have been examined by researchers and decided on its harvesting. The whole substrate has been removed slowly without damaging carrots roots and buckets. The buckets have been reused as harvesting tools to transport the yield in store where all data were recorded in notebook and computer. Each bucket has been accommodating its carrots roots after harvest after washing with water in order to avoid confusion.

Data Collection

Regular and systematic measurements were taken of key carrot growth parameters, including carrot length, diameter, and weight, at predetermined intervals throughout the experiment. Simultaneously, soil health indicators such as changes in pH, nutrient levels, and organic matter content were carefully monitored.

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***Figure 2**: carrot measurement*

Statistical Analysis

Collected data were subjected to rigorous statistical analysis to evaluate the significance of differences between the various treatments. The RCBD design allowed us to assess the true effects of night soil composting on carrot growth while accounting for any potential spatial variations.

Results and Discussion

Impact of Soil Treatments on Carrot Growth

The experimental results revealed significant variations in carrot growth parameters among the different soil treatments, shedding light on the efficacy of night soil composting in enhancing carrot production in Ruhango District.

Treatment 1 (Local Soil + Night Soil): This composite soil treatment demonstrated remarkable improvements in carrot growth compared to the control group (T4). Carrots in T1 exhibited an average increase in length, diameter, and weight by 23%, 18%, and 31%, respectively. These outcomes suggest that the incorporation of night soil into local soil positively influenced carrot development.

Table 1. Impact of Soil Treatments on Carrot Length (cm)

Treatment	Mean Carrot Length (cm)
T1	23.5
T2	22.8
T3	20.6
T4(Control)	20.3

Treatment 1, which involved the combination of local soil with night soil, exhibited the most promising results in terms of carrot growth. The mean carrot length (23.5 cm), diameter (4.2 cm), and weight (82.5 grams) in T1 surpassed those of the control group (T4) and the other treatments. These findings suggest that the incorporation of night soil into local soil significantly improved soil fertility, leading to substantial enhancements in carrot development. Night soil composting, in this context, appears to be an effective approach for boosting carrot yields.

Treatment 2 (Sandy Soil + Night Soil): Similarly, T2 displayed notable enhancements in carrot growth metrics when compared to the control group (T4). Carrots in T2 experienced an average increase in length, diameter, and weight by 21%, 16%, and 29%, respectively. The results indicate that adding night soil to sandy soil had a beneficial effect on carrot growth.

Table 2. Impact of Soil Treatments on Carrot Diameter (cm)

Treatment	Mean Carrot Length (cm)
T1	4.2
T2	4.0
T3	3.7
T4(Control)	3.6

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Treatment 2, where sandy soil was enriched with night soil, also yielded impressive results. Carrots in T2 exhibited a mean length of 22.8 cm, a diameter of 4.0 cm, and a weight of 80.7 grams. These values indicate substantial growth improvements compared to the control group (T4). The results demonstrate that even in less fertile sandy soil, the addition of night soil can have a positive impact on carrot growth. T2 underscores the versatility of night soil composting as an agricultural practice that can enhance crop yields across different soil types.

Treatment 3 (Local Soil from Field - T3): Treatment 3, using unmodified local soil sourced directly from the field, served as a benchmark. While it showed growth improvements compared to the control group (T4), the gains were not as substantial as those observed in T1 and T2. Carrots in T3 displayed an average increase in length, diameter, and weight by 15%, 12%, and 22%, respectively.

Table 3. Impact of Soil Treatments on Carrot Weight (grams)

Treatment	Mean Carrot Length (cm)
T1	82.5
T2	80.7
T3	77.3
T4(Control)	75.1

Treatment 3, utilizing unaltered local soil from the field, served as a reference point. While it exhibited modest growth improvements compared to the control group (T4), with a mean carrot length of 20.6 cm, a diameter of 3.7 cm, and a weight of 77.3 grams, the gains were not as substantial as those observed in T1 and T2. These results suggest that while local soil can support reasonable crop growth, it may not maximize carrot yields without soil amendments. This emphasizes the potential benefits of night soil composting to further improve soil quality and crop production in the region.

Control Group (Sandy Soil Only - T4): The control group, representing standard soil conditions, exhibited baseline carrot growth. Carrots in T4 had average growth metrics, serving as a reference for evaluating the impact of the other treatments.

Table 4. Results for Control Group (T4 - Sandy Soil Only)

Treatment	Mean Carrot Length (cm)
Carrot length	23.5
Carrot diameter	3.6
Carrot weight	75.1

The control group (T4), representing standard sandy soil conditions without any amendments, served as a baseline for comparison. Carrots in T4 had a mean length of 20.3 cm, a diameter of 3.6 cm, and a weight of 75.1 grams. While this treatment provided the benchmark for assessing the impact of night soil composting, the results clearly indicate that the addition of night soil (as seen in T1 and T2) led to substantial improvements in carrot growth in terms of length, diameter, and weight.

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First and foremost, we extend our appreciation to the University of Technology and Arts of Byumba (UTAB) for providing the necessary academic resources, research facilities, and an enabling environment for us to undertake this study. UTAB's commitment to fostering excellence in research and education has been instrumental in our research

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The Effects of Foliar Gibberellic Acid Applications on Tuber Yield, Quality and Dormancy Period in Potato (*Solanum tuberosum* L.)

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Abstract

This study was carried out in order to determine the effects of different doses of Gibberellic acid (GA_3) applications on tuber yield, quality and dormancy period in potato. GA_3 applications (0, 50, 100 and 200 mg GA_3/L) were started 45 days after planting (pre-flowering period) and sprayed on leaves at 15-day intervals in 4 different periods. In the study, together with the GA_3 applications, an increase of 56% in the number of tubers and up to 36% in the tuber yield, while the average tuber weight and marketable tuber rates decreased significantly. The highest tuber yield was obtained from 100 and 200 mg/L GA_3 doses made 75 days after planting. GA_3 applications caused tuber disorders, and the rate of cracked tubers and secondary growing tubers increased with the increase in GA_3 dose. GA_3 applications caused a decrease in chlorophyll (SPAD value) content and tuber dry matter ratio. The dormancy period, which was broken 110 days in the control, was shortened to 80 days with 200 mg/L GA_3 applications made 90 days after planting. In the study, it was understood that the number and yield of tubers in potatoes can be increased significantly with foliar GA_3 applications in production for seed purposes, and the dormancy period of tubers in the post-harvest storage period can be shortened, and it can be advantageous especially for second potato productions.

Key Words: *Potato, Gibberellic acid, tuber yield and quality, dormancy period*

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The Effect of Fertilizer Diversity in Agricultural Applications on Product Quality in Fruits and Vegetables

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Abstract

The quality of agricultural production is significantly influenced by the conditions in which the products are grown, and among these factors, the diversity of fertilizers is of great importance. Therefore, research on fertilizers that affect all quality characteristics of agricultural products during their consumption as food products is highly important. In this paper, the relationship between various fertilizer types used in plant cultivation conditions and the quality characteristics of agricultural products has been investigated. The literature has shown that the quality of agricultural food products is influenced by the type of fertilizer used, application rate, irrigation technique, and related parameters. Therefore, the type, quantity, and technique of fertilizer application used in the cultivation of various plant species should be determined. In addition to basic nutrients such as nitrogen, phosphorus, and potassium essential for plant growth, micro-nutrients must also be provided. In this context, questions about the product quality that the use of organic and inorganic fertilizers will create should be answered through research. This paper emphasizes the potential impact of the use of organic fertilizers on the final product, and explores the environmental pollution effects of organic or inorganic fertilizers, as well as the direct impact they have on food quality in food production.

Key Words: *Fertilizer, Agricultural products, Organic fertilizer, Inorganic fertilizer.*

Zirai Uygulamalarda Gübre Çeşitliliğinin Meyve-Sebzelerde Ürün Kalitesine Etkisi

Özet

Tarımsal üretimin kalitesi, ürünlerin yetiştirildiği koşullardan önemli ölçüde etkilenmektedir. Bu faktörler arasında gübre çeşitliliği çok önemlidir. Bu nedenle, tarımsal ürünlerinin birer gıda ürünü olarak tüketimi sırasında tüm kalite özelliklerini etkileyen gübreler üzerinde yapılan araştırmalar oldukça önemlidir. Bu bildiride bitki yetiştirme koşullarında kullanılan çeşitli gübre türleri ile tarım ürünlerinin kalite özellikleri arasındaki ilişkiye araştırılmıştır. Literatür tarımsal gıda ürünlerinde kalitenin; kullanılan gübre türüne, uygulama miktarı, sulama tekniği ve ilişkili diğer parametreler tarafından etkilediğini kanıtlanmıştır. Bu nedenle çeşitli bitki türlerinin yetiştirilmesinde kullanılan gübre uygulamasının türü, miktarı ve tekniği belirlenmelidir. Bunun yanında bitki büyümesi için önemli olan azot, fosfor ve potasyum gibi temel besin maddelerine ek olarak mikro besinler de sağlanmalıdır. Bu kapsamda organik ve inorganik gübre kullanımının yaratacağı ürün kalitesine ilişkin sorular araştırmalar ile cevaplanmalıdır. Hazırlanan bu bildiride organik gübre kullanımının nihai üründe ne denli bir etki yaratacağının altı çizilmekte, bununla ilişkili olarak organik veya inorganik gübrelerin çevre kirliliği etkileri ve gıda üretiminde gıda kalitesi ile doğrudan nasıl bir etkiye sahip olduğu araştırılmıştır.

Anahtar Kelimeler: *Gübre, Tarım ürünleri, Organik gübre, İnorganik gübre*

Giriş

Günümüzde teknolojik gelişmeler toplumlara sanayi, teknoloji ve zirai konularda önemli fırsat ve imkanlar sunmaktadır. Çoğunlukla tarımsal anlamda doğal denge ile ters orantılı ilerleyen teknolojik gelişmeler kullanılırken bir yandan da doğal denge bozulmaktadır. Kimyasal maddelerin kullanılması ve buna bağlı olarak atık birikimi sağlığı ve ekolojiyi etkilemektedir (Mercan, 2005). İnsan yaşamını özellikle ciddi boyutlarda tehdit eden ve giderek artan çevre kirliliğinin önüne geçmek için bilimsel çalışmalar yapılmakta ve kimyasal maddelerin kullanımının azaltılarak toprak kirliliğinin önüne geçmek hedeflenmektedir.

Canlı yaşamının devamı için hava ve su ihtiyacı gibi önemli bir diğer unsurda topraktır. Toprak, yeryüzündeki bitki örtüsünün yaşamını ve sürdürülebilirliğini sağlamak için kullanılan kaynaktır. Toprağın üst yüzeyi biyolojik popülasyonunun beslenmesi için önemlidir. Bir gram toprakta milyonlarca mikroorganizma yaşamını sürdürmektedir. Dünyadaki ekosistem dengesinin devamı her bir canlı için önem arz etmektedir. Toprağın verimli yapıda olmasını sağlayan ve humus bakımından zengin yapıda olan bölümü üst kısmıdır. Toprak, canlı yaşamı ve doğal denge için en önemli kaynaklardan biri olarak; tarım harici amaçlarla kullanılması, ağır metallere maruz bırakılması ve ağaç kaybı sonucu erozyona uğraması sonucu kayba uğrayarak verimi düşmektedir. Ciddi

boyutlarda kirlilik oluşturan ve depolanan atıklar sonucu verimsizleşen bu toprakların geri kazanılması uzun ve zor bir süreçtir. Toprağın 1 cm boyutunda üst tabakasının verimli forma geçmesi birkaç yüzyılı bulmaktadır. Dünyadaki toprakların tarım kapasitesine baktığımızda 1:10'inde üretim yapılabilmektedir. Türkiye'deki tarım arazilerinin de %36'sı işlenebilmekte olup, %28'i çayır ve mera, %30'u da orman ve fundalık olup kalan diğer payda da diğer arazilerde bulunmaktadır. Tarım arazisi olarak ekilebilir ve sulanabilir arazi kısmı da %18 kapasitedir (Anonim, 2018; Yavuz, 2005). Verimi yüksek olan topraklarımızda bilinçsiz kimyasal maddelerin kullanımı, atıkların birikimi, kontrolsüz sulama yapılması gibi işlemlerin sonucunda topraklarımız kirliliğe maruz kalmaktadır.

Kimyasal maddeler toprakta yetişen ürünlerin verimini yükseltmek ve artan nüfusla orantılı olarak oluşan gıda ihtiyacını karşılamak için büyüme hızını arttırmada kullanılmaktadır. Ancak bu kimyasal maddeler toprakta toksik birikime ve verimin dolayısıyla sağlıksız gıdaların üretimine neden olmaktadır. Günümüzde yapılan en önemli toprak kirliliği önleme metotlarından biri de organik tarımı yaygınlaştırma ve inorganik (kimyasal) maddelerin kullanımını en aza indirme yönündedir.

Toprak verimliliğini arttırmak için gübre kullanımı arkeolojik araştırmalara göre milattan önceye dayanmaktadır. Hindistan'da M.Ö. 7000 yıllarında ve Mezopotamya'da M.Ö. 5000 yıllarında, Amman'da ise 10.000 yıllık bir köyde arpa, buğday, bezelye ve mercimek yetiştiriciliği yapılarak tarımla uğraşıldığı bilinmektedir (Taban & Şahin, 2016).

Tarımsal getirinin büyük bir bölümünü oluşturan tarım ilacı ve gübre kullanımının bilinçsiz bir şekilde uygulanması toprakta toksik bir birikime neden olarak doğa ve insan sağlığını olumsuz yönde etkilemektedir. Klasik tarım yani kimyasal gübre uygulamasının insan sağlığına ve doğaya geçmişten günümüze yapılan çalışmalar sonucunda zararlı etkisinin olduğu bilinmektedir. Bunun yanında bu uygulama toprakta zamanla sıkılaşma denilen toprak yapısında bozukluğa, çevre kirliliğine, gıda ürünlerinde zararlı kalıntılar bırakmaya ve gıda kalitesinde düşüşe, hayvancılık alanında uygun olmayan beslenmeye, tarım ile uğraşan çiftçinin masraflı ve zahmetli bir uğraş içinde bulunmasına neden olmaktadır (Mercan, 2005). Klasik tarım uygulaması her bakımdan zararlı ve gelecek nesilleri de etkileyecek sonuçları olan bir uygulamadır.

Bu çalışmada kimyasal gübre kullanımı ve organik gübre kullanımı ile bu gübrelerin çeşitleri ve uygulama yöntemleri ile bilgiler verilmiştir. Yapılan kıyaslama çalışmaları ile ilgili literatür taraması yapılarak çalışma örnekleri verilmiştir. Yapılan bu çalışmada; organik gübre kullanımının yararlı bir uygulama olduğunu aktarmak, çevre kirliliğine engel olabilmeyi ve de gıda üretiminde gıda kalitesi ile doğrudan nasıl bir etkiye sahip olduğunun ortaya konması amaçlamaktadır.

Gübre ve Gübreleme

Tarım işlenmesine uygun topraklar artan nüfusunda etkisi ile gıda talebini karşılayabilmek için sürekli olarak hasat edilmektedir. Topraktaki verimi arttırmak ve üretimde sirkülasyon sağlayabilmek için toprakların gübrelenmesi gerekmektedir. Gübreleme işleminin bilinçli olarak uygulanması toprağın ve tarımın sürdürülebilirliği için önemlidir.

Gübre, ekosistemde yer alan bitki örtüsünün gerekli besin değerlerini sağlamak için ihtiyaç duyulan kimyasal elementleri karşılamak için toprağa uygun koşullarda ilave edilen maddedir (Hignett, 2013; Jordan-Meille et al., 2012). Bitki örtüsü (tarım arazileri, meralar, orman vb.) büyümek ve yaşamını sürdürmek için azot (N), kalsiyum (Ca), magnezyum (Mg), fosfor (P), potasyum (K), demir (Fe), kükürt (S), bakır (Cu), mangan (Mn), çinko (Zn), molibden (Mo) ve bor (B) gibi kimyasal elementlere ihtiyaç duymaktadır (Michalak et al., 2018).

Toprak ve su bitki örtüsü için her ne kadar besin kaynağı olarak kabul edilse de bitkilerin alması gerekli olan elementleri yeteri kadar karşılayamamaktadır. Gübre kullanımı bu sebeple geçmişten günümüze kadar devam etmektedir. Ancak yanlış uygulamalar toprakta kirliliğe ve verimsizliğe sebep olmaktadır. Gübre organik ve inorganik gübre olarak iki farklı çeşitte üretilmektedir. Toprak kirliliğine sebep olan gübre de içerisinde kimyasal madde ilaveleri bulunduran inorganik gübredir. Bu sebeple kimyasal elementleri kendinden ve doğal kaynaklardan olan organik gübrenin yaygınlaştırılması tarım ve çevre geleceği için önemlidir.

Her bitkinin ve gıda ürününün beslenmesi için kullanılan gübre çeşitliliği farklıdır. Bu sebeple işlenecek olan ürünün hangi elementlere ihtiyacı olduğu iyi bilinmelidir. Aşağıda Tablo 1'de beslenme eksikliği sonucunda bitkilerde meydana gelen belirtiler yer almaktadır.

Tarımsal üretimde hedeflenen verimli ve kaliteli gıda ürünlerine ulaşmak için; ürün çeşidine ve ihtiyacına göre hazırlanan içeriğinde bir ya da birden fazla besin maddesi bulunan organik veya inorganik (kimyasal) maddelerin işlenecek toprağa doğrudan veya dolaylı bir uygulama ile verilmesi işlemine gübreleme denilmektedir (Anonim, 2013).

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Tablo 1. Bitki beslenmesinde etkili olan kimyasal elementler ve eksiklik belirtileri (Anonim, 2007).

Kimyasal element	Belirtiler
Azot	Büyüme engellenir, bitki renginde sararma olur ve yaprak uçları alttaki yapraklardan başlayarak kızıl kahve renge dönüşür.
Fosfor	Bitki kök gelişimi engellenir, saplar uzamaya devam eder ancak olgunlaşma gecikir ve bitki morarır.
Potasyum	Yaprak uçları kavrulur, sararma yaşanır, saplar gelişmez ve meyve çekirdekler kurur.
Kalsiyum	Yaprak uçları parçalanır, bitki uç tomurcukları ölür, çiçeklerin olgunlaşması yaşanmadan taç yapraklar ölür.
Magnezyum	Yapraklar gevrek ve ince yapıda olurlar, yaprak damarlarında renk soluk sarı yeşilimsi renge döner.
Kükürt	Bitkinin alt bölümündeki yapraklar sararır, kök ve saplar küçülür.
Bor	Köklerde koyu siyah lekeler oluşur, saplarda çatlamalar meydana gelir.
Bakır	Bitki rengi ağarır, turunçgiller kırmızımsı kahve renge döner, normal olmayan büyüme olur.
Demir	Yapraklarda sararma, yukarı doğru kıvrılma olur. Ancak damarlar yeşil rengini korur.
Mangan	Meydana gelen bozulmalar demirde görülen bozulmalar gibidir. Yapraklarda ölü dokular oluşur ve pürüzlü bir görünüm oluşur.
Molibden	Azot eksikliğindeki bozulmalar gibidir.
Çinko	Uç yapraklar küçülür, yapraklarda ölü olan bölgelerde benekler görülür, tomurcuk oluşumu engellenir.

Gübrelemenin iki temel amacı bulunmaktadır. Bu amaçlar;
1. Hasat için kullanılacak toprakları yetiştirilecek ürün için gerekli besin maddelerince zenginleştirerek ekime hazır hale getirmek.
2. Geçmişten günümüze işlenmiş ve yıpranmış toprakları fiziksel ve biyolojik açıdan iyileştirerek, yetiştirilecek ürün için verimli bir gelişme ortamı sağlamaktır.
Yanlış uygulamalar sonucu toprakların verimini kaybetmesi ve kullanılabilir tarım arazilerinin azalması günümüzde önem teşkil etmektedir. Doğru gübreleme yapılması için hasat edilecek ve işlenecek toprağın ve tarım arazisinin çevre şartları iyi bilinmelidir. Etkili gübre uygulaması ve gübreleme sistemlerinden beklenen faydayı sağlamak için (Anonim, 2013);

- Gübreleme yapılacak toprağın besin içerikleri miktarları tayin edilerek toprağın özelliği saptanmalıdır.
- Hangi gübrenin ve gübrelemenin yapılacağı belirlendikten sonra hasat zamanına uygun şekilde doğru yöntem ve doğru gübre miktarı ile gübreleme yapılmalıdır.
- Verimli bir gıda ürünü elde etmek için gübreleme yapılacak toprak ve arazi çevre şartları iyi bilinmeli ve planlanmalıdır.

Hangi gıda ürünü yetiştirilecekse onun için uygun olup olmadığına dair analizler yapıldıktan ve gübre belirlendikten sonra ekim uygulaması yapılmadan önce kullanılacak gübreyi toprak yüzeyine kalın tabaka olmayacak şekilde sermek ve sonrasında tarım arazi araçları ile toprakla homojen hale getirerek uygulamak gerekmektedir. Gübreleme işlemi gerçekleştikten sonra ekim gerçekleştirilmektedir. Bir diğer uygulama yöntemi de bant yöntemi ile gübreleme tekniğidir. Bu yöntemde uygulama mibzer ile yapılmaktadır.
Doğrudan veya dolaylı yöntemlerle organik veya kimyasal gübre kullanılarak yapılan tarımda gübreleme işleminin yaraları aşağıda maddeler halinde verilmektedir:

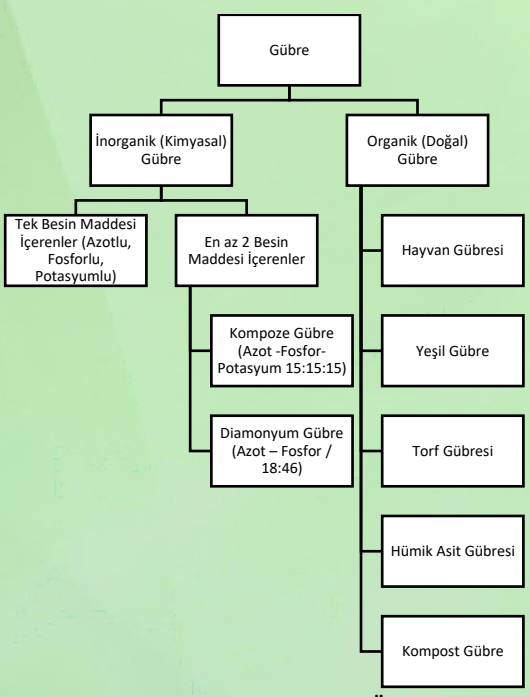
- Gübreleme işlenebilir toprakların verim kapasitesini arttırarak, birim alandan çok daha fazla verim alınmasını sağlamaktadır.
- Gübrelemenin doğru zamanda, yöntemde ve çeşitte yapılması halinde kalitesi yüksek verimli gıda ürünleri elde edilmektedir.
- Gübreleme ile işlenebilir topraklar verimini yitirmez ve tarım sürdürülebilirliği sağlanmaktadır.
- Toprağın kimyasal özelliği gübreleme ile besin ilave edilerek arttırılmaktadır. Ayrıca toprağın kimyasal yapısında toksik madde birikimi varsa gübreleme ile giderilmektedir.
- İşlenebilir tarım topraklarında, tarımın devamlılığı için toprakta bulunan mikroorganizmaların canlılığını koruması önemlidir. Gübreleme ile mikroorganizmaların faaliyeti devamlılığını korumakta ve toprağın veriminin artmasına katkı sağlamaktadır.
- Bitki yetiştiriciliğinde gübreleme kaliteli ve verimli bitkilerin yetişmesi için oldukça önemlidir. Eksikliğinde oluşabilecek deformasyonlar Tablo 1'de verilmektedir. Gübreleme ile bitkilerin verimini arttıracak kaliteli bir büyüme ortamı oluşturulmaktadır.

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- Geçmişten günümüze uzanan yanlış tarımsal uygulamalar sonucu topraktan uzaklaşan besin maddeleri doğru bir gübre uygulaması ile toprağa tekrar geri kazandırılmaktadır.
- Gübreleme işlemi çevre dostu bir uygulama olarak gelecek nesillere de verimli ve kullanılabilir toprakları iletmektedir.
- Gübreleme işlemi toprakta oluşan erozyon sorunlarının önüne geçmektedir.
- Toprağın zaman içerisinde yanlış işlenmesi sonucu oluşan toprak sıkışması problemleri doğru zamanda uygulanan gübreleme işlemi ile ortadan kaldırılmaktadır.
- Anız yakma işlemleri ile zamanla verimsizleşen ve sıkılaş toprağı tekrar işlenebilir hale getirmek için gübreleme uygun tedavi yöntemi olarak uygulanmaktadır.
- Gıdaların duyusal ve fizikokimyasal özelliklerini koruması için uygulanmaktadır

Gübre Çeşileri

Toprağa gereken besin maddesini sağlamak amacı ile kullanılan gübre çeşitleri temelde ikiye ayrılmaktadır. Ancak geçmişten günümüze gelen birçok yanlış uygulamalı gübre çeşidi vardır. Toprakta meydana gelen bozulmaları ıslah etmek amacıyla düzenlemeler yapılarak iki çeşit gübre kullanımı yasalar doğrultusunda her ülkenin iklimine ve coğrafya şartlarına göre belirlenmiştir. Şekil 1'te her ülkede standart olarak kabul edilmiş gübre çeşitlerine ait şema verilmektedir.



Şekil 1. Gübre ve gübre çeşitleri (Özyardımcı, 2021).

Klasik tarım uygulamalarının insan sağlığını ve ekolojik dengeyi bozduğu ve zararlı olduğu yapılan çalışmalar sonucunda bilinmektedir. Bunun yanı sıra toprakta verimsizliğe, çevre kirliliğine, gıda ürünlerde toksik madde birikimine ve bozulmalar gibi sonuçlara neden olmaktadır (Mercan, 2005). Klasik tarım uygulaması genellikle inorganik gübre kullanımı sonucunda ortaya çıkmaktadır. Organik gübre kullanımı günümüzde artan bilinç düzeyi ile gelişmekte ve klasik tarımın yerini almaktadır.

Organik (doğal) Gübre ve Çeşileri

Gıda ürünlerinin üretiminde; ürünün verimi ve kalitesi arasında ters bir orantı olduğu görülmektedir. Bu ters orantı organik tarımda doğru zamanda ve doğru bir uygulama ile ortadan kalkmaktadır. Verimdeki artış ile birlikte ürün kalitesi de artmaktadır. Bilinçli yapılan tarım uygulaması gıda ürününü tanımaktan ve hangi besine ne kadarlık bir ihtiyaç duyduğunu bilmek ile verim ve kalite kazanmaktadır. Organik gübre ile yapılan tarımda; kimyasal gübreler ve laboratuvar üretimi kimyasal ilaçlar, hasat sonrası depolama koşullarında bozulmalara karşı koruyucu kullanımı ve depolama koşullarında gıda ürünlerinde olgunlaşma sürecinin devam ettirecek kimyasal maddeler, hormon ilaçlarının ve ürünün büyüme şartlarını koşullayıcı maddelerin kullanımı kesinlikle yasaklanmaktadır (Aygün & Acar, 2004). Eğer gıda üretimi organik tarım adı altında üretilecekse organik gübrenin hiçbir kimyasal madde

kullanılmaksızın uygulanması gerekmektedir. Organik tarım yani organik gübre kullanımı ile yapılan tarımsal üretim şekli de girdi yapılarak uygulanan tarım şeklidir. Ancak burada kullanılacak organik gübre için girdiler üretileceği ülkenin yönetmelik ve mevzuatlarında belirtilen yine organik girdiler ile üretilmelidir (Yetgin, 2010).
Organik gübre çeşitlerinden ilki hayvan gübreleridir. Hayvan gübresi sığır, at, koyun, domuz gibi küçükbaş ve büyükbaş hayvanların yanında kuş gübresini de kapsamaktadır. Geçmişten günümüze kadar uygulanan gübreleme yöntemlerinin en klasik olarak kullanılan hayvan gübresi özellikle ülkemiz köylerinde kullanılmaktadır. Ancak yanlış biriktirme ve depolama koşullarında, kuş gübresinde de gerekenden fazla uygulama sonucunda gıda ürünlerinde verimsiz ve kalite düşüklüğüne neden olmaktadır.
Hayvan gübresi de kendi arasında doğal ve ahır gübresi olarak ayırılmaktadır. Doğal gübre daha çok bitki ve kuş gübresinin karışımını içerirken ahır gübresi büyükbaş ve küçükbaş hayvan atıklarını kapsamaktadır. Kuş gübresinin en önemlisi "guano" adındaki karışımdır. Burada %12 azot ve %12 fosfor pentaoksit maddeleri doğal olarak bulunmaktadır (Arslan & Mesut, 2020).
Hayvan gübresi doğru bir uygulama ve depolama ile kullanılmak istendiğinde hem uygulandığı toprağı ıslah etmekte hem de gıda ürünlerinin kalitesini ve verimini arttırmaktadır. Bu sebeple özellikle köylerimizde uygulanan hayvan gübresi kullanımı için eğitim verilmesi hem çiftçinin işinin kolaylaşmasını hem de tarım ürünlerinden en yüksek kaliteyi sağlamasına yardımcı olacaktır. Hayvan gübresinin uygulamasının öğrenilmesi ve yayılması toplumda kimyasal gübre kullanılmasının önüne geçerek kimyasal gübreye ilave edilecek kimyasal madde kullanımının ve buna bağlı maddi yükün de önüne geçile bilinecektir.
Hayvan gübresinin kuruması ve kullanıma hazır hale getirilmesi için biriktirildiği ortamın çevre koşullarına karşı korumasız olduğu alanlarda gübre; yağmur veya güneş ışığı gibi unsurlara direk maruz kalmaktadır. Bu korumasız koşullarda gübre içeriğinde doğal olarak bulunan ve tarım ürünleri için önem taşıyan besin maddeleri direk olarak etkilenmektedir. Bu sebeple koruma, depolama ve kullanma koşulları eksiksiz yerine getirilmelidir .
Hayvan gübresi ile toprakta kimyasal işlemler sonucu oluşan sıkılaşma sorununa çözüm getirilmektedir. Toprağın humus değeri tekrar kazandırılarak toprağın suyu bünyesinde tutma kapasitesi artarak hava alma ihtiyacı karşılanmaktadır (İrget & Cengiz, 2018).
Ülkemizde yanlış kullanım ve uygulama haricinde bir diğer sorunda eksik gübreleme uygulamasıdır. Tarım ürünün tanınmasından kaynaklanan bu sorun sonucunda tarım ürünü ihtiyacı olan besini alamadan verimsiz ve kalitesiz yapıda tüketime hazır hale gelmektedir. Tablo 2'te 1972 – 2000 yılları arasında ülkemizde tüketilmesi gereken gübre miktarı ve uygulanan gübre miktarlarına ait bilgiler verilmektedir (Eyüpoğlu, 1999).

Tablo 2. 1972-2000 Yılları arasında ülkemizde toprağın ihtiyacı olan gübre miktarı, uygulanan gübre miktarı ve verilemeyen gübre miktarına ait bilgiler (Eyüpoğlu, 1999).

Gübre Cinsi	Toprağın İhtiyacı Olan Gübre Miktarı (kg ha-1)	1972-2000 Yılları Arasında Toprağa Verilen Gübre Miktarı (kg ha-1)	Eksik Kalan Gübre Miktarı (kg ha-1)
Azot (N)	83,7	42,8	40,9
Fosfor (P2O5)	57,3	24,6	32,7
Potasyum (K2O)	5,7	2,13	3,6

Bir diğer organik gübre türü yeşil gübredir. İşlenmiş tarım arazilerinden ve doğanın kendi kendine ürettiği bitki örtüsünden kaynaklı zirai atıklar ya doğada çürükçül bakteriler tarafından kaybolmakta ya da çiftçiler tarafından toprak altı yapılarak toprağı verimsizleştirmektedir. Ülkemizde zirai atıkların değerlendirilmesi için yeşil gübre uygulamasının öğrenilmesi ve yaygınlaştırılması önemlidir. Yeşil gübre; atık olarak bilinen ancak gıda ürünlerinin verim ve kalite skalasına doğrudan etki edebilecek değerde gübre niteliği taşımaktadır.
Yeşil gübre zirai atıkların işlenmeye ve ekime hazır olan tarım arazilerinin üzerine serpme yöntemi ve tarım arazi aracı ile toprağın altına inmeyecek şekilde işlenmesi ile uygulanmaktadır. Oldukça kolay ve pratik olan bu gübreleme metodu ile oluşan gübre başka bir işleme ve ilave kimyasal maddeye ihtiyaç kalmaksızın doğrudan uygulanabilir verimli ve çevre dostu bir yöntemdir.
Ekim sonrası uygulama avantajı olan yeşil gübreleme ile gelişimini tamamlamış olan ekinler (baklagiller, buğdaygiller vb.) tarım araçları ile sürülerek toprağın altı ile harmanlanarak bir sonraki ekim için kullanılmaktadır. Hâlihazırda girdi ihtiyacını da ekinin kendisinden karşılayan yeşil gübre sürdürülebilir bir gübreleme metodu olarak bilinmektedir. Ekin haricinde park, bahçe, çim atıkları da yeşil gübre uygulaması için kullanılabilmektedir (Karakurt, 2009).
Torf gübresi incelenmiş olan üçüncü organik gübre çeşididir. Torf; genelde bataklık, gölet vb. sulak alanlarda dipte oluşmuş toprağa benzer bitkilerle kaplı kalıplaşmış yumuşak yapılardır. Torf gübresi bu kalıpların çıkarılarak veya uygun ortamlarda üretilmesi ile oluşmaktadır. Torf gübresi genel olarak süs bitkilerinde kullanılan gübre çeşididir. Nemli bir yapısı olan torf gübresi kullanılacak bitkinin nem ihtiyacını yüksek oranda karşılamaktadır. Çok yüksek bir su tutma kapasitesine sahip olan bu gübre çeşidi doğal içeriklere sahip yüksek besin maddeleri içermektedir. Ölü bitkilerin bir araya gelmesi ile oluşan torf gübresi saksı bitkileri için uzun süre kullanılabilir bir gübre türüdür.

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Torf gübresinin özellikle göl diplerinden çıkarılarak kullanılması ekolojik denge için önemlidir. Tatlı sulardaki çözünmüş oksijeni tüketen bu ölü bitki yığını sudaki canlı yaşamını da olumsuz etkilemektedir. Bu sebeple yapılan torf çıkarma çalışmaları ekolojiyi bozuyor gibi algı yaratsa da belli yönetmelikler ve mevzuatlar ile gözetim altında kontrollü yapılan bu çalışmalar doğal dengeyi korumaya yönelik çalışmalardır.

Diğer bir organik gübre tür grubu hümik asit gübreleridir. Hümik asit gübresi fosilleşmiş bitki özlerinin toprakta parçalanması ile oluşmaktadır. Özellikle lignin, kömür ve bitki örtüsünden kaynaklanan zirai atıkların toprakta reaksiyonlara maruz kalması ile parçalanarak fülvik asit, hümik asit ve hümin maddelerine dönüşerek meydana gelen kalıntılar hümik asit genel adı verilen sıvı gübreye dönüşmektedir. Hümik asit gübresi sıvı bir gübre olmasına karşın suda yavaş çözünmektedir. Siyah veya kahverengi renklerine sahip olan hümik asit gübresi azot ve fosfor bakımından zengin gübrelerdendir. Hümik asit gübresi en çok leonardit maddesinde bulunmaktadır. Bu madde de hümik asit %40-%90 arasında yer almaktadır (Akıncı, 2011).

Hümik asit fraksiyonları olan üç temel madde hümik asit, fülvik asit ve hümin maddeleri çoğu topraklarda yaklaşık değer olarak sırayla; % 40, % 10 ve % 50 oranlarında dağıldığı yapılan çalışmalar sonucunda tahmin edilmektedir (Özyardımcı, 2021). Hümik yapıda olan maddeler toprağın verimini ve biyolojik işleyişini arttırarak toprağın bünyesinde su tutabilme kapasitesini de arttırmaktadır.

Hümik asit gübresi kimyasal gübreler gibi ambalajlanarak satışa sunulmaktadır. Bunun sebebi üretiminin endüstriyel üretim şeklinde olmasından kaynaklanmaktadır. Ancak içerisinde hiçbir kimyasal madde ilavesi bulunmamaktadır. Hümik asit gübresi uygulama şekline göre farklı reaksiyonlar gösterebilmektedir. Bu sebeple üretiminde ne için ne kadar ve nasıl uygulanacağına dair bilgilerin iyi bilinerek kullanılması için ambalaj üzerinde dozajların ve kullanma talimatlarının yer aldığı bölümler bulunmaktadır. Hümik asit içeriğinde bulunan yoğun besin maddeleri sayesinde toprakta ıslah çalışmaları da yapmaktadır. Bu gübre hangi gıda ürünü için kullanılacaksa ona göre sulama suyuna ilave edilerek verilmektedir. Doğrudan uygulama tarım ürünlerinin yanmasına veya zarar görmesine neden olmaktadır.

Son organik gübre çeşidi kompost gübrelerdir. Kompostlaştırma işlemleri herhangi bir organik atığın fermantasyonu sonucunda oluşan gübre çeşididir. Daha çok zirai atıkların ve kahverengi atık olarak bilinen kuru yaprak, çürümüş organik maddelerden elde edilmektedir. Toprak için gerekli olan besin maddesi azotu temin eden yeşil kompost malzemeleri; evsel atık olarak bilinen sebze- meyve atıkları ve yumurta kabukları, park-bahçe atıkları, yeşil veya çay yaprakları, mezbaha atıkları vb. gibi doğal maddelerin her biri kompost gübre için malzeme olarak kullanılmaktadır. Karbon kaynağı kahverengi kompost malzemesi için ise; kuru yaprak veya otlar, dal ve kurumuş ağaç kabukları, talaş, çam iğneleri, ayıklanmış kuruyemişlerin atıkları, saman balyaları, mısır koçanları, ayçiçek sapları vb. malzemeler kullanılmaktadır (Özenç & Şenlikoğlu, 2017).

Kompost gübre üretiminde standart olarak kullanılan malzemelerin oranı 2:1 yani iki kahverengi malzeme varsa 1 yeşil malzeme karıştırılarak hazırlanmaktadır (Anonim, 2007). Kompost gübrede verim hacim ile ters orantılıdır. Karıştırma işlemi ne kadar çok yapılırsa verim o kadar artmaktadır. Ancak karıştırma işlemi sonucu hacim azalmaktadır. Kompost gübrenin oluşması çürümenin hızlı ve uygun olmasına bağlıdır. Çürümenin verimli bir şekilde gerçekleşmesi için malzemelerin taze olarak kullanılması ve reaksiyonların gerçekleşmesi için sulamanın sık yapılması gerekmektedir.

Kompost gübre malzemeleri sadece zirai atık veya evsel atıklardan üretilmemektedir. Üretimde hangi gıda ürünü için kullanılacaksa o ürünün ihtiyacına göre ekim yapılacak toprağın özellikleri de dikkate alınarak hayvan gübresinin de kullanılması ile elde edilmektedir. Kompost gübre üretimi anaerobik veya aerobik koşullarda üretile bilinen pratik gübre yöntemlerindendir. Açık arazilerde de kolayca oluşan kompost gübre kendi içinde de; soğuk, sıcak, bokaşi, kompost çayı, solucan kompostu ve sıvı gübre olarak 6 çeşide ayrılmaktadır (Gülçur, 1962).

Kompost gübre çeşitlerinin tümü kullanılacağı toprak yapısına, gıda ürününe, analiz sonuçlarında toprağın besin maddesi ihtiyaçlarına ve ıslah çalışmalarına göre farklı yöntem ve içeriklerle üretilmektedir.

Endüstriyel olarak üretilen kompost gübreleri belli mekanik reaktörlerde ısıya veya sektör içeriğine göre farklılık göstermektedir. Örneğin; katı atık bertaraf tesislerinde üretilen kompost gübreler evsel atıkların betonarme yapılı reaktörlerde ısı verilerek fermente edilmesi ile oluşturulmaktadır. Bunun yanı sıra anaerobik ortamda gerçekleşen bu fermentasyon sunucu oluşan gazlardan biyogaz da elde edilmektedir.

Solucan gübresi diğer adıyla vermikompost gıda ürünlerine zengin besin maddesi sağlamanın yanı sıra yapısı bozulmuş topraklarda ıslah çalışmalarında toprağın verimini ve kalitesini geri kazanmasını sağlamaktadır. Kompost gübrelerin büyük bir bölümü zirai atık ve hayvan gübresinden üretilse de bu gübre çeşidinin besin maddelerince zenginleştirilmesi organik madde çeşitliliğinin kullanılması ile mümkün kılınmaktadır. Bu maddelerden bazıları; kan tozu, kemik tozu, deri tozu, boynuz ve tırnak unu, işkembe içeriği vb. gibi organik maddelerdir.

İnorganik (kimyasal) Gübre ve Çeşitleri

İnorganik (kimyasal) gübreler en çok kullanılan gübre çeşitlerindendir. Bu gübrelere yapay (suni) veya sanayi tipi gübreler de denilmektedir. Kimyasal gübreler organik gübrelerden farklı olarak içerisinde bir veya birden fazla

ilave edilmiş besin maddelerini içermektedir (Anonim, 2013). Organik gübreler birçok organik atığın belli uygulamalar sonucu bir araya getirilmesi ile oluşturulurken kimyasal gübreler ticari olarak hazır bir halde üretilmektedir. Ancak kimyasal gübrelerin dezavantajı tarım arazilerinde yarattığı tahribat ve ilave besin takviyesi ihtiyacı yaratmasıdır. Kimyasal gübreler pratik bir kullanım gibi görünse de zaman içerisinde kullanıldığı tarım arazisinde toprak sıkışıklığına, o arazide üretilen besinlerde de verimsiz sonuçlara neden olmaktadır.

Ülkemizde büyük çoğunlukla kullanılan kimyasal gübreler işlenebilir arazilerde kalitesiz ve verimi düşük ürünlerin yetişmesine neden olmaktadır. Ülkemizde belirtilen yönetmelik ve mevzuatlara göre organik tarım dışında uygulama yapılıyorsa ziraat kooperatiflerinin denetim ve analizleri sonucu uygun gördüğü aşılama veya ilave kimyasal madde takviyesini belirlenen dozajlarda ve zamanlarda uygulamakla yükümlü kılmaktadır (Anonim, 2007). Geçmişten günümüze kadar bir uygulamaya maruz kalmış ve kalmakta olan topraklarımızın tahrip olmasında kimyasal gübre kullanımı önemli bir oynamaktadır. Bu sebeple organik tarım uygulamalarına yani organik gübre çeşitlerinin kullanımına yönelmek hem çevre kirliliğinin hem de toprak dengesinin yeniden kazandırılmasında önemli bir nitelik taşımaktadır. Toprak veriminin artması doğrudan gıda verimini etkilemektedir (Gündüz, 2021).

İnorganik gübreler tek bir besin maddesi içerenler ve en az iki besin maddesi içerenler olarak ikiye ayrılır. Kimyasal gübrelerin tek bir besin maddesi içeren gübre çeşitleri; azotlu gübre, fosforlu gübre ve potasyumlu gübre çeşitleridir. Bu kimyasal gübreler tarımsal üretimde tek başına yetersiz oldukları için genellikle takviye amaçlı olarak kullanılmaktadır (Karakurt, 2009).

Azot bitkilerin veya gıda ürünlerinin gelişimleri için hayati önem taşımaktadır. Azot besin maddesi toprakta bulunmasına rağmen işlenebilir arazilerin bilinçsiz ekim ve hasat edilmesi sonucunda hakimiyetini kaybetmektedir. Azotlu gübreler içeriğinde bulunan azotun ana formuna göre; nitratlı gübre, amonyum içeren gübre, amonyum ve nitratı bir arada içeren gübre, amidli gübre olarak dört gruba ayrılmaktadır. En fazla tercih edilen ve kullanılan azotlu gübre formu ise amonyum sülfat, amonyum nitrat ve üre formlarıdır (Anonim, 2013).

Fosfor tıpkı azot gibi bitki veya gıda ürünleri için oldukça önemli bir besin maddesidir. Suda kolayca çözünebilir fosfor besin maddesi bitkide fosfat anyonu formunda bulunarak toprağa geçtikten sonra içeriğindeki fosfor bitki tarafından bünyesine alınabilir hale geçmektedir. Fosforlu gübreler azotlu gübrelerden sonra dünyada en fazla kullanılan kimyasal gübre çeşidindendir. Fosforlu gübreler "süper fosfat ve triple süper fosfat" olmak üzere iki çeşittir (Anonim, 2013).

Potasyumlu gübreler azotlu ve fosforlu gübreler gibi ilave olarak kullanılmamaktadır. Potasyumlu gübreler potasyumun topraklarda oldukça fazla oranlarda bulunmasından dolayı gübreleme yapılmadan önce analiz yapılmış ve potasyum bakımından fakir topraklarda uygulanmalıdır. Ülkemiz toprakları potasyum bakımından zengin bir yapıya sahiptir. Bu nedenle genel olarak potasyumlu gübre ilavesine ihtiyaç bulunmamaktadır. Potasyumlu gübrelerin bilinçsiz tüketimi hâlihazırda potasyum bakımından zengin olan toprağa uygulanırsa yarardan çok bitki veya gıda ürününe direk olarak zarar vermektedir. Bu sebeple toprağın ekimden önce mutlaka analiz edilmesi gerekmektedir. Kimyasal gübrelerin içerik bakımından potasyum formları da " potasyum sülfat ve potasyum nitrat" olmak üzere iki çeşitten oluşmaktadır (Anonim, 2013).

Kimyasal gübrelerin besin maddesi açısından birden çok madde bulunduran gübre çeşitleri; kompoze gübre ve diamonyum gübre olmak üzere iki çeşitten oluşmaktadır.

Bitki veya tarım ürünü için gerekli olan birden çok besin maddesini içeren gübre çeşidi kompoze gübre olarak adlandırılmaktadır (Anonim, 2013). Burada besin maddesi olarak azot, fosfor ve potasyumun belirli oranlar ile direk karıştırılması ile üretilmektedir. En çok kullanılan oranlamalı kompoze gübre oranı 15:15:15 şeklinde oranlanmaktadır. Yani kullanılacak toplam gübrenin içeriğinde %15 azot, %15 fosfor ve %15 potasyum besin maddelerinin saf halde bulunduğunu ifade etmektedir (Çağlar & Demir, 2021; Pişkin, 2021).

Diamonyum gübre kimyasal yapısına bakıldığında içeriğinde fosfat bulunduran gübre çeşididir. Bu nedenle literatürde diamonyum veya diamonyum sülfat gübresi olarak bahsedilmektedir. Diamonyum gübresi potasyum besin maddesi ile karıştırılarak üretilmemektedir. Bunun dışında azot ve fosforun oranlanması ile karıştırılarak üretilmektedir. Diamonyum için belirlenen standart oranlama 18:46 şeklindedir. Yani kullanılacak toplam diamonyum gübrede % 18 azot ve % 46 fosfor besin maddeleri saf halde bulunmaktadır (Anonim, 2013).

Sonuç

Tarım uygulamalarında ilaç kullanımı bitki ve gıda ürünleri yetiştiriciliğinde böcekleri uzaklaştırmak veya canlıyı yok etmek amacı ile kullanılmaktadır. Ancak bu işlem uygulanırken bir taraftan da çevre kirliliği özellikle toprakta toksik madde birikimine ve doğrudan gıda ürünlerinin aracılığı ile canlı yaşamında etki etmektedir. İnorganik (kimyasal gübre) gübrenin bilinçsizce ve aşırı kullanımı toprakta bulunan solucan, çürükçüller vb. gibi toprakta fayda sağlayan canlı yaşamını ve organizmaları yok etmektedir. Toprak yapısı bozulmakta sıkılaşma sorunu yaşanmaktadır. Bu sebeple kimyasal gübreler yerine doğanın kendinde var olan besin maddelerince üretilen organik tarım önem arz etmektedir. Bu seminer çalışmasında da verilen örnekler ile organik tarımın klasik yöntemlere kıyasla ürün kalitesini ve verimini, toprağın humus yapısını olumlu yönde etkilediği gözlemlenmektedir. Daha iyi bir sonuca ulaşmak için organik tarım uygulamaları ve klasik yöntem arasındaki farklar aşağıda Tablo 3'de detaylı olarak verilmektedir.

Tablo 3. Klasik tarım ve organik tarım arasındaki farklar (Anonim, 2007).

Klasik Tarım (İnorganik (kimyasal) Gübre)	Organik Tarım (Organik Gübre)
Ekim zamanları planlı değildir.	Ekim zamanları planı zorunludur.
Bitki hastalığı ve zararlı canlılar yok edilir.	Zararlı canlılar kontrol altına alınır. Yok edilmez.
Topraktaki organik madde hızla kullanılır.	Topraktaki organik madde kullanılmaz. Birikir ve artar.
Topraktaki canlı habitatı ve ekosistem dengesi bozulur	Canlı habitatına destek sağlanır. Canlı yaşamı düzenlenir.
İlave kimyasal besin maddesi masrafı yüksektir.	Hiçbir kimyasal besin ilavesi yapılmaz. Masrafı yoktur.
Toprağın işlenmesi düzensizdir.	Toprak işlenmesi düzen içinde sürdürülür.

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Peyzaj Tasarım Çalışmalarında *Origanum sp.* Bitkisinin Kullanımı

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Özet

Dünyamızda ve ülkemizde küresel ısınmanın etkisiyle artış gösteren sıcaklık, susuzluk mevsimlerin kayması gibi nedenlerle bitki türlerinin yaşam koşulları zorlaşmaktadır. Çevresel koşullar bitki türlerinin ve çeşitlerinin gelişimini yavaşlatmaktadır. Dolayısıyla peyzaj planlama ve tasarım çalışmalarında kullanılabilecek bitki türlerinde seçici olmak zorunda kalınmıştır. Bu nedenlerle tasarım çalışmalarında o bölgenin doğal bitki türlerinin kullanımına yoğunluk verilmeye başlanılmıştır. Doğal bitki türlerinin ortam koşullarına uygun olması nedeni ile daha dayanıklı ve daha az bakım gerektirmektedir. Ayrıca doğal bitki türlerinin kullanım alanlarının genişletilmesi türün sürdürülebilirliğinin sağlanmasına neden olacaktır. Bu nedenle, çalışmamızda tıbbi ve aromatik özelliği bulunan *Origanum sp.* (kekik) bitkisi irdelenmiştir. Bitki türlerinin gelişim özellikleri bilinmeden tasarım çalışmalarında kullanmak mümkün olmamaktadır. Çalışmamızda, bölgesel çalışmalarda kullanılabilecek ve yaygın kullanımını sağlamak için *Origanum sp*. türü incelenmiş, kullanım alanları ile ilgili öneriler geliştirilmiştir.

Anahtar Kelimeler: *Aromatik Bitki, Doğal Bitki, Kekik, Peyzaj Tasarımı, Origanum sp.*

Origanum sp. ın Landscape Design Studies Use of the Plant

Abstract

In our world and in our country, the living conditions of plant species are getting difficult due to the increasing temperature, thirst, and the shift of seasons due to the effect of global warming. Environmental conditions slow down the development of plant species and varieties. Therefore, it has been necessary to be selective in plant species that can be used in landscape planning and design studies. For these reasons, the use of natural plant species of that region has been intensified in design studies. Since natural plant species are suitable for environmental conditions, they are more durable and require less maintenance. In addition, expanding the usage areas of natural plant species will lead to the sustainability of the species. Therefore, in our study, *Origanum sp*. plant was examined. It is not possible to use them in design studies without knowing the developmental characteristics of plant species. In our study, *Origanum sp*. types have been examined and suggestions have been developed regarding their usage areas.

Keywords: *Aromatic plant, Natural Plant, Thyme, Landscape Design, Origanum sp.*

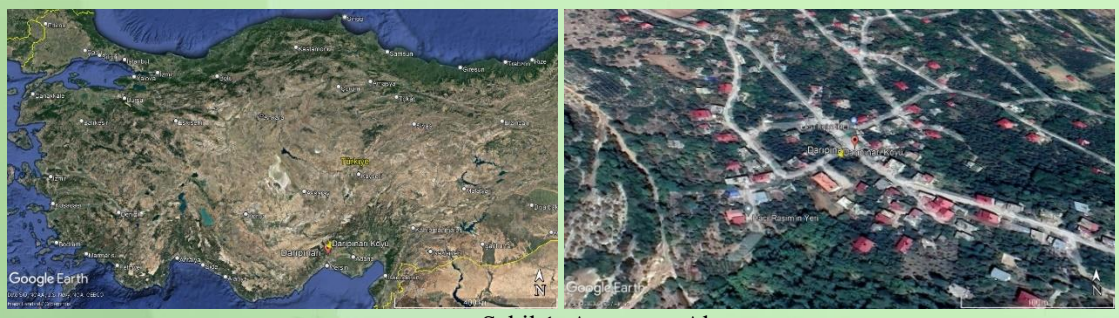
Giriş

Türkiye'de insanların kültür ve geçim kaynağının önemli bir parçasını çeşitli doğal bitkiler oluşturmaktadır. Yerli halk tarafından yiyecek, içecek, ilaç, ritüeller ve diğer hizmetler için kullanılan bitkiler büyük bir öneme sahiptir. Kırsal alanlarda gıda ve ilaç güvencesine yönelik zayıf biyofiziksel koşullar, uygun olmayan ulaşım, sınırlı tarım arazisi ve mevsimsel ekonomi, özellikle yüksek rakımdaki bölgelerde yerli halk için doğal kullanılabilen bitkiler farklı amaçlarla kullanılmaktadır (Ahmad ve ark., 2016, Ding ve ark, 2022).

Yerel toplulukların sağlık hizmet alımında veya ulaşımında bir takım zorluklarla karşılaşılabilmektedir. Çeşitli doğal bitkiler yerel halk için ücretsiz eczaneler gibi işlev görmektedir. Bunlardan biriside, *Origanum sp.* dir. Ekonomik bir kaynak olduğundan, bu bitkilerin büyük ölçekli toplanması bu bitkilerin populasyonuna etki etmektedir. Farklı çevrelerde yaşayan Mersin ve çevresinde kullanılan bitkilerin ve türlerin sayısı büyük ölçüde farklılık göstermektedir, muhtemelen farklı coğrafi alanlardaki bitki örtüsündeki farklılıklardan kaynaklanmaktadır. Yüksek rakımlı bölgelerde yetişen veya geniş bir dağılıma sahip olan otsu bitkilerden ve *Origanum sp.* yerli halk tarafından seçilir ve kullanılır (Turner ve ark., 2011). *Origanum sp.* bitkisi, insanların çeşitli amaçlarla kullanımının yanı sıra peyzaj tasarım çalışmalarında da tercih edilebilen bitkilerdendir. Özellikle günümüzde küresel ısınma, susuzluk gibi iklimsel faktörlerin artış göstermesi kullanılacak bitki çeşitliliğini sınırlandırmaktadır. Bu nedenlerle doğal bitki türlerinin peyzaj tasarım çalışmalarında kullanım alanı artış göstermektedir. *Origanum sp.* bitkisinin çevre tasarım çalışmalarında farklı alanlarda tercih edilmesi mümkündür. Sınırlarda, kaya bahçelerinde, terapi bahçelerinde, tıbbi ve aromatik bitki bahçelerinde ve saksılarda kullanılabilir. Bu çalışmanın amacı, Mersin ve çevresinde doğal olarak yetişen *Origanum sp.* bitkisinin peyzaj tasarım çalışmalarında kullanım alanlarını genişletmek, doğal türlerin sürekliliğini sağlamaktır.

Materyal

Darıpınarı, Mersin ilinin Çamlıyayla ilçesine bağlı bir köydür. Kadıncık vadisi üzerinde Toros Dağlarının eteklerinde kurulmuştur. İlçe merkezine 23 km, il merkezine 80 km uzaklıktadır. Denizden yüksekliği 500m dir. Yaz aylarında yayla olarak tercih edilmektedir. Kadıncık Irmağı, üzerine Gök Hes'in yapılmasıyla birlikte doğallığını kaybetmiştir. Köyde pınarlar, mağaralar ve kayalıklar oldukça fazladır (Anonim, tarihsiz). Oldukça maki bitki örtüsü hakimdir. Enlem derecesi 37° 8'28.37"K , Boylam 34°43'28.45"D dir (Şekil 1). Darıpınarı köyü çevresinde yetişen *Origanum sp.* bitkisi çalışmanın ana materyalini oluşturmaktadır.



Şekil 1. Araştırma Alanı

Metot

Darıpınarı ve çevresinde yetişen *Origanum sp.* bitkisinin dönem içerisinde gelişimi takip edilmiş çiçeklenme dönemi belirlenmiştir. Fiziksel özellikleri irdelenerek peyzajda kullanım alanlarını görselleştirmek için Autocad 2010, SketchUp ve Lumion proğramları kullanılmıştır.

Araştırma Bulguları

Origanum sp., Lamiaceae familyasına ait bir bitki türüdür ve Akdeniz bölgesi ile batı Avrasya'ya özgüdür. Bu aromatik bitki dünya genelinde baharat ve tıbbi bitki olarak yaygın bir şekilde kullanılmaktadır ve çeşitli geleneksel iyileştirme sistemlerinde tıbbi bitki olarak kabul edilmektedir. Özellikle C10 monoterpentenler bakımından zengin olan kekik esansiyel yağı, yaygın bir şekilde kullanılmış ve dolayısıyla araştırılmıştır. *Origanum sp.*, beyaz veya mor çiçekli, karşılıklı dizilmiş, mızrak şeklinde ve dişli yapraklara sahip, 30-50 cm yüksekliğinde aromatik bir çok yıllık ottur (Şekil 2).



Şekil 2. *Origanum sp.*bitkisinin genel görüntüsü

Origanum sp. dünya genelinde bir baharat bitkisi olarak tanınır. Aynı zamanda sağlık etkileri için geleneksel tıpta kullanılır ve başlıca bronş rahatsızlıkları, sindirim ve antiseptik etkileri, soğuk algınlığı, hazımsızlık ve mide rahatsızlıklarının tedavisinde kullanılır. İçerikleri, aynı tür içinde farklı kimyotiplerin bulunduğundan dolayı, türün coğrafi bölgesine göre hasat zamanı değişkenlik gösterebilir (Pezzani ve ark., 2017).

Origanum sp. tıbbi değeri nedeni ile yerli halk tarafından genç sürgünleri kesilmekte yada kökten sökülerek türün sürekliliğini kısıtlamaktadır. Doğal bitki olması ve susuzluğa dayanıklı olması nedeni ile peyzajda kullanım alanı görsel olarak şunları sıralayabiliriz.

1. Büyük saksı ya da çiçek tarhlarında

Kent ortamlarında yeşil alan olarak kullanılacak alanların günden güne sınırları küçülmektedir. Dar mekanlarda da olsa büyük saksılarda veya ağaç altlarında *Origanum sp.* kullanılabilir (Şekil 3).



Şekil 3. *Origanum sp*. bitkisinin çiçek kasalarında veya saksılarda kullanımı

2. Kaya bahçelerinde

Origanum sp. türü taşlık, kayalık alanlarda yetişen bitkilerdendir (Şekil 4).



Şekil 4.*Origanum sp.* bitkisinin doğal ortamından bir görüntü

Günümüz koşullarında sıcaklıklarda artış, sularda ise azalma görülmektedir. Bu nedenlerle kentlerde bitki kullanımı yerini taşlar, kayalar ve yapay bitkiler almaktadır. Kaya ya da taş kullanımının olduğu alanlarda *Origanum sp.* bitkisi alanda hareket kazandıracağı gibi yeşil bitkiler pozitif etki yaratacaktır (Şekil 5).



Şekil 5. *Origanum sp.* bitkisinin kaya bahçelerinde kullanımı

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3. Sınır bitkisi olarak

Ülkemizde sınır bitkisi olarak bir çok bitki türü kullanılmaktadır. En çok *Ligustrum vulgare, Euonymus japonica, Thuja sp., Leylandii sp*. tercih edilmektedir. Bu türlerin yanı sıra doğal olan *Origanum sp*. bitkisi sınırlandırma elemanı olarak kullanılabilir. Yaya yollarında, hastanelerde, okullarda vb. alanlarda tercih edilebilir (Şekil 6).



Şekil 6. *Origanum sp.* bitkisinin sınır bitkisi olarak kullanımı

Sonbaharda yaprakları dökerek kuru çalı formunu alır. Şekil 7'de görüldüğü gibi kayalıklar arasında çıkmış kuru dallar kekik bitkisinin kış döneminde almış olduğu formdur (Şekil 7).



Şekil 7. *Origanum sp.* bitkisinin kış mevsiminde aldığı form

Mevsimlere göre değişiklik gösteren *Origanum sp.*bitkisi peyzaj tasarım çalışmalarında fonksiyonel özelliklerine göre kullanmak mümkündür. Değişik alanlarda türün kullanımı sürdürülebilirliğini sağlayacağı gibi aroması ve kokusu için birçok amaçla kullanılabilir.

Sonuç

Çeşitli doğal bitkiler doğrudan ya da dolaylı olarak kullanılmaktadır. Bitki türlerinin kullanımı farklılık göstermiş olsa da estetik ve fonksiyonel özellikleri önemlidir. Sonuç olarak, bu çalışma, *Origanum sp.* türünün yağ durumu, etnobotanik özellikleri hakkında yapılan çok sayıda çalışma vardır. Fakat *Origanum sp*. türünün peyzajda kullanım olanakları ile ilgili bir çalışmaya rastlanılmamıştır. Tür peyzaj tasarımlarında kullanılarak doğal ortamlar oluşturulabilir.

Ayrıca, ekosistem hizmetlerinin değerlendirilmesi, sürdürülebilir bir ekosistemin anahtarıdır, çünkü birçok ekosistem hizmetinin korunması ve muhafaza edilmesi, türün korunması ve odaklanma ihtiyacını doğurmuştur. Bu çalışma ile türün kullanım alanlarının belirlenmesi, tercih olasılığını arttıracağı gibi sürdürülebilirliği de sağlanacaktır.

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Yeşil Alanların Fakülte Alanlarında Değerlendirilmesi

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Özet

Yeşil alanlar geçmişten günümüze kadar hayatımızın bir parçası olmuştur. Gelecekte de aynı şekilde devam edecektir. Fakat yeşil alanların sınırları zamanla azalmaktadır. Ruhsal ve fiziksel gelişimimiz için her yaşta yeşil alanlar büyük öneme sahiptir. Kentsel ya da kırsal alanda özel veya kamu alanlarında her yerde yeşil alan kullanımı önemlidir. Sosyal etkinlik alanlarında yeşil alanlara ihtiyaç duyulmaktadır. Bu nedenle eğitim kurumları, kampüs alanları içerisinde yeşil alanlar oluşturmak mekânın görsel kalitesini arttıracaktır. Öğrenciler akademik çalışmaları sırasında ihtiyaç duydukları mekan taleplerinin dikkate alınması, isteğe göre tasarımlar yapılması eğitmenleri ve öğrencileri olumlu etkileyecektir. Bu çalışmada, kampüs alanlarında fakültenin ihtiyacına göre yapılan tasarım konusu irdelenecektir. Fakültelerde fonksiyonel ya da estetik peyzaj tasarımları nasıl olur, kampüs sınırları içerisinde Fakültenin ihtiyacına göre peyzaj tasarımında nelere dikkat edilir sorularına göre öneriler oluşturulacaktır. Bu kapsamda, Niğde Ömer Halisdemir Üniversitesi iletişim Fakültesi peyzaj çalışması konusunda irdelemeler yapılacaktır.

Anahtar Kelimeler: *Fakülte, Peyzaj, Tasarım, Üniversite, Yeşil Alan.*

Evaluation of Green Areas in Faculty Areas

Abstract

Green areas have been a part of our lives from past to present. It will continue in the same way in the future. However, the boundaries of green areas are decreasing over time. Green spaces are of great importance for our spiritual and physical development at all ages. It is important to use green space everywhere in private or public areas in urban or rural areas. Green areas are needed in social activity areas. For this reason, creating green spaces within educational institutions and campus areas will increase the visual quality of the space. Considering the space demands that students need during their academic studies and making designs according to their wishes will positively affect the instructors and students. In this study, the subject of design in campus areas according to the needs of the faculty will be examined. Suggestions will be made according to the questions of what should be considered in landscape design according to the needs of the faculty. In this context, discussions will be made on the landscape work of Niğde Ömer Halisdemir University, Faculty of Communication.

Keywords: *Faculty, Landscape, Design, University, Green Area.*

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Effect of Fruit Juice Addition on Bioactive and Sensory Properties of Tahini Halva

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Abstract

In this study, sensory properties, total phenolic contents, total flavonoid contents, antioxidant activities and phenolic components of tahini halva prepared with the addition of orange juice and lemon juice in a halva enterprise in Akşehir district of Konya were investigated. The highest total phenolic content was found in the sample containing lemon juice (120.17 mg/100 g). The highest value in total flavonoid content was observed in the sample prepared with the addition of lemon juice (19.00 mg/100 g). Antioxidant activity of halva increased slightly with the addition of fruit juice. While the gallic acid and cinnamic acid contents of the samples decreased with the addition of fruit juice, it was determined that the 3,4-dihydroxybenzoic acid and catechin components increased with the addition of orange juice. When the fatty acid compositions were examined, while the oleic acid content decreased slightly with the addition of fruit juice (38.03-37.65%), no significant difference was found in the linoleic acid content (46.30-46.70%). Considering the general impression in this study, tahini halva with added fruit juice received high scores and was presented as an innovative taste.

Key Words: *Halva, Fruit juice, Phenolic compounds, Sensory properties*

Introduction

Halva (halva, halaweh, havah), one of the oldest and traditional flavors, is very famous in the Middle East and North African countries. Halva production is in the range of 35.000-40.000 tons per year in our country. It is a traditional Turkish dessert that is usually consumed at breakfast (Birer, 1985). Tahini (tehinah, tehena, tehineh), the raw material of halva, is mainly composed of 57-65% oil (oleic and linoleic acid), 23-27% protein (rich in methionine, cystine and tryptophan) and some minerals (calcium, phosphorus, potassium, magnesium) (Abu-Jdayil et al., 2002; Yamani and Isa, 2006). The lean fraction of sesame oil contains sesamol, sesamolin and sesamin compounds that are not found in other oils. These compounds retain their properties after hydrogenation (Nas, 1998). Sesame oil shows a significant antioxidant activity according to the amount of tocopherol in its composition. Sesamol, sesamolin and sesamin, which are natural antioxidant compounds, also affect the stability of the oil (Altuğ, 2001). Sesame oil is obtained by pressing, cleaning and roasting sesame seeds. Sesame oil can be stored for a longer period of time than other vegetable oils, and the quality of sesame oil is affected from roasting time and temperature (Özcan, 1993). Generally, it is mixed with tahini, sugar, citric acid, tartaric acid and Radix saponariae albae sive L. (soup) root extract to prepare halva. The prepared mixture can be cooked together with flavoring agents such as cocoa, pistachio, vanilla, bergamot, natural essences and milk powder (Var et al., 2007). Tahini halva has a shelf life of approximately two years from the date of production, thanks to its low moisture content (3.0%). Changes during production, storage, distribution and usage (depending on humidity and temperature conditions) can cause condensation problems. This may cause the growth of microorganisms (Sengun et al., 2005). In addition, improper usage and poor production processes can affect the hygienic and chemical quality of halva.

In this study, the effects of the addition of orange juice and lemon juice on the sensory properties, total phenolic, total flavonoid contents, antioxidant activities phenolic components and fatty acid composition of tahini halva were investigated.

Materials and Methods

Material

Tahini halvah is prepared in a halva business in Akşehir district of Konya. Sugar (500 g) and orange juice/lemon juice (200 ml) mixture were boiled at 145 oC. Soapwort water (12 ml) was added into the sugar syrup (malt). At the end of the mixing, the syrup (malt) turned white, softened and sponge-like with the effect of soapwort water. The bleached mesh cooled to 70-80 oC was poured on the tahini in a separate bowl at a ratio of 1:1 and shoveling was performed. The tahini and wax taken into the kneading boiler were shoveled homogeneously. The shoveling process ended when the wax completely absorbed the tahini. After kneading, the halva was molded and left to cool.

Methods

Moisture content

The moisture content of the tahini halva sample was determined by Kern Dbs 60-3 moisture analyzer (AOAC, 2000).

Extraction process

For extraction, 30 ml of MeOH:H2O was added to 5 g of tahini halva. It was kept in an ultrasonic water bath for 30 min. Afterwards, the samples were centrifuged for 10 minutes.

Total flavonoid content

The method used to determine the total flavonoid content of tahini halva extract was adapted from the aluminum chloride method. 0.3 ml of NaNO2, 0.3 ml of AlCl3 and 2 ml of NaOH were added to 1 ml of the extract, respectively. Absorbance values were read in the spectrophotometer at 510 nm. Results are given as mg quercetin (QE)/100 g (Hogan et al., 2009).

Total phenolic content

To determine the total phenolic content of tahini halva samples, the Folin-Ciocalteu method was used (Yoo et al., 2004). 2.5 ml of Folin-Ciocalteu reagent was added to 0.5 ml of extract and then 2 ml of Na2CO3 (7.5%) was added. At the last stage of the analysis, the samples were kept in the dark at room temperature for 2 hours. It was measured at a wavelength of 725 nm with a spectrophotometer (Shimadzu.Japan). Results are given as mg gallic acid equivalent (GAE)/100 g.

Antioxidant activity

In order to determine the antioxidant activity of the tahini halva samples, 2 ml of DPPH solution was added to the extract. The mixture was vortexed and left to stand in the dark at room temperature for 30 min. Absorbance was measured at 517 nm using a spectrophotometer (Lee et al., 1998). Results are given in mmol (TE)/kg.

Determination of phenolic compounds

The phenolic components of the extracts were carried out using HPLC (Shimadzu) equipped with a PDA detector and an Inertsil ODS-3 (5 µm; 4.6 mm × 250 mm) column. 0.05% acetic acid (A) and acetonitrile (B) in water were used as mobile phase at 30°C at a flow rate of 1 ml/min. The injection volume is 20 µL.

Oil content

The dried and ground tahini halva samples were placed in a Soxhlet apparatus. The extraction was performed using petroleum ether at 50°C for 5 hours. Petroleum ether was removed in the evaporator at 50°C. The crude oil content (%) was calculated gravimetrically.

Fatty acid composition

Fatty acid methyl esters of oils esterified according to the ISO 5509 method with some modifications. Gas chromatography (Shimadzu GC-2010, Kyoto, Japan) equipped with a flame ionization detector (FID) and a capillary column (Tecnocroma TR-CN100, 60 m × 0.25 mm, film thickness: 0.20 µm).

Sensorial properties

Hedonic test was applied to determine the sensory parameters of the tahini halva samples prepared with the addition of orange juice and lemon juice. Eight trained panelists were used to identify sensory characteristics. Each panelist evaluated the characteristics of the samples separately by giving the following scores (1 = very bad, 2 = bad, 3 = fair, 4 = good, 5 = very good).

Results and Discussion

Physicochemical Properties of Halva

Moisture contents, L*, a*, b* values and oil contents of halva containing fruit juice are given in Table 1. The highest moisture content was found in tahini halva (1.97%) obtained with the addition of lemon juice. When the oil contents of the samples were examined, it was observed that plain halva, which was the control sample, had the highest oil content (30.2%). In the study of Çetintaş (2022), the highest and the lowest oil contents of cheese halva were found as 20.83% and 19.32%, respectively. It was reported by Ünal (2011) that the oil content of lactitol-added cheese halva samples varied between 11.3-11.5%, and increasing lactitol rates had no effect on the oil amount.

While a* and b* values of halva samples were lower in the control sample, they increased with the addition of orange or lemon juice. On the other hand, L* value decreased with the addition of fruit juice. Pazir et al. (2013), the "L" (light-dark), "a" (redness) and "b" (yellowness) values of the samples were examined. Although there was a statistical difference ($P<0.05$) in the L values of the control and experimental samples, there was no statistical difference in the a and b values ($P>0.05$).). It was stated that this difference in L values was due to the white color of the maltodextrin in the structure of the gypsum extract powder (Radix saponariae Albae sive L.) used in the samples.

Table 1. Physicochemical properties of halva

Samples	Moisture Content (%)			*L**			*a**			*b**			Oil Content (%)		
Control	1.44	±	0.16	83.07	±	1.71	0.14	±	0.04	22.18	±	0.48	30.2	±	1.84
Containing orange juice	1.63	±	0.50	66.82	±	0.65	3.61	±	0.28	33.77	±	4.43	26.15	±	0.07
Containing lemon juice	1.97	±	0.02	64.96	±	0.09	5.98	±	0.17	34.24	±	0.24	25.95	±	0.78

Bioactive Properties of Halva

Total flavonoid contents, total phenolic contents and antioxidant activities of tahini halva samples are given in Table 2. The highest total flavonoid content was observed in the tahini halvah sample made with the addition of lemon juice (19.99 mg/100 g), while the lowest total flavonoid content was obtained from the control sample (3.57 mg/100 g). The highest total phenolic content was determined in the sample with added lemon juice (120.17 mg/100 g). The lowest total phenolic content was found in the control sample (38.50 mg/100 g). In a study by Çetintaş (2022), the highest total phenolic content was found to be 0.50 mg GAE/g, while the lowest total phenolic content was found to be 0.27 mg GAE/g. While the total phenolic content of halva was found to be high (215.8 mg GAE 100 g-1) after tahini processing, a decrease was detected after six months of storage at 25 °C (156.41 mg GAE 100 g-1) (Rababah et al., 2020). A slight increase in antioxidant activity results was observed with the addition of fruit juice. The highest antioxidant activity was determined in the halva sample with orange juice (0.47 mmol/kg). In a study, it was reported that storage time and temperature caused a decrease in the antioxidant activity of tahini halva. After processing in tahini halva, it was observed that the total phenolics and antioxidant activity content decreased by 38.5% and 16%, respectively (Rababah et al., 2020).

Table 2. Bioactive properties of halva

Samples	Total Flavonoid Content (mg QE/100g)			Total Phenolic Content (mg GAE/100g)			Antioxidant activity (mmol/kg)		
Control	3.57	±	1.31	38.50	±	5.08	0.41	±	0.00
Containing orange juice	4.71	±	0.86	48.50	±	1.24	0.47	±	0.00
Containing lemon juice	19.00	±	2.16	120.17	±	1.86	0.44	±	0.00

Phenolic Components of Tahini Halva

Table 3 shows the phenolic compounds of tahini halva prepared with the addition of orange juice and lemon juice. Major phenolics of the samples were gallic acid (84.64-104.32 mg/100 g), cinnamic acid (4.07-17.50 mg/100 g), catechin (0.92-15.47 mg/100 g), and 3,4-dihydroxybenzoic acid (4.11-6.45 mg/100 g). The addition of fruit juice caused a decrease in the gallic acid and cinnamic acid contents of halva. While the 3,4-dihydroxybenzoic acid and catechin contents of halva samples increased with the addition of orange juice, the addition of lemon juice led to a decrease.

Table 3. Phenolic Compounds of tahini halva

Phenolic compounds (mg/100 g)	Control			Containing orange juice			Containing lemon juice		
Gallic acid	104.32	±	1.27	84.64	±	7.27	99.08	±	0.00
3,4-Dihydroxybenzoic acid	4.57	±	0.05	6.45	±	2.73	4.11	±	0.09
Catechin	0.92	±	0.47	15.47	±	0.19	2.02	±	0.29
Caffeic acid	0.07	±	0.03	0.12	±	0.05	0.17	±	0.01
Syringic acid	0.10	±	0.01	0.18	±	0.05	0.14	±	0.02
Rutin	0.35	±	0.11	0.47	±	0.15	0.60	±	0.34
p-Coumaric acid	0.03	±	0.00	0.04	±	0.02	0.05	±	0.02
Ferulic acid	0.07	±	0.03	0.10	±	0.04	0.07	±	0.02
Resveratrol	0.12	±	0.01	0.20	±	0.04	0.15	±	0.02
Quercetin	0.79	±	0.18	0.84	±	0.18	0.69	±	0.39
Cinnamic acid	17.50	±	1.26	16.84	±	1.47	4.07	±	3.10
Kaempferol	0.09	±	0.03	0.24	±	0.09	1.46	±	0.77

Fatty Acid Composition of Halva

In Table 4, while the value of oleic acid decreased slightly with the addition of fruit juice (38.03-37.65%), no significant change was found in the amount of linoleic acid (46.30-46.70%). It was determined that the addition of fruit juice did not cause a significant change in other fatty acid contents. In a study by Özcan (1993), sesame oil samples contained 9.10-11.38% palmitic, trace-0.15% stearic, 31.61-57.19% oleic, 30.79%-57.33% linoleic, 0.30-0.79% linolenic and trace-2.62% arachidic acid. In tahini oil, these values were determined as 9.55-10.32% palmitic, % trace stearic, 37.42-45.04% oleic, 43.25-52.34% linoleic, 0.34-1.93% linolenic and trace-0.82%

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arachidic acid. Yazıcıoğlu and Karaali (1983) reported that native sesame oil contains 10.44% palmitic, 6.29% stearic, 36.31% oleic and 45.69% linoleic acid.

Table 4. Fatty acid composition of halva

Fatty acids (%)	Control			Containing orange juice			Containing lemon juice		
Palmitic	9.08	±	0.20	9.40	±	0.19	9.13	±	0.08
Stearic	5.45	±	0.02	5.41	±	0.04	5.38	±	0.01
Oleic	38.03	±	0.12	37.57	±	0.06	37.65	±	0.01
Linoleic	46.30	±	0.06	46.56	±	0.05	46.70	±	0.06
Arachidic	0.58	±	0.02	0.54	±	0.03	0.55	±	0.00
Linolenic	0.43	±	0.02	0.41	±	0.01	0.41	±	0.00
Behenic	0.13	±	0.01	0.11	±	0.01	0.12	±	0.00
Erucic	ND*			ND			0.06	±	0.01

*ND: Not dedected

Sensory Properties of Halva Samples

Hedonic test was performed to determine the sensory parameters of tahini halva. The results are given in Table 5. The control sample, tahini halvah obtained with the addition of orange juice and lemon juice, was scored between 1 and 5. In the taste criterion, tahini halva containing lemon juice showed the highest score with 4.57, and the control sample had the lowest score with 3.71. When we look at the results of the odor parameter, the lowest score was 4.57 in the tahini halva containing lemon juice, the highest score was observed in the control sample with 4.86. Tahini halva added both lemon juice and orange juice exhibited the highest score in the color factor with 4.57, and the control sample got the lowest score with 4.43. In the results of the texture parameter, tahini halva containing both lemon juice and orange juice showed the highest score with 4.43, and the control sample got the lowest score with 4.14. In the comparison of sandiness, tahini halva added lemon juice had the highest score with 4.29, and the control sample got the lowest score with 4.00. However, the general appearance showed the best score with 4.71 in halva containing lemon juice, followed by tahini halva added orange juice (4.29), and plain halva (4.14).

In a study by Çetintaş (2022), it was reported that halva prepared with semolina and sugar has the best properties based on the results of sensory analysis, but amaranth can be used instead of semolina. It has been stated that stevia can be used by substitution to a certain extent due to its bitter taste.

Table 5. Sensorial properties of halva samples

Samples	Flavour			Smell			Color			Texture			Grittiness			General View		
Control	3.71	±	0.95	4.86	±	0.38	4.43	±	0.79	4.14	±	0.90	4.00	±	1.15	4.14	±	0.69
Containing orange juice	4.14	±	0.90	4.71	±	0.49	4.57	±	0.53	4.43	±	0.53	4.14	±	0.69	4.29	±	0.95
Containing lemon juice	4.57	±	0.79	4.57	±	0.53	4.57	±	0.79	4.43	±	0.79	4.29	±	0.76	4.71	±	0.76

Conclusion

In this study, the effects of the addition of orange juice and lemon juice on the sensory properties, total phenolic and total flavonoid contents, antioxidant activities, phenolic compounds and fatty acid composition of tahini halva were investigated. The presence of bioactive compounds such as vitamin C, carotenoids and phenolic compounds in fruit juices represents the nutritional value of the product. It is known that the antioxidant substances found in fruit juices have positive effects on health, such as reducing the rate of cancer and preventing cardio and cerebrovascular diseases. For this reason, it is important to determine the effects of applied processes on bioactive and antioxidant components.

According to the results, it was observed that the adding orange and lemon juices caused an increase in moisture content and a decrease in oil content. When the total flavonoid content and total phenolic content results are examined, they are listed from high to low as halva with lemon juice, halva with orange juice and control sample. While no significant change was observed in the fatty acid compositions of halva samples with the addition of fruit juice, there was a decrease in the gallic and cinnamic acid contents of the samples with the addition of fruit juice. An increase in catechin content was detected. Considering the general taste in this study, tahini halva with fruit juice showed high scores.

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Effects Of Preservation Methods On Ph, Proximate Composition And Microbial Quality Of Laboratory Scale Tiger Nut Milk Beverage

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Abstract

Tiger nut (*Cyperus esculentus*) milk beverage is a nutritive, energetic and popular drink mostly produced and consumed in Northern Nigeria. However, the beverage has poor shelf-life which hampered its large-scale production and profitability. Big yellow tiger nut was soaked in 3 L of tap water at 60°C for 6 hours, additives such as coconut, date and ginger were added and blended. The extracted milk was divided into nine portions and subjected to the following treatments pasteurization, sterilization, ultraviolet light, freezing and sodium benzoate. Proximate composition and microbial quality of both the fresh and treated samples were investigated over 9 day storage period. The pH of the milk samples significantly (p<0.05) decreased over the storage period due to microbial activity. Preservation by freezing maintained most of the nutrient content of tiger nut milk whereas all ambient temperature preserved (28 to 32°C) samples had a significant (p<0.05) decrease in crude fiber and total carbohydrates and a significant increase in crude lipid. The less acidic the products are the higher their bacterial load. The bacterial load for the preserved milk ranged from 5.19±0.06 to 6.84±0.03 $\log_{10}$cfu/ml. The organisms isolated from the samples were *Staphylococcus species*, *Bacillus* species, *Clostridium species*, *Saccharomyces species* and *Rhizopus oryzae.* The findings indicate that the excellent keeping quality of tiger nut milk is due in great part to pH.

***Key words**: Microbial quality, milk, preservation methods, proximate, tiger nut beverage*

Introduction

Tiger nut (*Cyperus esculentus*) (also called chufa sedge, nut grass, yellow nut sedge, tiger nut sedge or earth almond) is a crop of the sedge family widespread across much of the world (Abaejoh *et al*., 2006). Tiger nut can be eaten fresh, dry or process to produce varieties of product including tiger nut milk, the tuber is known by various names in Nigeria, as "Aya" in Hausa, "Imumu" in Yoruba and "Aki Hausa" in Igbo. Tiger nut milk popularly known in the Northern part of Nigeria as "Kunu aya" is one of the indigenous, locally fermented, non-alcoholic beverage drinks that is widely consumed for its thirst-quenching property and nutritional content. Its extensive consumption occurs during the dry season (Okafor and Nwachukwu, 2003). Significant variations exist in the methods for production of the milk, depending on the desired taste that leads to differences in quality. While some prefer the milk with different fruit flavours, others prefer it with no sugar. Tiger nut milk has been tried as an alternative source of milk in fermented products, such as yogurt production, and other fermented products common in some African countries and can thus be useful replacing milk in the diet of people intolerant to lactose to a certain extent (Sánchez-Zapata *et al*., 2012). Tiger nut milk has a poor shelf life (Akoma *et al*., 2006) with significant microbial contamination, including bacteria and moulds (Onovo and Ogaraku, 2007; Nutso, 2014). This study was aimed at determining the effects of some preservation methods on the pH, proximate composition and microbial quality of laboratory produced tiger nut milk beverage.

Materials and Methods

Sample Collection

Big yellow tiger nut was obtained from Maggi Market in Sokoto, Sokoto State, Nigeria. The tubers were taken to the laboratory in a clean polythene bag for processing and analysis.

Sample Identification

The tiger nut was identified by a taxonomist in Botany unit, Usmanu Danfodiyo University, Sokoto and voucher number was assigned (UDUH/ANS/0082) and voucher sample was kept in the herbarium for future reference.

Sample Preparation

Tiger nut tubers were sorted out to remove unwanted materials, it was then rinsed in water to remove adhering soils. Ingredients such as coconut, date, cinnamon and ginger were processed, thoroughly washed in warm water and added to tiger nut for the milk production.

Tiger Nut Milk Preparation

One kilogramme (1 kg) of tiger nuts was soaked in 3 litres of boiled water at 60ºC for 6 hours according to modified method of Djomdi and Ndjouenkeu (2006). After washing the nut was mixed with 300 g of coconut, 150 g of date, 15 g of ginger and 3 g cinnamon, and then the mixture was blended with 6 L of cooled boiled water several times into slurry with engine moteur (GX 160) The slurry was pressed using muslin cloth to extract the milk. To the extracted milk 60 g of refined sugar were added. The extracted milk was transferred into sterile container. The milk was divided into nine portions and packaged into sterile cork bottle as 300 mL portions and subjected to the various treatments after 15 to 20 minutes of preparation.

Experimental Design

The milk was divided into twenty five portions and packaged into sterile cork bottle as 100 mL portions (each group has three representative samples except UTTM with four samples) and subjected to the respective treatments after 15 to 20 minutes of preparation as follows:
UTTM: Untreated tiger nut milk.
FRTM: Tiger nut milk stored at 0ºC.
TMS: Tiger nut milk treated with 0.05% Sodium benzoate and stored at 28 to 32ºC.
FSTM: Tiger nut milk treated with 0.05% Sodium benzoate and stored at 0ºC.
UVTM: Tiger nut milk irradiated with ultraviolet light and stored at 28 to 32ºC.
LLPTM: Tiger nut milk Pasteurized at 70 to 75ºC for 30 minutes and stored at 28 to 32ºC.
HSPTM: Tiger nut milk Pasteurized at 90 to 95ºC for 15 to 30 seconds and stored at 28 to 32ºC.
STM: Tiger nut milk Sterilized at 121ºC for 15 minutes and stored at 28 to 30ºC.

Analysis of Sample

Proximate composition and pH of the milk samples were analysed at day 0 for UTTM and after 2, 6 and 9 days for the remaining portions of UTTM and the preserved samples according to standard methods of Association of Official Analytical Chemists (AOAC, 1995).

Microbiological Analysis

Media Preparation

The media: Nutrient Agar and Sabouraud Dextrose Agar were prepared according to the manufacturer's (Titan Biotech Ltd) instruction.

Bacterial Count

The spread plate method of inoculation after serial dilution of the sample by 10^{-4} dilution factor was applied as described by Manga and Oyeleke (2008).

Bacterial Identification

Bacteria were identified based on microscopy and biochemical tests as described by Cheesbrough (2002) and characterization was done by method of Holt *et al*. (2000).

Isolation and Identification of Fungi

A sterile syringe was used to transferred 1 ml of 10^{-3} diluted sample onto the surface of prepared Sabouraud Dextrose Agar. The inoculum was then spread out thinly and evenly on the surface using a sterile bent glass rod. The plates were then incubated at 37ºC for 72 hours. Colonies were identified by colonial and microscopic characteristics based on taxonomic schemes described by Ainsworth *et al*. (1973).

Data Analysis

The analysis was done in triplicate; results were expressed as Mean ± Standard error of mean. All microbial counts were converted to the $base_{10}$ logarithm of the number of colony forming units per ml of tiger nut milk samples (log_{10}cfu/ml). Data was subjected to Analysis of Variance (ANOVA) and Dunnet compare all versus control was used to test for the level of significance between mean. Statistical significance was accepted at $p<0.05$.

Results

Effect of Preservation on pH

Table1.0 presents the pH of preserved and unpreserved tiger nut milk. The pH of the preserved samples varied from 2.58±0.01 to 6.16±0.01. The values within this range are higher than the pH of unpreserved tiger nut milk at day 2 to 9 (2.53±0.01 to 2.67±0.01) but lower than that of UTTM 0 (6.75±0.02). FSTM after day 2 has the highest pH value (6.16±0.01) while TMA after day 9 has the least value (2.58±0.01). The pH of the preserved tiger nut milk decreases as the storage time (day) increased. Frozen tiger nut milk with and without sodium benzoate (FSTM and FRTM respectively) have a pH range (6.08±0.01 to 6.16±0.01) near the neutral pH (6.70 to 7.20) while samples treated with other preservatives, but stored at ambient temperatures (28 to 32ºC), have pH ranging from 2.58±0.01 to 4.36±0.01 (in the acidic range).

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Table 1. Effect of Storage Time (Day) on the pH of Fresh and Preserved Tiger Nut Milk

DAY	UTTM	FRTM	TMS	FSTM	UVTM	HSPTM	LLPTM	STM
0	6.75±0.02							
2	2.67±0.01 [a]	6.15±0.02 [ab]	2.69±0.02 [a]	6.16±0.01[a]	3.34±0.01[ab]	3.97±0.01[ab]	3.61±0.01[ab]	4.36±0.01[ab]
6	2.61±0.01 [a]	6.13±0.01 [ac]	2.63±0.01 [a]	6.10±0.01 [ac]	3.27±0.01 [ac]	3.30±0.01 [ac]	3.30±0.02 [ac]	4.19±0.02 [ac]
9	2.53±0.01 [a]	6.12±0.01 [ad]	2.58±0.01 [a]	6.08±0.01 [ad]	3.05±0.01 [ad]	3.09±0.01 [ad]	3.14±0.02 [ad]	3.74±0.02 [ad]

Key: UTTM= Unpreserved Tiger Nut Milk (control), FRTM= Tiger Nut Milk at 0ºC, TMS= Tiger Nut Milk Treated with 0.05% Sodium Benzoate, FSTM= Tiger Nut Milk Treated with 0.05% Sodium Benzoate and Stored at 0ºC, UVTM= Tiger Nut Milk Irradiated with Ultraviolet Light, HSPTM= High Temperature Short Time Pasteurized Tiger Nut Milk, LLPTM= Low Temperature Long Time Pasteurized Tiger Nut Milk, STM= Sterilized Tiger Nut Milk. Values are means ± standard error of 3 determinations. ([a] denotes $p<0.05$ compared to negative control (FTM); [b,c,d] denote $p<0.05$ compared to positive control (TMA) at day 2, 6 and 9, respectively).

Effect of Preservation on Proximate Composition of Tiger Nut Milk

Table 2.0 shows the effect of storage time (day) on the proximate composition of preserved and unpreserved tiger nut milk. The moisture content of the preserved samples varied from 65.38±0.01 to 73.43±0.03%. FRTM 9 has the highest moisture value (73.43±0.03%) while STM 9 has the least value (64.43±0.02%). The moisture content of FRTM and FSTM increased with storage time (day). While the moisture content of preserved and unpreserved tiger nut milk stored at ambient temperature decreased with storage time (day). The ash content of the preserved samples ranged from 1.33±0.22 to 1.98±0.32%. STM 2 has the highest ash value (1.98±0.32%) while TMS 9 has the least value (1.33±0.22%). There are no significant ($p<0.05$) differences in the ash content of the samples compared to UTTM throughout the storage days.

The crude lipid content of the preserved samples ranged from 13.44±0.29 to 22.32±0.10%. The values within this range are significantly ($p<0.05$) lower than 21.18±0.11 to 24.31±0.19% for UTTM 2, UTTM 6 and UTTM 9 whereas, the crude lipid value for UTTM 0 (14.44±0.06%) is within the range. UVTM 9 has the highest crude lipid value (22.32±0.10%) and FSTM 9 has the least value (13.44±0.29%). The crude lipid content of FRTM and FSTM decreased with increased in storage time (day) while that of the preserved and unpreserved samples (kept at 28 to 32ºC) increased with increased in storage time (day). The crude protein content of the preserved samples ranged from 6.47±0.08 to 11.54±0.21%. STM 9 has the highest value (11.54±0.21%) while FSTM 2 has the least (6.47±0.08%). There are significant ($p<0.05$) differences in the crude protein of the samples as compared with UTTM 0 except with FRTM 6, FRTM 9, FSTM 2, FSTM 6 and FSTM 9 which are not significantly ($p>0.05$) different. There are significant ($p<0.05$) differences in the crude protein content of the milk samples as compared with UTTM 2, 6 and 9 at the respective days except TMS 2, UVTM 2, UVTM 6, HSPTM 6, HSPTM 9, LLPTM 6, LLPTM 9 and STM 2 ($p>0.05$).

The crude fiber content of the preserved samples ranged from trace to 2.13±0.01%. The values in this range are significantly ($p<0.05$) higher than that of UTTM at day 2, 6 and 9. FSTM 2 has the highest crude fiber content (2.13±0.01%). The total carbohydrate content of the preserved samples followed the same trend with the crude fiber, the values varied (trace to 5.67±0.73%). The values within this range are lower than that of UTTM 0 (7.54±0.64%). FSTM 9 has the highest carbohydrate content (5.67±0.73%) followed by FSTM 2 (5.15±0.62%) and the least carbohydrate content is in samples UTTM 2, 6, 9 and HSPTM throughout the storage period. There are significant ($p<0.05$) decrease in the total carbohydrate content of the samples as compared with UTTM 0 except FSTM 9. There are no significant ($p>0.05$) differences in the total carbohydrate content of most of the preserved tiger nut milk compared to UTTM 2, UTTM 6 and UTTM 9 except FRTM and FSTM which are significantly ($p<0.05$) higher throughout the storage period.

Effect of Preservation on Bacterial Count

Table 3.0 presents the effect of storage time (day) on the total bacterial count of preserved and unpreserved tiger nut milk. The values range from 5.19±0.06 to 6.84±0.03 $\log_{10}$cfu/ml for the preserved milk. The values in this range are significantly lower ($p<0.05$) than that of UTTM 0 (6.58±0.05$\log_{10}$cfu/ml) and significantly higher ($p<0.05$) than UTTM 2 to 9 (4.44±0.02 to 5.85±0.06 $\log_{10}$cfu/ml). FSTM after day 6 has the highest number of viable bacterial count (6.84±0.03 $\log_{10}$cfu/ml) while LLPTM after day 6 has the least count (5.19±0.06 $\log_{10}$cfu/ml).

Discussion

The importance of nutrient content of food to the growth and welfare of microorganisms cannot be overemphasized. With respect to nutrient content of food, moulds have the lowest requirement, followed by yeasts, gram-negative bacteria, and gram-positive bacteria (James, 2000; Norman, 2012). All the samples had high moisture contents. This could affect the stability and safety of food with respect to microbial growth and proliferation. Microorganisms need water in an available form to grow in food products (James, 2000). The range of moisture content obtained in this study does not corroborate previous studies; Belewu and Belewu (2007) reported 92.27% moisture content, Ukwuru and Ogbodo (2011) reported 77.0 to 80.7%, Musa and Hamza (2013) reported 62.80 to 82.50%, Adedokun *et al*. (2014) reported 79.29% and Sherifah *et al*. (2014) reported 70 to 80% moisture content for milk extracted from tiger nut.

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Table 2. Effect of Storage Time (Day) on the Proximate Composition of Preserved and Unpreserved Tiger Nut Milk

Samples	% Moisture	% Ash	% Crude lipid	% Crude Protein	% Fiber	% TC
UTTM	76.43±0.02	2.48±0.34	14.44±0.06	1.61±0.10	1.25±0.02	5.04±0.51
UTTM 2	72.70±0.01^{a}	1.67±0.34	23.18±0.11^{a}	2.45±0.10^{a}	Trace ^{a}	Trace ^{a}
UTTM 6	71.54±0.88^{a}	1.33±0.34	25.55±0.23^{a}	1.96±0.06	Trace ^{a}	Trace ^{a}
UTTM 9	70.48±0.01ad	1.33±0.34	26.23±0.19^{a}	1.96±0.06	Trace a	Trace ^{a}
FRTM 2	78.38±0.01^{ab}	2.67±0.34	14.58±0.11^{b}	1.09±0.08^{ab}	1.01±0.02^{ab}	3.28±0.53^{b}
FRTM 6	79.18±0.01^{ac}	2.33±0.66	13.33±0.19^{ac}	1.85±0.10	1.22±0.02^{c}	3.31±0.97^{c}
FRTM 9	79.68±0.03^{ad}	2.32±0.66	13.08±0.19^{ad}	1.68±0.09	1.22±0.02^{d}	3.24±0.98^{d}
TMS 2	73.14±0.01^{ab}	1.67±0.66	21.44±0.12^{ab}	2.28±0.14^{a}	0.50±0.01^{ab}	1.47±0.60^{a}
TMS 6	72.32±0.01^{a}	1.67±0.34	23.15±0.11^{ac}	1.95±0.06	0.20±0.02^{ac}	0.91±0.51^{a}
TMS 9	71.15±0.01^{ad}	1.67±0.34	24.56±0.12^{ad}	2.21±0.08^{a}	Trace ^{a}	0.41±0.54^{a}
FSTM 2	78.44±0.01^{ab}	2.33±0.58	14.68±0.88^{b}	1.97±0.06^{a}	1.51±0.03^{ab}	2.58±0.71^{ab}
FSTM 6	79.95±0.01^{ac}	1.33±0.34	13.89±0.29^{c}	1.96±0.06	1.98±0.06^{ac}	2.87±0.71^{c}
FSTM 9	80.11±0.02^{ad}	1.33±0.34	11.56±0.29^{ad}	2.03±0.16^{a}	2.38±0.09^{ad}	4.97±0.80^{d}
UVTM 2	72.83±0.01^{ab}	1.50±0.09	23.22±0.19^{a}	1.95±0.07^{b}	0.50±0.01^{ab}	0.50±0.36^{a}
UVTM 6	72.48±0.01^{a}	1.50±0.14	23.86±0.19^{ac}	1.71±0.06	0.45±0.01^{ac}	0.45±0.40^{a}
UVTM 9	71.19±0.01^{ad}	1.52±0.10	25.11±0.20^{ad}	1.68±0.06	0.50±0.01^{ad}	0.50±0.37^{a}
HSPTM 2	72.85±0.02^{ab}	2.00±0.31	23.33±0.10^{a}	1.82±0.08^{b}	Trace ^{a}	Trace ^{a}
HSPTM 6	72.18±0.02^{a}	1.97±0.28	24.08±0.12^{ac}	1.77±0.08	Trace ^{a}	Trace ^{a}
HSPTM 9	71.56±0.01^{ad}	1.95±0.29	24.89±0.12^{ad}	1.60±0.06	Trace ^{a}	Trace ^{a}
LLPTM 2	73.08±0.03^{ab}	2.00±0.32	22.92±0.24^{a}	1.67±0.03^{b}	0.33±0.02^{ab}	0.33±0.62^{a}
LLPTM 6	72.78±0.02^{ac}	1.72±0.32	23.85±0.18^{ac}	1.43±0.06^{c}	0.22±0.01^{ac}	0.22±0.58^{a}
LLPTM 9	72.44±0.02^{ad}	1.69±0.09	24.45±0.21^{ad}	1.42±0.06^{d}	Trace ^{a}	Trace ^{a}
STM 2	70.68±0.02^{ab}	2.41±0.34	24.11±0.07^{a}	2.30±0.19^{a}	0.50±0.01^{ab}	0.50±0.62^{a}
STM 6	69.72±0.02^{ac}	2.32±0.44	24.85±0.08^{a}	2.61±0.16^{ac}	0.50±0.01^{ac}	0.50±0.70^{a}
STM 9	69.18±0.01^{ad}	2.31±0.34	25.55±0.06^{ad}	2.45±0.13^{ad}	0.50±0.01^{ad}	0.51±0.54^{a}

Values are means ± standard error of 3 determinations. (^{a} denotes $p<0.05$ compared to control at day 0 (UTTM 0); ^{b,c,d} denote $p<0.05$ compared to control (UTTM) at day 2, 6 and 9, respectively).
Key: UTTM= Untreated Tiger Nut Milk (control), FRTM= Tiger Nut Milk at 0ºC, TMS= Tiger Nut Milk Treated with 0.05% Sodium Benzoate, FSTM= Tiger Nut Milk Treated with 0.05% Sodium Benzoate and Stored at 0ºC, UVTM= Tiger Nut Milk Irradiated with Ultraviolet Light, HSPTM= High Temperature Short Time Pasteurized Tiger Nut Milk, LLPTM= Low Temperature Long Time Pasteurized Tiger Nut Milk, STM= Sterilized Tiger Nut Milk.

Table 3. Effect of Storage Time (Day) on the Total Bacterial Count of Fresh and Preserved Tiger Nut Milk

DAY	UTTM	FRTM	TMS	FSTM	UVTM	HSPTM	LLPTM	STM
	(Log_{10}cfu/ml)							
0	6.58±0.05							
2	5.85±0.06 ^{a}	6.22±0.01 ^{ab}	5.70±0.03 ^{a}	6.44±0.08 ^{b}	6.01±0.04 ^{a}	5.52±0.10^{ab}	5.93±0.01 ^{a}	6.15±0.01^{ab}
6	4.44±0.02 ^{a}	6.57±0.12 ^{c}	5.43±0.27 ^{ac}	6.84±0.03 ^{c}	5.27±0.04 ^{ac}	5.28±0.01 ^{ac}	5.19±0.06 ^{ac}	5.47±0.04 ^{ac}
9	4.98±0.15^{a}	6.30±0.05^{ad}	5.56±0.04^{ad}	6.44±0.05^{ad}	5.53±0.08^{ad}	5.56±0.06^{ad}	5.47±0.04^{ad}	5.93±0.03^{ad}

Key: UTTM= Unpreserved Tiger Nut Milk (control), FRTM= Tiger Nut Milk at 0ºC, TMS= Tiger Nut Milk Treated with 0.05% Sodium Benzoate, FSTM= Tiger Nut Milk Treated with 0.05% Sodium Benzoate and Stored at 0ºC, UVTM= Tiger Nut Milk Irradiated with Ultraviolet Light, HSPTM= High Temperature Short Time Pasteurized Tiger Nut Milk, LLPTM= Low Temperature Long Time Pasteurized Tiger Nut Milk, STM= Sterilized Tiger Nut Milk. Values are means ± standard error of 3 determinations. (^{a} denotes $p<0.05$ compared to negative control (FTM); ^{b,c,d} denote $p<0.05$ compared to positive control (TMA) at day 2, 6 and 9, respectively).

The variation in the moisture content reported in earlier research works and present research could be due to the type of tiger nut used, environment where the nut was cultivated, different methods of preparation employed and varied ratios of ingredients used for the milk production. The addition of 0.05% sodium benzoate to tiger nut milk and the use of freezer for preservation of tiger nut milk might be a direct consequence of binding of moisture, without which microorganisms do not grow (James, 2000). The influence of freezing on microbial growth and proliferation might be bacteriostatic in nature. During de-freezing of the preserved milk binding water might be made available which might have rapidly led to high proliferation of inherent microorganisms as the total bacterial count of these samples were high. The fact that preservation by freezing maintained most of the nutrient content of tiger nut milk and as the milk de-froze the moisture content increased.
Morris (1962) stated that the presence of nutrients increases the range of water activity over which organisms can survive. This might support the result of total bacterial load of FRTM and FSTM.

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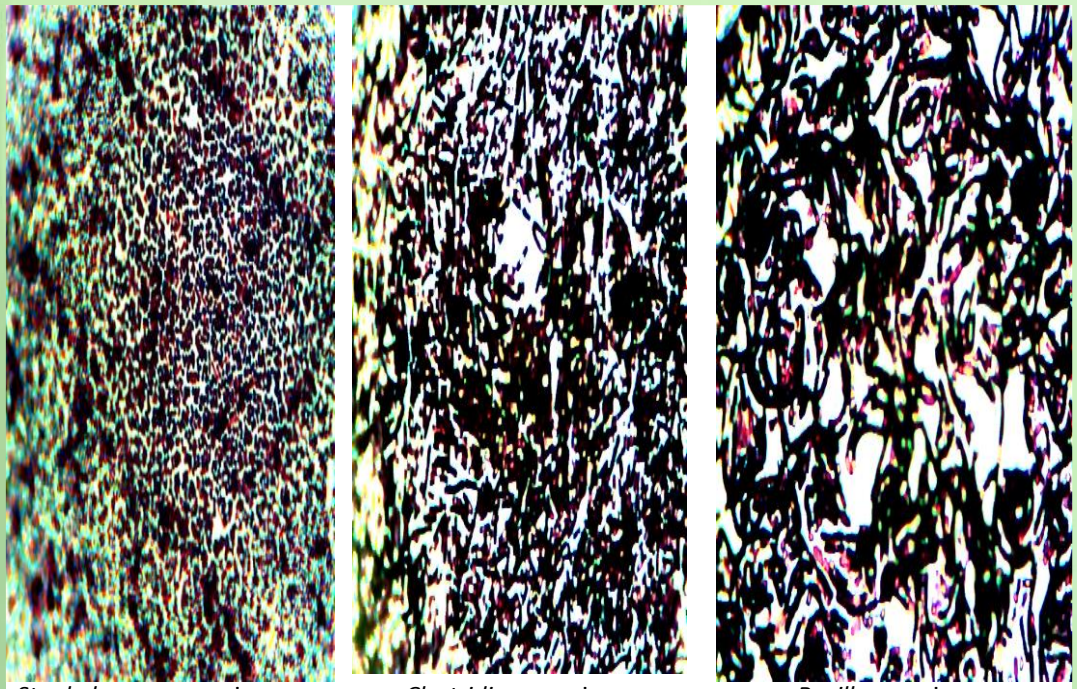


Figure 1. Light Microscopy Images of Isolated Dominant Bacteria in Tiger Nut Milk Beverage

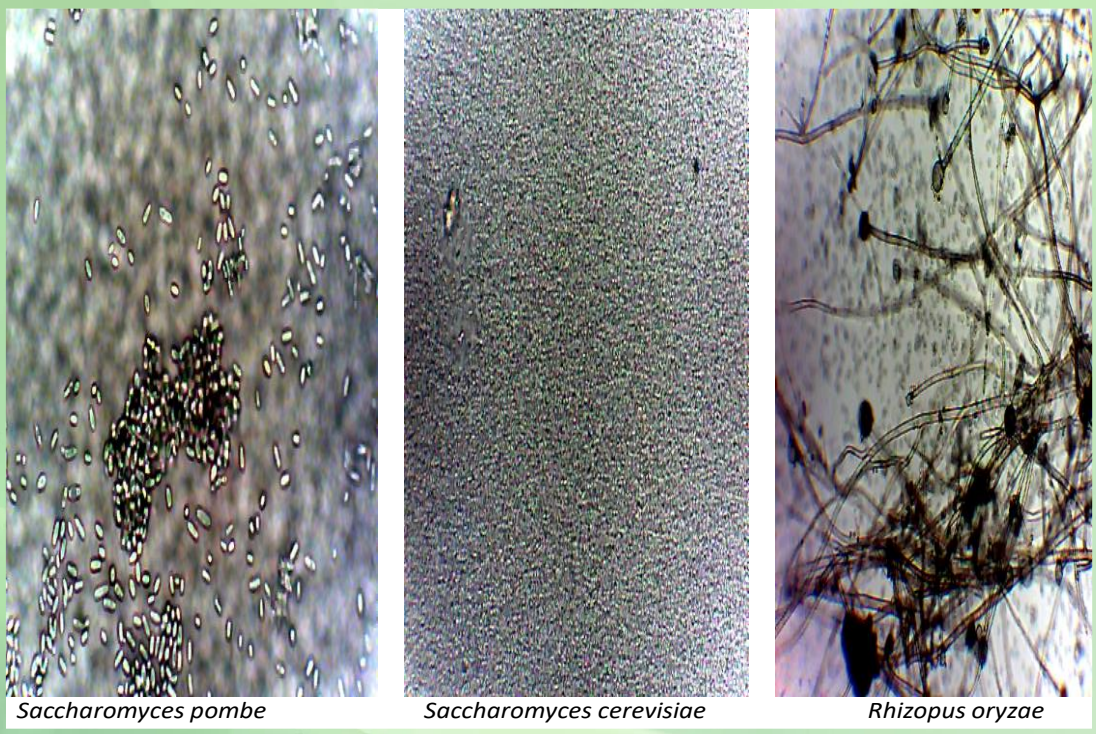


Figure 2. Light Microscopy Images of Isolated Fungi in Tiger Nut Milk Beverage

Microorganisms utilize carbohydrates as sources of energy (James, 2000) evidence from the result of proximate composition. The total carbohydrates of ambient temperature stored samples were low; this might have contributed to the low pH value of these samples, as anaerobic fermentation of sugar leads to increase in acidity and thus low pH which might cause a decrease in the total bacterial count. The significant increase (p<0.05) in the percentage total carbohydrates of FRTM and FSTM further support the assertion that preservation by freezing maintain most of the nutrient content of food (James, 2000; George, 2005). The low carbohydrates content of ambient temperature stored samples is an indication that most of the microorganisms in the tiger nut milk samples utilized carbohydrates as source of energy and as this component decreased, the milk become more acidic and the total viable bacterial load declined.

Fats are used also by microorganisms as sources of energy, but these compounds are attacked by a relatively small number of microbes in foods (James, 2000). The isolated organisms from the milk samples might not have utilize fats as source of energy. This may be attested to the fact that the percentage crude lipid content of ambient temperature stored tiger nut milk samples increased, this might be due to the types of spoilage microorganisms isolated as the organisms are oily in nature. Ukwuru and Ogbodo (2011) reported a decrease in percentage crude lipid content which differed from the finding of the present study. The range of percentage crude protein content obtained in this study agrees with previous studies. Belewu and Belewu (2007) reported 8.07%; Ukwuru and Ogbodo (2011) reported 6.40 to 8.20% from tiger nut milk. The high percentage crude protein content of TMA and all the preserved tiger nut milk that were stored at ambient temperature was not surprising as microorganisms are protein in nature and they will add to the protein content of the milk. The observed differences in the values of percentage ash content of all the samples were not statistically significant (p>0.05). This might be that activities of microorganisms have no effect on this component. The value of percentage ash content of previous study (Ukwuru and Ogbodo, 2011) was lower than what was reported in this study.

Most of the bacterial strains isolated were pathogenic (Figure 1) while the fungi were basically fermentative microorganism (Figure 2) which contributes to the acidity of the milk. The surfaces of harvested grains, legumes, nuts and other food substance retain some of the natural micro-flora they had while growing on the field in addition to contamination from soil, water, insects, and other sources (Edema and Omemu, 2004). *Staphylococcus* can cause a wide variety of diseases in humans and animals through either toxin production or penetration (Kloos, 1980). Staphylococcal toxins are a common cause of food poisoning (Kloos, 1980). *Bacillu*s species are food-borne pathogens associated with health hazards (FAO, 1979; Odu and Adeniji, 2013). They are inhabitants of soil and are able to withstand high temperature due to their ability to form spores (Pelczar *et al.*, 1993; Essien *et al*., 2011). The thermoduric nature of the spores of these microbes ensures survival at pasteurization and even sterilization temperatures (Essien *et al*., 2011) and hence their presence in the milk samples was not surprising. The ropiness associated with the fermented tiger nut milk has been associated with the presence of *Bacillus subtilis* (Adegoke *et al*., 1993). The presence of *Bacillus* species in most of the milk samples may be attributed to the fact that their immediate source is usually plant material due to their presence in the soil (Kawo and Abdulmumin, 2009). The fungi isolated were *Saccharomyces pombe, Saccharomyces cerevisiae and Rhizopus oryzae* (Figure 2). Udeozor and Awonorin (2014) also, reported the isolation of these organisms from tiger nut-soya milk drink. *Saccharomyces cerevisiae* has also been reported to be isolated from tiger nut milk (Onovo and Ogaraku, 2007). They are major spoilage organisms of carbohydrate foods (Rhodes and Fletcher, 1966). *Saccharomyces pombe* and *Saccharomyces cerevisiae* are harmless; there are no pathologies associated with the organisms (Lindner, 1893). They have an extensive history of use in the area of food processing, especially *Saccharomyces cerevisiae* which is commonly used in bread making and as a fermenter of alcoholic beverages (Battock and Azam-Ali, 1998). *Rhizopus oryzae* is the most common cause of mucormycosis, also referred to as zygomycosis (Julie *et al*., 2000). It is commonly found in dead organic matter and soil (Battock and Azam-Ali, 1998) also, used in fermented foods and alcoholic beverages.

Conclusion

Preservation methods have no significant effect on ash content of tiger nut milk beverage. The more acidic the milk beverages are, the lower the viable total bacterial load. The significant decreased in the total carbohydrates of tiger nut milk beverage over storage time suggest that, the harboured microorganisms utilized the macromolecule as source of energy. The dominant organism isolated from the milk beverage are *Staphylococcus* species, *Clostridium* species, *Bacillus* species, *Saccharomyces* species and *Rhizopus oryzae*. Preservation by sterilization and ultraviolet light were more effective at reducing the total viable bacterial load of the beverage, while preservation by freezing maintained the pH and nutrient quality of the tiger nut milk beverage than the other preservation methods.

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ID: 131

Impacts of Biochar Treatments on Some Soil Properties and Micronutrient Availability in the Farmland of Misau, Bauchi State, Nigeria

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Abstract

The application of biochar as a soil amendment has been recognized as an environmentally friendly and highly efficient strategy for restoring the fertility of the soil and increasing agricultural productivity. In this study, the impacts of *Senna tora* biochar treatments on soil properties and micronutrient availability in the farmlands of Misau, Bauchi State, Nigeria, were investigated. A complete randomized design replicated three times, which included control soil (no biochar/0 day), 30 days, and 60 days of biochar treatments, was adapted. After treatments, the biochar was removed and the soil samples from each treatment were analyzed for pH, soil bulk density (BD), cation exchange capacity (CEC), organic carbon (OC) and micronutrient levels using various analytical methods. The results of the analysis show pH, OC and CEC values increased significantly ($p \leq 0.05$) from 6.66 to 7.89, 3.40 to 3.90 g/kg and 5.16 to 7.29 cmol/kg respectively, while BD decreased significantly from 1.56 to 1.48 g/cm^3 after 60 days of biochar treatment. The levels of Mn, Cu and Zn increased from 188.25 to 286.12 mg/kg, 14.38 to 41.88 mg/kg and 68.63 to 140.19 mg/kg respectively, while levels of Fe decreased from 9460.00 to 4782.73 mg/kg after 60 days of biochar treatments. Application of *Senna tora* biochar has generally led to a significant improvement in the fertility of the soil. It is therefore recommended that *Senna tora* biochar be used in the field to demonstrate its practical application.

Keywords: *Biochar, Misau, Senna tora, soil amendments, Treatments*

ID: 132

In-vitro probiotic properties of *Lactobacillus satsumensis* LC311746.1 isolated from water kefir grains

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Abstract

Lactobacillus satsumensis LC311746.1 was isolated from water kefir grains. Then, the bacterial isolate was tested for gastrointestinal conditions, hydrophobicity, aggregation ability, antibiotic resistance, antimicrobial properties, and cholesterol-lowering properties. The results showed that the bacterial isolate was resistant to acidic conditions even after 3 hours of exposure. Resistance to bile salt, pepsin, and pancreatin enzymes was also greater than 90% at the end of each experiment. The isolate had a relatively low hydrophobic capacity of up to 20%, but had a high autoaggregation capacity. On the other hand, the isolate had relatively low coaggregation ability with Staphylococcus aureus. In addition, the isolate was sensitive to more than two antibiotics, indicating that it was safe for human consumption. Also, L. satsumensis showed medium antimicrobial activities against pathogenic bacteria, e.g. Campylobacter jejuni, Escherichia coli, Salmonella Enteritidis, Listeria monocytogenes and Salmonella Typhimurium. The cholesterol reducing ability of the isolate was also detected. In conclusion, L. satsumensis LC311746.1 has promising probiotic properties that could be useful for the development of novel health-friendly food products.

Key Words: *Water kefir grains, Tibicos, Probiotic, Lactobacillus satsumensis, Antimicrobial*

ID: 133

Arabidopsis *RAP2.6* gene is involved in tolerance to multiple biotic and abiotic stresses

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Abstract

Transcription factors constitute complicated defense responses in plants to combat biotic and abiotic stresses. The APETALA2/Ethylene Responsive Factors (AP2/ERF) particularly the RAP2 subgroup, play crucial roles in diverse stress responses and developmental processes. We studied RAP2 genes in *A. thaliana, G. max, M. truncatula, V. radiata, V. angularis, O. sativa, Z. mays*, and *S. bicolor* to elucidate their prevalence, structural characteristics, and evolution. After basic characterization, we elucidated their detailed expression profiling through analysing gene expression data available on SRA-NCBI and GEO projects in *A. thaliana* against biotic (fungi and nematodes) and abiotic stress (abscisic acid (ABC), jasmonic acid (JA), salicylic acid (SA), ethylene, and salt). Finally, the expression of RAP2.6 was studied in detail through RT-PCR, creating promoter::GUS and T-DNA mutant lines. A total of 73 RAP2 genes were identified in the above mentioned economically important crops and they were grouped into two distinct groups: ERF and RAV (Group 1), and AP2 (Group 2). The expression of RAP2 genes revealed that RAP2.6 (except nematodes) and RAP2.7 were upregulated in all cases, while RAP2.10 and RAP2.11 were downregulated. This suggests that these genes may play a different role in different stress responses. The overexpression and mutant lines revealed that RAP2.6 was inducible by *P. syringae* but downregulated in *H. schachtii* induced syncytia from a very early time point on. GUS expression of RAP2.6 revealed its highest expression in ABA (12 h), Mannitol (12 h), NaCl, and wounding (0.5 h) treatments. While it was downregulated in cold, heat and desiccation treatments at all time points. Overexpression of RAP2.6 led to an elevated resistance against *H. schachtii*. These findings provide new insights into the role of RAP2 genes in plant stress response and development. More research is needed to confirm these findings and to identify the specific pathways that are regulated by these genes. However, the results suggest that RAP2 genes play an important role in plant adaptation to a variety of stresses.

Keywords:*; Arabidopsis; RAP2.6 overexpression; RAP2 genes; biotic stress; abiotic stress.*

ID: 136

Influence of seed priming on morpho-physiological traits associated with drought tolerance in maize

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Abstract

Maize (*Zea mays* L.) is one of the most important grain crops in Pakistan and is produced throughout the country under diverse environmental conditions. The maize crop faces many drastic abiotic challenges, but drought is considered the most alarming factor that reduces plant growth and yield. Seed priming is a well-known method and most adapted mechanism that mitigates drought stress and ultimately enhances the growth development as well as grain yield of plants. The objective of the present study was to assess the effect of different seed priming approaches on plant growth and development in maize in addition to evaluate the potential of various seed priming techniques for mitigating drought stress in maize. By keeping these facts in mind, a pot experiment was conducted under a completely randomized design under natural conditions to study the influence of different priming agents on morpho-physiological characters related to water deficit conditions in maize. Seed priming agents developed drought tolerance mechanisms in maize plants which ultimately enhanced the morpho-physiological parameters and gradually increased growth development in early stage of development. The obtained data were analyzed through ANOVA and variations between all the parameters of both maize varieties were measured at 5% probability level. It was concluded that both varieties of maize through morpho-physiological attributes showed best behavior under seed primed conditions. Overall variety Pak-Afgoi responded well to the seed priming approach to mitigate the drought stress in maize. Moreover, the results demonstrated clear and significant impact of seed priming on both maize varieties under drought stress for various characters under study. Conclusively, based on the present study, the seed priming may lead to enhanced drought tolerance in maize.

Keywords: *Maize growth, seed priming, drought tolerance, morpho-physiological traits, crop management, abiotic stresses*

ID: 138

Comparison of Live Body Weight, Fluctuating Asymmetry, and Location Effect on Behavior in Laying Hens Reared on Litter Floor with or without Access to Different Plant Compositions

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Abstract

In this study, Lohmann LSL Classic and Lohmann Sandy strains were housed in litter floor pens without (LF: four replicate pens per strain) or with access to outside pens covered with *Petroselinum crispum* (PC), *Mentha piperita* (MP), and *Medicago sativa* (MS): three replicate pens per strain. LF hens stayed completely indoors from 4 to 52 weeks of age. For the PC, MP, and MS groups, accessibility to outdoor pens began from 12 to 52 weeks of age, daily and continuous between 8:30 a.m. and 15:30 p.m. Live body weight (LBW) data was obtained after weighing birds (n = 52) at 31, 42, and 52 weeks of age. Behavior observation was conducted at 32, 42, and 52 weeks of age, but the data was pooled for a more precise estimate. Fluctuating asymmetry (FA) in bilateral traits was assessed at 52 weeks of age (n = 52). LBW was increased with the aging of birds ($P<0.001$), higher in LS strain than LW strain ($P<0.001$), but similar among the housing environments ($P>0.05$). FA of all the 13 measured bilateral traits was similar between strains ($P>0.05$), but a larger FA of face length in MP hens than in other groups was observed ($P = 0.012$). Also, the strain*housing system interaction effect nearly reached a significant level ($P = 0.064$) for face length, with larger FA in LW hens housed in the MP environment than in other groups. The percentage of birds that were standing, walking, foraging, dust bathing, pecking objects, stretching and wing flapping was higher outside than inside. However, more pecking of other hens and preening behaviors were expressed inside than outside ($P<0.01$). This research confirms strain differences in live body weight and location effect on the expression of many behavioral repertoires in birds. It, however, demonstrates no strain and housing environment disparity in the fluctuating asymmetry of bilateral features.

Key Words: behavior, housing environment, layer chicken, welfare, bilateral traits

ID: 139

Comparison of Bcas Application Method for the Management of Leaf Rust in Bread Wheat

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Abstract

Wheat (*Triticum astivum*) is a staple crop in Pakistan, an important member of the family *Poaceae*. Wheat is a key global product in terms of acreage and tradeable value and is a staple food. Wheat is a rich source of nutrients (contains protein, carbohydrates and dietary fiber). Wheat production in Pakistan during 2021/22 was 26.0 million metric tons, 3% higher than last year of Wheat production of 25.0 million metric tons. Wheat is invaded by many diseases commonly Wheat rust* causes more damage. Wheat rust is caused by a fungus named *Puccinia triticina* (an obligate plant pathogen) that lies dormant in the temperate zone. The three rust diseases affecting Wheat are leaf, stem and stripe rust. The most common is leaf rust commonly known as Brown rust. Leaf rust causes 50% yield loss annually in Pakistan. The disease is more active in the maximum temperature range of 23.8-27.15°C, while the minimum temperature range of 16-18°C also plays an important role in the development of disease. In this study, different BCAs (*Trichoderma harizianum, Bacillus subtillus and Arthrobactor sp.*) was applied at maturity via foliar and drench methods and analyzed, to determine which one is the best bio-control agent for reducing the severity of leaf rust disease. In this study, the five Wheat varieties (Anaj-71, Inqlab-91, Punjab-96, Chanab-2000 and Shakar-95) were taken for the research trial. These varieties were cultivated in Randomized complete block design (RCBD) in field conditions. The collected data were analyzed using the analysis of variance technique and the results were analyzed by using the Least Significance Difference (LSD) test at a 5% significance level. Bio-control agents enhance the Wheat morpho-physiological growth which was evident from the characters like height, root weight, leaf fresh and dry weight, number of awns, awns length, number of seed per spikes, number of nodes per plants, internodal length, weight of grain per plants, 1000-grain weight, peduncle length and total production.

Key Words: *Wheat production, Wheat Rust Control, Bio-Control Agents, Wheat Varieties, Crop Disease Management*

ID: 142

Source-sink association of flag leaf with brown rust resistance under the application of BCAs in bread wheat

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Abstract

Wheat (*Triticum aestivum*) is a staple food in Pakistan and is an important crop all over the world. It contains carbohydrates, proteins and minerals which are the main ingredients of human diet. The production per unit area of wheat in Pakistan is low due to a number of biotic and abiotic stresses. Among biotic stresses, leaf rust is very important which is infected by the *Puccinia triticina*. Under favorable environmental condition, leaf rust causes yield losses up to 40%. Flag leaf contributes in grain production and the objective of this study was to assess the source sink relationship between flag leaf and grain yield under leaf rust attack followed by application of different biocontrol agents (BCAs). In the current studies, four wheat varieties were treated with different BCAs and were sown under field conditions along with necessary control treatment. The experiment was conducted under randomized complete block design (RCBD) with three replications. The plants were inoculated with *P. triticna* both naturally as well as artificially. The result showed the presence of strong source-sink association of flag leaf with grain yield hence this trait could be used as morphological markers for selection of wheat genotypes having superior photosynthetic activity and higher grain yield. Collected data were statistically analyzed for analysis of variance technique and means were compared using Least Significance Difference (LSD) test at probability level of 5%. The result also showed the clear and significant impact of BCAs in the control of this very important wheat disease. The results demonstrated that variety Arooj-2022 showed highest resistance against leaf rust and application of *Trichoderma* sp. led to maximum control of the disease. The present findings are a way forward for environment friendly management of leaf rust disease in wheat.

Keywords: *Wheat, Leaf rust, seed priming, biocontrol agents, disease severity, morpho-physiological parameters, crop management.*

ID: 143

Climate Change, demographic Pressure and Adaptation of Agropastoralism in the Tandjilé province Southern Chad

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Abstract

This work set out to examine the link between Soil pressure, The Forage Deficit, Impact of climate change on agropastoral households, Relation between users of agro-pastoral resources misunderstandings between users and some reasons mentioned, Change in transhumance mode and Adaptation in the Tandjilé. The climate by its variability has affected several agro-pastoral sectors in the Province of Tandjilé. Pastoralism has been in crisis in Tandjilé province. Several (negative) factors contribute to the weakening of animal production and pasture: pressure on pastoral resources, period of flooding, period of low rainfall and the galloping demography. Another solution to the crisis of pastoralism consist to engage in agriculture, alongside livestock breeding. In ten years land pressure was increase to 81.92%. The changes have impacted several agro-pastoral sectors through fodder deficits, declines in agricultural and livestock production, poor distribution of rains and floods. Misunderstanding between the users of agro-pastoral goods often leads to conflicts marked by the deaths of men in the province of Tandjilé.

Keywords: *Climate Change, Pressure, Adaptation, agropastoralism, Tandjilé province, ferrick.*

Introduction

The expansion of pastoralism in the Tandjilé savannah is a recent phenomenon and has gained momentum over the past 30 years.

Faced with a crisis situation, herders reacted by mobility, seeking above all an outlet in this part of Tandjilean savannahs where resources are available and whose seasonal alternation is the opposite of North zone. They manage new relationships in the new environment and have invented another pastoralism: agropastoralism. Adapt to this new context, once installed, breeders are rebuilding the herd, despite the fact that the pastoral system remains fragile: they have to fight with nature caprice, new pathologies in the area, a relatively limited number of animals, the difficulties in relationship with farmers, a precarious land status on the new pastures occupied by agricultural activities and city pressure make most of those pastoralists vulnerable.

Materials and Methods

Samples were collected from Tandjilé ProvinceFig.1. (GPS coordinates: 9° 24'N latitude and 16° 18' E longitude). It is characterized by a Sudanese tropical climate with a long dry season (7 months) and a short rainy season (5 months).

Tandjilé has a population of 661 906 inhabitants (INSEED, 2014). This population is estimated in 2018 at 895042 inhabitants (ANADER/CHAD, quoted by Nang-yana 2018), of whom 52.3% are women. The growth rate is 3.5%. However, over 80% of this population lives in rural areas. The density of the population is about 42.09 inhabitants per square kilometre.

The thermal regime is marked by a relatively cold period from December to February (from 11 ° to 22 ° C) and a hot period from March to June (from 39 to 45 ° C).

The sampling of the population investigated was extracted on the basis of the formula of Anderson et al., (2015). Initial sampling was targeted agropastoral settlement or villages with more than 30 years of existence. A settlement not subjected to season flood and of neighbourhood to crop-farmers was selected for the survey. The agropastoralists who had more than 50 cattle has selected for the interview. A comprehensive list of agropastoral herders and crop-farmers that close to one another was make.

Anderson's formula: $X = \frac{(Z_{a/2})^2 P \times (1-P) N}{(Z_{a/2})^2 P(1-P) + (N-1)E^2}$

X = sample size; N = size of the grand population; P = Proportion (50%); E = Margin of error (5%); 95% confidence interval and Zα / 2 = 1.96.

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Out a total of 140,366 households, a sample of 196 was interviewed and the interviewees were the head of household. The stratified sampling at two levels was investigated 50% agropastoralists (98); 40% crop-farmers (78) and 10% authorities and heads of agriculture and livestock service (20). The first level involved the agropastoralists village and ferrick, the second concern household.
The survey on impact of climate change (rain fall and temperature) and demographic pressure was conducted to capture agro pastoralist's adaptation capacity for climate change, demographic pressure.

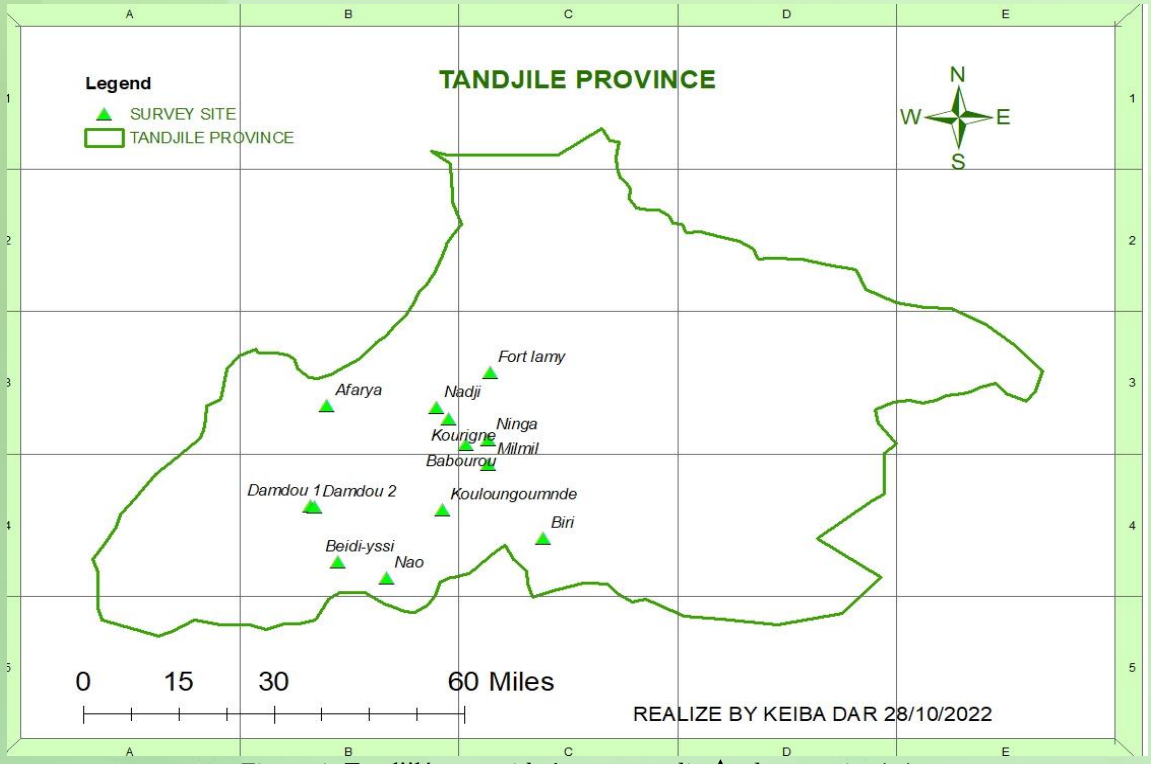


Figure 1. Tandjilé map with Agropastoralist settlement site ( )

Study Design and Sampling

The field surveys lasted from June to October 10, 2021 in Tandjilé.
Data were collected individually from 196 heads of household ranging in age from 40 to 70 years. Most of the respondents were over 65 years old.
In each ferrick surveyed (the choice of which was based exclusively on their ages), a focus group was set up around a Chief of the Ferrick. This made it possible to carry out 6 focus groups in total of 13 ferrick we visited.

Table 1. Ferricks Names and Number of Sampling (n=196)

Province	Ferricks	Ethnic groups	Sample
Tandjilé-Est	Babourou	Arabe	13
	Fort lamy	Arabe	11
	Kourigne	Peulh	07
	Milmil	Peulh	10
	Nadji	Peulh	29
	Ninga	Peulh	10
	Biri	Arabe	11
Tandjilé-Centre	Beidi-yssi	Peulh	06
	Kouloungoumnde	Arabe	14
	Nao	Arabe	34
Tandjilé-Ouest	Afarya	Arabe	13
	Damdou 1	Arabe	28
	Damdou 2	Arabe	10
Total		196	

Source: Based on field survey

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Result

Soil pressure

According to information received from agro-pastoralists and official services such as the cadastral service of the province of Tandjilé, there were two periods of urban and peri-urban subdivision from 1962 to 2009 and 2009 to 2019. This first phase of extension of living spaces on the East side of the city concerned a distance of 1km from 1962 to 2009; approximately 1 km on the South side and also 900m on the North side. These extensions of residential areas have had an impact on agricultural areas and forced peri-urban agriculture towards open spaces considered as grazing areas.

From 2009 to 2019, the extension of the city on crop area was estimated on the East side reached 1.7km; 1.6m on the South side and 1.5km on the North side.

The west side of the department of Tandjilé East where this work took place is occupied by the Logone River which is also under threat on its borders due to climatic impacts and especially the action of men (earth taking and brick making).

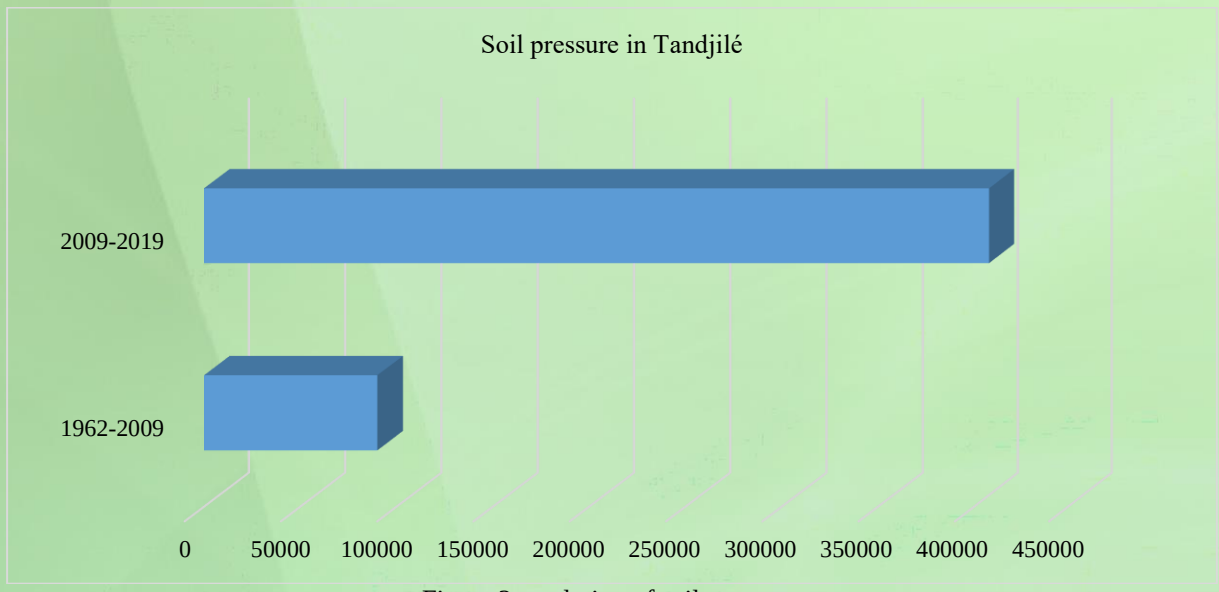


Figure 2. evolution of soil pressure.

From 1962 to 2009 we witnessed a subdivision of 90,000 ha only for residential areas in 47 years.

From 2009 to 2019 we have a subdivision area of 408,000 ha in 10 years.

That is a total of 498,000 ha of residential land. This demographic pressure has played a role in the disappearance of resources and influences on the areas reserved for agriculture and livestock. In 10 years we note an occupancy of 81.92%.

The Forage Deficit

98% of interviewers observe the forage deficit. Recently in the Tandjilé Province, most of transhumant herders and agropastoralists (88%) have turned to aerial grazing, which is over-exploited during certain periods of the year between the months of February to May due to the low reconstitution of the herbaceous cover. Passage of the bush fire and the late arrival of the rainy season. This overexploitation of aerial pastures strongly affects the regeneration of certain species. *Faidherbia albida, Daniella oliveri, Zizyphus mucronata, Zizyphus mauritiana, Adansonia digitata* are highly threatened species during our work in the area.

Water resources

For majority of agropastoralists surveyed (87%), water resources in the region were abundant. All ferricks are located near a water point. The availability of ponds, rivers and traditional wells, has meant that the projects intervening in pastoralism have only built 3 modern wells for livestock in those 13 ferricks visited.

During the focus group, the agro-pastoralists declared that in the past the ponds and even the traditional wells are perennial and the animals do not need to go down to the river. Currently the wells and the ponds dry up from the month of March. The reasons mentioned were, among others: the silting up of the ponds, but above all the descent of the transhumant with the herd of dromedaries very early in the locality on January.

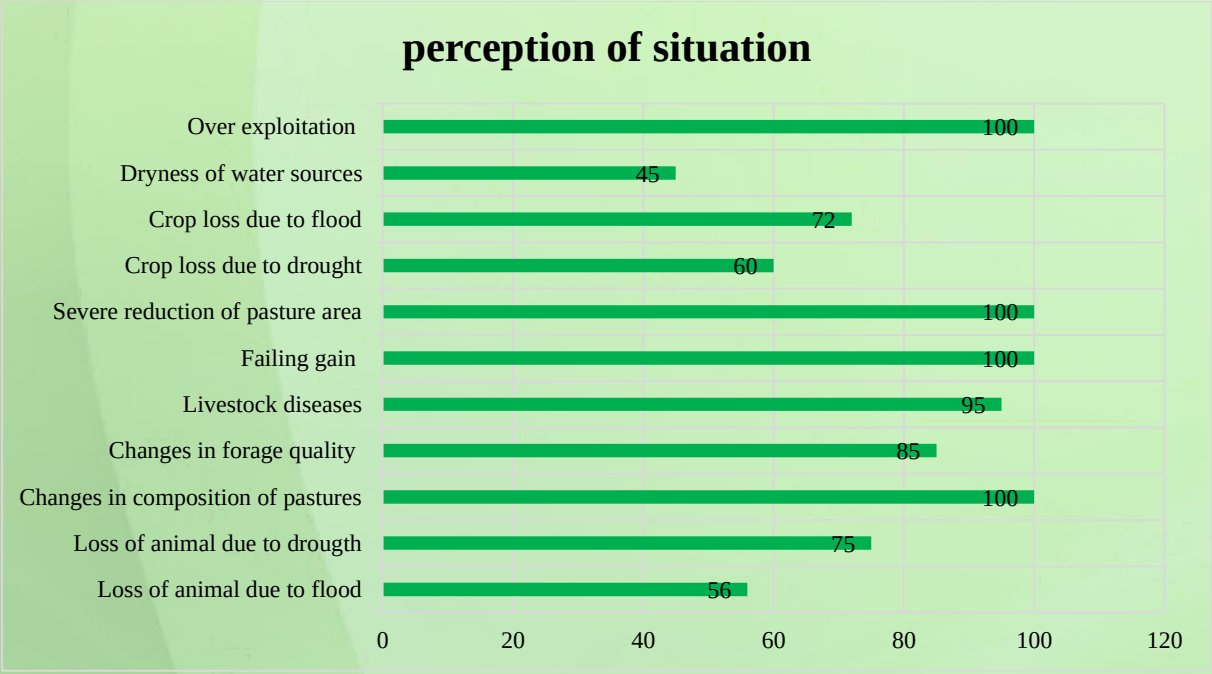


Figure 3. shock situation

Impact of climate change on agropastoral households

All the agro-pastoralists interviewed felt that there is a big change in Tandjilé province. The drought of 1984 and the famine of 1985 are still in the minds. "We survived these years by grace of God said the head of Nao ferrick". For all the agro-pastoralists, the events of 1984 and 1985 are the causes of the decline of a large number of pastoralists and agro-pastoralists recognizes the head of another ferrick of Damdou.

The loss of our animals has imposed the work of cultivation on us, but at this level also the yields of the crops are only decreasing.

Climate change has undoubtedly had an impact on incomes. For 86% of agropastoralists, eating habits have changed: milk is only served to children and the rest is intended for sale. 76% of agro-pastoralists eat one meal a day between March-April and the month of July due respectively to insufficient income from the sale of milk caused by forage deficit and mosquitoes.

All of the women (100%) interviewed said they went to the market every day with fresh milk, curd and butter more than years ago, but today very few of them (22%) said, they went to the market every day with fresh, curdled milk and butter; half sell curd and butter and the rest of the women sell fresh milk irregularly.

Relation between users of agro-pastoral resources in the Tandjilé

Tandjilé has long remained a conflictive Province between farmers, agro-pastoralists and transhumant herders.

After the murderer conflicts of recent years, which have recorded hundreds of deaths in the cantons of Kolon, Bere, Tchoua, Boulou, Mouroum and Kabalaye in the Tandjilé, a forum for peace and peaceful cohabitation was initiated by civil society and religious leaders in 2020. This forum showed 17 points considered by the participants as the origin of the conflict. On both sides, the participants agreed to respect the principles and peacefully resolve their problem from the representative head of the villages or ferricks.

According to the local NGOs and during the focus-group, the remarks were the same: “The years ago, migration initially was seasonal, with herders spending November to May in the Southern zone before returning north. Over the last decades, the available pastures shrank in the far north, herders have been staying in the southern zone longer and recently, some have chosen to graze their herds there permanently and cultivate around their ferricks. This has triggered increasing disputes over land use with growing populations of sedentary crop farmers in Tandjilé province”.

Misunderstandings between users and some reasons mentioned

According to the agro-pastoralists (78%) met in the Tandjilé Province, climate change contributes to misunderstandings between users of natural resources. Such misunderstandings often lead to conflicts that are sometimes so violent that they cause deaths on both sides, as in the Tchoua, Kolon and Boulou Cantons over the past five years.

90% of agro-pastoralists had also mentioned that the use of ponds by farmers for irrigating fields in the dry season causes misunderstandings.

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The breeder must bypass the trap fields and travel for miles to water his herd. The distance already covered for watering leads to an increase in expenditure linked to walking (maintenance expenditure) which means that animals in free grazing in the dry season, instead of gaining in weight gain, rather fall in weight gain declared the respondents during the focus group.

Agropastoralists and Farmers

Conflicts between Agropastoralists and farmers in Tandjilé were frequent according to 92% of population interviewed. 44% of agropastoralists said that these conflicts are linked to climate change. 31% felt that conflicts were low in the Tandjilé region unlike other southern regions. 25% of ferric agropastoralists have not experienced conflicts between users of natural resources.

Agropastoralists and transhumants

More than half of the agropastoralists (65%) underlined that the most frequent conflict between agropastoralists and transhumant people arises around water points and on rangelands. Transhumant herders contribute to degrading the resources strategically defended by agropastoralists around the ferricks. The other conflicts are much more related to cattle rustling. The Peulh agro-pastoralists had felt that they were victims of cattle theft organized by transhumant traders of the Arab ethnic group.

Table 2. Distribution of agropastoralists on the frequency of conflicts around resources between transhumant and agropastoralists.

Cause of conflicts	Pasture	Water	Others
Percentage	55	30	15

The cultivation on pastoral passages, the transformation of pastures into rice fields, the devastation of fields by animals, the monopolization of pastoral water points by groups of market gardeners, the new transhumant people settle, the non-respect of transhumance calendars to facilitate agricultural activities, the anarchic creation of residential areas, management of the passage of breeders, cattle theft, alcoholism, bad trials are the points raised during the Provincial Forum for Peace and Cohabitation peaceful which took place in June 2022 in the Tandjilé.

Those situations create misunderstandings leading to conflicts, sometimes very violent.

The outcome of this framework forum for consultation and peaceful cohabitation a document providing for the possible prevention and management of these conflicts by securing pastoral mobility on the basis of clear and consensual rules of access to resources and respect for transhumance.

This cropland expansion was pointed out by breeders as one of the factor which amplifies the misunderstanding.

Change in transhumance mode

88% of agropastoralists said they send animals on transhumance only when germination shoots are good or during periods of flooding. In Tandjilé there is a wide variety of crops, but the most dominant are those of rice and flood recession sorghum. Rice is grown in all departments with the exception of a few cantons. However, sorghum is cultivated only in the department of Tandjilé-EST and more precisely in Soumraye, Tchaguine and Ndam cantons, suggested the heads of rural development departments.

According to the agro-pastoralists interviewed, they send the animals to graze during the rainy season, which corresponds to the plowing period in those Cantons. The stay of the animals is linked to the activities in the three cantons which only began to plant sorghums that had receded after the withdrawal of the rainwater.

For the majority of agro-pastoralists, around 30 years ago, the start of transhumance was early. But currently less than 6.02% were sending animals to fallback areas in June. Most of it left late between July and August. The overall return is early from October just after the last rains.

Adaptation

For agropastoralists interviewed in Tandjilé, each group adapts according to its strategy, its type of livestock farming and the feeding habits of the livestock which imposed the choice of the area on them. The Arabs are found all around the ponds and the river, not far from the urban center and the main axes. They affirmed that in the past, milk was the basis of their food. But, with the decrease in milk production, maize flour consumption as in the form of porridge has become their food habits. Consequently, rice is inaccessible because the prices had increased and making the exchange milk also become difficult.

The majority of Fulani pastors encountered were mainly involved in livestock breeding, even if they also engage in agriculture or small business. Some agropastoralists families still have a large number of cattle; small ruminants and poultry. Most of their herd is entrusted to a family member who continues to raise in a transhumant mode system. Others on the other hand (who can be described as herdsmen) mainly have entrusted animals (businessmen and traders...). The price of cereals increase that is why we plant crops to get cereals for our own consumption. We are convinced and know that livestock rearing cannot be our only source of food.

The most important adaptation practice are seen in figure 4.

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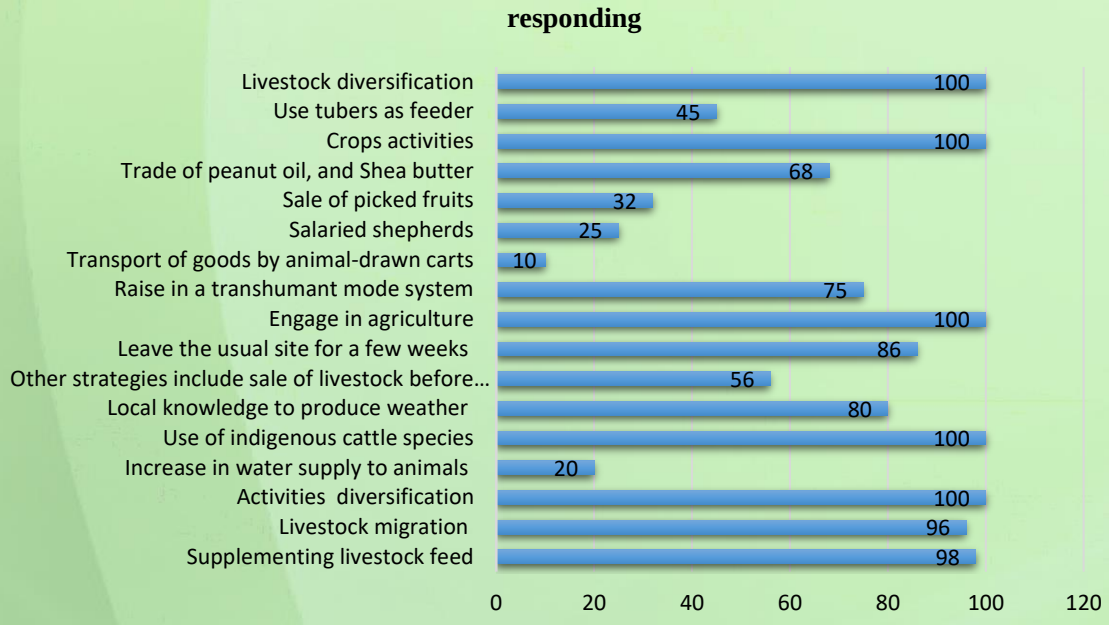


Figure 4. Agropastoralist adaptation strategy

100% of Agropastoralists do mostly activities and species' diversification; and also livestock transhumance but in addition they use also improved varieties of maize around there ferrick.
For some agropastoralists (86%) living in the plains of Tandjilé, they have an idea of the flood periods of their site. Their strategy is to leave the usual site for a few weeks to settle near the roads until the waters recede.
There are various factors undermining the adaptation of families of agropastoralists, even old ones, on the site for more than thirty years. The responses and strategies developed by the latter in the face of climatic influences always revolved around mobility, the development of certain activities such as the transport of goods by animal-drawn carts, young people converted into motorcycle taxi drivers and parents in ferricks have remained salaried shepherds (25%), paid to keep the animals of the political elites and traders of the province. It is a good deal for us without agriculture activities.
During our survey work, the chief of ferrick of Ningua declares in these terms "we lost most of our herds during the droughts of 1984 and the rest of the cattle in the resolution of conflicts and to face insecurities, which you see are the entrusted animals. Even if you have the animals I am ready to raise for you against a salary which is paid monthly at 1000F CFA per head of cattle".
The women meanwhile, in addition to the milk trade, had turned to the sale of picked fruits, the trade of peanut oil, and shea butter.
These agro-pastoralists practice agriculture on the small parking plots around the ferrick which are very profitable during the rainy season. These agropastoralists become good cereal farmers and buy back the females after the sale of the cereals thus produced to reconstitute their herd.
The other populations have a purely agricultural vocation, turning to off-season crops and market gardening. There is also an intense development of fruit growing on land near water points around agropastoralists ferricks.
To recall, for 96 % of agropastoralists, Cattle remains important species according to the agropastoralists, the small ruminants are becoming more and more important because they requiring less water and food and are less vulnerable to warming. For economic reasons corn and millet are the most important crops cultivated around ferrick.

Discussion

Soil pressure

The soil pressure in Tandjilé province is reel. There was a land occupation of 90 000 ha from 1961 to 2009 against an occupation of 408 000 ha from 2009 to 2019. Between 2009, to 2019 we assist to the speed expansion of 82.92% of demographic pressure to the land. The results show a real demographic pressure on the soil. Akpan and Ebong, (2021), in Nigeria, revealed that agricultural land has continued to increase and currently averaged at 68.78%, indicating massive land expansion for use in farming. Furthermore, the findings showed that most arable crop outputs increase majorly from land expansion rather than land productivity. This situation cannot assure sustainable agricultural land use for food security in the near future. Besides, the country's agricultural land policies should focus on achieving land productivity and sustainable land-sharing strategies among major land

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users. The result show that the speed expansion of land use in Tandjilé province is superior to the result obtained by Akpan and Ebong in Nigeria. The study of Hansen, and Reenberg, (1998), in Burkina has showed rather the fields expansion onto idle bush land.

Forage deficit

98 % of interviewers observed the forage deficit in Tandjilé province. The deficits sometime are caused by the farmers themselves who burn crop residues such as rice straw preventing the animals of the breeders from grazing in their fields. For Harouna et *al*., (2020) anthropogenic practices such as the collection of straw, which leads to a reduction in the edaphic stock of seeds, and the extension of crop fields to grazing areas, aggravate this degradation. These practices are the result of population growth and the decline in agricultural production.

Most of transhumant herders and agropastoralists (88%) in Tandjilé Province have turned to aerial grazing, which is over-exploited during certain periods of the year between the months of February to May due to the low reconstitution of the herbaceous cover. Passage of the bush fire and the late arrival of the rainy season. This overexploitation of aerial pastures strongly affects the regeneration of certain species. *Faidherbia albida, Daniella oliveri, Zizyphus mucronata, Zizyphus mauritiana, Adansonia digitata* are highly threatened species during our work in the area. Our results confirm the study conducted by Dione et al. (2020) in Senegal which showed that 82.14% of the woody species inventoried are considered fodder. These include *Adansonia digitata, Cordyla pinnata, Faidherbia albida, Ficus capensis, Ziziphus mauritiana* and *Sterculia setigera*. This observation shows the importance of the specific richness of the fields where all these species are found. Other respondents use these woody fodder for human food, pharmacopoeia, crafts, lumber, firewood, etc. This shows a strong pressure on these resources. According to Sarr et *al.* (2018), trees are the main source of green aerial fodder in the Sahel in all seasons and are found not only in agroforestry systems, but also in natural pastures. In pastoral areas, fodder supply during the dry season or in years of low rainfall is difficult with annual plants, and in these cases woody pasture becomes an important element (Niang, 2009).

Woody fodder species are much more exploited in the dry season when natural food resources become critical. This shows the importance of woody species in animal feed in the dry season. Our survey results confirm those of many authors who note the maximum use of aerial fodder by livestock during the dry season (Dione et al. 2020; Bakaye, 2014; Bechir and Kaboré-Zoungrana, 2012), the dry season is the period during which woody plants are more exploited by agropastoralists. To access the different parts of the trees, breeders often practice cutting or pruning (Bakhoum, 2020). Diallo, (2019) in Mali confirm that the high demand for woody fodder crops leads to overexploitation of the most demanded. The consequence is the scarcity of these species in the harvesting areas. The results of the survey reveal the existence of overexploitation of woody fodder species which are consequently less and less abundant in the area. The overexploitation of species leads to the rarity or even the total disappearance of the species in the area.

Relation between users of agro-pastoral resources in the Tandjilé

Conflicts between Agropastoralists and farmers in Tandjilé were frequent according to 92% of population interviewed. Tandjilé has long remained a conflictive Province between farmers, agro-pastoralists and transhumant herders. This murderer conflicts of recent years, have recorded hundreds of deaths. However in Nigeria in 2016, ICG have given an alarming figure of 2500 deaths. These conflicts are, by every measure, complex and multidimensional. Formulating appropriate responses requires a clear diagnosis of their root causes, evolution, impacts and implications.

Historically, relations between herders and sedentary farming communities have been harmonious. By and large, they lived in a peaceful, symbiotic relationship: herders' cattle would fertilize the farmers' land in exchange for grazing rights. But tensions have grown over the past decade, with increasingly violent flare-ups spreading throughout central and southern states in Nigeria.

Migration initially was seasonal, but over the last decades, with available, pastures in southern part of the country, herders staying in the southern longer. This last 30rd years, some have chosen to graze their herds there permanently and cultivate areas around their Ferricks. This situation is general and was reported also in Nigeria by ICG, 2017. For ICG, Among the principal causes and aggravating factors behind this escalating conflict are climatic changes (frequent droughts and desertification); population growth (loss of northern grazing lands to the expansion of human settlements); technological and economic changes (new livestock and farming practices); crime (rural banditry and cattle rustling); political and ethnic strife (intensified by the spread of illicit firearms);and cultural changes (the collapse of traditional conflict management mechanisms). A dysfunctional legal regime that allows crime to go unpunished has encouraged both farmers and pastoralists to take matters into their own hands reported the ICG in their paper published in 2017.

Adaptation Strategies

Agropastoralists in Tandjilé have adopted several strategies to deal with climate change (fig. 9). Coulibaly et *al.* (2022) note that agropastoralists have implemented strategies to adapt to climate change by making their activities less sensitive and more resilient to climate change, the most widespread of which are: transhumance, the recomposition of the herd, purchase of complementary feed, destocking, use of crop residues, storage of dry grass, compliance with vaccination schedules, diversification of sources of income (trade and agriculture), adoption new farming techniques (zai, ridge, half-moon) and the use of improved breeds and seeds. These strategies are almost

similar to those implemented by agropastoralists in the province of Tandjilé. Overall, the adaptation results obtained in Tandjilé confirm those of other authors (Coulibaly (2021) in Mali, Ouédraogo (2010) in Burkina cited by Coulibaly (2022).), who mention that mobility, in particular transhumance, constitutes one of the adaptation strategies most practiced by pastoralists to cope with climate change. Nowadays, transhumance is still practiced, but it differs a little from that of before because the departures are early, the returns late and the distances traveled longer and longer. Zaza, *et al.* (2022) notes that mobility continues to characterize livestock systems in the Ras El Ma region in connection on the one hand with the degradation of rangelands and on the other hand with the new rules of access to food resources and fodder, in particular paying.

Other coping strategies existing in fig. 9 such as the sale of milk, sale of fruit, etc. have been noted by Sarr, (2019) in Mauritania and Dangar, (2018) in Chad. These two authors are unanimous on the contribution of agro-pastoral by-products as a source of household income to increase the resilience of agro-pastoralists in the face of climatic hazards. Agropastoralists in Tandjilé have adopted several strategies to deal with climate change (fig. 9). Zaza, *et al.* (2022), note that mobility continues to characterize livestock systems in the Ras El Ma region in connection on the one hand with the degradation of rangelands and on the other hand with the new rules of access to food resources and fodder, in particular paying. Other coping strategies existing in fig. 9 such as the sale of milk, sale of fruit, etc. have been noted by Sarr, (2019) in Mauritania and Dangar, (2018) in Chad. These two authors are unanimous on the contribution of agro-pastoral by-products as a source of household income to increase the resilience of agro-pastoralists in the face of climatic hazards.

Change in transhumance mode

88% of agropastoralists said they send animals on transhumance only when germination shoots are good or during periods of flooding. In Tandjilé there is a wide variety of crops, but the most dominant are those of rice and flood recession sorghum. Rice is grown in all departments with the exception of a few cantons. However, sorghum is cultivated only in the department of Tandjilé-EST and more precisely in Soumraye, Tchaguine and Ndam cantons, suggested the heads of rural development departments. Pour Bakuom (2020), les éleveurs, pour faire paître et abreuver le bétail en saison sèche, sont obligés de pratiquer la transhumance.

According to the agro-pastoralists interviewed, they send the animals to graze during the rainy season, which corresponds to the plowing period in those Cantons. The stay of the animals is linked to the activities in the three cantons which only plant sorghums after the end of rainy season. When land productivity declines due to climate change, farmers often migrate to urban areas (IPCC, 2014). This last migration strategy is also used during surveys carried out among herders in Tandjilé. For the majority of agro-pastoralists, around 30 years ago, the start of transhumance was early. But currently less than 6.02% were sending animals to fallback areas in June. Most of it left late between July and August. The overall return is early from October just after the last rains. For Benkhe et al. (1993) the organized mobility of people and herds essential to the sustainable development of these ecosystems through pastoralism is a basic strategy for adapting to the strong spatiotemporal variability of pastoral resources.

Impact of climate change on agropastoral households

The impact of climate change affected negatively on agropastoralism households. All the agro-pastoralists interviewed felt that there is a big change in Tandjilé province. The drought of 1984 and the famine of 1985 are still in the minds. "We survived these years by grace of God said the head of Nao ferrick". For all the agro-pastoralists, the events of 1984 and 1985 are the causes of the decline of a large number of pastoralists and agro-pastoralists recognizes the head of another ferrick of Damdou.

The loss of our animals has imposed the work of cultivation on us, but at this level also the yields of the crops are only decreasing.

Climate change has undoubtedly had an impact on incomes. For 86% of agropastoralists, eating habits have changed: milk is only served to children and the rest is intended for sale. 76% of agro-pastoralists eat one meal a day between March-April and the month of July due respectively to insufficient income from the sale of milk caused by forage deficit and mosquitoes.

All of the women (100%) interviewed said they went to the market every day with fresh milk, curd and butter more than years ago, but today very few of them (22%) said, they went to the market every day with fresh, curdled milk and butter; half sell curd and butter and the rest of the women sell fresh milk irregularly.

Yabrir *et al.* (2015), therefore reveals that sedentarization remains a large-scale option adopted by the elevations to deal with resilience.

Conclusion

This study highlights and examine the link between Soil pressure, The Forage Deficit, Impact of climate change on agropastoral households, Relation between users of agro-pastoral resources misunderstandings between users and some reasons mentioned, Change in transhumance mode and Adaptation in the Tandjilé. The analysis of responses indicated that there is problem in the Tandjilé province. Agropastoralists have reported an increased frequency of land pressure, forage deficit and misunderstanding. Given that agro-pastoral systems in this area are rain-fed, production have been falling, affecting the livelihoods of the agropastoralists negatively. Income sources and food supply systems are already compromised by climate change and environmental degradation.

Transhumants in Tandjilé are still considered as strangers and discriminated upon by crop-farmers as far as land is concerned.

Adaptation to climate change needs a well-structured resource base system and collaboration amongst actors. It is recommended that farmers and grazers, local administrative and traditional authorities should work in a participatory way. This will help them to co-develop locally appropriate climate-sensitive methods, build resilience and improve on food production.

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ID: 144

Effect of extraction solvent and drying condition on the antioxidant potential of Peel and pulp membrane of *Punica granatum*.

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Abstract

The current study was designed to study the effect of extraction solvent and drying condition on antioxidant activity of pulp membrane and peel of two varieties of *Punica granatum*. The plant material were dried under sun and shade condition. Extracts were prepared in different extraction solvents including methanol, ethyl acetate, hot water and cold water. DPPH (diphenyl-2-picrylhydrazyl) method was used to measure the negative radical scavenging potential of extracts. The study's findings reveal that all of the shade-dried extracts of plant materials had more antioxidant capacity than the extracts of plant materials dried in the sun. The sun-dried peel extracts also showed similar results of 80%, and 78% for both methanol and water extracts at 250µg/ml. The ethyl acetate and hot water extracts showed almost 70% activity. In contrast, the shade-dried peel methanol extracts of fruity pomegranate showed nearly 83% antioxidant activity followed by hot water with about 81%, water with 78% and ethyl acetate with 72% activity at 250g/ml. In comparison, the sun-dried peel also showed similar results for all the solvent extracts except ethyl acetate, which showed the least activity of 68% at 250g/ml. Furthermore, the extracts prepare in various solvents had varying results in terms of negative radical scavenging activity. Hot water and methanol extracts showed strong antioxidant activity of 80% to 82% while ethyl acetate and water extracts indicated almost the similar 70% antioxidant potential capacity for wild peels of pomegranate. The extracts of peel of wild pomegranate indicate higher antioxidant potential than peel of commercially available pomegranate indicating the genotypic and environmental effect on the expression of metabolites involved in antioxidant activity.

ID: 145

Genomic Identification, Characterization and Phylogenetic analysis of the AP2 Gene Family in Glycine Max

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Abstract

Genetic makeup of Glycine max is crucial for unraveling its traits, improving crop yield and quality, and developing sustainable agricultural practices. Glycine max harbors a large number of transcription factor families, including AP2/EREBP, MYB, WRKY, NAC, and bZIP which are involved in diverse developmental processes and stress responses. The AP2 gene is a member of the AP2/EREBP (APETALA2/Ethylene Responsive Element Binding Protein) transcription factor family, which is widely distributed in plants and involved in various physiological and developmental processes. To learn more about the evolution of the AP2 gene family in soybean, the gene structure, or the distribution pattern of introns and exons, of 50 AP2 genes, was identified. Using the NCBI webserver's basic local alignment search tool (BLASTP), the potential AP2 TFs were verified. Map Chart was used to create a chromosomal localization map of the non-redundant Glycine max AP2 genes. The neighbor-joining approach was used to create a phylogenetic tree using the generated alignment. The discovered genes were then checked to see if the proteins they encoded included any AP2-specific primary domains. The average peptide length of AP2 proteins was 211 amino acids, although the range from 2 to 420 amino acids. Two genes are scaffold genes which gives structural support and tissue development in soybean. Gene Structure analysis revealed that Soybean AP2 genes exhibited a diversity with respect to the number of introns e.g ranging from 1 to 9. The gene structure of Glyma.08G225200 was observed because of having maximum portion of exons and only two introns, while there is absence of non-coding region due to very short size of its genomic DNA sequence i.e 0.7 Kb. To identify conserved domains, MEME was applied to the peptide sequences of all AP2 TFs. According to NCBI, all of the genes exhibit duplication in conserved regions. Using the cercoletto tool, genomic areas from Glycine max (soybean) and Arabidopsis thaliana (as a model plant) were examined to learn more about the evolutionary link and functional conservation of the AP2 genes found in both species. These analyses will greatly aid in expediting the functional characterization of AP2 TF.

Key Words: *Glycine max, AP2 gene family, Arabidopsis, Characterization, Phylogenetic Analysis*

ID: 146

Integrated Use of Low Cost Materials with Traditionally Used Sawdust in Oyster Mushroom (*Pleurotus Ostreatus*) Cultivation in Sri Lanka

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Abstract

Although several alternative substrates have been introduced, Sri Lankan Oyster mushroom (*Pleurotus ostreatus*) farmers rely only on sawdust. Currently, there is difficulty in finding traditionally used sawdust as they are used in other industries. Therefore, a study was conducted to cut off the traditionally used mango sawdust (MSD) requirement by combining low-cost natural materials such as Guinea grass (*Panicum maxima*) leaves (GL) and paddy husk (PH), and another potential sawdust - teak sawdust (TSD). The experiment was designed as a Complete Randomized Design (CRD) with eight substrates; T1: 100% MSD (Control), T2: 50% MSD + 50% PH, T3: 25% MSD + 75% PH, T4: 50% MSD + 50% GL, T5: 25% MSD + 75% GL, T6: 100% TSD, T7: 75% MSD + 25% TSD, T8: 50% MSD + 50% TSD. All the treatments comprised the substrate (30 kg), rice bran (3 kg), mungbean flour (300 g), Calcium oxide (600 g), and Magnesium Sulphate (60 g). Among the substrates evaluated, T1 showed the highest mycelium growth rate (6.83 mm/day), while T7 showed the lowest (5.78 mm/day); T3 spent a minimum duration for primordia initiation (07 days) and first harvest (10 days from the bag opening and 39 days from the inoculation); T7 showed the highest cap diameter (8.07 cm) which is statistically similar to all other treatments except in T3 (7.47 cm); and T4 showed the highest dry weight (46.18 g/kg) and the fresh weight (561.07 g/kg) of harvested mushroom. The biological efficiency was significantly higher in T4, T5 and T2, and it was significantly lower in T7, T6 and T8 than the control. Therefore, incorporation of guinea leaves or paddy husk would be effective to reduce the amount of traditionally used mango sawdust in Oyster mushroom cultivation. Further, Teak sawdust would not as effective as traditionally used mango sawdust.

***Key words**: Teak sawdust, Panicum maxima, paddy husk, biological efficiency*

Introduction

Since time immemorial, many people have consumed wild mushroom as a food source. Initially, these edible wild mushrooms were gathered by hunting, but later people began to cultivate mushrooms because they were not available naturally throughout the year (Gamage and Ohga, 2018). At present, mushroom cultivation has become popular as a reliable source of food and a sustainable source of income, particularly among rural communities in the developing world (Higgins et al., 2017). Mushroom cultivation is also an environmentally benign, profitable agri-business that converts low-cost lingo-cellulosic material into protein-rich foods without requiring high capital investments and maintenance (Marshall and Nair, 2009; Rathod et al., 2021). Mushroom is also called as 'white vegetables' or 'boneless vegetarian meat' due to its high protein, vitamin, and fiber contents (Abirami et al. 2023). In addition, mushroom possess certain medicinal properties bioactivities (Amin and Ganapathy, 2023).

In Sri Lanka, mushrooms have contributed to the well-being of local livelihoods since the introduction of commercial mushroom cultivation in 1985 (Karunarathna et al., 2017). Currently, there are four main mushroom varieties being cultivated in Sri Lanka namely American oyster (*Pleurotus ostreatus*), Abalone (*P. cystidiosus*), Bhutan oyster (*P. eous*), and Button mushroom (*Agaricus bisporus*) (Fernando et al., 2022). Of these varieties, *P. ostreatus* is the most popular among the Sri Lankan mushroom growers (Karunarathna et al., 2017). All the mushroom farmers in Sri Lanka rely on sawdust as the substrate for *P. ostreatus* cultivation due to the convenience and year-round availability (Thilakarathne and Sivasankar, 2018). It has been found that sawdust of soft-textured woods such as Mango, Lunumidella, Mahogany and Rubber ideal for cultivation of *P. ostreatus* (Hami, 1990; Joseph et al., 1998).

However, at present mushroom growers are in a difficulty to find sawdust, as many of sawdust suppliers have started to make furniture from sawdust, which are often used as mushroom substrates (Fernando et al., 2022). Therefore, it is timely to investigate alternative cultivation media to sustain mushroom production in Sri Lanka. Rajapakse et al., (2007) introduced paddy straw and sugarcane bagasse as alternative mushroom substrates, which proved to be equally good as sawdust for *P. ostreatus*. However, mushroom growers in Sri Lanka still lack a good perception on alternative substrates rather than relying on sawdust (Thilakarathne and Sivasankar, 2018). In the present study, we attempt to introduce an integrated approach to mushroom substrates by blending locally available low-cost materials with traditionally used sawdust instead of completely replacing the traditionally used sawdust.

We evaluate the performance of different combinations of three substrate materials namely teak sawdust that is not a soft-wood that mushroom farmers traditionally use; guinea grass (*Mana* or *Panicum maxima*), a perennial invasive weed in Sri Lanka that grows naturally in all ecological zones and invades forest gaps, roadsides, grasslands and agricultural lands; and rice husks, a waste product generated during the rice milling process with the traditionally used mango sawdust for *P. ostreatus* cultivation.

Methodology

Location

The study was conducted at the mushroom unit, faculty of Agriculture, Rajarata University of Sri Lanka, Puliyankulama, Anuradhapura.

Experimental design and treatment combinations

The experiment was planned as a Complete Randomize design (CRD) with triplicates. There were eight treatments each comprised with 30 kg of substrate, 3 kg of rice bran, 300 g of mungbean flour, 600 g of Calcium Oxide (CaO), and 60 g of Magnesium Sulphate (MgSO4) (DOA, 2022). In each treatment, there were different substrate compositions of mango sawdust , teak sawdust , guinea grass and paddy husk as follows: T1: 100% mango sawdust, T2: 50% mango sawdust + 50% paddy husk, T3: 25% mango sawdust + 75% paddy husk, T4: 50% mango sawdust + 50% guinea leaves, T5: 25% mango sawdust + 75% guinea leaves, T6: 100% teak sawdust, T7: 75% mango sawdust + 25% teak sawdust, T8: 50% mango sawdust + 50% teak sawdust. Each treatment was triplicated.

Preparation of mushroom growing media

Guinea grass were harvested before flowering, chopped into 1-2 cm size, and sun dried to remove excess moisture. Before media preparation, dried Guinea grass and paddy husks were treated with 2% Calcium Hydroxide [$Ca(OH)_2$] solution for 24 hours in order to soften the cell walls for easy penetration of fungal mycelia. Substrate materials were dried before preparation of mushroom growing media. All the ingredients were mixed thoroughly by adding water and moisture content checked by palm squeezing method (Boulware et al., 2014). The prepared mushroom growing media were filled into 7" width and 14" height gauge 300 polypropylene bags gently pressing by hand. A ¾" width and ½" height PVC ring was inserted into the collar of bag, sealed using cotton plug and covered with a paper piece. The prepared bags were steam sterilized under 100 ^{0}C and high pressure for 3 hours.

Cultivation of Oyster mushroom

Oyster mushroom (*P. ostreatus*) spawns were obtained from seed and planting material center Kundasale, Sri Lanka. First, the sterilized bags were allowed to cool before inoculation of mushroom spawns. The paper piece and cotton plug were then removed and a table spoonful of mushroom spawn was inoculated into the bags containing growing media under aseptic conditions. Then the inoculated bags were sealed with a sterile cotton plug and covered with a sterile paper piece. The bags were then incubated for 3-4 weeks under dark conditions with uncontrolled temperature and RH. The incubated bags were then transferred into the cropping room after full colonization of mycelium. The bags were opened for cropping by removing the necks and keeping them under 32ºC temperature and 86% RH. Mushrooms were harvested manually when they got matured by twisting to uproot from the base.

Data collection and measurements

C:N ratio of substrates

The C:N ratio was determined after estimating the total nitrogen and total carbon content of each substrate following kjeldahl oxidation method (Anderson and Ingram, 1989) and loss-on-ignition method (Goldin, 1987), respectively.

Mycelium growth rate

The growth rate of fungal mycelium was measured during the incubation by taking linear length of the mycelium (beginning from the neck of the bag) at three different places of the bag, periodically. The first measurement was taken 7th day after inoculation and then it was regularly taken every 4-day interval up to full colonization. Mycelium growth rate was determined by the following formula: Average length of mycelium (mm)/ number of days (Sarker, 2004).

Time taking to primordia initiation and first harvesting

The number of days were counted from the bay opening to primordia initiation and first harvesting, respectively.

Mushroom cap diameter (cm)

Broadness of cap was determined by measuring average diameter of the cap using randomly selected 15 mushrooms per each treatment after harvesting.

Fresh and dry weights of mushroom

The harvested mushroom was weighed on an electronic balance (Model: Kern EMB 6000-1, Germany) to get the fresh weight. The dry weight was measured after drying of mushroom in an oven (Model: 3511-11, China) at 60ºC temperature for 48 hours. Both fresh and dry weights were determined with respect to 1kg of each substrate.

Biological efficiency

The biological yield (g/kg) was determined by measuring the weight of all cluster of fruiting bodies produced during the cropping period and dividing it by initial weight of the substrate (Li et al., 2017).

Data analysis

One-way analysis of variance (ANOVA) was conducted with Duncan's multiple range tests to compare the mean significant differences ($p < 0.05$) among each treatments by using computer software on SAS version 9.0.

Results and discussion

Mycelium growth on different substrates

Daily mycelium growth of *P. ostreatus* on different substrates showed in Table 1. Mycelial expansion serves as an initial phase that establishes favorable internal circumstances for the formation of fruiting bodies. Consequently, robust mycelial growth plays a crucial role in the successful cultivation of mushrooms (Pokhrel et al. 2009). The highest mycelium growth rate was observed in sole mango sawdust (T1) treatment (6.83 mm/day) while the lowest was observed in 75% mango sawdust + 25% teak sawdust (T7) treatment (5.78 mm/day). Sole teak sawdust (T6) and supplementation of the mango sawdust using teak sawdust (T7 and T8) showed a significantly decline in the mycelium growth rate compared to the supplementation of the mango sawdust with paddy husk and guinea leaves (T2-T5). This difference could be due to the high C: N ratios (Table 1) and the compacted nature of teak sawdust-added treatments. Chukwurah et al. (2012) has suggested that the lack of proteinaceous materials in the substrates and/or the physical properties of the materials used are the reasons behind the poor mycelium growth rate of oyster mushroom during the incubation period. Li et al. (2017) also reported that the nitrogen deficiency is known to inhibit the hyphal growth, hence the substrates containing high C:N ratio resulted slow spawn running rates. Further, it is considered that the antifungal properties present in the teak sawdust (Asdaq et al., 2022) may inhibit the fungal colonization within the substrate. Similar to the present results, Baysal et al. (2003) and Thongklang and Luangharn (2016) also obtained accelerated mycelium growth rates in paddy husks added treatments. Incorporation of paddy husk and guinea leaves with the mango sawdust enhanced the porosity which led more aeration within the substrate that eventually affected on the proliferated mycelium growth.

Table 1. C:N ratio, mean mycelium growth rate, Number of days required to primordia initiation and first harvest in different substrates

T	C:N ratio	Mean mycelium growth (mm/day) (±SD)	Days required to primordia initiation (±SD)	Days from bag opening to 1st harvest (±SD)	Days from inoculation to 1st harvest (±SD)
T1	286.39	6.83 ± 0.07^{a}	14 ± 1.15^{b}	19 ± 0.67^{ab}	44 ± 0.67^{b}
T2	246.96	6.51 ± 0.02^{b}	11 ± 1.53^{c}	15 ± 1.53^{c}	43 ± 0.88^{b}
T3	192.71	6.72 ± 0.04^{ab}	7 ± 00^{d}	10 ± 00^{d}	39 ± 00^{d}
T4	191.20	6.52 ± 0.01^{b}	8 ± 00^{d}	12 ± 0.33^{d}	41 ± 0.33^{c}
T5	187.78	6.72 ± 0.10^{ab}	8 ± 0.58^{d}	11 ± 0.88^{d}	40 ± 0.88^{cd}
T6	572.80	6.09 ± 0.12^{c}	16 ± 1.53^{a}	20 ± 1.16^{ab}	44 ± 0.66^{b}
T7	455.23	5.78 ± 0.02^{d}	14 ± 0.58^{b}	17 ± 0.33^{b}	43 ± 0.33^{b}
T8	427.16	6.00 ± 0.16^{cd}	16 ± 0.58^{a}	21 ± 0.33^{a}	46 ± 0.33^{a}

T: Treatment; (T1: 100% mango sawdust, T2: 50% mango sawdust + 50% paddy husk, T3: 25% mango sawdust + 75% paddy husk, T4: 50% mango sawdust + 50% guinea leaves, T5: 25% mango sawdust + 75% guinea leaves, T6: 100% teak sawdust, T7: 75% mango sawdust + 25% teak sawdust, T8: 50% mango sawdust + 50% teak sawdust; Means with different letters are statistically different at $p<0.05$)

Time (days) taking to primordia initiation and first harvesting

The time duration required for primordia initiation and first harvesting in different substrates were presented in table 1. T3 treatment (25% mango sawdust + 75% paddy husk) showed the fastest growth rate spending a minimum number of days for the primordia initiation (07 days), first harvest from the bag opening (10 days) and first harvest from the inoculation (39 days). Overall, the teak sawdust incorporated substrates and sole mango sawdust required the highest time period for the primordia initiation (14-16 days) and first harvest (17-21 days from the bag opening and 43-46 days from inoculation).

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The result of the current study is in line with Vetayasuporn's (2006) study that primordia were formed 2-3 weeks after the completion of the mycelium growth. Further, Vetayasuporn (2007) suggested that P. ostreatus began to appear in their primordia within 10-14 days after the opening of the cylindrical bags and Bhattacharjya et al. (2014) stated that it was ranged from 6.0-8.0 days. However, the present results are not tally with Ruiz-Rodriguez et al. (2010) findings; where they found that pin heads of *P. ostreatus* appeared within 17-21 days after the inoculation. Further, previous studies depicted similar results to the current study that sugarcane bagasse and 100% corn cob required 44 days and 46.02 days respectively in order to obtain the first harvest of oyster mushrooms (Vetayasuporn, 2006; Hoa et al., 2015). In addition, Getahun (2011) reported that sawdust substrates needed 41 days for the primordia initiation due to their high C:N ratios (459.9). C: N ratio is the one of main reasons for the higher primordia formation and it is stated that the 20:1 C: N ratio of the substrate is crucial for a good number of primodia initiation (Chang and Miles, 1992). Moreover, Cueva et al. (2017) reported that lower nitrogen content in the substrates caused to variation in fruiting and spent a longer time to start the harvest. Thus, the substrates containing less C:N ratios (paddy husk and guinea leaves incorporated substrates - T2, T3, T4 and T5) spent less time (ranging between 7-11 days) for the primordia formation. Further, the substrates containing higher C: N ratios (Table 1) such as teak sawdust containing substrates required more time duration for the initiation of primordia and first harvest in contrast to the other substrates in the present study. Since the sawdust contains a high amount of lignin, low degradation of lignocellulosic substances of sawdust by *P. ostreatus* might be another factor affecting to the slower growth of mushrooms. According to the present study, substrates comprised only of sawdust (teak sawdust incorporated treatments and sole mango sawdust) have gained significantly longer duration (approximately 14 days) to initiate mushroom primordia. It would probably be due to poor water retention and quick drying than the other substrates under relatively high temperatures in the cropping room.

Interestingly, Das and Mukherjee (2007) reported that weed substrates significantly increase the protein content and reduce the production time of oyster mushroom due to adequate nutrients in the substrates as well as good physical properties favoring the fruiting body formation. The present study has also shown the same phenomenon that substrates consist with paddy husk (T3) and guinea grass (T5) produced primordia and fruiting bodies earlier than the other treatments. Moreover, Baysal et al. (2003) have reported that increment of the paddy husk amount in the substrates accelerate mycelium growth rate, pin head formation and fruiting body formation.

Mushroom cap diameter

The cap diameter of the oyster mushroom in eight different substrates is illustrated in figure 1C. The highest cap diameter was recorded from T7 (8.07 cm) which is statistically similar to all other treatments except T3 treatment (25% mango sawdust + 75% paddy husk) (7.47 cm). Patel and Trivedi (2014) have obtained similar results that range from 6.11cm to 7.43cm. Oyster mushrooms grown on T3 (25% mango sawdust + 75% paddy husk) substrate produced clusters containing more caps. However, their caps were in small size and poor quality compared to other treatments which may be due to the poor nutrient content and slower degradation of the constituents in the substrates. At the same time, sole mango sawdust, paddy husk and guinea leaves containing substrates produced clusters with larger and significantly higher numbers of caps than the teak sawdust-supplemented substrates. The present results agreed with Kimenju et al., (2009) findings, where cap diameter was very much dependent on the number of caps per cluster and the quality of the substrates. Thus, wider caps were produced in the clusters with few numbers of caps and good quality substrates produced large size caps compared with poor quality substrates.

Dry weight, fresh weight and biological efficiency

The current results depicted that different substrates significantly influenced the yield of *P. ostreatus* (Figure 1). The highest dry weight (46.18 g/kg), fresh weight (561.07 g/kg) and biological efficiency 56.11% were observed in T4 substrate (50% mango sawdust + 50% guinea grass). However, the fresh weight and biological efficiency obtained in the T5 substrate (25% Mango sawdust + 75% guinea leaves) were statistically similarly to the T4 substrate. Generally, the yields of *P. ostreatus* are varied due to the difference in bulk density and constituents of the substrates used (Dey et al., 2008; Samuel and Eugen, 2012). High cellulose content and lower C:N ratio may be the reasons for the highest yield in guinea leaves incorporated substrates. Overall, the teak sawdust-containing substrates showed the lowest dry weight, fresh weight and biological efficiency in contrast to the other treatments. Neupane et al. (2018) reported that slow mycelium running rate and low yield are possible due to presence of the polyphenolic compounds, low content of cellulose and poor water-holding capacity in the sawdust substrates. Further, Hoa et al. (2015) suggested that differences arisen in the yield and biological efficiency of *P. ostreatus* and P. cystidiosus were due to the variations of the physical and chemical composition of substrate formulas such as cellulose/lignin ratio and mineral contents, pH and EC of the substrate and especially C:N ratio. Moreover, it is reported that organic residues having a higher C:N ratio reduced the yield and quality of *P. ostreatus*, *P. florida*, and *P. sajor-caju* (Mintesnot et al., 2014; Hoa et al., 2015). Therefore, lower nitrogen content, higher lignin content, presence of phenolic compounds and more hard-wood portion are the factors that affected to the reduction of yield and biological efficiency of oyster mushrooms grown on the teak sawdust in the present study.

Further, average dry weight of the oyster mushrooms was higher than the values reported in the previous studies. For instance, the range of dry weight in different substrates was reported as 4.28 g - 29.98 g (Sarker et al., 2007) and 30.08 g to 35.15g (Biswas et al., 2016). Moreover, Miah et al. (2017) reported that the highest dry yield 18.88 g was obtained from the mahogany sawdust and the lowest from gamari sawdust. In 1998, Ahmed revealed that the lower diameter of caps led to the lowest yield and concluded that when the diameter of caps increased, the dry weight also increased. Thongklang and Luangharn, (2016) pointed out that the optimal substrate to cultivate *P. ostreatus* is sawdust + paddy husks with an average fresh weight of mushroom was 277.50 ± 79.74 g. However, comparatively higher amount of fresh weight of *P. ostreatus* mushroom was recorded during the current study, which accounted for an average of 480.93-503.73 g.

Previous studies have confirmed that the biological efficiency of oyster mushrooms depends on the different substrates and the values were reported as 39.55%-46.31% (Onyeka et al., 2018), 21.05%- 64.69% (Shah et al., 2004), 44%-103% (Vetayasuporn, 2006), and 31.56%-55% (Salami et al., 2017) which were aligned with the results of the present study that was accounted for 33.92% to 56.11%. Li et al. (2017) demonstrated that *P. ostreatus* gave higher yield and biological efficiency on mixed substrates. Similarly, most of the supplemented substrates in the current study showed a higher biological efficiency than the sole sawdust substrate, especially mango sawdust incorporated with guinea weed. Ashrafi et al. (2014) reported that spent mushroom substrates supplement with 60% sawdust + 20% wheat bran gained the highest biological yield (193 g/packet). Further, highest yield of *P. ostreatus* was obtained with the substrate composed of 20% paddy husk by Baysal et al. (2003). Das and Mukherjee, (2007) reported that supplementation of weed substrate with paddy straw increased the biological efficiency of mushrooms. Mintesnot et al. (2014) further found that *P. ostreatus* gave the highest biological efficiency when grown on *Parthenium hysterophorus* weed due to the high cellulose content and low lignin content of the substrates.

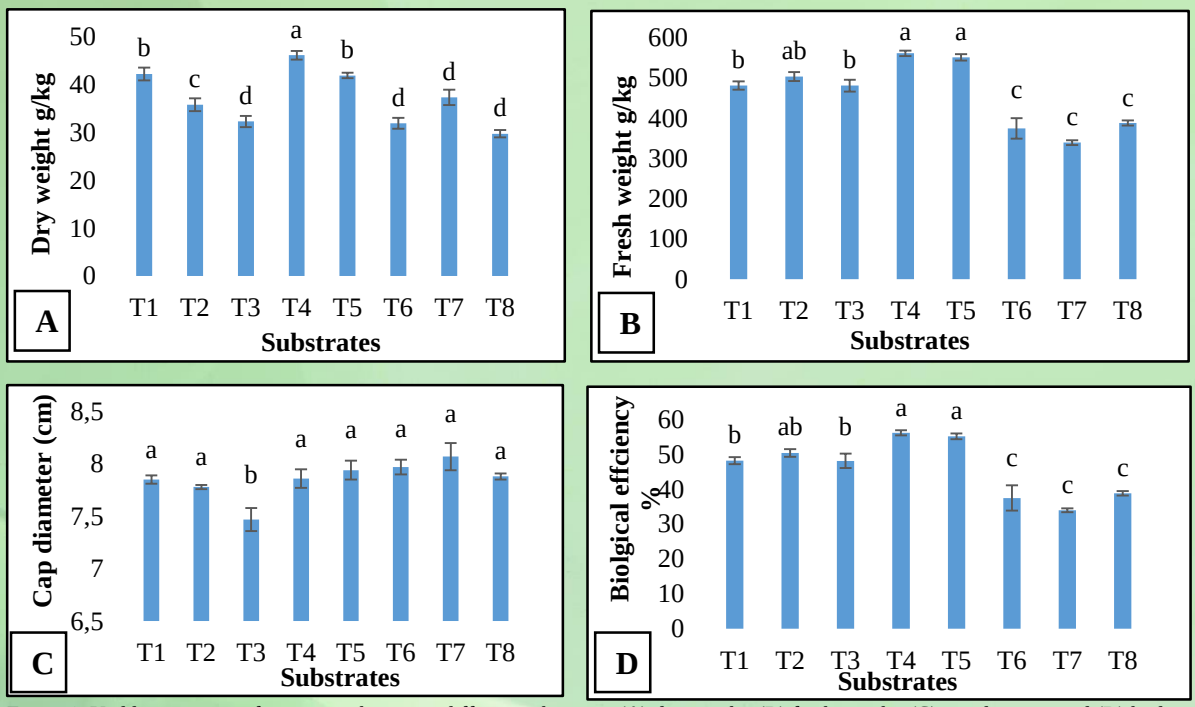


Figure 1. Yield parameters of oyster mushroom in different substrates: (A) dry weight, (B) fresh weight, (C) cap diameter and (D) biological efficiency (T1: 100% mango sawdust, T2: 50% mango sawdust + 50% paddy husk, T3: 25% mango sawdust + 75% paddy husk, T4: 50% mango sawdust + 50% guinea leaves, T5: 25% mango sawdust + 75% guinea leaves, T6: 100% teak sawdust, T7: 75% mango sawdust + 25% teak sawdust, T8: 50% mango sawdust + 50% teak sawdust; Means with different letters are statistically different at $p<0.05$)

Conclusions

Considering biological efficiency and other aspects, blending of guinea leaves or paddy husks in particular proportions was found to be more effective than the sole use of traditionally-used mango sawdust. Similarly, our attempt to incorporate teak sawdust did not yield better results. Therefore, integrated use of these low-cost and locally available materials will be a better option for the shortage of traditionally-used sawdust. However, in terms of feasibility, paddy husk is the most suited choice compared to guinea grass, since the preparation of guinea grass as a substrate necessitates the use of chopping machinery.

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Physicochemical, Sensorial and Textural Properties of Vegan Ice Creams Produced From Cowpea Milk Analogs

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Abstract

The aim of this study was to determine the physicochemical, sensorial, and textural properties of vegan ice creams made from different concentrations of cowpea milk (5-20 %), fat (8-20 %), sugar (15-30 %), gum (0.2-1 %), emulgator and aroma (at fixed concentrations). Twenty different formulations of ice cream or frozen dessert were produced using response surface methodology, Box-Behnken design. The whiteness value of the products was significantly affected by the amount of fat, independent of the legume concentration. However, *b** values of the ice creams showed high and significant correlation with the concentration of the cowpea. Destabilized fat index increased in formulations with high fat and low gum content ($p<0.05$). The amount of gum was also highly effective on the melting characteristics of the ice cream samples. The higher the gum content, the longer the first dripping time. When the textural properties were examined, it was determined that the highest stickiness was observed in ice cream samples which have the minimum sugar content and *vice versa*. Also, it was observed that the gumminess and chewiness values were higher in the samples with less sugar and more gum content ($p<0.05$). Consumer acceptance test was conducted to assess the appeal and overall acceptability of the vegan ice cream samples using 9-point hedonic scale. The scores of overall acceptance ranged between 5.50 and 7.50. In general, it was determined that the formulations with the highest sensory scores were the samples with high sugar content and medium concentrations of gum and cowpea.

Keywords: *Plant-based milk, milk analog, milk substitute, cowpea, legume, sensory properties*

ID: 149

Influence of Sprouting Duration on the Nutrient, Functional, and Phytochemical properties of Tiger nut flour and Bread

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Abstract
The influence of sprouting on tiger nut's (TN) nutritional, functional, and phytochemical quality was examined, and the flour used for bread making to evaluate the feasibility as a functional ingredient. TN was sprouted and sampled at 3 days intervals for 12 days, dried and milled into flour and analyzed. Subsequently, 25% of wheat flour (WF) was replaced with the 9 days-sprouted TN flour for bread. Sprouting for 9 days increased the protein content from 9.19 ± 0.04 to 9.79 ± 0.15 g/100 g dry matter (DM), fiber from 6.75 ± 0.16 to 9.27 ± 0.44 g/100 g DM, and ash from 2.34 ± 0.10 to 2.70 ± 0.06 g/100 g DM but decreased fat content from 26.10 ± 0.18 to 23.18 ± 0.43 g/100 g DM and soluble sugar from 33.13 ± 1.25 to 23.75 ± 1.44 ◦Bx. We observed increases in the polyphenols (94.16 ± 6.43–214.23 ± 6.98 mg GAE/100 g) and ascorbic acid (26.66 ± 0.17–65.13 ± 0.19 mg AE/100 g) and decreases in the cyanogenic glycosides (273.79 ± 0.37–231.54 ± 3.53 mg/100 g) and oxalates (19.04 ± 1.14–5.65 ± 0.93 mg/100 g) contents. Sprouting decreased the particle size and increased the water retention and swelling power of TN flour. WF bread was described as stretchy, sweet, and creamy, whereas sprouted TN bread was brown, nutty, and wheat-like. Consumer acceptance for the sprouted TN bread was comparable to WF bread, showing the possible application in bread making.

Keywords: *Bread, consumer acceptability, sprouting duration, tiger nut*

ID: 152

Animal-based milks and Plant-based milks: Nutritional and environmental impacts

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Abstract

Consumption of plant-based milk in the world has improved in recent decades, with significant implications for both human nutrition and global health. This paper will discuss the environmental issues and global benefits of significantly reducing or eliminating animal-based milks from our diet. Furthermore, it outlines the therapeutic benefits of a plant-based diet in managing chronic diseases, such as obesity, cardiovascular disease, cancer, and diabetes. The focus of this study is global perspective and consumption of animal and plant based milks. All the data regarding the health and environmental impacts of animal-based milk and plant-based milk, as well as their nutritional components were evaluated. Many plant-based milks are fortified to fit nutritional profile comparable to animal-based milk. Depending on the main components, there are notable differences, particularly in protein, zinc, and potassium content. Plant-based milks were generally associated with lower environmental impacts (greenhouse gas emissions, water use, land) than animal-based milks, with significant exception of the higher water footprint of plant-based milk. A plant-based diet (vegetarian and vegan) protects against a number of common chronic diseases including cardiovascular disease, obesity, and certain types of cancer. A plant-based diet rich in fiber and phytochemicals not only prevents disease but also has a substantial impact on gut microbiota. When appropriately planned, a plant-based diet (consisting of minimally processed foods) could be nutritionally adequate. Vegetarians especially vegans, should have a well-balanced diet and use fortified foods and/or supplements regularly. Calcium, iron, vitamin D, and vitamin B_{12} should all be prioritized. It is critical to promote plant-based milk with adequate protein and micronutrients and a lower ecological carbon footprint due to the safety and potential health implications of their long-term and more frequent intake of plant-based milk.

Key Words: *Animal-based milk, Plant-based milk, Carbon footprint, Nutritional awareness*

Süt ürünleri ve süt benzeri bitkisel bazlı içecekler: Beslenme ve çevresel etkileri

Özet

Hayvansal gıdaların tüketimi son yıllarda değişim göstermektedir ve bu durum hem beslenme hem de çevresel etkiler açısından önemli etkiye sahiptir ve bitkisel bazlı sütler de tüketici tercihlerinde ilgi görmektedir. Bu derlemede, hayvansal bazlı gıdaları beslenmemizden önemli ölçüde azaltmanın veya ortadan kaldırmanın çevreye ve beslenmeye etkisi irdelenmiştir. Ayrıca, bitkisel bazlı bir diyetin obezite, kardiyovasküler hastalıklar ve kanser gibi kronik hastalıkların tedavisindeki önemi ve güvenliği de değerlendirilmiştir. Bu çalışmanın odak noktasını süt ve bitkisel kaynaklı süt tüketimi oluşturmaktadır. Süt ve bitkisel bazlı sütlerin sağlık ve çevresel etkileri ile bunlara ilişkin tüketici eğilimleriyle, süt ürünleri ve aroma içermeyen bitkisel bazlı sütlerin besin değeri ile ilgili tüm bulgular değerlendirilmiştir. Pek çok bitkisel bazlı süt, hayvansal kaynaklı sütün besin içeriğine benzer şekilde geliştirilmiştir. Temel bileşenler ve her bir ürüne bağlı olarak özellikle protein, çinko ve potasyumda dikkate değer farklılıklar söz konusudur. Bitkisel bazlı sütler genellikle hayvansal kaynaklı sütlere göre daha düşük çevresel etkilere (sera gazı, su tüketimi ve arazi kullanımı) sahiptir. Bitkisel bazlı beslenme (vejataryen ve vegan beslenme) kardiyovasküler problemler, obezite ve belirli kanser türleri gibi bir dizi yaygın kronik hastalığa karşı koruma sağlamaktadır. Lif ve fitokimyasallar açısından zengin bitkisel bazlı bir diyet, yalnızca hastalıkları önleyici faydalar sağlamakla kalmayıp aynı zamanda bağırsak mikrobiyotasının işlevi üzerinde de önemli bir etkiye sahiptir. Uygun şekilde planlandığında, bitkisel bazlı bir diyet, temel besin öğeleri açısından yeterlidir. Vejetaryenler ve özellikle veganlar dengeli beslenmeli ve düzenli olarak zenginleştirilmiş gıdalar ve/veya takviyeler kullanmalıdır. Kalsiyum, demir, D vitamini ve B_{12} vitaminine özellikle dikkat edilmelidir. Yapılan çalışmalar, bitkisel bazlı süt tüketiminin daha çok tercih edildiğini doğrulamaktadır. Bitkisel bazlı sütlere yönelik tüketici tutum ve davranışları; ve bunların uzun vadeli ve daha sık tüketimiyle ilgili güvenlik ve potansiyel sağlık etkileri göz önüne alınırsa yeterli protein ve mikro besin öğelerine sahip, ekolojik karbon ayak izi daha düşük olan bitkisel bazlı ürünlerin teşvik edilmesi önem arz etmektedir.

Anahtar Kelimeler: *Hayvansal süt, süt benzeri bitkisel bazlı içecek, Karbon ayak izi, Beslenme farkındalığı*

ID: 154

The Effect of Pumpkin Seed Oil on Pentylenetetrazole-induced Neuronal Damage in HT-22 Cell Line

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Abstract

Recent studies have shown the positive effects of pumpkin seed oil (PSO) in different disease models. However, the effect of PSO on neurological diseases has not been clarified yet. Therefore, the aim of this study is to elucidate the effects of BBS on pentylenetetrazole (PTZ)-induced neuronal damage and the possible roles of oxidative and nitrosative stress in this effect in vitro. The HT-22 hippocampal neuronal cell line was used in the study. In the study, the effect of pre-treatment with BSO on cell survival after PTZ-induced neuronal damage was evaluated with the XTT test. While the effects of BBS on total antioxidant status (TAS) and total oxidant status (TOS) after PTZ were measured with colorimetric commercial kits, its effects on neuronal nitric oxide synthase (nNOS) and nitric oxide (NO) levels were determined by ELISA kits. In light of the data obtained, it was found that pre-treatment with PSO prevented the decrease in cell survival after exposure to PTZ. In addition, it has been found that PSO normalizes the increase in TOS, nNOS, and NO in neuronal cells after PTZ. As a result, it was determined that the treatment of neuronal cells with PSO prevented neuronal damage caused by PTZ and showed neuroprotective properties. It is thought that PSO may achieve these effects through oxidative and nitrosative systems. Enrichment of a daily diet with PSO might be beneficial in reducing the risks of neurological diseases.

Keywords: *Pumpkin seed oil, Pentylenetetrazole, Oxidative stress, Nitrosative stress HT-22 cells*

HT-22 Hücre Hattında Kabak Çekirdeği Yağının Pentilentatrazol ile Oluşturulan Nöronal Hasarlanma Üzerine Etkisi

Özet

Güncel çalışmalar kabak çekirdeği yağın (KÇY)'nın farklı hastalık modellerinde olumlu etkilerini ortaya koymuştur. Ancak KÇY'nın nörolojik hastalıklar üzerine etkisi henüz aydınlatılamamıştır. Bu nedenle bu çalışmanın amacı KÇY'nın in vitro olarak pentilentetrazol (PTZ) ile oluşturulan nöronal hasar üzerine etkilerini ve bu etkide oksidatif ve nitrozatif stresin olası rollerini ortaya koymaktır. Çalışmada HT-22 hipokampal nöronal hücre hattı kullanılmıştır. Çalışmada KÇY ile ön muamele edilmesinin PTZ ile oluşturulan nöronal hasar sonrası hücre sağ kalımına etkisi XTT testi ile değerlendirilmiştir. KÇY'nın PTZ sonrası oluşan total antioksidan durum (TAS) ve total oksidan durum (TOS) üzerine etkileri kolorometrik ticari kitler ile ölçülürken nöronal nitrik oksit sentaz (nNOS) ve nitrik oksit (NO) seviyeleri üzerine etkileri ELISA kitleri ile belirlenmiştir. Elde edilen veriler ışığında, PTZ'e maruziyet sonrası ortaya çıkan hücre sağ kalımındaki azalmayı KÇY ile ön muamelenin engellediği bulunmuştur. Buna ek olarak KÇY'nın PTZ sonrası nöronal hücrelerde meydana gelen TOS, nNOS ve NO artışını normale çevirdiği tespit edilmiştir. Sonuç olarak nöronal hücrelerin KÇY ile muamelenin PTZ ile oluşturulan nöronal hasarlanmayı engellediği ve nöroprotektif özellik gösterdiği belirlenmiştir. Bu etkileri KÇY'nın oksidatif ve nitrozatif sistemler üzerinden gerçekleştirebileceği düşünülmektedir. KÇY ile günlük beslenmenin zenginleştirilmesi nörolojik hastalık risklerini azaltmada faydalı olabilir.

Anahtar Kelimeler: Kabak çekirdeği yağı, Pentilentetrazol, Oksidatif stres, Nitrosatif stres, HT-22 hücreleri

ID: 155

DNA marker-assisted diversity analysis of *Mangifera indica* L. populations

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Abstract

The genetic diversity of various mango cultivars was evaluated using Start Codon Targeted (SCoT) and Inter-Simple Sequence Repeat (ISSR) markers, and their utility for analyzing genetic variants was compared. Mango breeding requires seedling germplasm resources. Different types of markers were looked at and compared to each other. In total, we used 10 primers each for SCoT and ISSR markers. Genetic diversity assessments based on genomic data can provide valuable information for germplasm management and varietal characterization. For many species, start codon targeted (SCoT) markers and inter simple sequence repeats (ISSR) are useful and highly polymorphic phylo-genetic markers. The genetic diversity of 29 SCoT and 28 ISSR polymorphic alleles was assessed in light of the findings. According to SCoT, there were an average of 4.3 alleles per locus, ranging from 3 to 6. The SCoT genetic diversity index had a mean of 0.383 and a range of 0.16 to 0.44. While the ISSR genetic diversity index has a mean of 0.392 and a range of 0.19 to 0.475. Although both analyses produce comparable findings, the mean values of the number of effective alleles (Ne), genetic diversity (H), and Shannon's information index (I) revealed that SCoT analysis better represents the actual relationships than ISSR analysis. The outcomes show that the SCoT marker system is helpful for mango genetic diversity study and mango species identification. Most of the parameters looked at were found to work better in the SCoT system. The most amazing finding from this study is that by using cluster analysis on SCoT and ISSR data, we were able to clearly identify different cultivars based on their genetics. This research found that the genetic makeup of the evaluated samples is diverse. The dendrogram derived from the ISSR marker and the dendrogram derived from SCoT markers had many similarities, although there were some differences. SCoT and ISSR analysis can find enough differences in DNA for identifying it.

***Keywords**: Genetic diversity, SCoT marker, ISSR marker*

ID: 159

Aquafaba as an Emulgator for Spreadable Fish Pate

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Abstract

Within increasing global population, the utilization of all the by-product and cooking product of animal and plant based food items has gain importance in both academia and food industries. Aquafaba is a nutritionally-rich, cooking water that left after boiling process of legumes and this product most commonly sold as dried form commercially. In addition to its nutritional value, aquafaba offers rheological and functional properties in the food products. Emulsified fish products have become popular over the world, especially ready to eat products due to its spreadable form and admirable sensory characteristics. Besides these benefits, water holding capacity impact on the rheological properties and chemical properties are crucial for storage period.In this research, aquafaba was used as a emulsifier food additives at the 5 and 10 % levels in emulsified carp fish product. Control group was evaluated as without aquafaba addition. The proximate composition and water holding capacity was determined following to production emulsified products. The results clearly indicate that the aquafaba addition improve the emulsification capacity of carp product. The statistically significant proximal differences were observed among groups, especially in protein level. The higher water holding capacity and highest protein level was observed in the 10% aquafaba added groups. The usage of aquafaba as an emulsifier food additives has the potential to be used in different food products.

Key Words: *Aquafaba, fish pate, carp meat, quality,emulsifier,seafood*

Introduction

Climate change and increasing human pooulation limit the accessibility of protein source globally. Alternative animal based and protein based protein sources have gained interest to meet the protein demand over the world. Besides to valorisation of animal and protein based food item's wastes and by -products, utilization of cooking juices of foods have increased over the last decade Caponio et al.,2022). Especially cooking juices from high protein content of food can be used owing to its high nutrition value (Blejan and Nour, 2023). Aqafaba is a robust model for meeting this protein demand which can be obtained from boiling water of several kind of legumes (Buhl et al.,2019). In addition to vegetarian diets, this excellent protein sources used in different food complex due to its functional properties (Damian et al.,2018). Well-emulsifing capacity of aquafaba is one the important active role of this food additive therefore in addition to common usage of aquafaba in the bakery products, alternative usage of this product in other food mixtures has gained attention (Meurer et al.,2020).
Within increasing demand and consumer attidues to speadable food products from speadable cheese and lives and nuts, spreadble fish products have commonly take a part in the commercial markets (Cedeño-Pinos et al.,2022). Fish pate is known one of the traditional and frequently used spreadable fish products in the world (Bolívar et al.,2023). Due to the demand of smoothy texture and easily spreadable characteristics, different kind of emulsifiers can used to improve emulsifier capacity of the end products (Schilling,2019). Carp (*Cyprinus carpio*) widelt distrubutred in freswater and accepted as a non-economic species (Acar et al.,2018).Valorisation of this non-economic species in a new product could be important fpr sustainibilty of fresh water species. In this research, the investigeations of utilization of aquafaba at different rate as an emulsifier in the carp pate.

Materials and Methods

Aquafaba, in the form of cooking juice from chickpeas, was kindly donated by commercial producers (Döhler Inc., Turkey). Fresh carp (*Cyprinus carpio*) was purchased from a local fishery market in the Eskişehir province,Turkey. Carp was transferred to the laboratory at the cold chain on the caching day.
Carp is then washed and eviscerated prior to the filleting process. Then fresh fish were filleted with a sharp filleting blade and then mixed by laboratoy type mixer. The total amount of carp meat was divided into three groups for further application. Carp meat was mixed with iced water, salt,spices and mush pateto. Aquafaba in the dried form was added to mix at the 5% and 10 %.Carp pate without any aquafaba addition condiedered as control group.

All the pate groups were full filled into packaging materials (around 100 g) manually and closed. Then, thermal treatment was applied in a laboratory-type oven at 80 °C through 45 min in laboratory type oven.Pâté groups were stored in the refrigerator at 2±1 °C during 2 weeks. Following to 2 weeks, WHC analyses was performed to evaluate emulsifier capacity.

Water-holding capacity (WHC) of carp pategroups were determined according to El Khalifa et al.(2005) 1 g of pate sample was placed into the previously weighted centrifuge tubes, and mixed with 14 mL of deonized water and stirred in an automatic tube stirrer.Then mixture was kept at the ambient temperature during 30 min prior to centrifugation.Then sample was centrifugated at 5,000 × g during 25 min. Following to centrifugation, the tube was inversed to excessin of water by tissue paper. The water absorption was determined by the difference between the weight of sample prior and after to centrifugation and expressed as g/g of water hold of sample.

Results and Discussion

Water holding capacity is an important parameter in emulsified products quality,shelf life and sensory attributes. This value also essential critical for the industry due to being related to the total weight of end products and thereof profit.Statically important variations were found in the WHC capacity of carp pate ($p < 0.05$).The differences in WHC of carp pate groups are given in Figure 1.While the lowest water holding capacity was determined in the control group as without any aquafaba addition.Thw water holding capacity was increased within rising rate of aquafaba addition as seen in Figure 1.

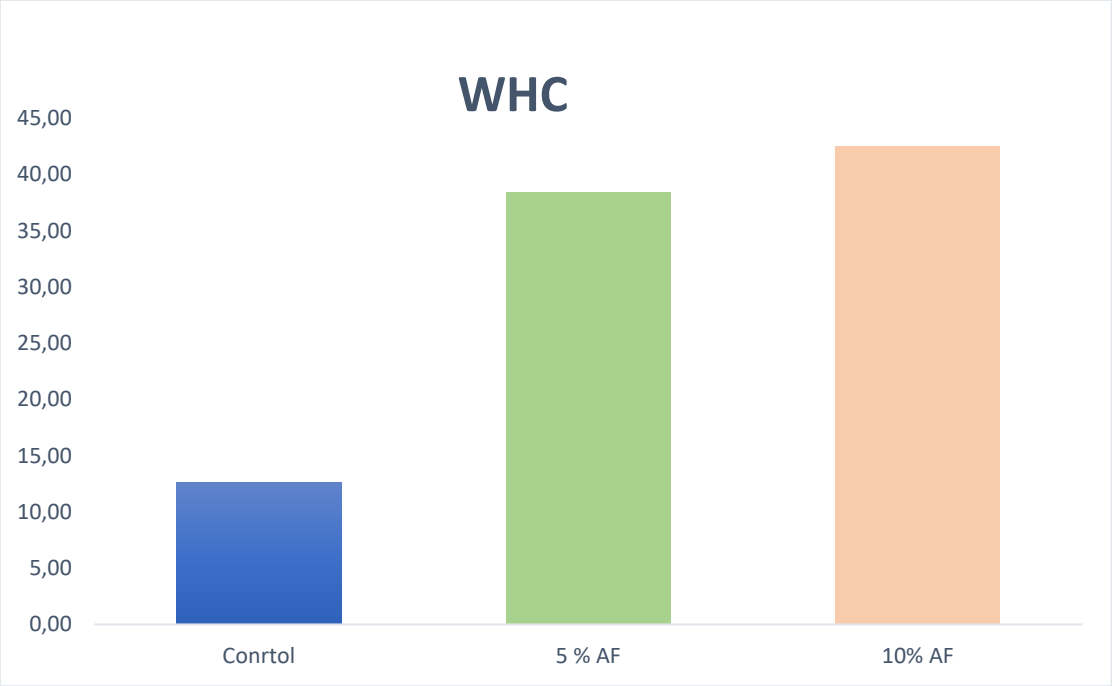


Figure 1. Differencess in water holding capacity of fish pate groups

The differences of water holding capacity of aquafaba enriched carp pate groups were not found statically significant.Thww WHC were found as 39.2 and 42.6 % rate in 5% and 10% aquafaba enriched groups.Relatively higher WHC rate was found in the 10% group that could be related to aquafaba's emulsifier role.These results are in accordance with previous resesearch that also highlighted the emulsifier enhanging properties of aquafaba in different food matrices (Mustafa and Reaney., 2019). Especially in protein –rich food, the characteristic behavior of emulsifiying capcity of aquafaba has superior than other food products (Buhl et als.,2019). As stated in an official report the market of food emulsifiers has grown and estimated to reach nearly US$ 8 billion in 2025 (Grand View Research.,2017).To meet the food emulsifier demand globally, aquafa could be used as emugator in especially emulsified seafood products.

Conclusion

In this research two different valorization processes were applied in a products.Value added plant based aquafaba used as emulsifier in valorization of non-economic carp meat in fish pate.The emulsifier capacity of aquafa clearly showed that this excellent food addtivies could be used in not only bakery products, but also in meat and seaffod industry.

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Production and Characterization of Probiotic Mixed Fruit Juice Using Selenium Infused Lactic Acid Bacterial Starter, *Sorghum bicolor* (*Poporo*) Extract, *Ananas comosus* (Pineapple), *Annona muricata* (Soursop) Juices

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Abstract

Incorporation of selenium and probiotics into dairy products provides the grounds for selenium deficient, lactose intolerant and dairy allergic individuals to have access to probioticated and selenium supplemented foods that can improve their health. This study aimed at production of selenium supplemented mixed probiotic juices from *Sorghum bicolor* extract, pineapple, and soursop juices using selenium infused lactic acid bacteria as starter. Probiotic viability, physicochemical, antagonistic, antioxidant properties were evaluated during four weeks storage. The selenium infused lactic acid bacteria was viable throughout storage time. Increase in color intensity, total soluble solids, vitamin C content, lactic acid production, and antioxidant activity was observed. Also, reduction in pH and specific gravity was observed during storage time. The lactic acid contentment ranged from 8.02 – 72.06 mg/L, 9.08 – 171.15 mg/L, 18.02 – 112.11 mg/L, 9.08 – 126.10 mg/L and 9.08 – 135.12 mg/L (Dy 0, 1, 2, 3 and 4 weeks) respectively. There was significant difference ($p \leq 0.05$) in the proximate composition of the probioticated mixed juice samples during storage. The crude protein and crude fibre at week 0 and 4 ranged from 0.57- 1.84% and 0.26 – 1.53%, 0.30 – 0.65% and 0.15 – 0.80%. The juice samples has antagonistic activity against *Staphylococcus aureus* and *Escherichia coli.* In conclusion, the mixed fruit juice supported viability, vitamin C development, antagonistic and antioxidant potential of the probiotic candidate used. The probioticated selenium supplemented fruit juice can be used as a functional foods and nutraceutical with health beneficial effect.

Keywords: *Sorghum bicolor extract, probiotication, selenium infused lactic acid bacteria*

ID: 162

Inhibitory Activities and Characterization of Greenly Synthesized Silver Nanoparticles using Culture Free Supernatant of *Lactobacillus plantarum*

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Abstract

This study is aimed at the biosynthesis, characterization and inhibitory activity of silver nanoparticles using *L. Plantarum* culture free supernatant (CFS). Silver nanoparticles (SNPs) were biosynthesized by *L. plantarum* and characterized using Visual detection, UV-Visible spectroscopy, Fourier Transformed Infra-red spectroscopy (FTIR) and Scanning Electron Microscopy (SEM). The effect of the cultivation conditions on the biosynthesis of SNPs was carried out. Antibacterial activity of the biosynthesized silver nanoparticles by *L. plantarum* was done using agar well method. Biosynthesis of SNPs by *L. plantarum* was characterized by a strong plasmon resonance peak at 450 nm and a broad band at 350 - 550 nm. There were colour changes from yellow to brown. FTIR confirmed the presence of hydroxyl, aldehyde, carboxylic acid, amino acid, and esters which are responsible for the stability of silver nanoparticles (SNPs). The shape of the biosynthesized nanoparticles was spherical and partially aggregated with particle size ranging from 0.7- 10.0 nm. The antibacterial activity of the synthesized SNPs by *L. plantarum* (LPSNPs) ranged from 14 – 22 mm. *Staphylococcus aureus* and *Escherichia coli* were more susceptible to the synthesized SNPs. 24 hr incubation time, 25°C, pH 9 and 5 mM gave the best SNPs production. The culture free supernatant of *L. plantarum* can be used for the synthesis of SNPs with highly effective antibacterial activities.

Key words: *Biosynthesized Silver nanoparticles, Antibacterial activity, Culture free supernatant, Scanning Electron Microscopy, L. Plantarum*

Introduction

Nanoscale technology is a new and essential domain in science. Nano-scale involves the use of matter on an atomic, molecular, and supra-molecular scale for industrial purposes (Anusha, 2020). Nanoscale technology has major applications in medical health, environmental science, biotechnology and physics (Scribenjarat et al., 2020). Nanoparticles synthesized by a biological approach are more desirable than that synthesized by chemical methods and has several advantages, including easy scaling up of the procedure, cost- effectiveness and its green nature (Hidayat et al., 2020).

Silver is the most used material in all of the nanotechnology; the desirable antimicrobial property activity of silver has drastically increased at the Nanoscale. Silver nanoparticles (AgNPs) are one of the most studied among metallic nanoparticles due to their effective antibacterial agents and possess a strong antimicrobial activity against bacteria, viruses, and fungi (Sreedevi et al., 2015). The reason for these antimicrobial properties is because silver ions and silver based compounds are highly toxic to a wide range of microorganisms including major species of drug resistant bacteria. These nanoparticles of silver have been studied as a medium for antibiotic delivery and synthesis composites for use as disinfecting filters and coating materials. They have extremely large surface area which permits the coordination of a vast number of ligands. Nano-silver has chemical and biological properties that are appealing to the consumer products, food technology, textile/fabrics, and medical industries. Nano silver also has unique optical and physical properties which are considered to have great potential for medical applications (Scribenjarat et al., 2020). Nano silver is an effective bactericidal agent against a broad spectrum of Gram-negative and Gram-positive bacteria which is due to interaction with the DNA of the bacteria cell, thus making them to lose the ability to replicate and finally leading to the death of the cell (Qasim et al., 2018).

Lactic acid bacteria are beneficial heterogeneous group of bacteria that has important roles in medicine, food industries and agricultural sector. Lactic acid bacteria are probiotics that are highly beneficial to the human body aiding in enhancing immune responses, preventing infection by enteropathogenic bacteria (*Escherichia coli*), treating and preventing diarrhoea (Bikila, 2015). However, more than one hundred species of the *Lactobacillus* genus are microorganisms' identified as commercial probiotics. Examples are *L. acidophilus, L. rhamnosus, L. reuteri, L. casei, L. Plantarum*. These microorganisms are well known for their ability to produce lactic acid as the main end-product of their anaerobic metabolism and for synthesizing a wide range of metabolites that beneficially

affect the nutritional, sensorial, and technological properties of fermented food products. Due to their essential beneficial properties, lactic acid bacteria have been extensively used as starter cultures, as probiotics and in the production of interesting compounds like nutraceutical products because of their resourceful metabolism (Ruiz Rodríguez et al., 2017a).

Lactobacillus Plantarum are Gram positive organisms, non-motile, acid-tolerant and non-sporulating facultative anaerobes that has significant properties of reducing blood cholesterol, increase resistance of low density lipoprotein oxidation, leading to decrease of blood pressure and inhibiting the growth of microorganism with the help of the metabolites produced (Dhewa et al., 2014). The resistance of microorganisms to some bactericidal agents and the use of a safe and eco-friendly antimicrobial agent has been a major issue. Green synthesis of nanoparticles is non-toxic, cost effective and eco-friendly in nature which has made it to attract the interest of numerous researchers. Examples are: the green synthesis of silver nanoparticles using supernatant of biosynthesized SNPs by *Lactobacillus casei* LPW2 and *Lactobacillus fermentum* LPF6 cultured in modified exopolysaccharides selection medium (Popoola and Adebayo-Tayo, 2017). The biosynthesis of silver nanoparticles with potent antimicrobial activity using lactic acid bacteria (Kabo et al., 2019). Also, there are research reports on bacterial synthesis of silver nanoparticles by culture free supernatant of lactic acid bacteria isolated from fermented food samples (Adebayo-Tayo et al., 2017). This research is aimed at the biosynthesis, characterization and antimicrobial activity of silver nanoparticles using the culture free supernatant (CFS) of *L. Plantarum.*

Materials and Methods

Culture Collection

Lactobacillus plantarum (LP) previously isolated from fermented food (locust beans) was collected from the culture collection of the Microbiology Laboratory, Department of Biological Sciences, KolaDaisi University. The culture was kept in a maintenance medium (De Mann Rogosa and Sharpe broth (LabM, UK) with 12% v/v glycerol). The stock culture were stored at 4ºC and sub-cultured regularly for its viability.

Test Organisms

Five test organisms: *Escherichia coli, Klebsiella sp, Staphylococcus aureus, C. albicans* and *Salmonella typhi* were obtained from the Department of Medical Microbiology, University College Hospital (UCH), Ibadan. The isolates were resuscitated on nutrient agar before use.

Biosynthesis of Silver Nanoparticles using the culture free supernatant of L. Plantarum

The culture free supernatant was produced by culturing *L. Plantarum* in sterile MRS broth. The inoculated broth was incubated microaerobically at 35ºC for 24 hrs. After incubation, the inoculated medium was centrifuged at 5000rpm for 20 mins and the supernatant obtained were used for the biosynthesis of SNPs.

1 ml of the culture free supernatant was challenged with 10 ml of freshly prepared 10 mM silver nitrate ($AgNO_3$) in deionized water under stirring conditions. The mixture was incubated at room temperature in a dark place for 24 - 48 hrs. Formation of brown colour indicates the formation SNPs (Popoola and Adebayo-Tayo, 2017).

Characterization of the Silver Nanoparticles

Visual detection and UV-Visible spectrophotometry characterization of the synthesized SNPs

The culture free supernatant treated with silver nitrate solution was observed for colour change in comparison to control as a visual method of detection of silver nanoparticle biosynthesis. Changes in colour from the initial colour of the various samples to brown indicate formation of silver nanoparticles.

The bio reduction of silver ions (Ag+) to silver nanoparticles (Ag°) in aqueous solution with various samples was monitored using UV-Visible spectrophotometer (Lambda 25UV/V, USA) with a resolution of 0.5 nm. The absorbance of the sample was read with the wavelengths ranging from 250 nm - 750 nm.

Fourier Transformed Infra-red spectroscopy (FTIR) analysis of synthesized SNPs

FTIR analysis was carried out to characterise the functional groups of SNPs. The synthesized SNPs were air dried at room temperature and used for FTIR analysis. The analysis of the dried SNPs was carried out using Potassium Bromide (KBr) pellet (FTIR grade) method in a ratio of 1:100. The spectrum was recorded using JASCO FT/IR-6300 Ibadan in the range of 450-4000 cm^{-1}. Fourier Transformed Infra-red spectrometer equipped with JASCO IRT-7000 Intron infrared Microscope using Transmittance mode operating at a resolution of 4 cm^{-1}.

Scanning Electron Microscopic (SEM) analysis of synthesized SNPs

SEM of the biosynthesized SNPs was used to determine the morphology of the SNPs. The aqueous solution of the biosynthesized SNPs were dried and subjected to scanning electron microscopy machine (Qantas 200 Environmental SEM, USA).

Effect of some physicochemical parameters on the biosynthesized SNPs

The effect of some physicochemical parameters like silver nitrate concentrations, incubation time, temperature and pH on the biosynthesized SNPs was evaluated.

The effect of incubation time (24 and 48 hrs), different concentrations of $AgNO_3$ (1mM - 5mM), temperature (25ºC, 35ºC and 45ºC) and pH (3, 5, 7, 9, 11 and 14) on the biosynthesized SNPs was evaluated.

Antimicrobial activity of SNPs

The antimicrobial analysis was done using agar well diffusion method on Gram positive and Gram negative bacteria: *Escherichia coli, Klebsiella sp, Staphylococcus aureus, C. albicans* and *Salmonella typhi*. A 24 hr old culture of each test organism was inoculated into 5 ml normal saline in a test tube and standardized to 0.5 Macfarland. A sterile swab stick was used to apply the suspension to the surface of freshly prepared Muller Hinton Agar (MHA) plates. The plates were allowed to dry and a sterile cork borer of 5 mm was used to cut uniform wells in the agar. Each well was filled with 40 µL biosynthesised SNPs. The plates were incubation at 37ºC for 24 hr. The zone of inhibition excluding well, for each case was measured and recorded (Abd El-Raheem et al., 2011).

Results and Discussion

Biosynthesis and characterization of SNPs using culture free supernatant of L. plantarum

The functions of biological synthesis in nano-scale technology and other fields of nanoscience are very significant in the biosynthesis of nanoparticles. In this study, culture free supernatant of *L. plantarum* was evaluated for the biosynthesis of silver nanoparticles (SNPs). Plate 1 shows the visual characterization of biosynthesized SNPs by *L. plantarum*. There was a colour change. The biosynthesis of SNPs was observed visually based on the colour changes observed after incubation. The colour change from golden yellow to dark brown indicates the production of silver nanoparticles which was as a result of the excitation of surface plasmon vibrations. The colour exhibited by the metallic nanoparticles could also be as a result of the coherent excitation of entire free electrons within the conduction band leading to surface plasmon resonance (SPR). This result is in correlation with the work of Popoola and Adebayo-Tayo, (2017) who worked on the green synthesis of silver nanoparticles using supernatant from *Lactobacillus casei* LPW2 cultured in modified exopolysaccharides selection medium. Abhishek and Rashmi, (2017) reported that the solution mixture turned into brown from yellow solution at room temperature suggesting the formation of SNPs.

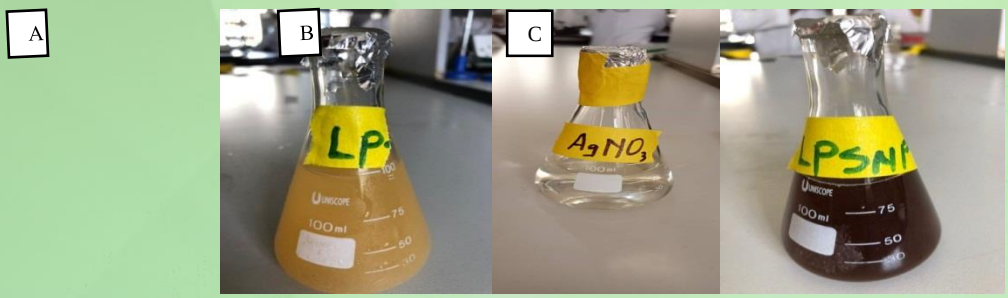


Plate 1. Visual Characterization of biosynthesized SNPs by *L. plantarum*
Key: A- CFS of *L. plantarum* (LP); B- $AgNO_3$; C- SNPs synthesized by CFS of *L. plantarum* (LPSNPs)

The biosynthesized SNPs produced were characterized with UV-visible Spectrophotometer. The spectra obtained from the biosynthesized SNPs by culture free supernatant of *L. plantarum* (LPSNPs) is shown in Figure 1. Surface Plasmon Resonance (SPR) peak was at 450 nm for LPSNPs indicating the formation of SNPs. LPSNP had the highest absorbance for the biosynthesis of SNPs and the least absorbance was recorded for LP. A broad band spectrum between 350 nm and 550 nm was observed for LPSNP and LP. The biosynthesized SNPs by culture free supernatant of *L. plantarum* (LPSNP) shows maximum production. The maximum production of the culture free supernatant indicates that the reduction of the ions occurs extra-cellularly through reducing agents released into the solution by the lactic acid bacteria. SNPs exhibits size and shape dependent on SPR bands. Similar studies have been reported by Sreedevi et al. (2015) who stated that the Surface Plasmon Resonance band in the SNPs solution of *Lactobacillus plantarum* was centred at 420 nm, indicating the particles are dispersed in the aqueous solution with no evidence of aggregation. This study is in correlation with the work of Soltani et al. (2015) who reported that the synthesis of SNPs by *Streptomyces somaliensis* showed a strong SPR peak at 450 nm. This result is similar to the study conducted by Kamani and Lim, (2013) who reported that SNPs showed a strong SPR peak at 400 – 550 nm with a broad band and size, indicating the formation of SNPs that varied in shape and size.

The biosynthesized SNPs were further characterized using Scanning Electron Microscopy. This is an important tool used to determine the morphology and size of the SNPs produced. The micrograph of SNPs synthesized by CFS of *L. plantarum* is shown in Plate 2. The SEM analysis confirmed that SNPs synthesized by CFS of *L. plantarum* was spherical and partially aggregated with particle size ranging from 0.7- 10.0 nm. The aggregation observation may be due to the drying process. The size differences are caused by concentration of reducing agent and the presence of stabilizer which is crucial to the size and shape control of nanoparticles in a biosynthesis

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system. Similarly, Adebayo-Tayo et al. (2017) reported that the SEM for the biosynthesis of SNPs by *L. casei and L. fermentum* was partially aggregated with particle size ranged from 0.7-10 nm and 1.4 -10 nm.

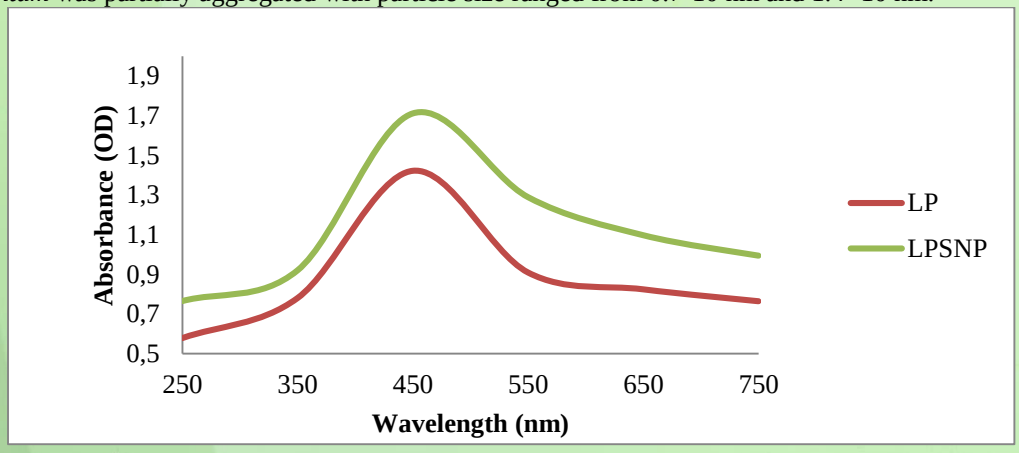


Figure 1. UV-Visible absorption spectra of SNPs synthesised by culture free supernatant of *L. plantarum*
KEY: LP- CFS of *L. plantarum*, LPSNPs – SNPs synthesized by CFS of *L. plantarum*

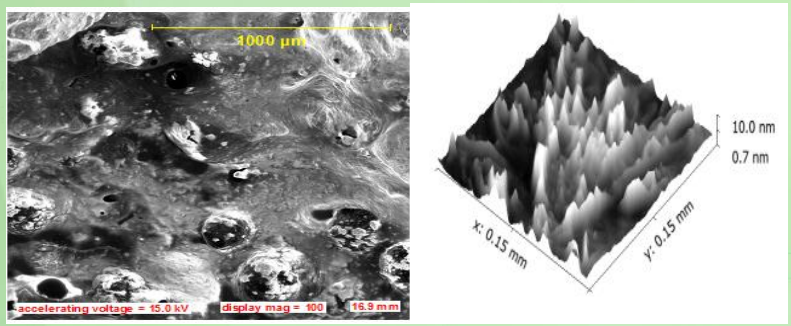


Plate 2. Scanning electron micrograph of LPSNPs (Silver nanoparticle synthesized by *L. Plantarum*

FTIR determines the functional groups present in samples. The FTIR spectrum of SNPs biosynthesised by cell free supernatant of *L. plantarum* is shown in Figure 2. 15 bands were present at 3401.08, 2098.88, 1642.74, 1458.7, 1415.73, 1121.51, 1080.53, 1037.6, 986.13, 735.56, 515.75, 505.77, 478.66, 471.77, and 456.21 cm^{-1} as shown in fig 3. The peak at 3401.08 cm^{-1} was observed to have the strongest and broadest absorption peak indicating a stretching vibration of hydroxyl group (OH). The peak at 2098.88 cm^{-1} indicates the presence of C=C stretching alkenes while the peak at 1642.74 cm^{-1}corresponding to the C=O carbonyl stretching frequency and carboxyl groups. The absorption peak at 1458.7 cm^{-1} indicates the presence of N-H bend of secondary amide and 1415.73 cm^{-1} peak shows the presence of C-N stretch of primary amide. The peak at 1121.51 cm^{-1} indicates C-H in plane bend of alkanes. The absorption peak at 1080.53 and 1037.6 cm^{-1} was identified to be the C-N stretch of aliphatic amines. The peak at 986.13 cm^{-1} showed the presence of C-O stretch of carboxylate while 735.56 cm^{-1} corresponded to the C-H stretching of mono-substituted benzene. The peaks at 515.75 cm^{-1} and 505.77 cm^{-1} showed the presence of S-S disulphide stretch. The absorption peaks at 478.66 cm^{-1}, 471.77 $cm^{-1}$and 456.21 cm^{-1} indicates the presence of acetylenic C-H bend of alkynes. All functional groups observed indicated that hydroxyl, aldehyde, carboxylic acid, amino acid, and esters may be responsible for the stability and bio-reduction of silver nitrate ($AgNO_3$) to silver nanoparticles (SNPs). These functional groups are present as a result of the presence of biomolecules from the cell membrane of *L. plantarum*, which was involved in the biosynthesis process. Carbonyl groups from the amino acid residues and peptides of protein has strong ability to bind silver, this protein form a coat covering the metal nanoparticles and aids its stabilisation in the medium. This is in accordance with the work of Balashanmugam et al. (2013) who reported that from FITR spectrum analysis, their SNPs were surrounded by proteins and amino acids which may be responsible for the stability. Also, Hidayat et al. (2020) reported the presence of proteins and amino acids which are a stabilising agent for SNPs. Akinsete et al. (2017) observed that the functional groups found in the biosynthesized SNPs by *B. ferruginea* includes carboxyl gourp, hyroxyl group, carbonyl group, secondary amides and aromatic conjugates and are responsible for the stability of SNPs.

The Effect of physicochemical parameters on the biosynthesized SNPs by culture free supernatant of L. plantarum

The UV-Visible spectra for the biosynthesis of SNPs by cell free supernatant of *L. plantarum* at different incubation time is shown in Figure 3a. SPR peak was at 450 nm for the SNPs at 24 hrs and 48 hrs and a broad

band at 350 - 550 nm was observed. The absorbance recorded for SNPs at 24 hrs was the highest while SNPs at 24 hrs had the least absorbance. The effect of incubation time on the biosynthesis of SNPs was evaluated and maximum absorbance was observed at 24 hrs with the SPR peak at 450 nm indicating the production of SNPs with different sizes and shapes. This is in accordance with the work Adebayo-Tayo et al. (2017) who reported that the UV-visible spectra of biosynthesized SNPs by *Lactobacillus casei* LPW2 and *Lactobacillus fermentum* LPF6 showed a broad band at 400 – 600 nm at 24 h and 48 hrs. Sreedevi et al. (2015) reported that at 48 hrs synthesis of SNPs were able to produce different shapes.

The effect of different concentrations (1 - 5 nm) of $AgNO_3$ on biosynthesis of SNPs by culture free supernatant of *L. plantarum* was evaluated. The UV-Visible spectra on the effect of different concentration of $AgNO_3$ on the biosynthesis of SNPs by culture free supernatant from *L. plantarum* is shown in Figure 3b. The SNPs showed strong SPR peak at 450 nm and highest broad band at 350 nm - 550 nm for all the concentrations. 5 mM had the highest absorbance followed by 4 mM and the least absorbance was recorded at 1mM concentration of $AgNO_3$. The ability of 5 mM $AgNO_3$ concentration to induce the highest SNPs biosynthesis may be due to the faster rate of bio-reduction with increased concentration of precursor salt. Also, SPR increases with increase in salt concentration. This result is in agreement with the report of Babu et al. (2013) who reported that the SPR peak intensity increased with the increase in silver nitrate concentration (1 to 5 mM). In contrary, the report of Annadurai et al. (2013) evaluated the effect of silver nitrate concentration using 1 mM to 5 mM and concluded that the optimum $AgNO_3$ concentration was 1 mM.

Temperature is one of the most important physical parameter on the synthesis of SNPs. Figure 3c shows the UV-visible absorption spectra for the effect of temperature on the biosynthesis of SNPs by culture free supernatant of *L. plantarum*. SPR peak was observed at 450 nm for all the temperatures and a broad band at 350 - 650 nm. The SNPs at 25ºC had the highest absorbance followed by SNPs at 35ºC and the least absorbance was recorded at 45ºC. The SNPs biosynthesis may be as a result of complete reduction of silver ions to SNPs. Denaturation of proteins capping occurs at higher temperature leading to higher rate of agglomeration. This result is in agreement with the work of Adebayo-Tayo and Popoola (2017) who reported that the highest production of biosynthesized SNPs by lactic acid bacteria was obtained at 28ºC. Muhammed et al. (2012) observed that with increase in temperature from 25ºC - 45ºC, the SPR peaks were sharp, yellowish-brown solution was obtained after 30 min of stirring the formation of SNPs and 45ºC was the optimum temperature required for the completion of the reaction. Figure3d shows the UV- visible spectra for the effect of different pH on the biosynthesis of SNPs by culture free supernatant of *L. plantarum*. The stabilized LPSNPs showed SPR peak at 450 nm for pH 7 and 9. Two peaks were observed for SNPs at pH 5 and pH 3 at 350 nm and 550 nm. The highest absorbance was recorded for SNPs at pH 9 followed by SNPs at pH 7 and the least absorbance was recorded for pH 5. The absorbance increased from 350 - 550 nm and then declined to 650 nm. At alkaline pH SNPs are stable while at low pH the protein structure gets affected, denatured and loses its activity. The ability of pH 7 to support SNPs biosynthesis may be attributed to the capping proteins secreted by the bacteria in the solution which was stable at high pH. Hydrogen ion are nucleophiles which play crucial role in maintaining the stability of SNPs by absorbing on it and in synthesis of smaller size SNPs by providing electrons for reduction of silver ions. Ability of pH 9, pH 7 and pH 11 to support the maximum biosynthesis of SNPs may be due to the fact that more nucleation regions are formed due to the availability of OH^- ions. Increases in pH increases more competition between protons and metal ions for negatively charged binding sites. This work is similar to the study of Sonal et al. (2015) who observed that pH 9 and pH 11 showed the maximum absorbance and peak at 425 nm and 436 nm respectively and there was no need for agitation of mixture in alkaline pH before all the silver ions supplied will be converted to SNPs. This is in accordance with the work of Afreen and Vandana (2011) who reported that absorption maxima show a sharp peak at pH 7.

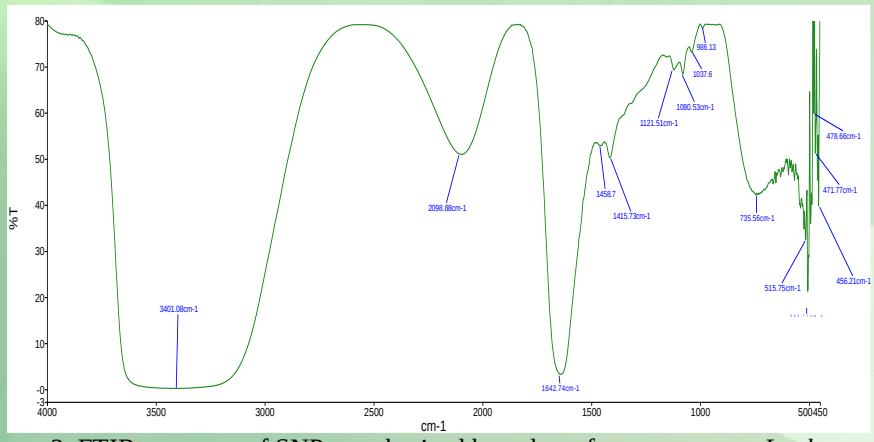


Figure 2. FTIR spectrum of SNPs synthesized by culture free supernatant *L. plantarum*

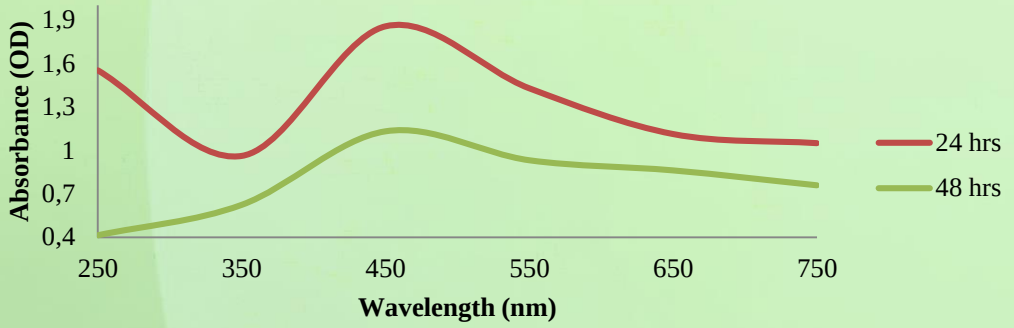


Figure 3a. UV-Visible absorption spectra on the effect of incubation time on the biosynthesis of SNPs by *L. Plantarum*

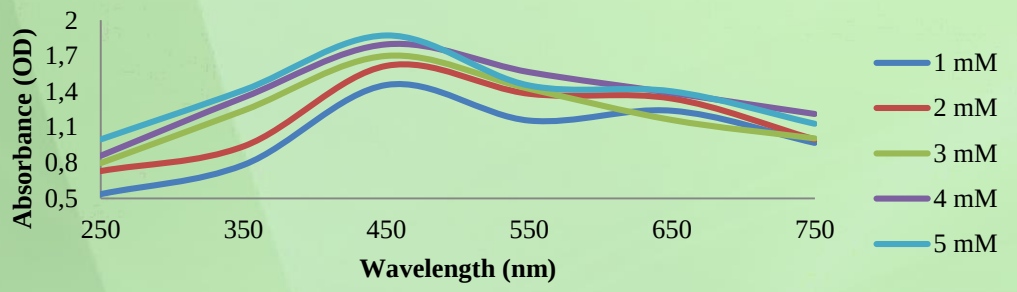


Figure 3b. UV-Visible absorption spectra of the effect of $AgNO_3$ concentration on the biosynthesis of SNPs by *L. Plantarum*

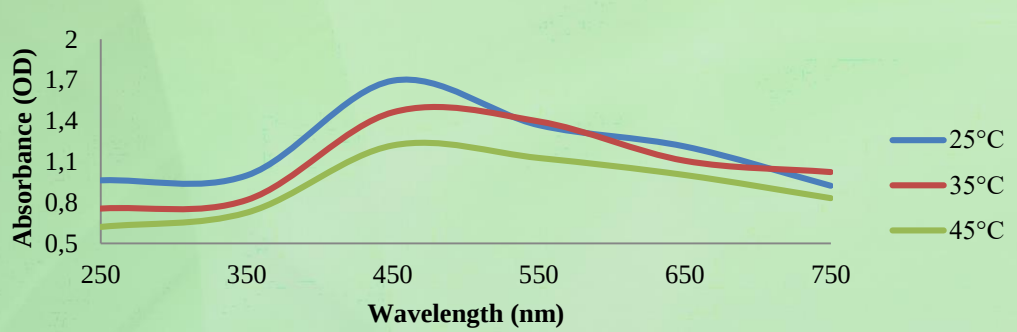


Figure 3c. UV-Visible absorption spectra of the effect of temperature on the biosynthesis of SNPs by *L. Plantarum*

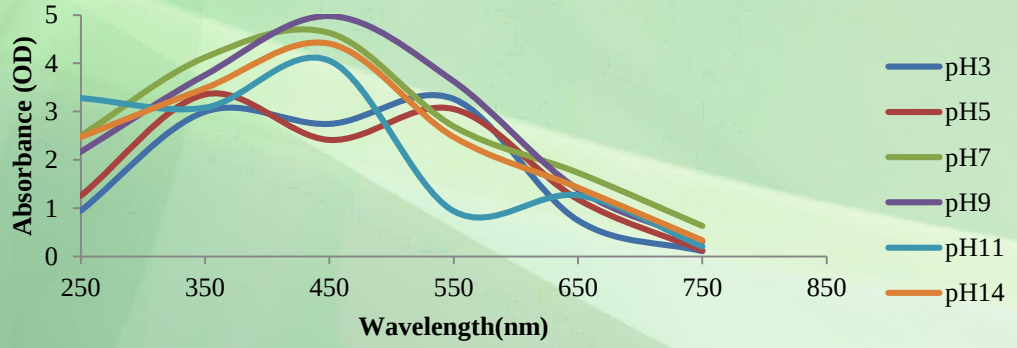


Figure 3d. UV-Visible absorption spectra of the effect of pH on the biosynthesis of SNPs by *L. Plantarum*

The Antimicrobial activity of the biosynthesized SNPs on the test organisms

The antimicrobial activity of LPSNPs, $AgNO_3$, LP and antibiotics (Ciprofloxacin) against some selected test organism were investigated.

Table 1 shows the antimicrobial activity of the biosynthesized SNPs. The zone of inhibition of LPSNP ranged from 15 - 22 mm. *S. aureus* had the highest susceptibility followed by *E. coli* and the lowest susceptibility was recorded against *Klebsiella sp.* The antimicrobial activity of Ciprofloxacin ranged from 14 - 20 mm. *S. typhi* had the highest susceptibility while the lowest susceptibility was recorded against *C. albicans.* The antimicrobial activity of LP and $AgNO_3$ ranged from 8 - 12 mm. The biosynthesized SNPs by culture free supernatant of *L. plantarum* (LPSNP) had the highest zone of inhibition.

The SNPs synthesized by *L. plantarum* exhibited varied antimicrobial activities against the test organisms. The antibacterial effects of SNPs are well established and several mechanisms of their bacterial effect have been proposed. The Gram-positive bacteria were more susceptible to the SNPs than the Gram-negative bacteria. Nanoparticles interact with DNA, thus losing its ability to replicate leading to cell death. The result is similar to work of Adebayo-Tayo and Popoola (2017) who reported that *Staphylococcus aureus*, a Gram positive organism was the most susceptible to their SNPs. Kabo et al. (2019) who reported the biosynthesis of silver nanoparticles with potent antimicrobial activity using lactic acid bacteria. This is also in accordance with the work of Adebayo-Tayo et al. (2017) who used the bacterial synthesis of silver nanoparticles by culture free supernatant of lactic acid bacteria isolated from fermented food samples. This is in contrast with the work of Hidayat et al. (2020), who reported that the inhibitory effects of SNPs were more pronounced on Gram-negative bacteria compared to Gram-positive bacteria due to the thickness of the cell wall and cell composition. Some of the antimicrobial properties exhibited by the fermented food strain (*L. plantarum*) may be as result of the low pH of the food as well as metabolites (SNPs) produced by LAB involved in the fermentation.

Table 1: Antimicrobial Activity of Silver Nanoparticles against Some Selected Test Pathogens

Test organisms	Zones of Inhibition (mm)				
	$AgNO_3$	LP	LPSNPs	Ciprofloxacin	
S. typhi	11	9	18	20	
S. aureus	10	10	22	18	
Klebsiella sp	10	9	15	14	
E. coli	9	12	20	19	
C. albicans	12	8	14	15	

Keywords; $AgNO_3$: Silver nitrate; LPSNPs: SNPs synthesized from *L. plantarum*; LP: Cell free supernatant of *L. Plantarum*

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Effect of Replacing Alfalfa Hay with Dried Moringa Oleifera Leaves on Rumen Fermentation, Rumen Microbial Protein Synthesis and Methane Production in Lactating Dairy Cows

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Abstract

Alteration of the microbial ecosystem and ruminal function can be used to improve feed utilization and production performance of ruminant animals. This study aimed to assess the effect of supplementing Moringa leaves in dairy cows fed on basal Rhodes grass hay on rumen fermentation, microbial protein production, and ruminal methane gas production. Nine lactating Holstein-Friesian cows (444±39.7 kg) were randomly assigned to three dietary treatments supplemented with 0, 5 and 10% of Moringa leaves in place of 10, 5 and 0% of Lucerne hay on a DM basis in a randomised complete block design for 8 weeks. There was no significant difference in the pH, VFAs, estimated methane, microbial protein, and microbial mass, even though there was a variation in the Moringa-supplemented treatment and the control. Compared with the control, Moringa leaves decreased (P=0.0017) the rumen protozoa and increased (P=0.0092) rumen Ammonia-N concentration. It is concluded that Moringa leaves enhanced rumen fermentation kinetics in lactating Holstein-Friesian cows and can be used as a protein supplement for dairy cows and a substitute for Lucerne hay.

***Keywords**: Ammonia-N, Feed efficiency, Methane, Moringa oleifera, Ruminal fermentation*

Introduction

Despite the economic potential of the dairy industry in developing countries, they are constrained by numerous factors, including a shortage of year-round supply of high-quality feeds, low-quality milk-producing breeds, poor management, and their impacts on climate change, and this has led to poor livestock productivity (Hao et al., 2017).

Smallholder dairy farmers constitute the higher percentage of dairy producer in the tropics, and they use crop residues for their livestock with little or no supplementation and their storage methods are insufficient to preserve the quality of the feeds, which results in seasonal variations in feed availability and a reduction in milk production (Njarui et al., 2016).

Animal nutritionists and microbiologists have altered the microbial ecosystem and rumen function to improve feed utilization and performance by including Ionophores and antibiotics. This intervention's metabolism and residual effect have led to anti-microbial resistance, which has caused great public concern and strict regulations on ruminant production (Matloup et al., 2017).

Hence, there is a need to explore alternative resources, such as fodder trees and shrubs, that can replace antibiotics in manipulating the rumen function to increase productivity on a sustainable basis. In this regard, the drought-tolerant Moringa (*Moringa oleifera*) tree can be considered one of the numerous top feed resources in the tropics. Moringa is a tree native to India but has spread to many areas worldwide. It's a perennial evergreen tree (Palada et al., 2007) whose forage contains 5.9% moisture, 38.6% carbohydrates, 27.2% protein, and 17.1% fat (Yameogo et al., 2011). Moringa's versatility allows multiple harvests throughout the growing season, and the dried leaves can be stored for extended periods without losing nutritional content (Mendieta-Araica et al., 2011).

Numerous studies have demonstrated that Moringa can enhance the health and performance of ruminants, such as oxidative status and milk production (Babiker et al., 2016), improve their nutrition via microbial protein synthesis (Soliva et al., 2005), and regulate rumen microflora as it contains large quantities of active substances, such as flavonoids, and other phenolic compounds (Kholif et al., 2016). The various nutrients in Moringa, including protein, fatty acids, minerals, and vitamins, make it a good feed resource for livestock (Moyo et al., 2012).

Several studies have reported that the inclusion of Moringa leaves in ruminant diets have improved animal performance quantitatively and qualitatively (Mendieta-Araica et al., 2011; Sultana et al., 2015; Babiker et al., 2016; Cohen-Zinder et al., 2016; Kholif et al., 2016; Kholif et al., 2017; Zeng et al., 2018). Therefore, this study aimed to assess the effect of supplementing Moringa leaves in dairy cows fed basal Rhodes grass hay on ruminal fermentation, microbial protein production, and ruminal methane gas production.

Materials and Methods

Study Site

This research was conducted at Tatton Agriculture Park (TAP), Egerton University, Njoro, Kenya. It is located between longitude 35º 57'E and latitude 0º 23'S at an elevation of 2,200 and 2,280 m above sea level, with a daily mean temperature of 21ºC. The precipitation pattern is bimodal, with mean annual precipitation between 900 and 1,020 mm. The long rain occurs between March and May, occasionally extending into June, and the short rain occurs between September and November.

Experimental Animals and Design

A total of nine lactating Holstein-Friesian cows weighing 444±39.7 kg were housed in sheltered cubicles within the vicinity of the University Biogas unit. They were randomly assigned to three experimental groups of three animals each, using a Randomised Complete Block Design (RCBD). During the first week of the feeding trial, the animals were drenched with an anthelminthic to control internal parasites and sprayed weekly to control external parasites.

Experimental Diets and Treatment

Rhodes grass (*Chloris gayana*) hay served as the basal diet, while Lucerne (*Medicago sativa*) hay and dried Moringa (*Moringa oleifera*) leaves were used as supplements. Rhodes grass hay was acquired from neighbouring stores, and Lucerne hay was acquired from Kenya Agriculture and Livestock Research Organisation (KALRO), Naivasha. The hay was shredded using a fodder chopper and stored in gunny bags.

Moringa leaves were sourced from Kiorimba/Machegene, Meru County, Kenya. The leaves were removed from the branches, air-dried on plastic sheets under partial shade, and then stored in gunny bags.

The cows were fed three different experimental diets, as stated in Table 1, and were randomly assigned to one of three treatments as follows:

- T1: The basal diet with 0% Moringa (10% Lucerne); control
- T2: The basal diet with 5% supplementation of Moringa (5% Moringa + 5% Lucerne);
- T3: The basal diet with 10% supplementation of Moringa (10% Moringa).

Table 1. Composition of dietary treatments

Ingredients	Dietary treatments		
	T1 (Control)	T2	T3
Dried Moringa leaves (%)	0	5	10
Lucerne hay (%)	10	5	0
Rhodes grass hay (%)	90	90	90
Total (%)	100	100	100

Dry matter intake (DMI) was estimated as 4% of the live weight of each cow, the supplements (Moringa leaves and Lucerne hay) were fed at 10% of the total estimated daily DMI for each cow, and the basal diet (Rhodes grass hay) was offered ad libitum. The basal diets were offered to each cow ad libitum at 08:00 hr, 13:00 hr, and 16:00 hr, and to ensure that the supplement was wholly consumed, it was provided prior to ad libitum feeding of the basal diet. The basal diet was also adjusted based on the previous day's intake to ensure that the cow receives sufficient basal feed without leaving too many leftovers and to avoid selective feeding. There was also unlimited access to water and mineral supplement. The feeding trial lasted for eight (8) weeks, with two prior weeks assigned to adaptation to the treatments.

Collection of Rumen Liquor

During the last week of the feeding trial, rumen liquor was collected manually from the animals using a stomach tube connected to a vacuum pump 3 hr after the morning feeding (Lodge-Ivey et al., 2009). Feed particles were removed from the rumen liquor by straining it through four layers of cheesecloth. This was used to determine the pH, NH_3-N, VFA, protozoa number, and microbial protein synthesis.

Determination of pH and NH_3-N

The pH of the rumen liquor was measured immediately using a pH metre calibrated at pH 4.0 and pH 9.0 using respective pH buffers. To determine the NH_3-N, a portion (8 ml) of the rumen liquor was preserved by adding 2 ml of freshly prepared 25% metaphosphoric acid to prevent further microbial activity and NH_3 loss through volatilization. The mixture was stored in tightly capped tubes at -20°C until further analysis. The rumen Ammonia-

N was determined using the procedure of Smith & Murphy (1993). It is based on the principle that ammonia reacts with alkaline hypochlorite and phenol in the presence of a catalyst (sodium nitroprusside) to form indophenol (blue), and the concentration of ammonia is directly proportional to the absorbance of indophenol, which is measured spectrophotometricaly.

Determination of VFA, Protozoa Number and Microbial Protein

An aliquot of the rumen liquor was frozen at -20°C for analysis of the VFAs. The concentration of the VFAs (acetate, propionate, and butyrate) was determined using the spectrophotometric method for determining high-range VFA concentration in mixed-acid fermentation samples developed by Aramrueang et al. (2022) using acetic, propionic, and butyric acid as standards.

To determine the protozoa number, a subsample of the rumen liquor was fixed with 18.5% formalin immediately (Dehority, 1984), and a portion of each sample was stained and stored in methyl green formalin saline (MFS) solution (Gürelli, 2014). A well-mixed sample was used for the determination of the population of protozoa in the rumen fluid (Gürelli and Göçmen, 2012) with the aid of a microscope.

Microbial protein was determined using Lowry's procedure, where centrifugation was used to separate bacterial cells from the rumen liquor. Proteins from cells were released by suspending them in 0.25 N NaOH and heating them in a boiling water bath for 10 minutes. Microbial crude protein was then determined by the Folin phenol method (Lowry et al., 1951).

Estimation of Microbial Mass and Ruminal Methane Gas Production

The concentration of the VFAs was used to estimate the values of ATP using the equation described by Widiawati and Thalib (2009):

ATP_{pr} =[2.5x(A)] +[2.75x(P)] +[3.5x(B)]

where: ATP_{pr} – is the amount of ATP produced (mole)

(A)– is the concentration of acetate (mole)
(P) – is the concentration of propionate (mole)
(B) – is the concentration of butyrate (mole)

As Widiawati and Thalib (2009) suggested, the values of ATP produced and the values of ATP required for synthesizing a unit of the microbial cell were employed to predict the microbial protein synthesized in the rumen during fermentation. It is based on the assumption that each mole of ATP produces 10 g of the microbial cell. As a result, the microbial mass was computed using the equation described by Widiawati and Thalib (2009):

Microbial mass = 10 x ATP_{pr}

where: Microbial mass – is the amount of microbial cells produced (g)

ATP_{pr} – is the amount of ATP produced (mole)

Ruminal methane gas produced during the fermentation of the diets was estimated from the VFA proportions using the equation described by Widiawati and Thalib (2009):

CH_4 =[0.5x(A)] +[0.5x(B)] –[0.25x(P)]

where: CH_4 – is the amount of methane produced (mole)

(A) – is the concentration of acetate (mole)
(B) – is the concentration of butyrate (mole)
(P) – is the concentration of propionate (mole)

Statistical Analysis

Data were subjected to an analysis of variance (ANOVA) procedure following a Randomised Complete Block Design (RCBD) using the Generalized Linear Model (GLM) procedure of SAS (SAS, 2009). The different means were separated using Tukey's Studentized Range (HSD) Test at $P<0.05$.

The statistical model of Randomised Complete Block Design (RCBD) was used:

$Y_{ij} = \mu + \alpha_i + \beta_j + \varepsilon_{ij}$

where: Y_{ij} - the jth observation of the ith treatment
μ - the population mean
α_i - the effect of the ith treatment, i = {1, 2, 3}
β_j - the effect of the jth block
ε_{ij} - the random error of the ith treatment on the jth block

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Results

Rumen Fermentation Kinetics

The effect of supplementing lactating Holstein-Friesian cows with different levels of Moringa leaves, and Lucerne hay on their rumen fermentation kinetics are presented in Table 2. The highest pH was observed in T2 (6.5), and no significant difference was across the treatments. The Ammonia-N content significantly differed across the treatments, and the highest was recorded in T2 (41.03 mg/L). Supplementing with Moringa leaves did not affect the concentration of acetate, butyrate, or propionate (P=0.0092), and there was no difference (P<.0001) in the acetate: propionate concentration across the treatments.

There was a decrease in protozoa number and an increase in microbial protein synthesis in the Moringa-supplemented treatment compared to the control. There was no significant difference (P=0.0092) across the treatments regarding the estimated methane gas and microbial biomass.

Table 2. Effect of supplementing lactating Holstein-Friesian cows with different levels of Moringa leaves and Lucerne hay on rumen fermentation, microbial protein and methane gas production

Parameters	Dietary treatments			SEM	P
	T1	T2	T3		
pH	6.17[a]	6.50[a]	6.30[a]	0.07	0.2563
Ammonia-N (mg/L)	10.31[c]	41.03[a]	24.25[b]	4.67	0.0092
Acetate (mmol/L)	27.51[a]	28.93[a]	27.67[a]	1.47	0.9912
Propionate (mmol/L)	41.27[a]	43.40[a]	41.50[a]	2.21	0.9912
Butyrate (mmol/L)	55.02[a]	57.86[a]	55.33[a]	2.95	0.9912
Acetate: Propionate	0.67[a]	0.67[a]	0.67[a]	0.00	<.0001
Protozoa number (x10^3 cells/ml)	70.57[a]	14.21[b]	4.26[b]	10.56	0.0017
Microbial protein (mg/L)	92.45[a]	92.38[a]	100.10[a]	4.28	0.3697
Methane (mmol/L)	30.95[a]	32.55[a]	31.12[a]	1.66	0.9912
Microbial mass (mmol/L)	3748.30[a]	3941.70[a]	3769.30[a]	200.88	0.9912

[abc]Means in the same row with the same letter are not significantly different at P<0.05; T1= Rhodes grass hay supplemented with Lucerne hay; T2= Rhodes grass hay supplemented with Lucerne hay and Moringa leaves; T3= Rhodes grass hay supplemented with Moringa leaves; SEM= Standard error of the mean.

Discussion

Rumen Fermentation Kinetics

The rumen microbiome is critical to the host animal's effective feed breakdown and utilisation, ultimately affecting its nutritional status. It is believed that the rumen microbiota of cattle produces around 70% of the total energy substrates ingested and utilised by the animal through their fermentation characteristics (Hungate, 1966).

The rumen is an ideal habitat for the growth of anaerobic microbes, and the normal pH of grass-fed ruminants is between the range of 6-7 (Russell et al., 2009). The pH observed in this experiment is within the range of 6.1-6.8, which shows that the animals had a healthy rumen, and the diets did not have a significant effect (P=0.2563) on the rumen pH. The result is consistent with that of Kholif et al. (2017), who studied the effect of Moringa leaf extract on rumen fermentation, and Soliva et al. (2005), who compared Moringa leaves with soybean and rapeseed meal.

The rumen Ammonia-N concentration ranged from 10.31-41.03 mg/L, and it falls within the range reported by Satter and Slyter (1974) to maximize microbial growth and activity in the rumen. The result showed an increase in rumen Ammonia-N concentration with supplementation with Moringa than the control diet.

This shows that the level administered can enhance rumen fermentation by making N available for microbial growth and enhancing microbial protein synthesis (Soliva et al., 2005). It explains the high microbial protein content observed in the Moringa-supplemented diet. However, Li et al. (2019) reported a decrease in ruminal Ammonia-N concentration in cows fed the Moringa diet compared to the control diet. Kholif et al. (2016) also observed a decrease in the concentration when they fed Moringa as fresh leaves, hay, or silage to lactating goats.

Ruminants can derive energy from complex carbohydrates through microbial fermentation to yield volatile fatty acids (VFAs), estimated to provide up to 75% of the total metabolizable energy (Bergman, 1990). The VFA production in the rumen depends on nutrient digestibility, the rate of absorption, the rate of digesta passage from the rumen, and the activity of the microbial population in the rumen (Li et al., 2019).

This study showed no significant difference in the acetate, propionate, butyrate, and acetate: propionate concentration of the Moringa-supplemented treatments compared to the control. It can also be observed that there was an increase in the concentration of the VFAs with the addition of Moringa leaves, although the combination of Moringa and Lucerne showed the highest increase. This increase indicates an improvement in fermentation due

to the increase in the microbial mass, mostly bacteria (Li et al., 2019). This result agrees with Kholif et al. (2015) and Li et al. (2019), who reported that feeding Moringa improves the VFA concentration in lactating goats and cows.

The rumen protozoa have been demonstrated to enhance methanogenesis and impact intraruminal recycling of microbial protein even though they contribute to fibre degradation and stabilize ruminal pH changes (Puniya et al., 2015). Some of the methanogenic bacteria have a symbiotic relationship with rumen ciliate protozoa and remain either inside the body of the protozoa or are attached to their surface, and this is the reason why defaunation is usually associated with reduced production of methane in the rumen as the methanogens lose their symbiotic association resulting in their reduced biological activity (Santra and Karim, 2003).

In this study, there was a drastic decrease in protozoa number in the Moringa-supplemented diet compared to the control diet, and this can be attributed to the active substances in Moringa leaves such as saponin, which has been documented as an antiprotozoal agent (Ebeid et al., 2020). This decrease can also result from the unsaturated fatty acids present in Moringa leaves, as they are toxic to rumen ciliate protozoa (Moyo et al., 2011) and cause defaunation. This result is consistent with the result of Sultana et al. (2018), Ebeid et al. (2020), and Abdel-Raheem & Hassan (2021), who reported that Moringa supplementation decreases the amount of rumen ciliate protozoa in goats, water buffaloes, and buffalo calves respectively.

As a consequence of the decrease in the protozoa numbers, an increase in the total bacterial population is expected as there is no predation of bacteria by the protozoa, and this will decrease the energy loss through methanogenesis by 5.5–7.9 % of gross energy intake (Mathieu et al., 1996). The decrease in the estimated methane production in the Moringa-supplemented diet can also result from the secondary metabolites present in the leaves because they have an inhibitory effect on ruminal methanogenic bacteria (Bodas et al., 2012). This result agrees with the report from Kholif et al. (2017) and Li et al. (2019), who used lactating goats and cows as their model animals to investigate the effect of Moringa on methane emission.

In this study, Moringa leaves generally had a positive effect on rumen fermentation, and studies have shown that low or medium levels of secondary metabolites in ruminant diets have a positive effect on rumen fermentation and productivity compared to high levels (Salem et al., 2014). The variation among the results of studies might be related to the nature and concentration of secondary metabolites in different leaves.

Conclusion

Based on the result of this study, it can be concluded that Moringa leaves can serve as a substitute for Lucerne hay in the diet of dairy cows to improve rumen fermentation as they enhanced fermentation kinetics and decreased methane production through effective modulation of the rumen microbiome. Moringa leaves can be used as supplements for dairy cows subsiding on low-quality basal diets during the period of feed scarcity in arid and semi-arid regions and agro-pastoral areas and therefore help to mitigate the feeding crisis as a non-conventional protein source for ruminants.

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A New Approach to Assessing Landscape Diversity: Relative Diversity Index

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Abstract

Landscape character analysis is a process that provides an understanding of the natural and man-made characteristics of a region or area by examining elements such as landscape diversity, type and unit. Landscape diversity refers to the differences between different ecosystems, plant and animal species, natural features and other landscape elements in a landscape and is the result of a combination of biological, ecological and geographical factors. Landscape type is a combination of key features that reflect the overall character and structure of this diversity. The smallest part of this combination, the landscape unit, is the repetition of types in their spatial distribution. Expressing landscape diversity in terms of type/unit-based mathematical indices is important for making sustainable planning decisions in landscape management. Among these indices, the common Shannon's diversity index includes the number of types and the proportion of each type in total types, while Simpson's diversity index is the opposite of Shannon's index. In other words, low values indicate high diversity and high values indicate low diversity. In this study, in addition to these two mathematical indices, the relative diversity index, which is a new approach that includes the evaluation of the number of units of landscape types and the size of the area together, was calculated for landscape diversity in the sub-basin boundaries including all units of Afşin-Elbistan Thermal Power Plant. In landscape planning studies, Geographic Information Systems were used as a tool to express the area with mathematical indices. For this purpose, the spatial distribution of landscape types was found by overlaying forest stand types with CORINE land cover/land use classes dated 2018. Landscape diversity in this area was assessed by comparing three different indices. Thus, the importance of the relative diversity index in considering the components that make up landscape diversity as a whole was emphasized, and the importance of measuring diversity with mathematical indices in making sustainable planning decisions was revealed.

Key Words: *landscape diversity, Shannon's Diversity Index, Simpson's Diversity Index, Relative Diversity Index, Landscape character analysis*

Peyzaj Çeşitliğinin Değerlendirilmesinde Yeni Bir Yaklaşım : Bağıl Çeşitlilik Endeksi

Özet

Peyzaj karakter analizi; peyzajın çeşitliliği, tipi ve birimi gibi unsurların incelenerek bir bölgenin veya alanın doğal ve insan yapısıyla şekillenmiş özelliklerinin anlaşılmasını sağlayan bir süreçtir. Peyzaj çeşitliliği, bir peyzajdaki farklı ekosistemler, bitki ve hayvan türleri, doğal özellikler ve diğer peyzaj unsurları arasındaki farklılıkları ifade eder ve biyolojik, ekolojik ve coğrafi faktörlerin birleşimi sonucu oluşmaktadır. Peyzaj tipi ise, bu çeşitliliğin genel karakterini ve yapısını yansıtan temel özelliklerin bir kombinasyonudur. Bu kombinasyonun en küçük parçası olan peyzaj birimi, tiplerin yersel dağılımındaki tekrarı olarak yer almaktadır. Peyzaj çeşitliliğinin tip/birim bazında matematiksel endekslerle ifade edilmesi, peyzaj yönetiminde sürdürülebilir plan kararlarının alınması yönünden önemlidir. Bu endekslerden yaygın olan Shannon's çeşitlilik endeksi, tip sayısını ve her tipin toplam tipler içindeki oranını içerirken, Simpson's çeşitlilik endeksi ise Shannon's endeksinin tam tersidir. Yani düşük değerler yüksek çeşitliliği, yüksek değerler ise düşük çeşitliliği gösterir. Bu çalışmada Afşin-Elbistan Termik santralinin tüm birimlerini içeren alt havza sınırlarındaki peyzaj çeşitliliği, bu iki matematiksel endeksin yanı sıra, peyzaj tiplerinin alan büyüklüğü ve birim sayısının birlikte değerlendirilmesini içeren ve yeni bir yaklaşım olan Bağıl çeşitlilik endeksi hesaplanmıştır. Peyzaj planlama çalışmalarında, alanın matematiksel endekslerle ifade edilmesi için Coğrafi Bilgi Sistemleri bir araç olarak kullanılmıştır. Bu amaçla peyzaj tiplerinin yersel dağılımı, 2018 tarihli CORINE arazi örtüsü/alan kullanımı sınıfları ile orman meşçere tipleri çakıştırılarak bulunmuştur. Bu alandaki peyzaj çeşitliliği, üç farklı endeksin karşılaştırılması ile değerlendirilmiştir. Böylece peyzaj çeşitliliğini oluşturan bileşenlerin bir bütün olarak ele alınmasında Bağıl çeşitlilik endeksinin önemi vurgulanarak, sürdürülebilir plan kararları alınması noktasında, matematiksel endekslerle çeşitliliği ölçmenin önemi ortaya konulmuştur.

Anahtar Kelimeler: *Peyzaj çeşitliliği, Shannon's Çeşitlilik Endeksi, Simpson's Çeşitlilik Endeksi, Bağıl Çeşitlilik Endeksi, Peyzaj Karakter Analizi*

Giriş

Peyzajların sürdürülebilirliği, kaynakların korunması, peyzaj tiplerinin belirlenmesi ve çeşitliliğinin korunması ve bu amaçla peyzajın zamanla gösterdiği değişimin tespit edilmesi, Avrupa Peyzaj Sözleşmesi (APS) ve PAN Avrupa Biyolojik Çeşitlilik Peyzaj Sözleşmesi'nde de belirtildiği gibi önemlidir (Atik ve ark., 2010; Tülek ve Atik, 2017.). Aynı zamanda APS, peyzajın iyileştirilmesi ve değerinin yükseltilmesini peyzaj planlama kapsamında da dikkate almıştır. Bu bağlamda insan faaliyetlerinin peyzaj üzerindeki etkisini peyzaj karakter analizi yöntemiyle ortaya koyup, peyzaj çeşitliliğiyle ilişkilendirmek oldukça önemlidir. Doğal ekosistemlerin ve insan etkileşiminin sonucu ortaya çıkan karmaşıklığını dolayısı ile peyzajların sahip olduğu arazi örtüsü, alan kullanımları ve peyzajı oluşturan diğer doğal unsurların (morfolojik yapı, anakaya gibi) göz önünde bulundurularak çeşitliliğin ortaya konulmasında ve tanımlanmasında peyzaj karakter analizi ve buna bağlı olarak matematiksel endekslerin kullanılarak peyzajların tanımlanması ve değerlendirilmesi mümkündür.

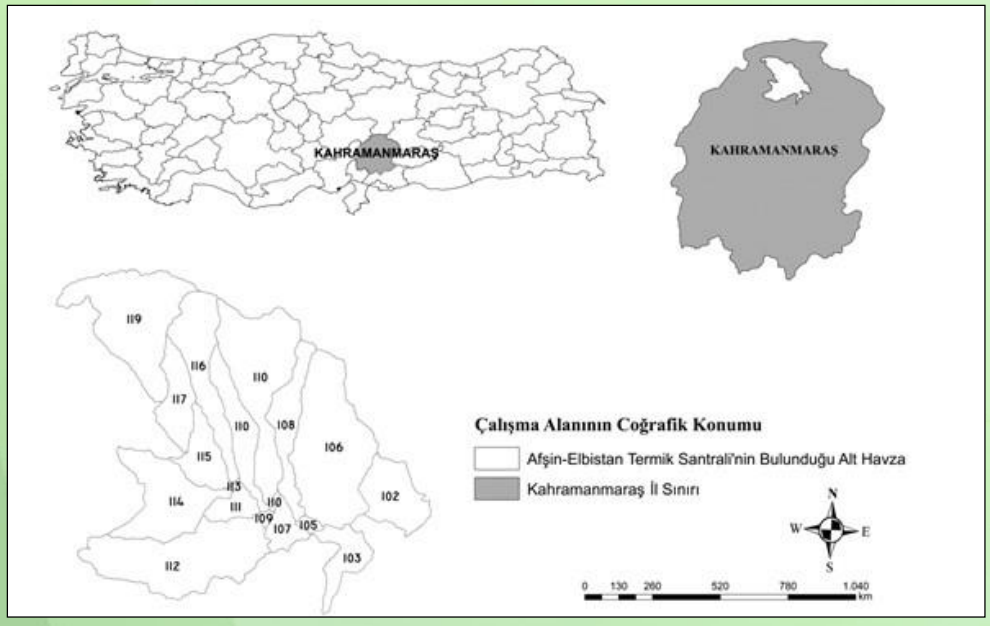
Peyzaj karakter analizi, peyzajı oluşturan canlı ve cansız bileşenlerin birlikte değerlendirilmesine dayanan bir yöntemdir. Bu yöntemin temelini oluşturan tematik veriler, Coğrafi Bilgi Sistemleri (CBS) aracılığıyla çakıştırılması sonucunda elde edilen , peyzajın karakteristik özelliklerini barındıran peyzaj tiplerini ve birimleri ni içerir. Özellikle havza yönetimi planlarında bu veriler kullanılmaktadır (Koç ve Yılmaz, 2020; Turgut & Tırnakçı, 2020.). Günümüzde bu yöntemler ekologlar, çevre yöneticileri, peyzaj mimarları ve bir çok meslek disiplini tarafından uygulanan metodolojilerde temel birer araçtır (Cherrilla ve McClean 1999; Kliskeya ve ark. 1999). Bu araçlar/yöntemler ekosistemlerin koruma bölgelerinin belirlenmesi, peyzajın ekolojik zenginliğinin ve çeşitliliğinin değerlendirilmesinde etkin rol oynamaktadır (Yılmaz 2002). Peyzaj çeşitliliğinin niteliği, peyzajın parçalılığı ve büyüklüğü ile ilişkilidir. İnsan kullanımları bu parçalılığı arttırdığı için, çeşitliliğin arttığı gözlemlenir. Ancak artan bu çeşitlilik beklenen anlamda ekolojik zenginliği içeren bir çeşitlilik olmadığı gibi insan faaliyetlerinin neden olduğu bir durum olabilir. Peyzajlardaki bu parçalılık, bir peyzaj bütünü içerisinde sahip olduğu doğal ve kültürel özellikleri nedeniyle farklı yapıya sahip peyzaj tiplerinin ve bu tiplere ait birimlerin yersel dağılımları haritalanarak sayısal verilerle ifade edilir. Çeşitliliği gösteren bu sayısal veriler matematiksel endeksler ile değerlendirilerek peyzajların çeşitliliği ortaya konulmaktadır. Kırsal ve kentsel peyzajlardaki çeşitliliğin değerlendirilmesinde peyzaj karakter analizi ve bununla ilişkili yöntemler kullanılmaktadır. (Kutlu, 2002; Özkan, 2015; Gülçin, 2018; Gülçin ve Yılmaz, 2020; Karagöz, 2020; Deniz ve Güneroğlu, 2022; Nergiz ve Şahin, 2022; Özkan ve Mert, 2022; Karagöz ve Ünlükaplan, 2023; Eren ve Cengiz, 2023; Aksu, 2023).
Peyzaj planlamada sürdürülebilir kararların alınmasında peyzaj çeşitliliğinin ortaya konulması ve değerlendirilmesi noktasında daha kapsamlı ve yeni yaklaşımların gerekliliği ortaya çıkmaktadır. Bu peyzajların sahip oldukları çeşitliliğin değerlendirilmesinde en yaygın kullanılan çeşitlilik endeksleri Shannon ve Simpson Çeşitlilik endeksleridir. Bu endeksler, zamana bağlı olarak peyzajların doğal/mevcut yapısının çevresel değişikliklere vermiş oldukları tepkiler sonucunda meydana gelen değişim ve çeşitliliği ölçmek ve farklı alanları karşılaştırmak için kullanışlı araçlardır.
Bu çalışmanın ana çerçevesini bir insan faaliyeti olan, fosil kaynaklı yakıtlara dayalı termik santrallerinin, kurulu oldukları alanlardaki peyzaj çeşitliliğini tespit etmek ve bu çeşitliliği matematiksel endekslerle değerlendirmek oluşturmaktadır. Bu amaçla, Ceyhan Havzasının bir alt havzası olan ve Afşin-Elbistan Termik Santralinin tüm birimlerini içeren mikro havza sınırlarında faaliyetin peyzaj çeşitliliği üzerindeki etkileri Shannon ve Simpson çeşitlilik endeksleri ile farklı özelliklerdeki peyzaj tiplerinin sahip olduğu birim sayıları ve kapladıkları alan büyüklüğü dikkate alınarak ortaya konulmuştur. Daha sonra bu peyzaj tiplerinin alan büyüklüğü ve birim sayısını birlikte ele alan ve Yılmaz (2016) tarafından ortaya konulan "Bağıl Çeşitlilik Endeksi" ile hesaplanarak, peyzaj çeşitliliğinin endeks değerleri karşılaştırılmış ve peyzaj çeşitliliği daha kapsamlı ve bağlamsal bir şekilde değerlendirilmiştir. Bu değerlendirmeler, peyzajların koruma stratejilerini geliştirme ve doğal kaynakların sürdürülebilir bir şekilde yönetilmesi konusunda daha etkili kararlar almamıza yardımcı olacaktır.

Materyal ve Yöntem

Materyal

Çalışma alan sınırını Ceyhan Havzasının bir alt havzası olan ve Afşin-Elbistan Termik Santralinin tüm birimlerini içeren mikro havza sınırları oluşturmaktadır. Akdeniz kıyı ardı bölgesinde bulunan, yaklaşık 53107 ha olan ve Afşin-Elbistan Termik santralinin de içinde bulunduğu 102, 106, 108, 110, 112, 114, 116 numaralı yan havzaları ve 103, 105, 107, 109, 111, 113, 115, 117, 119 numaralı ara havzalarını içeren Ceyhan Havzası'nın bir alt havza çalışma alanını oluşturmaktadır (Şekil 1). Çalışma alan sınırında yer alan Afşin-Elbistan Termik Santrali, fosil kaynaklı yakıt kullanılarak, açık ocak maden işletmeciliği olan bu santral ile ülkemizdeki 19.320.000.000 ton kömür rezervinin yaklaşık %24'ü sağlanmaktadır (MTA, 2019).
Çalışmanın ana materyallerini Afşin-Elbistan Orman İşletme Şefliklerinden temin edilen 2014 yılına ait Orman Meşçere tiplerinin yersel dağılımı ve PAN-Avrupa'nın oluşturduğu 2018 tarihli CORINE AÖ/AK sınıflarına ait 3. düzey verileri oluşturmaktadır.

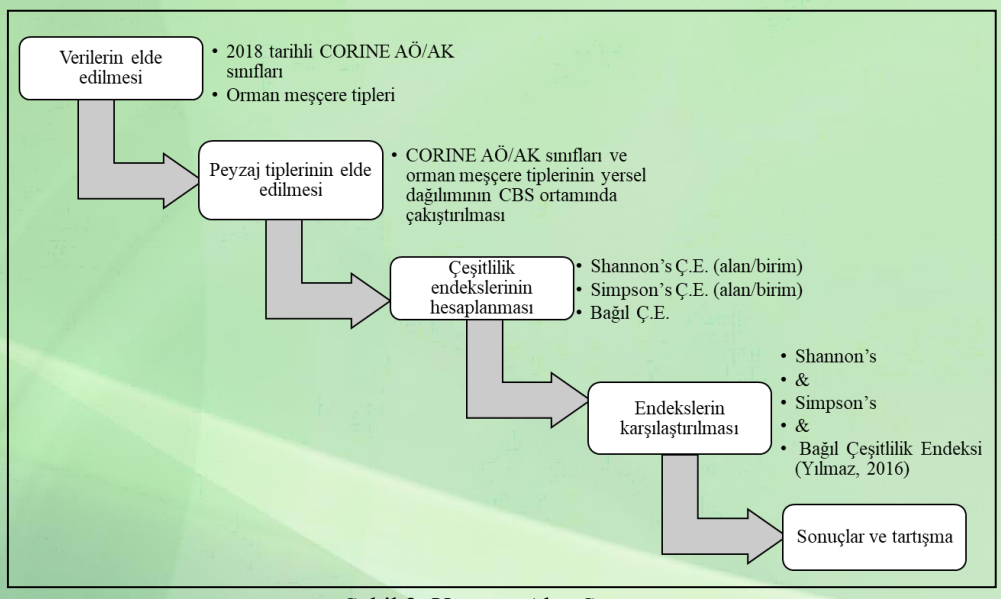
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Şekil 1. Çalışma Alanının Coğrafik Konumu

Yöntem

Çalışma, verilerin elde edilmesi, peyzaj tiplerinin oluşturulması, çeşitlilik endekslerinin hesaplanması ve "Bağıl çeşitlilik endeksi" ile karşılaştırılması olmak üzere dört aşamadan oluşmaktadır (Şekil 2). Alt havza ölçeğinde yürütülen bu çalışmada, enerji santralinin etkisine bağlı olarak peyzaj çeşitliliğinin yerel ölçekte ortayakonulması adına CORINE 3. düzey sınıfları ve Orman Meşçere verilerinin yersel dağılımı CBS ortamında ArcGIS 10.6.1 yazılımı ile çakıştırılarak peyzaj tipleri tespit edilmiştir. Bu iki peyzaj bileşenlerinden aynı özelliklere sahip her bir peyzaj tipine ait birimlerin birim sayısı ve kapladıkları alanlar (ha) bazında hesaplanmıştır.



Şekil 2. Yöntem Akış Şeması

Peyzaj çeşitliliği, peyzaj tiplerinin birim sayıları ve her bir tipin alan büyüklüğü dikkate alınarak alanın Shannon's ve Simpson's çeşitlilik endeksleri ile hesaplanmıştır (Çizelge 1). Çünkü Shannon's ve Simpson's Çeşitlilik Endeksleri, bir bölgedeki/peyzajdaki farklı türlerin/birim sayısını dikkate alarak çeşitliliği hesaplar (Shannon, 1949). Shannon's çeşitlilik endeksi 0'dan 1'e doğru artmakta iken Simpson's çeşitlilik endeksinde tam tersidir.

Çizelge 1: Shannon's ve Simpson's Çeşitlilik Endekslerinin Alan/Birim Bazında Formülleri

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Shannon's Ç.E. (birim)	Shannon's Ç.E. (alan)
$-\Sigma(p_i x \ln pi)$ p_i : alandaki her bir tipin birim sayısının tüm birim sayısına oranı $\ln pi$: pi'nin doğal logaritması	$-\Sigma(p_i x \ln pi)$ p_i^* : alandaki her bir tipin alan büyüklüğünün tüm alan büyüklüğüne oranı $\ln pi^*$: pi*'nin doğal logaritması

Simpson's Ç.E. (birim)	Simpson's Ç.E. (alan)
$1 - \Sigma(p_i{}^2)$ p_i : alandaki her bir tipin birim sayısının tüm birim sayısına oranı	$1 - \Sigma(p_i{}^2)$ p_i^* : alandaki her bir tipin alan büyüklüğünün tüm alan büyüklüğüne oranı

Çalışmanın sonraki aşamasında, Yılmaz (2016)'ın ortaya koyduğu ve Gülçin ve Yılmaz (2020)'ın her bir peyzaj tipinin birim sayısı ve alan büyüklüğü birlikte hesaplandığı, Bağıl çeşitlilik endeksi kullanılmıştır. Ele alınan planlama alanının alt birimleri olarak tanımlanan peyzaj kümeleri ve peyzaj tiplerinin, peyzajın tüm tipolojisini temsil etme performanslarına göre sıralamak için kullanılır. Yani belirli bir alanda (örneğin, bir mikro havza veya bir alt havza) peyzaj tiplerinin varlığı ile bu tiplerin temsil eden peyzaj yamaları arasındaki ilişkiyi tanımlamaktadır. Bağıl çeşitlilik endeksi, her bir peyzaj kümesine ait peyzaj yamalarının hem sayısını hem de toplam alanını dikkate alır. Belirli bir alanın bağıl peyzaj çeşitlilik değeri, eşitlik kavramı söz konusu olduğunda, daha geniş bir alanda (örneğin bir havza) tespit edilen tüm peyzaj tipolojisinin ortaya çıkma oranını yansıtır. Bir peyzaj kompleksini oluşturan komşu peyzaj birimlerini peyzaj çeşitliliği açısından karşılaştırmak için kullanışlı bir araçtır. Bu endekste tüm peyzaj tiplerinin ortalama alanını ifade edilirken, herhangi bir peyzaj tipinin alanının gözlenen değeri arasındaki farkında sonucu sıfır ise, çeşitlilik değeri en yüksektir (Gülçin ve Yılmaz, 2020).
Bu çalışmada, bağıl çeşitlilik endeksinin kullanıldığı diğer çalışmadan farklı olarak 15 x 15 km gridler yerine, peyzaj tipleri göz önünde bulundurulmuş ve kullanılan "küme" kavramı yerine 5 farklı AÖ/AK sınıfı peyzaj kümesi olarak belirlenmiştir. Bu sınıflar; *yerleşim, tarımsal alan, orman alanları, bozulmuş orman alanları ve faaliyet alanı* olup, özellikle faaliyet alanın, tüm alanı ne kadar temsil ettiği Bağıl çeşitlilik endeksi ile ortaya konulmuştur.
Bu endeks insan kullanımlarına bağlı olarak parçalanan peyzajlardaki birim sayısı ve alan büyüklüğü birlikte değerlendirilebilmekte ve belirli bir alanda (örneğin, bir mikro havza veya bir alt havza) peyzaj tiplerinin varlığı ile bu tiplerin peyzaj birimleri arasındaki ilişkiyi tanımlamaktadır. Ayrıca her bir peyzaj tipine ait birimlerin hem sayısını hem de toplam alanını dikkate alır. Bu çalışmada Afşin-Elbistan Termik Santrali ile birlikte diğer kullanımların tüm alan genelinde çeşitliliği ne ölçüde temsil ettiği, bağıl çeşitlilik endeksi hesaplanmıştır (Çizelge 2).

Çizelge 2. Bağıl Çeşitlilik Endeksi

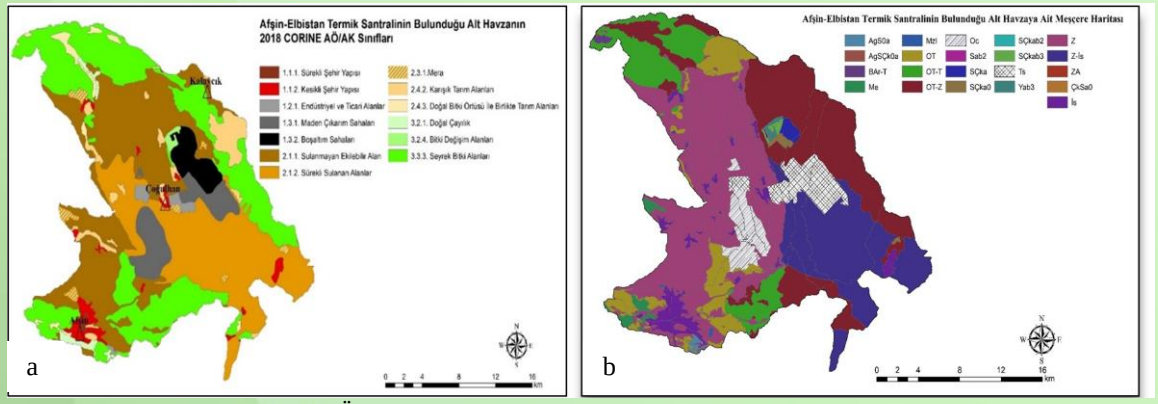
Bağıl Çeşitlilik Endeksi (Yılmaz, 2016)
$\Sigma\, a - \left(\frac{Apk}{Npk} \times \frac{1}{n}\right)$
Apk: Peyzaj kümesinin alanı (AÖ/AK)
Npk: Toplam peyzaj tipi sayısı
n: Kümenin(AÖ/AK) içerdiği tip sayısı
a: Peyzaj tipinin alanı

Çalışmanın son aşamasıda birim sayısı ve alan büyüklüklükleri dikkate alınarak hesaplanan Shannon ve Simpson çeşitlilik endeks değerleri ile "Bağıl Çeşitlilik Endeks" sonuçlarları karşılaştırılmıştır.

Bulgular ve Tartışma

Çalışma alanındaki CORINE AÖ/AK sınıfları '*Yapay Alanlar*'; Sürekli Şehir Yapısı(111), Kesikli Şehir Yapısı(112), ve faaliyetin yer aldığı Endüstriyel ve Ticari Alanlar (121), Maden Çıkarım Sahaları (131) ile Boşaltım Sahaları(132), '*Tarımsal Alanlar*'; Sulanmayan ekilebilir alan(211), Sürekli Sulanan Alan(212), Mera(231), Karışık Tarım Alanları(242), Doğal Bitki Örtüsü ile Karışık Tarım Alanı(243), '*Orman ve Yarı Doğal alanlar*'; Doğal Çayırlıklar(321), Bitki Değişim Alanları(324), Seyrek Bitki Alanları(333) olmak üzere 3 farklı kategoriden oluşmaktadır (Şekil 3 a).
Orman Meşçere tiplerinin yersel dağılımı incelendiğinde, 19 farklı meşçere tipi arasından, faaliyetin bulunduğu alanda "yanmış alanlar (Yab3)" ve en fazla alana "ziraat (Z)", en az alana ise "ağaçsız alan olup temizliği yapılmış ancak fidan dikilmemiş, gençlik/sırıklık çağındaki sedir ve karaçamın karışık olduğu (AgSÇk0a)" meşçere tipinin sahip olduğu saptanmıştır (Şekil 3 b).

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Şekil 3. CORINE AÖ/AK Sınıflarının(a) ve Orman Meşçere Tiplerinin(b) Yersel Dağılımı

Orman meşçere tipleri ve CORINE AÖ/AK sınıflarının CBS ortamında çakıştırılmasıyla 592 birime ait 105 peyzaj tipinin olduğu saptanmıştır. Çalışma alanındaki peyzaj tiplerinin birim sayısı (adet) ve alansal büyüklüğü (ha) hesaplanmıştır

Çizelge 3.Peyzaj Tiplerinin Birim Sayısı ve Alan Büyüklüğü

Tip Adı	Peyzaj Tipi		Birim (adet)	Alan (ha)	Tip Adı	Peyzaj Tipi		Birim (adet)	Alan (ha)
	CORINE AÖ/AK	Orman Meşçere				CORINE AÖ/AK	Orman Meşçere		
1	111	İs	6	70	54	231	İs	4	5
2	112	İs	18	1086	55	231	Z	5	102
3	112	OT-Z	4	67	56	231	OT-T	1	30
4	112	Z-İs	3	59	57	231	Ts	2	49
5	112	OT-T	1	1	58	231	Mzl	1	8
6	112	Mzl	1	1	59	231	Me	1	134
7	112	Z	15	48	60	242	Z-İs	4	115
8	112	AgS0a	1	1	61	242	OT-Z	4	1266
9	121	Z-İs	3	16	62	242	OT-T	1	1
10	121	Ts	6	413	63	242	Mzl	1	1
11	121	Z	5	16	64	242	OT	1	2
12	121	Oc	1	14	65	242	İs	22	235
13	121	İs	4	37	66	242	Z	12	558
14	121	AgS0a	1	2	67	242	SÇkab3	1	2
15	121	SÇka0	1	1	68	242	Yab3	1	1
16	121	OT	1	3	69	243	OT-Z	5	473
17	131	Oc	11	1598	70	243	BAr-T	1	1
18	131	Ts	4	1188	71	243	Z	10	158
19	131	OT-Z	1	4	72	243	OT-T	4	13
20	131	Z-İs	4	39	73	243	OT	10	23
21	131	Z	7	108	74	243	İs	4	33
22	131	OT	4	59	75	243	AgSÇk0a	1	2
23	132	Ts	3	536	76	243	Mzl	1	1
24	132	OT-Z	3	574	77	243	Me	6	5
25	132	SÇka	2	252	78	243	ZA	1	6
26	132	SÇkab3	1	74	79	321	OT-Z	1	102
27	132	SÇka0	2	145	80	321	OT-T	1	2
28	132	Yab3	1	8	81	321	OT	7	74
29	211	OT-Z	12	2722	82	321	Z	9	179
30	211	OT-T	8	62	83	321	İs	4	41
31	211	Mzl	3	28	84	321	SÇkab2	1	1
32	211	OT	25	359	85	321	Sab2	3	20
33	211	İs	29	264	86	321	AgS0a	1	29
34	211	Z	32	11554	87	321	Me	2	1
35	211	SÇka	2	6	88	324	SÇkab3	2	36
36	211	Z-İs	2	98	89	324	SÇka0	2	17
37	211	SÇkab3	1	3	90	324	SÇka	1	8
38	211	Yab3	1	3	91	324	Yab3	1	114
39	211	Ts	6	57	92	324	OT-Z	1	7
40	211	Oc	2	51	93	333	OT-Z	19	5938
41	211	Me	2	8	94	333	Z-İs	3	190
42	212	Oc	9	154	95	333	BAr-T	1	97

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43	212	İs	13	144	96	333	OT-T	16	4585
44	212	SÇka0	1	6	97	333	Z	41	297
45	212	OT-Z	9	519	98	333	OT	27	3413
46	212	Z-İs	10	8145	99	333	İs	8	27
47	212	Z	19	3356	100	333	SÇka0	2	6
48	212	Ts	8	56	101	333	Oc	1	5
49	212	OT	3	6	102	333	AgSÇk0a	1	1
50	212	OT-T	1	5	103	333	Me	10	353
51	231	SÇka0	1	21	104	333	Sab2	1	1
52	231	OT-Z	3	169	105	333	AgS0a	4	95
53	231	Z-İs	2	28	Genel Toplam			592	53107

Peyzajlardaki insan faaliyetleri alan kullanımları ve arazi örtüsü üzerinde parçalılığa neden olarak, çeşitliliği artması veya azalması yönünde etkilemektedir. Bu çalışmada insan faaliyetlerinin neden olduğu parçalılığı incelemek gerekirse, her bir peyzaj tipinin ortalama kapladığı alan büyüklüğü 90 ha'dır. Ancak alanda birim başına düşen alan büyüklüğü parçalılıkla ilişkili olarak farklılık göstermektedir. Örneğin; 10 adet birim sayısı ve 8145 ha büyüklüğü ile en büyük ortalamaya sahip "iskan edilmiş sürekli sulanan tarımsal alan" (46 numaralı peyzaj tipi)dır. 12 adet birim sayısının toplam alanı 2722 ha büyüklüğündeki peyzaj tipi, sulanmayan ekilebilir alan ile ormansız taşlı bölgeyi içeren (29 numaralı) peyzaj tipidir. Bunların aksine 4 adet birim sayısı olup toplamda 1188 ha olan peyzaj tipi doğrudan faaliyetle ilişkili olan maden çıkarım sahası olan tesis bölgesi (18 numaralı)dir.
Sahnnon's ve Simpson's çeşitlilik endeksleri 592 birimden oluşan, 105 tipin dahil edildiği 53107 ha büyüklüğüne sahip çalışma alanı için, her bir tipin içerdiği birim sayısının tüm birim sayısına oranı ve her bir tipin alan büyüklüğünün tüm alan büyüklüğüne oranı kullanılarak alan ve birim bazında olmak üzere iki farklı şekilde hesaplanmıştır (Çizelge 4). Buna göre Shannon's "alan" çeşitlilik endeksi 0.009, peyzaj birimlerinin çeşitlilik endeksi 0.047 olarak hesaplanmış ve alandaki bu çeşitlilik endeksleri "düşük" olarak değerlendirilmiştir. Simpson's çeşitlilik endeks değeri de her iki hesaplama için "düşük" çıkmıştır.

Çizelge 4. Çalışma Alanının Tüm Endeks Değerleri ve Karşılaştırılması

Çeşitlilik endeksi	Peyzaj tiplerinin **birim sayısına** göre;	Peyzaj tiplerinin **kapladıkları alan büyüklüğüne** göre;	Peyzaj çeşitlilik derecesi
Shannon's Ç.E.	0.047	0.009	Düşük
Simpson's Ç.E.	0.999	0.999	Düşük

Yılmaz (2016) tarafından ortaya konulan ve Gülçin ve Yılmaz (2020)'ın kullandığı, çeşitlilik kavramını zenginlik kavramından ayıran bağıl çeşitlilik endeksi Afşin-Elbistan Termik santralinin tüm birimlerini içeren alt havza sınırları için hesaplanmıştır (Çizelge 5). Bu çalışmada diğer çalışmadan farklı olarak, grid sistemi olarak tanımlanan peyzaj kümesi yerine AÖ/AK sınıfları kullanılmıştır. Çalışmadaki 5 AÖ/AK sınıfının (Peyzaj kümesi) alanı (Apk); her bir AÖ/AK sınıfını oluşturan birimlerin toplam alan büyüklüğü olarak hesaplanmıştır. Dolayısıyla da her AÖ/AK sınıfına ait peyzaj kümesinin alan büyüklüğü ile peyzaj tipinin (a) alan büyüklüğü eşit alınmıştır.

Çizelge 5. Çalışma Alanındaki Peyzaj Kümesinin (AÖ/AK Sınıfları) Bağıl Çeşitlilik Endeksi

Peyzaj Kümesi	B.Ç.E	a	Apk	Npt	n
Tarımsal Alan	773,17	25760,00	25760,00	105,00	33,00
Bozulmuş Orman Alanı	685,07	20058,00	20058,00	105,00	29,00
Faaliyet Alanı	266,64	5384,00	5384,00	105,00	20,00
Yerleşim Alanı	120,39	1337,00	1337,00	105,00	11,00
Orman Alanı	46,88	568,00	568,00	105,00	12,00

Yılmaz (2016), çeşitlilik kavramını zenginlik kavramından ayıran düzgün dağılım koşulunun eklenmesiyle peyzaj çeşitliliği değerinin, biyo-çeşitlilikle ilgili çalışmalarda kullanılan indislerdeki yaklaşıma daha yakın değerler üretilebileceğini belirtmiştir.
"Faaliyet Alanı" kümesini temsil eden alan, toplam 53.107 ha'lık alanın yaklaşık %1'ine ve fazla parçalılığa (n=20) sahip olması ile birlikte, kümenin parçalılığı bağıl çeşitliliğini düşürmüştür. Buna karşın "Tarımsal Alan" kümesi, içerdiği 33 peyzaj tipine ait peyzaj parçalarının alansal büyüklük açısından yüksek heterojenite göstermesi nedeniyle, bağıl peyzaj çeşitliliği değerlendirmesinde en düşük değeri almıştır.

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Afşin-Elbistan Termik Santralinin bulunduğu alt havzada 1990-2018 yılları arasında santralin faaliyete geçmesiyle birlikte AÖ/AK sınıflarında değişim olduğu tespit edilmiştir (Ünlükaplan ve Karagöz, 2022). Bu değişim alandaki peyzajın parçalanmasına, dolayısıyla da birim sayısında artışa neden olurken, peyzaj kümesinin (AÖ/AK sınıfları) de toplam alan büyüklüğü ile ters orantılı olabilir. Peyzajdaki insan faaliyetlerinin sonucu olarak AÖ/AK sınıflarında bir değişim söz konusu olduğunda, daha yüksek "peyzaj çeşitlilik" değerinin çıkması kaçınılmazdır. Elde edilen sonuçlar göstermiştir ki, peyzajın çeşitliliğinin ölçülmesinde peyzaj tiplerinin sahip oldukları birim sayısı ve kapladıkları alan büyüklüğü birbirinden bağımsız düşünülmemelidir. Çünkü peyzaj tipinin birim sayısı ve kapladığı alan büyüklüğü paralellik gösterebildiği gibi, tam tersi durum da söz konusu olabilmektedir. Bu durum, peyzajın parçalılığı ve beraberindeki çeşitliliğin değerlendirilmesinde çelişki yaratabilmektedir. Bu nedenle, özellikle korunan alan planlamasında peyzaj çeşitliliği açısından planlama alanı genelini temsil etme yeteneğine sahip alt birimlerin (kümeler) belirlenmesi, mutlak koruma alanlarının tespiti açısından yarar sağlayabilecektir.

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Evaluation of Total Polar Materials in Cooking Oils Obtained from Food and Beverage Establishments within Shopping Centers

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Abstract

The amount of Total Polar Material (TPM) is one of the indicators of oil quality, its suitability for further use, and the degradation of oil used during frying processes. The high temperatures and repeated long-term use of frying oils during frying lead to various compounds, including polar compounds, through reactions like oxidation, hydrolysis, and polymerization. These compounds can have adverse effects on the quality of both frying oil and food, and depending on consumption levels, they may also pose potential health risks, including various forms of cancer. The percentage of total polar compounds in frying oil serves as a standard in food establishments to determine when the oil should be replaced with fresh oil. Various countries have regulations that define maximum TPM reference values, indicating when frying oil should be discarded. Generally, a TPM value exceeding 25% is considered unsuitable for health. Examples of countries include Italy, Belgium, France, Portugal, Spain, Thailand, and Brazil, with a maximum TPM limit of 25%. In France, Germany, and the USA, the limit is 24% TPM, while China and Austria follow a limit of 27%, and Hungary is at 30% TPM. This study was conducted using the Testo 270 Frying Oil Measurement Device in a total of 36 food establishments located in three different shopping malls in Istanbul. Its purpose was to determine the TPM content in frying oils. According to the measurement results, TPM values above 25% were detected in frying oils from 5 (14%) out of the 36 establishments. The remaining 31 establishments had an average TPM value of 14.2% in their frying oils. In conclusion, regular monitoring and measurement of TPM content in food establishments are crucial to maintaining oil quality, upholding food quality and safety standards, and minimizing potential health risks, including various forms of cancer, associated with human consumption.

Keywords: *Total Polar Materials, Frying Oil, Food Safety*

Alışveriş Merkezleri Bünyesindeki Yiyecek İçecek İşletmelerinden Alınan Kızartmalık Yağların Toplam Polar Madde Açısından Değerlendirilmesi

Özet

Toplam Polar Madde (TPM) miktarı yağ kalitesinin, yağın daha fazla kullanım için uygunluğunun ve kızartma işlemleri sırasında kullanılan yağın bozulduğunu göstergelerin ölçütlerden biridir. Kızartmalık yağların yüksek sıcaklıklarda ve tekrarlayan uzun süreli kullanımları, kızartma esnasında gerçekleşen başlıca oksidasyon hidroliz ve polimerizasyon gibi reaksiyonlar etkisiyle ortamda polar bileşikler dahil olmak üzere, çeşitli bileşiklerin oluşmasında neden olur. Bu bileşikler, kızartma yağı ve yiyeceklerin kalitesini olumsuz etkileyebildiği gibi tüketim miktarına bağlı olarak insan sağlığı üzerine de potansiyel olumsuz etkilere sebep olabilirler. Kızartma yağının içindeki Toplam polar bileşiklerin yüzdesi çoğunlukla gıda işletmelerinde yağın ne zaman atılması gerektiğini belirlemek ve taze yağların değiştirilmesini sağlamak için bir standart olarak kullanılmaktadır. Mevzuat gereği ülkeler kızartmalık yağların atılması gerektiği maksimum TPM referans değerleri belirlemiştir. TPM değerinin %25'ten fazla olması sağlık açısından uygun görülmektedir. Ülkemizin de dahil olduğu, İtalya, Belçika, Fransa, Portekiz, İspanya, Tayland ve Brezilya gibi ülkelerde TPM limiti maksimum %25 iken Fransa, Almanya ve Amerika %24 TPM, Çin ve Avusturya %27, Macaristan'da ise %30 TPM limitleri kabul edilmektedir. Bu çalışma İstanbul'daki üç farklı AVM bünyesinde bulunan toplam 36 gıda işletmesinde Testo 270 Kızartmalık Ölçüm Cihazı kullanılarak, kızartmalık yağlardaki TPM miktarını belirlemek amacıyla gerçekleştirilmiştir. Ölçüm sonuçlarına göre 36 işletmenin 5 (%14) tanesinden alınan kızartmalık yağların TPM değerleri %25 üzerinde tespit edilirken geri kalan 31 işletmeye ait kızartmalık yağların TPM ortalaması ise %14.2 olarak bulunmuştur. Sonuç olarak, TPM içeriğinin gıda işletmelerinde düzenli ölçülerek izlenmesi, yağın kalitesini koruyarak, gıda kalitesi ve güvenliği standartlarını sürdürmede ve insan sağlığı açısından çeşitli kanserler dahil potansiyel sağlık risklerini en aza indirmede önem taşımaktadır.

Anahtar Kelimeler: *Toplam Polar Madde, Kızartmalık Yağ, Gıda Güvenliği*

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Sustainable Food Technology and Nutrition

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Abstract

Sustainable nutrition is defined by the Food and Agriculture Organization of the United Nations as "diets that use human and natural resources in the best possible way, are respectful of biodiversity and ecosystems, culturally acceptable, easily accessible, economically viable, nutritionally adequate, safe and with low environmental impacts of food consumption." Sustainability encompasses various disciplines, from ecology to the environment, nutrition to agriculture, clean air and accessible water to natural resources, and from work life to technology. It promotes living in harmony with the environment, preserving natural balance and resources, replacing what we take from nature, and leaving a more livable world for future generations. Sustainable nutrition includes principles such as promoting plant-based food choices, preventing food waste, and limiting consumption of ultra-processed foods. Sustainable food systems are founded on ensuring food security, environmental balance, and societal well-being for future generations. Sustainable food technologies have the potential to enhance agriculture by reducing water and chemical usage. Sustainable technological methods such as fertigation (efficient irrigation with fertilizers), crop rotation, protected cultivation, synthetic meat production, aeroponics, aquaponics, and hydroponics exist. Fertigation, for example, increases efficiency in fertilizing through water. Synthetic meat production aims to sustainably meet the demand for meat in the future. Local food systems and the preference for sustainable seafood are also parts of this approach. Overall, sustainable food systems and dietary patterns support the goal of ensuring food security and environmental balance for the future. Given the current peril to planetary health, adopting sustainable nutrition and lifestyles, which strive to provide sufficient, balanced, and healthy food, is necessary to reduce the impact of food production on the climate crisis, minimize harm to the planet during food production, and decrease food waste. In this document, sustainable food technologies and nutrition are explained, and their relationship is evaluated.

Keywords: *Nutrition, Ecology, Food Technologies, Sustainability*

Sürdürülebilir Gıda Teknolojileri ve Beslenme

Özet

Sürdürülebilir beslenme, Birleşmiş Milletler Gıda ve Tarım Örgütü tarafından "İnsan ve doğa kaynaklarını en iyi şekilde kullanan, biyoçeşitliliğe ve ekosisteme karşı saygılı, kültürel olarak kabul edilebilir, ulaşımı kolay, ekonomik, beslenme açısından yeterli, güvenilir ve besinlerin çevresel etkilerinin az olmasına bağlı düşük besin ayak izine sahip diyetler" şeklinde tanımlanmaktadır. Sürdürülebilirlik ekolojiden çevreye, beslenmeden tarıma, temiz hava ve sudan erişilebilir doğal kaynaklara, iş yaşamından teknolojiye kadar pek çok disiplini içinde barındıran bir kavramdır. Çevre ile uyum içinde yaşama, doğal denge ve kaynakları koruma, doğadan aldığımızı yerine koyabilme ve gelecek nesillere daha yaşanabilir bir dünya bırakma öğretisi benimsenmektedir. Sürdürülebilir beslenme, bitki bazlı gıda tercihinin teşvik edilmesi, gıda israfının önlenmesi ve ultra işlenmiş gıda tüketiminin sınırlandırılması gibi ilkeleri içermektedir. Sürdürülebilir gıda sistemleri gelecek kuşakların gıda güvencesini, çevresel dengesini ve toplumsal refahı gözeterek temellendirilen yapıdır. Sürdürülebilir gıda teknolojileri, su ve kimyasal kullanımını azaltarak tarımı iyileştirme potansiyeline sahiptir. Fertigasyon, ekim nöbeti, örtü altı yetiştiriciliği, sentetik et üretimi, aeroponik, akuaponik ve hidroponik tarım yetiştiriciliği gibi sürdürülebilirliğe yönelik teknolojik yöntemler bulunmaktadır. Fertigasyon, su ile gübrelemenin verimliliği arttırabileceği bir yöntemdir. Sentetik et üretimi gelecekte et ihtiyacını sürdürülebilir bir şekilde karşılamayı amaçlamaktadır. Yerel gıda sistemleri ve sürdürülebilir deniz ürünlerinin tercihi de bu yaklaşımın bir parçasıdır. Genel olarak, sürdürülebilir gıda sistemleri ve beslenme modelleri geleceğin gıda güvencesini ve çevresel dengeyi sağlama hedefini desteklemektedir. Gezegen sağlığının tehlikede olduğu günümüzde yeterli, dengeli ve sağlıklı gıdaya ulaşabilmesini amaçlayan sürdürülebilir beslenme ve sürdürülebilir yaşam tarzını benimsenmesi besin üretiminin iklim krizi üzerindeki etkilerinin azaltılması, besin üretim aşamasında gezegene verilen zararın en aza indirilmesi ve besin israfının azaltılması açısından gereklidir. Bu bildiride, sürdürülebilir gıda teknolojileri ve beslenme açıklanmış olup aralarındaki ilişki değerlendirilmiştir.

Anahtar Kelimeler: *Beslenme, Ekoloji, Gıda Teknolojileri, Sürdürülebilirlik*

Giriş

İklim, toprak, hava, su kullanımı ile ilgili küresel eğilimler her geçen yıl kötüleşmekte ve bu durum sistemleri sürdürülebilirlik açısından ele alma durumunu gündeme getirmektedir. 1987 yılında Brundtland Komisyonu tarafından 'sürdürülebilir' terimi 'sürdürülebilir kalkınma' tanımından türetilmiştir ve 'uzun vadede sürdürülebilme ve mevcut ihtiyaçları tehlikeye atmadan günümüzün ihtiyaçlarını karşılama kapasitesi' şeklinde tanımlanmıştır (Bastian et al., 2021). FAO (Birleşmiş Milletler Gıda ve Tarım Örgütü) ile WHO (Dünya Sağlık Örgütü) tarafından 1992 yılında düzenlenen uluslararası beslenme konferansı "Beslenme ve Kalkınma: Küresel bir Sorun" başlığı altında dokuz ana beslenme alanı sunmuştur. Bu ana başlıklar; hane halkı gıda güvenliğinin iyileştirilmesi, mikro besin eksikliklerinin önlenmesi, bulaşıcı hastalıkların önlenmesi ve yönetilmesi, sağlıklı beslenme ve yaşam tarzlarının teşvik edilmesi, bakım kapasitesinin arttırılması, gıda kalitesi ve güvenliğinin iyileştirilmesi, beslenme durumlarının değerlendirilmesi, analiz edilmesi ve izlenmesi, beslenme hedeflerinin kalkınma politikalarına ve programlarına dahil edilmesi, emzirmenin teşvik edilmesi şeklindedir (Berry, 2019).
Gıda sistemleri; gıdanın üretimini, işlenmesini, dağıtımını, tüketimini içeren bir dizi birbirine bağlı unsur ve faaliyetin bir araya geldiği yapılar olarak tanımlanmaktadır (Willett et al., 2019). Gıda sistemleri, ekosistem hizmetlerinin sunumunu etkilerken aynı şekilde ekosistem hizmetleri de gıda sistemlerini etkilemektedir (Camaréna, 2020). Dünya çapındaki gıda endüstrisi, özellikle sağlık ve duyusal kalite konularında daha fazla fayda sağlayan güvenli gıda taleplerinden kaynaklanan çeşitli değişiklikler ve zorluklarla karşı karşıyadır (Petrescu et al., 2020). Sağlıklı gıdaların geliştirilmesine yönelik genel fikir birliği veya belirli tüketici gruplarının ihtiyaçlarına ve özelliklerine dayalı talepler dikkate alınmış ayrıca vegan, vejetaryen, organik, esnek beslenme gibi farklı beslenme seçenekleri ve alışkanlıkları da göz önünde bulundurularak çeşitli bilgiler bir araya getirilmiştir. Teknik ve bilimsel ilerlemeler, beslenme ve gıda işleme alanında giderek daha sofistike ve bireyselleştirilmiş yaklaşımlar oluşturmaktadır (Aguilera, 2018; Gan et al., 2019; Knorr et al., 2020). Yeni yaklaşımlar arasında nanokapsülleme, 3D baskı, yüksek basınçlı işleme ve darbeli elektrik alanı gibi yeni teknolojiler bulunmaktadır. Aynı zamanda geleneksel yöntemlerle birleştirilen UV ışığıyla desteklenmiş yüksek basınçlı işleme gibi yöntemler de balık ürünlerinde tuzun azaltılması gibi benzer uygulamalarda kullanılmaktadır (M. L. G. Monteiro et al., 2021).
2008 yılında dünyada meydana gelen finans ve gıda krizinin ardından gıda güvenliğine dördüncü bir boyut olarak istikrar eklenmiştir. Sürdürülebilir diyetler, sürdürülebilir gıda sistemleri ve sürdürülebilirlik teşvik edilmiştir (Burlingame et al., 2012). Dünya nüfusu giderek kentleştiği için gıda sistemlerinin insan kaynaklı ve doğal afetlerin yol açtığı jeopolitik zorluklar ile başa çıkabilecek şekilde genişletilmesi gerektirdiği kabul edilmektedir (Willett et al., 2019).
Gıda güvenliği insanların aynı anda, yeterli miktarda, güvenli, besleyici, aktif ve sağlıklı kalmaları için beslenme ihtiyaçlarını karşılamak adına tercih ettikleri gıdaya erişebildiği durum olarak tanımlanmaktadır. Gıda güvenliğinin sağlanabilmesi için gıdanın yeterli miktarda bulunması, beslenme eksiklerini önlemek amacıyla istikrarlı şekilde erişilebilir olması, gıda dışı kontaminasyon riski olmadan her zaman tüketilebilmesi gerekmektedir. Ekonomik kriz, iklim değişiklikleri ve COVID-19 salgını sonucu gıda güvensizliği on yıldan daha kısa sürede etkisini fazla hissettirmiştir (FAO's Agriculture and Development Economics Division (ESA), 2006). Küçük çocuklar ve yetişkinler 'sağlıklı beslenme modellerini' benimsemek amacıyla çaba göstermekte fakat kitle iletişim araçları yolu ile edindikleri bilgileri sağlıklı şekilde yürürlüğe koymaları konusunda yetersiz kalabilmektelerdir. Bu durum ortoreksiya gibi yeme bozukluklarına sebep olmaktadır (Athanasaki et al., 2023). Daha sağlıklı ve sürdürülebilir diyetlere geçiş, mevcut beslenme alışkanlıkları ve bunlar ile ilgili çevresel etkilerin değerlendirilmesi ile mümkündür.

Sürdürülebilir Gıda Sistemleri

Sürdürülebilir bir gıda sistemi gelecek kuşakların gıda güvencesi ve beslenme ihtiyaçlarını karşılayan, aynı zamanda ekonomik, sosyal ve çevresel dengeyi gözeterek temellerini atmaktan kaçınmayan bir yapıdır. Bu sistem, herkes için beslenme ve gıda güvenliği sağlama amacını taşımakta ve bu hedefleri gerçekleştirirken gelecek nesillerin ihtiyaçlarını da gözetmektedir (HLPE, 2014).
Gıda kalitesi ve güvenliğini sağlayan denetim sistemlerini geliştirmek amacıyla çeşitli araştırma projeleri yürütülmektedir (Śliwińska et al., 2014). Diyetler ve gıda sistemleri birbiriyle yakından ilişkili olmalarına rağmen gıda sistemi kavramı gıda odaklıdır. Bireylerin tüketim seçimleri, besin sistemlerinin sunumları arasında seçim yaparak oluşturdukları diyetleri yansıtmaktadır. Bunun karşısında farklı diyetlerin toplamı, genel gıda talebini şekillendirerek gıda sistemlerini yönlendirmektedir. Bu bağlamda diyetler, gıda sistemlerinin hem sonucu hem de itici gücü durumundadır (Meybeck & Gitz, 2017).
Yapılan son araştırma Akdeniz bölgesi dışında ancak buna paralel olarak bu bölge için de geçerli olan on bir ülkeden gelen sürdürülebilirlik kılavuz ilkelerini incelemiştir. Bu araştırmada yaklaşık olarak on üç önemli nokta sıralanmıştır. Araştırmada öne çıkan en çok tavsiye edilen üç öneri şu şekildedir: (1) Bitkisel gıdaların tüketiminin arttırılması (9 ülke), (2) Gıda israfının azaltılması (7 ülke) ve (3) Et tüketiminin azaltılması (5 ülke). Bu öneriler genel olarak "Çatalı bıçağa tercih edin" şeklinde özetlenmektedir (Rose et al., 2019). Pestisit kullanımının

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azaltılması amacıyla Orta Doğu'da başlatılan özgün bir girişim İsrail, Ürdün ve Filistin'deki çiftçiler arasında biyolojik haşere kontrolünü teşvik etmektedir. Bu yaklaşım, kemirgen popülasyonlarını kontrol etmek için peçeli baykuşlar ve kerkenezler gibi doğal yırtıcıların kullanılmasını öngörmektedir. Böylece "doğa doğayla mücadele edecek" şeklinde bir strateji benimsenmektedir (Meyrom et al., 2009).

Sürdürülebilir Gıda Teknolojileri

Tarım işletmelerinde alınan karar ile su gibi sınırlı kaynakların veya kimyasallar gibi zararlı tarımsal girdilerin azaltılması gelişmiş tarım ekosistemleriyle bağlantılıdır. 2004 tarihli bir literatür taraması, hassas tarım konusundaki akademik çalışmaların "Hassas tarımının sadece gerektiği yerlerde ve gerektiği zamanlarda gübre ve böcek ilacı uygulayarak çevresel etkiyi azaltma" fikrini doğruladığını göstermektedir (Gebbers & Adamchuk, 2010). Geçtiğimiz yüzyılda yaşanan 'Yeşil Devrim' süreci sentetik gübre kullanımının tarımsal üretimi arttırmasına büyük katkı sağlarken daha büyük tarım ekosistemleri için geliştirilen yönergeler yerel toprak ve su koşullarını yansıtmakta yetersiz kalmaktadır. Bu yaklaşım, olumsuz çevresel sonuçları göz ardı ederek sadece artan üretkenliği odak noktası olarak ele almaktadır. Toprak sensörlerinin tarımda kullanımı inovatif dikey yatay tarım yaklaşımlara imkân tanıyarak yerel toprak ve çevre koşullarını tanımlayabilmektedir. Bu yaklaşım, çiftçi gelirlerini en üst düzeye çıkarmayı ve çevresel etkileri minimize etmeyi hedefleyerek üretim verimliliğini temelden değiştirebilir (Viscarra Rossel & Bouma, 2016). Tarım üretiminin sürekliliğini sağlamak amacıyla mevcut arazileri koruyucu tedbirler almak ve açlık ile yetersiz beslenme sorununu azaltmaya yönelik olarak verimli ve sürdürülebilir tarımsal yöntemler geliştirilmiştir.

Ekim Nöbeti

İklim ve toprak özellikleri bölgede öncelikli olarak göz önünde bulundurularak, çeşitli tarım ürünleri karşılıklı olarak sıralı bir şekilde ekilerek birbirlerinin büyümesine destek sağlayan ekim nöbeti yöntemi, en üst düzeyde verim ve kalite elde etme amacını taşımaktadır (Dağ, 2022). Ekim sırasının çeşitlendirilmesi ve koruyucu toprak işleme yöntemlerinin kabul edilmesiyle toprak erozyonunun azaldığı ve aynı zamanda topraktaki besin maddelerinin korunduğu gözlenmiştir (Arshad & Gill, 1997; Balabanlı et al., 2005).

Fertigasyon

Fertigasyon, damlama su ile gübreleme anlamına gelmektedir. Sulama suyu ile bitki için gerekli olan besin elementleri yeterli miktarda sağlanmaktadır (Merken, 2016). Karaşahin ve ark. (2018), bu yöntemi sayesinde gübrelemenin nitrojen sızmasını engelleyerek çevre kirliliğini azalttığını aynı zamanda üretim verimini arttırarak sürdürülebilirliği sağladığını vurgulamıştır (Karaşahin et al., 2018).

Örtü Altı Yetiştiriciliği

Örtü altı yetiştiriciliği, toprağın bulunmadığı veya toprağın kalitesiz olduğu durumlarda bitkilerin normal yetişme mevsimlerinin de dışında yetiştirilmesine olanak sağlayan bir üretim sistemidir (Tuzel et al., 2020). Örtü altı tarımı sebze, meyve, süs bitkileri ve kesme çiçek gibi birçok ürünün üretimine olanak sağlamaktadır. İklim kontrolünün mümkün olması ve üretim koşullarının ayarlanabilir olması sayesinde gıda üretiminin sürdürülebilirliği açısından büyük bir öneme sahiptir.

Aeroponik, Akuaponik ve Hidroponik Tarım Yetiştiriciliği

Hidroponik sistem, toprak kullanmadan bitki ile diğer bitki örtüsünü büyütme yöntemi ve sistemi şeklinde tanımlanmaktadır (Anderson, 2017). Sadece su ve bitkinin kullanıldığı bu yöntem, topraksız tarımda kullanılan ilk yöntemdir. Bu tarım iklim kontrolü, toprağın yabani ot ve zararlı böcekler karşısında hastalanmaması, su tasarrufu, hızlı büyüme, mahsul artışı, daha az kimyasalın kullanılması açısından avantajlıdır (Bingöl, 2020).

Aeroponik tarım yetiştiriciliği ise dikey tarım içerisinde en verimli sistemlerden biridir ve bu sistemde %90'a kadar daha az su kullanılmaktadır (Jeff Birkby, 2016). Düşük kaliteli sularda bile kullanılan bu yöntem sayesinde hızlı gelişim ile ekimde artış sağlanmaktadır (Bingöl, 2020).

Akuaponik tarım yetiştiriciliği, su ürünleri yetiştiriciliği (genellikle ılık su balık türleri içerir) ile hidroponik tarımın (topraksız bitki yetiştirme) birleştirildiği simbiyotik bir sistemdir, yani iki yöntemin bir araya getirilmesiyle oluşturulan bir tarım yaklaşımını ifade etmektedir (Bingöl, 2020). Bu yaklaşımda, su ürünleri yetiştirme bölümünde üretilen balıkların artıkları ayrıştırılmakta ve bu artıklar hidroponik bitki yetiştirme bölümünde bulunan bitkilerin beslenmesi için kullanılmaktadır. Sistemin sürdürülebilir bir şekilde işlemesi için güneş panelleri gibi bir enerji kaynağı gereklidir (Kargın & Bilgüven, 2018).

Sentetik Et Üretimi

Sentetik et üretimi, *in vitro* koşullarda ileri düzey doku mühendisliği yöntemleri kullanılarak çiftlik hayvanlarının kök hücrelerinin alındığı ve biyoreaktör ortamında kültürlenerek geleneksel et üretimine ihtiyaç duymadan et elde edilen bir yöntemdir. Bu yöntem, çiftlik hayvanlarından hücrelerin izole edilip ardından büyüme faktörleri, enerji sağlayıcılar gibi besinleri içeren uygun bir ortama aktarılması sürecini içermektedir. Bu sayede kontrollü ve manipüle edilebilir, sürdürülebilir temelde tasarımcı, kimyasal açıdan güvenli ve hastalıksız et üretmek mümkün olabilmektedir (Bhat et al., 2015).

Sürdürülebilir Beslenme

Sürdürülebilir diyetler, insan ve doğal kaynakları optimal şekilde kullanarak biyoçeşitliliğe, ekosisteme saygılı, kültürel olarak kabul gören, herkesin erişebileceği, ekonomik açıdan makul ve uygulanabilir, beslenme gereksinimlerini karşılayan, güvenilir ve sağlıklı diyetlerdir. Çevresel bozulmanın temel nedenleri arasında besin üretimi ve tüketimi yer almaktadır (Gülden Pekcan et al., 2019). Makalelerden elde edilen sonuçlar ve beslenme eğitimcilerinin deneyimleri temel alınarak altı ana araştırma alanı belirlenmiştir. Bu alanlar; et/bitki bazlı diyetlerin azaltılması, gıda israfının azaltılması, aşırı işlenmiş gıdaların etkileri, yerel gıda üretiminin önemi, balık ve deniz ürünlerinin rolü ile enerji tasarrufu sağlamak için yemek pişirme yöntemleri şeklindedir (Bastian et al., 2021).

Sürdürülebilir beslenme, uygun politika ve teşviklerle kabul edilip etkinleştirilebilecek bir yaklaşım olarak görülmektedir. Uluslararası kuruluşlar özellikle Birleşmiş Milletler Gıda ve Tarım Örgütü (FAO) sürdürülebilir beslenmeye özel ilgi göstermektedir. Dünya Doğayı Koruma Vakfı (World Wide Fund for Nature-WWF) tarafından yürütülen 'Avrupa'da Düşük Etkiyle Gıda için Sağlıklı Beslenme Tablosu' (LIFE) projesi, sağlıklı beslenmeyi sürdürülebilirlikle ilişkilendiren bir yaklaşım benimsemektedir. Bu proje kapsamında;

- Sebze ve meyve tüketimi teşvik edilmekte,
- Besin çeşitliliği desteklenmekte,
- Et tüketimi makul düzeylere indirilmeye çalışılmakta,
- Gıda israfı önlenmeye çalışılmakta,
- Sertifikalı gıdaların tercih edilmesi teşvik edilmekte,
- Şeker, şekerli içecekler, yağ, tuz ve yüksek tuz içeriğine sahip gıdaların tüketimi azaltılma hedeflenmektedir." (Baybut & Bilici, 2021).

Sürdürülebilir beslenme ilkeleri; bitki bazlı gıdaların tercih edilmesi, et tüketiminin sınırlandırılması, organik gıdaların tüketilmesi, ultra işlenmiş gıdaların tüketiminin sınırlandırılması, bölgesel ve sezonluk ürünler, yerel gıda sistemlerinin teşviki, sürdürülebilir deniz ürünlerinin (balık, kabuklu deniz hayvanları, deniz yosunu) tüketimi, kaynak tasarrufu sağlayan temizlik, keyifli yemek kültürü gibi kavramlarla genişletilmiştir (Bastian et al., 2021; Von Koerber et al., 2017).

Küresel Ayak İzi ağından elde edilen verilere göre, Akdeniz ülkelerinin ekolojik ayak izi yüksek gelirli ülkelerdekinden daha büyük çıkmaktadır. Bu artışta Gıda (%35), Ulaştırma (%28) ve Konut (%9) gibi ana etkenler belirleyici olmuştur. Gıda ayak izi, Slovenya (%20) ile Fas (%70) arasında değişen geniş bir yelpazede bulunmaktadır. Mısır ve Slovenya düşük proteinli beslenme ve yüksek mahsul verimliliği sayesinde düşük ayak izine sahipken, Portekiz ve Malta'da balık (%44) ve et ürünleri (%16) ağırlıklı protein içeren beslenme nedeniyle yüksek ayak izi görülmektedir (Global Footprint Network, 2015). Gıda temel bir insan ihtiyacı olduğundan kaynak kullanımı sınırlı şekilde değiştirilebilmektedir. Nüfus artışı, kentleşme ve yüksek proteinli enerji açısından zengin beslenmeye geçiş, dünya çapında ekosistem hizmetlerini daha fazla etkilemektedir. Bu nedenle, gelecekteki gıda güvenliği verimliliğin arttırılmasına, gıda israfının azaltılmasına ve daha sağlıklı daha az kaynak tüketen bir beslenme biçiminin teşvik edilmesine bağlıdır. Akdeniz diyeti birçok özgün yerel özellik taşıdığı için değerlidir. Dengeli gıda tedariki, düşük karbon yoğunluğuna sahip geleneksel tarım yöntemlerine ve yüksek kaliteli gıdalara katkıda bulunabilmektedir. Akdeniz diyetine verilen değer, gıda kalite kontrolüne ürünlerin izlenebilirliğine (üretici ile tüketici arasındaki mesafenin azalmasına) ve küçük yerel geleneksel üreticilere yönelik artan pazar fırsatlarına dayanmaktadır (Berry, 2019).

Et Tüketiminin Sınırlandırılması

Tüketicilerin hayvan bazlı gıdalar yerine daha fazla bitki bazlı gıdalara yönelmesi önerilmektedir. Bunun nedeni (özellikle sığır eti ve diğer geviş getiren hayvanlar, daha az oranda domuz eti, kümes hayvanları, yumurta ve süt ürünleri) hayvansal gıdaların üretiminin bitki bazlı gıdaların üretimine göre daha fazla çevresel etki yarattığı konusunda sağlam kanıtların bulunmasıdır (Hedenus et al., 2014; Hyland et al., 2017; Mekonnen & Hoekstra, 2012; Nelson et al., 2016; Pimentel & Pimentel, 2003; Stephenson & Willett, 2023; Vries & Boer, 2010). Hayvansal bazlı gıdaların çevresel etkisi sera gazı emisyonlarının yaşam döngüsü yoluyla değerlendirilmiştir. Arazi kullanımı, su kullanımı ve enerji oranlarını (bir gıdayı yetiştirmek için gereken enerji miktarına karşılık gıdanın kilokalori veya gram protein cinsinden sağladığı enerji miktarının oranı) incelenerek değerlendirilmiştir (Gerber et al., 2013). Gıda zinciri boyunca tüm sera gazı emisyon kaynakları göz önüne alındığında hayvan bazlı gıdaların bitki bazlı gıdalara kıyasla kilogram başına önemli ölçüde daha fazla karbondioksit eşdeğeri oluşturduğu sonucu ortaya çıkmaktadır (Poore & Nemecek, 2018).

Gıda İsrafının Önlenmesi

'Gıda kaybı' ve 'gıda atığı' terimleri, başlangıçta insan tüketimi için üretilen ancak sonunda tüketilmeyen ve atılan veya başka bir yöne yönlendirilen yenilebilir gıda ürünleri şeklinde tanımlanmaktadır. Tarladan tabağa kadar besin zincirinin her aşamasında gıda kaybı ve israfı meydana gelebilmektedir. Gıda israfının önlenmesi sürdürülebilirlik açısından önemlidir (Göbel et al., 2015).

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Ultra İşlenmiş Gıdaların Tüketiminin Sınırlandırılması

Ultra işlenmiş gıdalar, alkolsüz içeceklerden tatlılara hazır yemeklerden işlenmiş et ürünlerine kadar geniş bir yelpazede bulunan gıdaları ifade etmektedir. Bu gıdalar hidroliz, hidrojenasyon gibi yoğun kimyasal ve endüstriyel işlemler veya koruyucular, emülgatörler ve gıda boyaları gibi gıda dışı bileşenlerin ilave edilmesi gibi bir dizi dönüşüm sürecinden geçirilerek büyük ölçüde değiştirilmiş gıdalardır (C. A. Monteiro et al., 2019). Ultra işlenmiş gıdaların kullanımı, obezite, kanser, tip 2 diyabet, kardiyovasküler rahatsızlıklar ve metabolik sendrom gibi bir dizi kronik sağlık sorunuyla ilişkilendirilmiştir (Elizabeth et al., 2020; Pagliai et al., 2021).

Yerel Gıda İşletmelerinin Tercihi

Sadece sera gazı emisyonları ve enerji tüketimi değil aynı zamanda yapılan araştırmalar yerel gıda sistemlerinin sürdürülebilirliğe katkı sağlama konusunda başka birçok yol sunabileceğini ortaya koymaktadır. Avrupalı yerel gıda tedarikçilerine dair 90 farklı vaka çalışmasının incelenmesi bu sistemlerin ekonomik, çevresel ve sosyal boyutlarıyla sürdürülebilirliği olumlu bir şekilde etkilediğini göstermektedir (Jarzebowski et al., 2020). Küresel gıda sistemlerine kıyasla, yerel gıda sistemleri biyoçeşitlilik, hayvan refahı, yönetişim ve dayanıklılık gibi kritik sürdürülebilirlik faktörlerinde daha üstün bir performans sergilemiştir (Schmitt et al., 2017).

Sürdürülebilir Deniz Ürünlerinin Seçimi

Deniz ürünleri temelde balık ve kabuklu deniz hayvanlarını içerse de D vitamini, iyot gibi diğer besin kaynaklarından elde edilmesi zor olan birkaç kritik besin maddesini içeren, besinsel olarak hayati bir öneme sahip olan gıda grubunu temsil etmektedir. Ayrıca, selenyum ve omega-3 yağ asitleri olan eikosapentaenoik asit (EPA) ve dokosaheksaenoik asit (DHA) gibi unsurları da içermektedirler. 'Sürdürülebilir deniz ürünleri' terimi altında değerlendirilen ürünlerin türlerine, menşe ülkelerine ve üretim yöntemlerine bağlı olarak incelenmesi gerektiği vurgulanmıştır. Tür bazında düşünüldüğünde genel eğilim düşük besin değerine sahip veya düşük besin zincirinde yer alan deniz ürünlerinin daha sürdürülebilir olduğu yönündedir (Tlusty et al., 2019; Watson et al., 2014).

Sonuç

Sürdürülebilirlik, uzun vadeli kalkınma ve mevcut ihtiyaçların denge içinde karşılanması olarak tanımlanmıştır. Beslenme ve gıda sistemleri, sürdürülebilirlik açısından kritik öneme sahiptir ve bu bağlamda uluslararası konferanslar ve araştırmalar önemli ilkeleri ortaya koymuştur. Gıda sistemlerinin ekosistem hizmetleri üzerindeki etkisi gıda kalitesi ve güvenliği ile yakından ilişkilidir. Teknolojik ve bilimsel ilerlemeler, beslenme alışkanlıklarını ve gıda üretimini değiştirmekte ve sürdürülebilirliği desteklemektedir. Finansal ve gıda krizleri gibi faktörler gıda güvenliği üzerinde baskı yaratmaktadır. Beslenme modellerinin sürdürülebilirliği, tüketici bilincinin artması, gıda israfının azaltılması, ultra işlenmiş gıdaların sınırlanması gibi faktörlere dayanmaktadır. Aynı şekilde, et tüketiminin azaltılması, yerel gıda işletmelerine yönelme ve sürdürülebilir deniz ürünlerinin tercih edilmesi de önemli adımlardır. Sürdürülebilirlik ve beslenme arasındaki ilişkinin sağlanması için gıda sistemlerinin gelecek nesillerin ihtiyaçlarını gözeterek dengeli bir şekilde geliştirilmesi gerekmektedir. Tarım teknolojileri, hidroponik, aeroponik ve sentetik et üretimi gibi yenilikçi yöntemler de sürdürülebilirlik hedeflerine katkı sağlamaktadır. Yerel gıda sistemleri ekolojik denge, biyoçeşitliliğin koruması ve topluluk dayanışması gibi faktörler açısından avantajlı durumdadır. Sürdürülebilirlik yaklaşımı gıda sistemleri, tarım ve beslenme alanlarında gelecekteki gıda güvenliği ve çevresel dengenin sağlanmasında kritik bir faktördür. Bu noktada, farkındalığın arttırılması, inovasyon ve iş birliği ile sürdürülebilir gıda sistemleri ve beslenme modellerinin oluşturulması hedeflenmektedir.

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Use of Olive Leaf Extract in Edible Films and Coatings in Foods

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Abstract

Edible films and coatings are used to protect and improve the quality of food and extend its shelf life. One of the most important features of edible films and coatings is their biodegradability. Environmentally friendly, safe, non-toxic biopolymer-based active films are being developed and applied in the food industry. Edible coating is the thin edible layer created as a coating on food. Edible film is a thin layer made and shaped from edible film. Olive leaf is a natural material with high nutritional value and many biological activities. It is an easily accessible and natural source of phenolic compounds. Olive leaf has antioxidant, antimicrobial, anti-inflammatory, hypoglycemic, antiviral, anticarcinogenic and antiatherosclerotic functional properties. Thanks to its functional properties and composition, it has widespread use in foods. The inclusion of olive leaf extract in numerous foods increases the biological activity of the diet. As a result of the developing food industry and technology and scientific research, it appears that olive tree by-products have the potential to be used in human nutrition by adding them to food formulations in various areas of the food industry in different forms. Usage areas of olive leaf in food: to enrich it with antioxidant and bioactive compounds, to extend shelf life by increasing oxidation stability and to produce new functional products. Olive leaf has a significant potential in achieving specified goals and technological properties, and its use in food formulations is widespread. Among these areas of use, edible films and coatings are widely used. Examples of foods for which film and coating are applied are milk, tomato paste, lamb meat, apples and cherries. As a result of the applications carried out; The original quality of the tomato paste is preserved very well, the antimicrobial effect in the meat is observed, the number of psychrophile bacteria is 5 times lower, there is an increase in the ripening process and anthocyanins in the cherry, and the shelf life of the products has increased. Olive leaves represent an inexpensive and useful source for the recovery of bioactive compounds with high potential in innovative functional foods. It is an option with high working potential, suitable for use in different foods with the selection of appropriate extraction technology. It has potential especially in edible film and coating applications.

Key Words: *Olive leaf extract, edible film, edible coating, food*

Zeytin Yaprağı Ekstraktının Gıdalarda Yenilebilir Film ve Kaplamalarda Kullanımı

Özet

Yenilebilir film ve kaplamalar gıdanın kalitesini korumak, iyileştirmek, raf ömrünü uzatmak amacıyla kullanmaktadır. Yenilebilir film ve kaplamaların en önemli özelliklerinden biri biyobozunur olmalarıdır. Gıda sektöründe çevre dostu, güvenli, toksik olmayan biyopolimer bazlı aktif filmler geliştirilmekte ve uygulanmaya çalışılmaktadır. Yenilebilir kaplama, gıda üzerinde kaplama olarak oluşturulan ince yenilebilir tabakadır. Yenilebilir film ise yenilebilir filmden yapılan ve şekillendirilen ince tabakadır. Zeytin yaprağı, besin değeri yüksek ve birçok biyolojik aktiviteye sahip doğal bir malzemedir. Kolay erişilebilir ve doğal bir fenolik bileşik kaynağıdır. Zeytin yaprağının antioksidan, antimikrobiyal, anti-inflamatuar, hipoglisemik, antiviral, antikarsinojenik ve antiaterosklerotik fonksiyonel özellikleri bulunmaktadır. Bu fonksiyonel özellikleri ve bileşimi sayesinde gıdalarda yaygın kullanım alanına sahiptir. Zeytin yaprağı ekstraktının çok sayıda gıdaya dahil edilmesi, diyetin biyolojik aktivitesini artırmaktadır. Gelişen gıda endüstrisi ve teknolojisi ile bilimsel araştırmalar sonucunda, zeytin ağacı yan ürünlerinin farklı formlarda gıda endüstrisinin çeşitli alanlarında gıda formülasyonlarına ilave edilerek insan beslenmesinde de kullanım potansiyeli olduğu görülmektedir. Zeytin yaprağının gıdalarda kullanım alanları; antioksidan ve biyoaktif bileşiklerce zenginleştirmek, oksidasyon stabilitesini artırarak raf ömrünü uzatmak ve fonksiyonel yeni ürünler üretmektir. Zeytin yaprağının, belirlenen amaçlara ve teknolojik özelliklere ulaşılması bakımında kayda değer bir potansiyel taşımaktadır ve gıda formülasyonlarında kullanımı yaygındır. Bu kullanım alanlarından yenilebilir film ve kaplama, yaygın olarak kullanılmaktadır. Film ve kaplama uygulaması gerçekleştirilen gıdalara örnek olarak süt, domates salçası, kuzu eti, elma ve kiraz verilebilir. Gerçekleştirilen uygulamalar sonucunda; salçanın orijinal kalitesini çok iyi koruma, etlerde antimikrobiyal etki ve 5 kat az psikrofil bakteri sayısı gözlemleme, kirazda olgunlaşma sürecinde ve antosiyaninlerde artış gerçekleşmiştir ve ürünlerin raf ömrü artmıştır. Zeytin yaprakları, yenilikçi fonksiyonel gıdalarda yüksek potansiyele sahip biyoaktif bileşiklerin geri kazanılması için ucuz ve kullanışlı bir kaynak oluşturmaktadır. Uygun ekstraksiyon teknolojisi seçimi ile farklı gıdalarda kullanıma uygun, çalışma potansiyeli yüksek bir seçenektir. Özellikle yenilebilir film ve kaplama uygulamalarında potansiyel içermektedir.

Anahtar Kelimeler: *Zeytin yaprağı ekstraktı, yenilebilir film, yenilebilir kaplama, gıda*

ID: 171

Ecological Risk Indices Analysis on Heavy Metal Contamination in Akinyele Local Government, Oyo State, Nigeria

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Abstract

Levels of Chromium, Copper, Lead, Manganese and Zinc in soil samples from tropical ecosystems of Akinyele Local Government, Oyo State, Nigeria were determined using sequential extraction. The concentrations of Cr, Cu, Pb, Mn and Zn ranged from 0.23-0.26, 0.44-2.42, 0.56-1.15, 5.01-6.16 and 3.73-10.02 mg/kg respectively. The mean metal levels did not show significant variations among study sites during wet and dry seasons. Contamination Factor CF and Pollution Load index PLI indices were used for the assessment of heavy metal contamination and estimation extent of human made inputs from different activities in the area. From the results, it was observed that sites B, C and D had considerable contamination (3<CF<6) and deterioration quality (PLI>1). The ecological risk indices (Hazard Quotient and Risk Quotient) were in good agreement with existing pollution indices and followed the ascending sequence Zn>Mn>Pb>Cu>Cr which indicates moderate hazards. The findings of this study using ecological risk indices has provided information on the exposure of the heavy metals to humans and the environment.

Keywords: *Pollution load index, Contamination factor, Soil, Metal, Ecological risk*

ID: 172

Effect of microgravity on rhizosphere and endophytic microorganisms

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Abstract

Outer space agriculture and planetary colonization are two major goals in space science as well as in agriculture in the future world. It is not an easy task that cultivate crop plants in outer space with limited resources as well as under several abiotic stresses. For cultivate crops in outer space, it is essential to take a better understanding about the behavioral differences as well as physical and chemical compositional changes in the plant bodies as well as the microbiomes that related to the plant root system and some plant tissues such as leaves. Usually, many microorganisms that related to the plant rhizosphere and endophytes behave in different way under the microgravity conditions that has been created within the laboratory conditions for demonstrate the conditions which the earth gravity is not affecting to plant growth and development. As an example, that has been observed, *Pseudochrobacterium kiredjianiae* a type of microorganism that inhibited the rhizosphere increasing the growth of the wheat (*Triticum aestivum* L.) by increasing the root length and biomass accumulation. With the influence of the earth's gravity this *P. kiredjaniae* also behaving in the same manner. But specially under the microgravity conditions, their activities have been enhanced. Like *Pseudochrobacterium kiredjianiae* there is a possibility to change some strain of microorganisms that can be behave on plants with resulting negative effects on the cultivations such as by decreasing the growth rate of the plant. Because of that, the understanding regarding the behavioral changes of the rhizosphere and endophytic microorganisms will be definitely helpful for the future agriculture in space and the colonization programs that based on some other planets such as Mars. Ultimately, studies regarding the studies of microgravity on rhizosphere and endophytic microorganisms will open a new chapter of agriculture in the future generations.

***Key words**: Microgravity, Behavior; Rhizosphere; Endophyte, Agriculture*

Introduction for microgravity

Microgravity can simply define as the condition which people as well as the objects that are appearing as weightless things in the space and artificially created situations under laboratory conditions. In other tern, microgravity can be defined as the condition that feels very small weight in the space. (micro-very small). Usually this condition is feeling by the astronauts who are working in the international space station and traveling through space. sometimes, microgravity is misleading as zero gravity condition. but, there is a very small gravitation pull can be observed in the space (May, 2012) and because of that, it is not a totally weightless condition. With the advancement of the technology, there are many researches regarding the affect of microgravity on human (Unsworth & Lelks, 1998) and plant tissues through more than a decade. Unlike the earth's gravity, microgravity is differently affected to the human's and plant's growth, development as well as metabolism. Usually, due to the microgravity, human bones and tissues get weaker (May, 2012). It also affects to the signaling pathways of the cells according to the molecular biological analysis (Ingber, 1999). This condition is also valid to the plants as how it valid to the human. Because, plants are also living organisms that are growing under the earth gravity. Usually many of the metabolite reactions of the plants are directly depending on the help of earth's gravity such as the root formation, transpiration of the water and the mineral nutrients through the plant body, growth and development of the apical meristem etc. But under the microgravity, plants are facing several challenges to growth of the root system and some of its metabolite pathways. when farming on space, those studies on plants will be highly affected for a sustainable farming as well as they will be important for the future of the space travels and colonization of other planets.

Importance of studying about the behavior of plants under microgravity

Major issue that should think about the space era because due to an unavoidable global issue, dramatic increasing of the global population. In the long period of the earth's history, human was cover only near to 3 million years of time. But within this time, there were more than 80 billion of people were lived and currently there are 10% of them are living (Sadigov, 2022). According to the statistical analysis, world population is more than 7 billion 884 million (Sadigov, 2022). Major reason for the dramatic increasing of the population because due to the imbalance of the births and current deaths. With the increasing of the population, cultivation lands are decreasing over time. However, colonization of a planet is not an exact solution for the increasing of the population. But with the

advancement of the science and the technology through the space exploring can be directly use for the sustainable agriculture. Also, it definitely helps to colonize other planets such as mars and moon.

Now a days, the major task in study of plants in space is to observe and analyze the adaptation of plant tissues for low gravity and the micro gravitation conditions. These studies are important for make the plants as a life -saving organisms in space. Usually the space is a harsh condition with limited number of resources. Under this conditions, plant's ability to recycling of carbon and other trace elements, recycling of carbon dioxide and producing oxygen to breath and provide food for consuming are important for the astronauts who are lining months in the space and continuing researches (Patterson, 2012). As current researches, NASA and ESA are continuing researches based on plants such as *Arabidopsis thaliana* (Patterson, 2012) to investigate about the growth and development of the root under the microgravity condition.

Why microorganisms are important for these studies?

Microorganisms are playing a key role when studying about the growth and development of plants under the earth's gravitation. In all the domains (bacteria, archaea and eukarya) microorganisms can be observable they possess significant role in the ecosystem of the earth. They are ubiquitous and because of that, they can be observed in everywhere around the earth's biosphere (Prosser, et al., 2007). Through the microbial interactions with all the other organisms on land, they possess specific interactions with plants. Usually almost all the plants in the world are possessing some kind of relation with the microorganisms. Rhizosphere, phyllosphere and the endosphere are colonizing by various types of microorganisms (Hassani, et al., 2018).

Microbial interactions with plants can be categorize under different categories. They may be symbiotic, mutualistic, pathogenic or parasitic interactions. As examples, when mycorrhizal fungi are showing mutualistic relationships with their host species, some fungi species such as *Puccinia* sp. Shows parasitic/pathogenic reactions with their particular host. In a sustainable agriculture, studying of all the types of interactions are taking an important role.

Plant-microbial interactions are using for sustainable organic farming in earth. Plant growth promoting rhizobacteria such as *Azospirillum* spp, *Rhizobium* spp, *Azotobacter* spp, *Arthrobacter* spp, *Bacillus* spp, *Clostridium* spp, *Enterobacter* spp, *Gluconoacetobacter* spp, *Pseudomonas* spp and *Serratia* spp (Mishra et al., 2016) as well as mycorrhizal fungi species and bacteria species such as *Frankia* spp. (belonging to actynomycetes family) are some microorganisms that are involving to the promoting of plant's growth and metabolism. Some microorganisms such as zinc solubilizing microbes like *Bacillus* spp. and *Pseudomonas* spp. (Mishra et al., 2016) are important in recycling of the nutrients for the plants in sustainable agriculture. As well as the nitrogen fixing microbes such as *Rhizobium* spp and some cyanobacteria species also important in the well growth of plants. In modern agriculture, these types of microorganisms are using in organic farming such as produce biofertilizers, seed coating techniques, sustainable nutrient recycling processes as well as for decrease the pathogenic infections too. With the advancement of the technology, biotechnology, molecular biology and Recombinant DNA technology like tools are using to transfer economically important microbial genes in to the plant cells and produce new plant varieties.

In the space agriculture, it is crucial to study regarding the microbial activities in order to a sustainable agriculture. All the headed microorganisms are continuing their interactions with plants under the earth's gravitation condition. But the microgravity is a totally different condition without any sense of weight and a combination of extreme conditions. Under the extreme conditions, microbial interactions with their host species are probably may be differ than the interaction in the optimum conditions. Because of that, under the microgravity conditions, those microorganism's beneficial properties could be altered. Because of that reason, studying regarding the rhizosphere and the endophytic microorganisms under the micro gravity condition is a key study for sustainable agriculture.

Rhizosphere and endophytic microorganisms.

Plant rhizosphere is a hot spot of soil microorganisms as well as microbial interactions. There are thousands of various microbial species are growing, developing and dying in rhizosphere region and plant root system is hostage for all of them. Rhizosphere is the narrow region that located around the root system and it secrete various organic components such as carbohydrates, flavonoids and they become the major food source of microorganisms and the driving force for increasing of their population (Raajmakers et al., 2009). In nature, rhizosphere is a region that consist of both beneficial as well as pathogenic microorganisms and contain the organisms that belonging to domain archaea, eukarya as well as bacteria. Some examples for the rhizospheric microorganisms are *Rhizobium* spp. *Bradirhizobium* spp, *Agrobacterium tumefaciens*, *Pythium* spp, *Fusarium oxysporous* etc. (Raajmakers et al., 2009).

In the rhizosphere, particular microbes have different roles. Some of them are beneficial (Mendes, et al., 2013) such as secreting plant growth promoting substances (oxines, cytokines) and enhance the immunity against the pathogens, improve the absorption of mineral nutrients (mycorrhizal fungi) fixing atmospheric nitrogen (*Rhizobium* spp) and modulate the timing of plant flowering (Lu et al., 2018). In other way, some rhizosphere

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microorganisms are pathogens. Crown gall disease (*Agrobacterium tumefaciens* (Raajmakers et al., 2009) Wilting diseases are some examples.

Endophytic microorganisms are hostage the plant tissues and they are belonging to archaea, bacteria or actinomycetes (Nair & Padmavathy, 2013). Like the rhizosphere microorganisms, they also may be symbiotic, neutral or pathogenic organisms. Some of the examples for the endophytic microbes are *Enterobacter* spp., *Colletotrichum* spp., *Phomopsis* spp., *Phyllosticta* spp., *Cladosporium* spp etc. (Nair & Padmavathy, 2013).

In organic agriculture under earth's gravity, both rhizosphere as well as the endophytic microorganisms are very much important as beneficial or pathogenic. But under the microgravity, their behavior can be altering.

Microbial behavior under the microgravity.

Unlike the earth's gravitation, microbial behavior under the microgravity condition is differ. The major change is the decreasing of the number and the speed of colonization of microorganisms become decreasing significantly (Foster et al., 2014). Major reasons for this are the limited number of nutrients, lack of water draining and because of that, the poor aeration of the growing soil. In the cultivation in the space, soil is directly not use as we are seen in earth. Instead of that, plants can be grown on a pillow like structure that containing a clay mixed growth medium and fertilizers (Heiney, 2021). But all the other conditions such as light, carbon dioxide condition as well as the water is supplying artificially and the supplying rates and quantities are differing than the quantities that naturally occurring in the earth. This change could be affected microbes negatively as well as affect to the symbiotic relationship as well.

Pathogenicity

Under the microgravitational condition, microbial pathogenicity usually get increased with the controls under the earth's gravity condition. Because due to the harsh conditions with limited number of resources, microorganisms are usually adapting their best to thrive the environment and as a result of that, their pathogenicity can get increase. Also, under this condition, plant also growing with stressful manner and that will be enhance the pathogenic microbial invitations (Bishop, et al., 1996). As an example, soybean cultivations are usually get infecting with *Phytophthora sojae*, a pathogenic fungus under the earth's gravity. But the virulence of *P. Sojae* is higher in the microgravity condition than the earth's gravity. With the studies of the Soybean and the particular fungi has been proved the higher virulence (Foster , et al., 2014). Also, with the *Acremonium* sp. Fungi has been proved this experimental fact too. Usually under the greenhouse condition, *Acremonium* sp. Can be discovered in wheat plants and they are symptomless. But under the space conditions, they are displaying significant symptoms is seeds of wheat plants (Bishop, et al., 1996). Also, with the study regarding *Neothypodium* spp. fungi and the wheat seeds has demonstrated the same results like the previous case study. The particular also displayed critical symptoms under the space condition, but they were symptomless under earth's gravity (Fu et al., 2017). Usually, the fungi species become the prominent pathogens in space conditions and when they invade plants, it is hard to control the process of the pathogen if they invade their particular plant host.

Growth promotion of plants

Because due to the pathogenic invasions in the plants, it is crucial to study regarding the disease control methods and plant immune system suppression for a healthy and sustainable space agriculture. Like the pathogens are increasing their virulence under the microgravitational condition, there are some microorganisms that increase the beneficial properties for the growth of plants. The studies based on *Pseudochrobactrum kiredjianiae* A4 strain has been proved the disease control properties of the bacterium under the microgravitational condition. Under the studies, *P. kiredjianiae* A4 strain has displayed the antifungal properties by biomass accumulation and the enhance the root growth of the wheat seedlings (Fu et al., 2017). Also, *P. kiredjianiae* A4 is the strain that adapted to the low temperature under the earth's condition (Fu et al., 2017). Because of that, this characteristic also important for thrive the harsh environment in the space too.

Uses of microbial properties under the microgravity

Identifying and examining of the microbial properties under the microgravity condition is basically importance for the sustainable agriculture in the space. Majority of microorganisms in soil as well as inside the plant tissues are altering their properties to thrive the microgravity condition. Because of that, this study will be importance in plant pathology as well as plant microbial interaction studies. Also, the capabilities of usual soil microbes under the extreme conditions, their environmental and physical parameters can be revealing by studying their behavior under the space condition. At last, these studies will be help to protect the lives of the astronauts who leave the earth and habitat the space for months.

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Conclusion

Microbes are fascinating and ubiquities organisms that can be live under various harsh conditions. When consider their symbiotic relationships, plant and microbial interactions are very much important for human because human is directly or indirectly depending on the plant materials. In the modern, sustainable organic agriculture, rhizospheric and endophytic microorganisms are using for increase the yield with organic fertilizers. With the beginning of the space era, people colonize the space and, in that plants, take a special place to save the lives of astronauts. For the sustainable growth and the development of plants, microbial symbiosis is important and their behavioral, metabolite, reproducing and colonization rates are differing with the microgravitational conditions. By studying those properties, the relevant microorganisms or their specific pathways can be used for the sustainable agriculture in space. Also, by studying of the pathogenic microbes, they can be control when an infection occurs under the microgravity condition. By continuing this studies could be able to colonize the space and other planets successfully.

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ID: 174

Improving Salt tolerance of Cotton through Breeding and Biotechnological Approaches

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Abstract

Cotton is widely used for fiber and oil production all over the world. It is classified as moderately salt-tolerant crop and at its seed yield and growth are greatly hampered by high salinity levels. Salinity is one of the major abiotic stresses that has a detrimental impact on plant development, growth and production processes, ultimately reducing yield. To counteract the oxidative and osmotic stresses caused by salinity, plants adopt specific mechanism and activate different salt tolerance genes to withstand saline environment. In order to increase the cotton productivity in saline conditions, a variety of approaches are proposed to improve plant breeding efficacy. Cotton cultivars that grow in saline conditions are developed using breeding techniques. Enhancing the specific alleles involved in cotton's ability to tolerate salinity is main objective of breeding programs for salinity tolerance. To increase the salinity tolerance in plants, one must have a thorough understanding of both conventional and modern breeding methods as well as biotechnological approaches. Traditional breeding methods are widely used in breeding programs to improve the salinity tolerance of cotton. These include (i) germplams screening for salinity tolerance in specific environments, (ii) making use of genetic variation already present in genotypes through backcross and pedigree methods of breeding, (iii), developing hybrids by best parental lines as a result of extensive germplams screening, (iv) mutation breeding; utilizing the variations produced by induced mutations, (v) interspecific hybridization, transferring the salinity tolerance related traits from wild relatives into well-known cotton cultivars to increase the level of tolerance. However, traditional breeding methods used to increase salinity tolerance have encountered issues, and the progress has been slow. The disadvantages of breeding approaches are mitigated by the use of Biotechnological tools for accurate genomics-assisted salinity breeding. Biotechnological approaches to enhance the salinity tolerance and fiber quality of cotton include Marker assisted selection, QTL mapping, genome editing through CRISPR-Cas9, RNAi, transgenic technology and transcriptome analysis.

Key Words: *Abiotic stresses, Genome editing, Breeding, Backcross, Marker assisted selection*

ID: 175

Opportunities to Enhance Seed Cotton Yield through various Biotechnological Approaches under water deficit Conditions

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Abstract

Earth is blessed with a huge quantity of water reservoir, but yet it's a limiting factor for crop production. Emission of greenhouse gases is a dark reality of industrialization. The huge cause of this emission is the burning of fossil fuels which leads to the global warming. It is a destructive and alarming situation for agriculture economies especially for crop husbandry. Cotton is a C3 crop and is sensitive to abiotic stresses, a little change from its optimal temperature, moisture and water content can affect its yield, growth and biomass. The objective of this review is to examine various biotechnological methods and their potential to increase seed cotton yield under water deficit conditions. It includes techniques like genetic engineering, molecular breeding, physiological interventions, and omics technologies. Genetic engineering has shown promising outcomes in improving cotton resistance to water stress, including the insertion of drought-tolerant genes, stimulation of stress-responsive genes, and modified hormone signaling mechanisms. Similar to this marker-assisted selection in molecular breeding, gene editing methods like zinc-finger nucleases (ZFNs), transcription activator-like (TAL) effector nucleases (TALENs), CRISPR technology, RNAi interference, somaclonal variations and Omics technology which includes genomics, transcriptomics, proteomics, metablomics, glyomics and phenomics are those biotechnological approaches that make it possible to precisely manipulate the genetic makeup of cotton plants, offering better management of desired characteristics. In addition, plants respond well to drought stress by application of biofertilizers, hydrogel and nanoparticles. The detrimental effects of water stress on seed cotton yield can be reduced by these interventions, which support the regulation of physiological processes, uphold cellular homeostasis, and improve stress tolerance mechanisms in cotton plants. In conclusion, integrating biotechnological techniques into cotton farming has the potential to significantly improve productivity, profitability, and resilience to water stress, guaranteeing sustainable cotton production for the next generation.

***Key words**: Abiotic stress, Genetic engineering, Genome editing, Omics technologies.*

ID: 176

Enzymatic Responses of Some Pear Cultivars against *Erwinia amylovora* by Salicylic Acid and *Bacillus subtilis* Applications

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Fire blight caused by *Erwinia amylovora* (Ea), is a destructive and contagious disease affecting mainly pear and apple and some other members of Rosaceae family and, most of the world it is a quarantine disease. In an attempt to prevent new infections, plants are sprayed with either streptomycin, copper or both, but widespread use of their have led to antibiotic resistance in some areas. Some plant defence activators as salicylic acid (Sa) is one of the major chemicals in the regulation of the plant defense against pathogens, and additionally also beneficial bacterium *Bacillus subtilis* (Bs) can also prevent fire blight from infecting new trees. In this study, the efficacy of Sa and Bs and the enzymatic responses of the plants were investigated on Santa Maria and Ankara pear cultivars to prevent shoot blight of fire blight disease. Applications were performed as Bs, Bs+Ea, Sa, Sa+Ea, Bs+Sa, Bs+Sa+Ea and as positive control Ea and as negative control steril distilled water (SDW). When the new season shoot lengths of 3-year-old plants with homogeneous growth reached 20-25 cm, Sa, Bs and Bs+Sa were sprayed 2 times with 1 week intervals, and 3 days after the second applications, cutting the youngest 2 leaves on the shoot tip bacterial inoculations were carried out with a sterile scissors dipped in 10^8 CFU^{-1} of str. Ea ARDY5 solution. Leaf samples at different times from three individual plants were collected, and were homogenized for enzyme analysis. According to the results, it was determined significant differences ($p<0.01$) between applications, diseases severities (%) and enzymatic reactions (Peroxidase, Superoxide dismutase and Catalase) of pear cultivars. The most successful application in preventing the disease was in cv. Santa Maria Bs+Sa (57,4%) and in cv. Ankara Bs (67 %) the enzymatic responses of both pear cultivars showed compatibility with the disease severity levels. The successful results have shown that the application of *B. subtilis* and salicylic acid can be evaluated as new, eco-friendly and sustainable in the combat against fire blight.

Keywords: *Erwinia, pear, organic, management, enzyme*

Salisilik Asit ve Bacillus subtilis Uygulamalarıyla Bazı Armut Çeşitlerinin *Erwinia amylovora*'ya Karşı Enzimatik Tepkileri

Özet

Erwinia amylovora (Ea)'nın neden olduğu ateş yanıklığı, başta armut ve elma olmak üzere Rosaceae familyasının diğer bazı üyelerini etkileyen yıkıcı ve bulaşıcı bir hastalık olup, dünyanın büyük bir bölümünde karantina hastalığıdır. Yeni enfeksiyonları önlemek amacıyla bitkilere streptomisin, bakır veya her ikisi birden uygulanmaktadır ancak bunların yaygın kullanımı bazı bölgelerde antibiyotik direncine yol açmıştır. Salisilik asit (Sa) gibi bazı bitki savunma aktivatörleri, patojenlere karşı bitki savunmasının düzenlenmesinde ana kimyasallardan biridir ve ayrıca faydalı bakteri *Bacillus subtilis* (Bs) de yeni ağaçlara bulaşmasını önleyebilir. Bu çalışmada, Santa Maria ve Ankara armut çeşitlerinde ateş yanıklığı hastalığına karşı Sa ve Bs'nin etkinliği ve bitkilerin enzimatik tepkileri araştırılmıştır. Uygulamalar, Bs, Bs+Ea, Sa, Sa+Ea, Bs+Sa, Bs+Sa+Ea, pozitif kontrol Ea ve negatif kontrol steril distile su (SDW) olarak gerçekleştirilmiştir. Homojen gelişim gösteren 3 yaşındaki bitkilerde yeni sezon sürgün boyları 20-25 cm'ye ulaştığında; Sa, Bs ve Bs+Sa 1 hafta arayla 2 kez uygulanmıştır. İkinci uygulamalardan 3 gün sonra, sürgün ucundaki en genç 2'şer adet yaprağa bakteriyel inokulasyonlar, 10^8 hücre ml^{-1} str. Ea ARDY5 çözeltisine batırılmış steril bir makasla kesilmesiyle gerçekleştirilmiştir. Üç ayrı bitkiden farklı zamanlarda yaprak örnekleri toplanarak enzim analizi için homojenleştirilmiştir. Elde edilen sonuçlara göre armut çeşitlerinin uygulamaları, hastalık şiddetleri (%) ve enzimatik reaksiyonları (Peroksidaz, Süperoksit dismutaz ve Katalaz) arasında önemli farklılıklar ($p<0.01$) tespit edilmiştir. Hastalığı önlemede en başarılı uygulama Santa Maria çeşidinde Bs+Sa (57,4%), Ankara çeşidinde ise Bs (67%) olmuştur ve her iki armut çeşidinin enzimatik tepkileri hastalık şiddet düzeyleri ile uyumluluk göstermiştir. Elde edilen başarılı sonuçlar ateş yanıklığı ile mücadelede *B. subtilis* ve salisilik asit uygulamasının yeni, çevre dostu ve sürdürülebilir olarak değerlendirilebileceğini göstermiştir.

Anahtar kelimeler: *Erwinia, armut, organik, mücadele, enzim*

ID: 177

Potential Biological Control Agents against Soft Rot Diseases Caused by Pectobacteria on Some Sugar Beet Cultivars

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Abstract

Sugar beet is one of the most economically important agricultural crops cultivated in many provinces of Turkey. Especially in recent years, there has been an increase in bacterial tuber rot due to factors related to climate change. In preliminary trials, soft rot disease by *Pectobacterium caratovorum* subsp. *caratovorum* (Pcc) and *Pectobacterium betavasculorum* (Pb) were detected predominantly in sugar beets in Central Anatolia. Today, some cultural measures and copper compounds are used against soft rot agents in sugar beet, but successful results cannot be obtained in preventing the disease. In this study, a total of 270 soil samples were taken from the rhizosphere of 10 different fields in 3 different periods in 3 different ecologically diverse districts (Çumra, Altınekin and Seydişehir) of Konya, one of the provinces with the highest amount of sugar beet production in Turkey. As a result of the isolations, a total of 3064 bacterial isolates were purified and 265 of them showed antibacterial activity against Pcc and Pb *in vitro* conditions. In addition, 15 antagonist bacteria with the highest inhibitory effect on the development of both pathogens were tested in greenhouse conditions, and according to the results obtained from here, 3 antagonists with the highest effect and their mixtures were tested in field conditions in the cultivation areas of 3 different districts named above. Biochemical, morphological and molecular diagnoses of antagonist bacteria with high efficacy were made. According to the results obtained, it has been concluded that rhizospheric bacteria with antagonistic effect have a success rate of 45-89% against Pcc and Pb pathogens, and that the biological products to be prepared in future studies can be used in ecological, climate friendly and within sustainable agricultural practices in sugar beet production areas.

***Keywords**: sugar beet, soft rot, biological control, climate change, eco-friendly*

Bazı Şeker Pancarı Çeşitlerinde Pektobakterilerin Neden Olduğu Yumuşak Çürük Hastalıklarına Karşı Potansiyel Biyolojik Kontrol Ajanları

Özet

Şekerpancarı Türkiye'nin çok sayıda ilinde yetiştiriciliği yapılan ve ekonomik düzeyde en önemli bitkilerinden biridir. Özellikle son yıllarda iklim değişikliğine bağlı faktörlerlerden dolayı bakteriyel yumru çürüklüklerinde artış gözlenmektedir. Ön denemelerde, bölgede şeker pancarında baskın olarak *Pectobacterium caratovorum* subsp. *caratovorum* (Pcc) ve *Pectobacterium betavasculorum* (Pb) tespit edilmiştir. Şeker pancarında günümüzde yumuşak çürüklük hastalık etmenlerine karşı bazı kültürel önlemler ve bakırlı bileşikler kullanılmakta olup hastalığı önlemede başarılı sonuçlar alınamamaktadır. Bu çalışmada, Türkiye'de en yüksek miktarda üretime sahip illerden biri olan Konya İlinin ekolojik olarak farklılık gösteren 3 ilçesindeki (Çumra, Altınekin ve Seydişehir) 10'ar farklı şeker pancarının rizosfer bölgesinden 3 ayrı dönemde toplam 270 toprak örneği alınmıştır. İzolasyonlar sonucu toplam 3064 adet bakteriyel izolat saflaştırılmıştır ve bunlardan 265 adedi *in vitro* koşullarda Pcc ve Pb'ya karşı antibakteriyel etki göstermiştir. Ayrıca her iki patojenin gelişimini engelleyici etkiye sahip 15 antagonist bakteri sera koşullarında denemeye alınmış ve burdan elde edilen sonuçlara göre en yüksek etkiye sahip 3 adet antagonist ve karışımları yukarıda isimleri verilen 3 farklı ilçenin ekim alanlarında tarla koşullarında denenmişlerdir. Yüksek etkililk düzeyine sahip antagonist bakterilerin biyokimyasal, morfolojik ve moleküler olarak tanıları yapılmıştır. Elde edilen sonuçlara göre, antagostik etkiye sahip rizosferik bakterilerin Pcc ve Pb etmenlerine karşı %45-89 oranlarında başarıya sahip oldukları, ileriki çalışmalarda hazırlanacak biyolojik ürünlerin şekerpancarı üretim alanlarında ekolojik, iklim dostu ve sürdürülebilir tarım uygulamaları içerisinde kullanılabilecekleri sonucuna ulaşılmıştır.

***Anahtar kelimeler**: şeker pancarı, yumuşak çürüklük, biyolojik mücadele, iklim değişikliği, çevre dostu*

ID: 178

Effectiveness of Phosphorus acid, *Bacillus subtilis* and Commonly Used Copper Compounds in the Control of Fire Blight on Apple cv. Gala with M9 Rootstock

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Abstract

Necrogenic Gram-negative bacterium *Erwinia amylovora*, which causes economic losses especially in pome fruits such as apple, pear, quince and loquat, some berries and many ornamental plants, causes fire blight disease. Copper compounds are used extensively in disease control programs and they can cause toxic problems in terms of plant and environmental health. In addition, the formation of resistance to copper in the pathogen is frequently observed. In this study, plant activator Phosphorus acid and biological control agent *Bacillus subtilis*, and 3 different copper compounds, Copper sulfate, Copper oxychloride and Copper hydroxide which are commonly used against *E. amylovora*, on apple cv. Gala with M9 rootstock were evaluated comparatively. When the new season shoot lengths of 3-year-old plants with homogeneous growth reached 20-25 cm, chemicals and *B. subtilis* were applied first time before one week ago from the pathogen inoculation, and after 2 times with 1 week intervals. The youngest two leaves at tips of actively growing terminal plant shoots were inoculated by cutting off using scissors dipped in suspension of *E. amylovora* str. EaARADY5 containing 10^8 CFU ml^{-1}. Disease assessments were made after the disease severity (%) was determined on the basis of shoot blight after symptom development of the disease stopped, and the results were found to be statistically significant ($p<0.05$). According to the findings, while the highest effect was obtained by copper oxychloride with 69% effectiveness among all applications, the lowest effectiveness was obtained with 43.5% copper sulfate. It has been revealed that the use of the most effective of the copper compounds in field applications will result in less exposure to chemicals in terms of human and environmental health, and that *B. subtilis* and phosphorous acid can be used significantly in the integrated control of fire blight.

***Keywords**: fire blight, control, copper, plant defence*

M9 Anaçlı Gala Çeşidi Elmaların Ateş Yanıklığı Mücadelesinde Fosforoz Asit, *Bacillus subtilis* ve Yaygın Olarak Kullanılan Bakır Bileşiklerinin Etkililiği

Özellikle elma, armut, ayva ve yenidünya gibi yumuşak çekirdekli meyvelerde, bazı meyvelerde ve birçok süs bitkisinde ekonomik kayıplara neden olan nekrojenik gram-negatif bakteri *Erwinia amylovora* ateş yanıklığı hastalığına neden olmaktadır. Bakır bileşikleri hastalık kontrol programlarında yoğun olarak kullanılmakta olup, bitki ve çevre sağlığı açısından toksik sorunlara yol açabilmektedir. Ayrıca patojende bakıra karşı direnç oluşumu da sıklıkla gözlenmektedir. Bu çalışmada, M9 anacı ile elma cv. Gala üzerinde bitki aktivatörü Fosforoz asit ve biyolojik mücadele ajanı *Bacillus subtilis* ile *E. amylovora*'ya karşı yaygın olarak kullanılan 3 farklı bakır bileşiği, Bakır sülfat, Bakır oksiklorür ve Bakır hidroksit karşılaştırmalı olarak değerlendirilmiştir. Homojen gelişim gösteren 3 yaşındaki bitkilerde yeni sezon sürgün boyları 20-25 cm'ye ulaştığında kimyasallar ve *B. subtilis* ilk kez patojenin inokulasyonundan bir hafta önce, sonra 1 hafta arayla 2 kez uygulanmıştır. Aktif olarak büyüyen terminal bitki sürgünlerinin uçlarındaki en genç iki yaprak, 10^8 hücre ml^{-1} içeren *E. amylovora* str. EaARADY5 süspansiyonuna batırılmış makas kullanılarak kesilerek aşılanmıştır. Sürgün yanıklığı bazında hastalığın belirti gelişimi durduktan sonra hastalık şiddeti (%) belirlenerek hastalık değerlendirmeleri yapılmış ve sonuçlar istatistiksel olarak anlamlı bulunmuştur ($p<0.05$). Bulgulara göre tüm uygulamalar içerisinde en yüksek etki %69 etkinlikle bakır oksiklorür ile elde edilirken, en düşük etkinlik %43,5 bakır sülfat ile sağlanmıştır. Bakır bileşiklerinden en etkilisinin saha uygulamalarında kullanılmasının insan ve çevre sağlığı açısından kimyasallara daha az maruz kalınmasını sağlayacağı, *B. subtilis* ve fosforoz asidinin ateş yanıklığının entegre kontrolünde önemli ölçüde kullanılabileceği ortaya konulmuştur.

***Anahtar kelimeler**: ateş yanıklığı, mücadele, bakır, bitki savunması*

ID: 179

Relationship of *PCSK9* and *MTRR* Variants with Myocardial Infarction in Southern Punjab Population of Pakistan

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Abstract

Myocardial infarction (MI) being the most common disease is leading cause of mortality across the world, being a multifactorial disease. it is caused by several environmental and genetic factors. We investigated the association of single nucleotide polymorphism in *PCSK9* and *MTRR* and the effects of different demographic factors like age, gender, education, family history, hypertension, diabetes and smoking habit with Myocardial Infarction in 200 individuals suffering from of MI and 155 healthy individuals. The polymerase chain reaction technique was used with TETRA-ARMS primers to investigate the single nucleotide polymorphism, and genotypes of individuals in the *PCSK9* and *MTRR* genes. There is a significant difference in the genotypic frequency of SNP rs2479409 and rs1801394 in patients and normal individuals ($P < 0.05$). Our results also indicate that both polymorphisms of *PCSK9* and *MTRR* were associated with risk of MI in the population of Southern Punjab, Pakistan

ID: 181

Sivas Solid Waste Landfill Area Biogas Electricity Generation Facility And Evaluation of Establishment of Greenhouse From Stable Heat

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Abstract

An average of 300 tons of waste is delivered to Sivas Solid Waste Landfill Per day. Biogas is obtained from the separated organic wastes from the municipal landfill. 1414mwh electricity is produced from these wastes. Waste heat generated in the facility will be used to heat the greenhouse. The need of the greenhouse will be supplied from inert heat, 20% of the 9 million kcal per hour heat. Soilless agriculture will be implemented in the planned greenhouse, and tomatoes will be produced in the all-glass greenhouse and exported to Europe. In this study, the operational performance of the landfill and how the waste heat to be generated will be used in the greenhouse, the characteristics and evaluation of soilless agriculture will be made.

Sivas Katı Atık Düzenli Depolama Sahası Bıogaz Elektrik Üretim Tesisi Ve Atıl Isısından Sera Kurulmasının Değerlendirilmesi

Özet

Sivas Katı atık düzenli depolanma tesisine günlük ortalama 300 ton atık gelmektedir. Ayrıştırılan organik atıklardan belediyeye ait deponi sahasından biyogaz elde edilmektedir. Bu atıklardan 1414mwh elektrik üretimi yapılmaktadır. Tesiste oluşan atık ısı seranın ısıtılmasında kullanılacaktır. Seranın ihtiyacı saat de 9 milyon kkal lük ısının %20'lik kısmını atıl ısıldan sağlanacaktır. Planlanan serada topraksız tarım uygulanacaktır ve tamamı cam olan serada domates üretilip, Avrupa'ya ihraç edilecektir. Bu çalışmada deponi sahasının işletme performansı ve oluşacak atık ısının serada nasıl kullanacağının topraksız tarımın özellikleri ve değerlendirilmesi yapılacaktır.

ID: 182

Antibacterial Potential and Characterization of Selenium Nanoparticles Synthesized by *Saccharomyces cerevisiae*

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Abstract

Nanometals are special group of materials with broad area of applications. Selenium nanoparticles (SeNPs) are of great importance especially when synthesized biologically with an eco-friendly organism. This study was aimed at characterization and antibacterial activity of Selenium nanoparticles synthesized by *Saccharomyces cerevisiae*. Selenium nanoparticles was synthesized by *S. cerevisiae* filtrate and characterized using Visual detection, UV-Visible spectroscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Fourier Transform Infrared Spectroscopy, Energy Dispersive X-Ray and X-Ray Diffraction. Antibacterial activities of the synthesized SeNPs were evaluated using agar well diffusion method. Biosynthesis of SeNPs by *S. cerevisiae* filtrate was characterized by a strong plasma resonance peak at 350 nm and had a broad band between 350 – 450 nm. There were colour changes from golden yellow to ruby red. The nanoparticles were spherical and rod like in shape with size ranging from 20 – 100 nm. Hydroxyl, aldehyde, amine and esters groups were responsible for the formation of SeNPs. There were strong signal from Se atom in the nanoparticles and weaker signals from Oxygen. The nanoparticles were crystallographic in nature. The Gram negative bacteria were more susceptible to the SeNPs than the Gram positive bacteria. The biological synthesis of SeNPs with *S. cerevisiae* induces the inhibition of pathogenic organisms.

Key Words: *Nanometals, Biological synthesis, Antibacterial activities, Saccharomyces cerevisiae filtrate, Selenium nanoparticles (SeNPs).*

ID: 183

Efficacy of Copper Compounds on Transmitted by Seed of Different Dry Bean Cultivars against *Xanthomonas axonopodis* pv. *phaseoli*

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Abstract

Dry beans, which have an important place in human nutrition, are mostly produced in the Central Anatolia Region with a rate of 56.8% in our country. Common bean bacterial blight disease caused by *Xanthomonas axonopodis* pv. *phaseoli* (Xap), which is carried by bean seeds, causes significant economic losses under favorable climatic conditions. The disease has started to be seen at high rates in our cultivation areas, especially in the areas where sprinkler irrigation is applied and in the increasing temperature conditions due to the climate crisis. In this study, efficacy of several copper compounds in seeds of 3 different bean cultivars were determined in comparison with antibiotic in order to prevent the disease / reduce economic losses. According to the findings, copper sulfate was found to be the most successful compound in seeds of all bean varieties, both in reducing bacterial populations *in vitro* and in preventing the disease *in vivo*. Considering the negative effects of copper use in terms of human and environmental health and the risks of copper resistance in the pathogen, it is thought that the success in combating the increasingly common bean blight disease will increase with the use of the most effective copper compound in eco-friendly approaches.

Keywords: *dry bean, copper, seed, Xanthomonas, control*

Farklı Kuru Fasulye Çeşitlerinin Tohumlarıyla Taşınan *Xanthomonas axonopodis* pv. *phaseoli*'ye Karşı Bakır Bileşiklerinin Etkinliği

Özet

İnsan beslenmesinde önemli bir yere sahip olan kuru fasulye, ülkemizde en çok %56,8 oranıyla İç Anadolu Bölgesi'nde üretilmektedir. Fasulye tohumlarıyla taşınan *Xanthomonas axonopodis* pv. *phaseoli*'nin (Xap) neden olduğu fasulye adi bakteriyel yanıklık hastalığı, uygun iklim koşullarında önemli ekonomik kayıplara neden olmaktadır. Hastalık ekim alanlarımızda, özellikle yağmurlama sulama uygulanan alanlarda ve iklim krizi nedeniyle artan sıcaklık koşullarında yüksek oranlarda görülmeye başlanmıştır. Bu çalışmada, hastalığın önlenmesi/ekonomik kayıpların azaltılması amacıyla 3 farklı fasulye çeşidinin tohumlarında çeşitli bakır bileşiklerinin etkinliği antibiyotikle karşılaştırmalı olarak belirlenmiştir. Bulgulara göre, bakır sülfatın tüm fasulye çeşitlerinin tohumlarında hem *in vitro*'da bakteri popülasyonunu azaltmada hem de *in vivo* koşullarda hastalığı önlemede en başarılı bileşik olduğu belirlenmiştir. Bakır kullanımının insan ve çevre sağlığı açısından olumsuz etkileri ve patojendeki bakır direnci riskleri göz önüne alındığında, giderek yaygınlaşan fasulye bakteriyel adi yanıklığı hastalığıyla mücadeledeki başarının, çevre dostu yaklaşımlar içerisinde, en etkili bakır bileşiğinin kullanılmasıyla artacağı düşünülmektedir.

Anahtar kelimeler: *kuru fasülye, bakır, tohum, Xanthomonas, mücadele*

Introduction

Beans (*Phaseolus vulgaris* L.) are an economically significant agricultural product, with a cultivation area of 38,225,000 hectares worldwide, grown in 105 countries. Among food legumes worldwide, beans rank first in economic importance. In Turkey, as of 2021, in terms of production quantity, beans are the second most important crop (29.03%) after chickpeas (45.22%). Approximately 51% of the cultivation area for dry beans is located in the Inner Anatolia Region, followed by the Eastern Anatolia Region at 7.4% (Balçık and Baştaş, 2021).

There are numerous disease agents that affect yield and quality in beans (Kadakoğlu and Karlı, 2022). The most common bacterial agents worldwide are *Xanthomonas axonopodis* pv. *phaseoli*, *Pseudomonas savastanoi* pv. *phaseolicola*, *P. syringae* pv. *syringae*, and *Curtobacterium flaccumfaciens* pv. *flaccumfaciens* (Hall, 1994; Howard et al., 1994; Agrios, 1997). It has been reported that these agents can lead to yield losses of over 40% when suitable conditions are present (Seattler, 1989).

In the Central Anatolia Region, especially in bean cultivation areas with overhead irrigation, the bacterial blight agent *Xanthomonas axonopodis* pv. *phaseoli* (Xap) is commonly observed and is often confused with bean anthracnose disease.

The optimum temperature range required for the development of the disease is 23-32 °C, and disease development stops at temperatures above 35.5 °C (Sönmezalp, 1966; Saettler, 1989). Xap causes more severe infections in plants at 28 °C compared to lower temperatures (Goss, 1940). The symptoms caused by the pathogen on leaves initially appear as wetness, and then these wet areas expand, covering the surface. The areas with wetness turn necrotic, surrounded by a narrow, fine lemon-yellow halo. Lesions are typically observed along the edges of leaves and between veins. Lesions expand and merge, eventually leading to symptoms of leaf blight (Saygılı et al., 2008). In the general management of the disease, several methods are recommended for disease control. These methods include the use of disease-free and certified seeds, disinfection of tools and equipment used during harvest and other operations with chemicals such as chlorine dioxide and sodium hypochlorite, collection and disposal of infected plant residues after harvest, the use of resistant varieties, foliar spraying with copper compounds, and antibiotic application to seeds (Schwartz et al., 2007). Worldwide, different types of copper preparations are used as part of chemical control programs for bacterial diseases. However, it is important to use only a limited number of effective copper compounds against the disease due to issues such as the rapid development of resistance to copper preparations, resulting in a loss of effectiveness, harm to beneficial bacteria, and phytotoxicity.
This study aims to determine the effectiveness levels of various copper compounds used in the control of bean bacterial blight, a disease that has become widespread in recent years in bean production areas, leading to significant economic losses. The goal is to reduce the use of copper while ensuring the most effective chemical for the sake of human and environmental health.

Materials and Methods

Materials

In this research, commercially available seeds of three dry bean varieties, namely Tezgeldi (Sarıkız), Saltan (Magnum) and Göynük-98, were used.
The highly virulent (88%) isolate of the bean bacterial blight pathogen, *Xanthomonas axonopodis* pv. *phaseoli*, with the Xap1 code, was obtained from the culture collection of the Molecular Bacteriology Laboratory at the Department of Plant Protection, Selçuk University. The copper compounds and antibiotics used in the experiment were procured from the companies listed in Table 1 in the commercial chart.

Table 1. Chemicals Used in the Experiment and their Application Dosages

Applications	Commercial Names	Formulation	Usage Dosage
Control (Xap 1)	-	Suspension	10^8 cells ml-1
Copper sulfate	Mastergold	SC	150 ml / 100 liters of water
Copper oxychloride	Cuprocol	SC	200 ml / 100 liters of water
Copper hydroxide	Kocide 2000	WG	200 g / 100 liters of water
Streptomycin sulfate	-	WG	250 ppm (mg/lt)

Method

Before bacterial inoculation, seeds of the Tezgeldi (Sarıkız), Saltan (Magnum), and Göynük-98 dry bean varieties were sterilized with a 3% sodium hypochlorite solution and then dried in a laminar cabinet. Freshly cultures of Xap, grown on Nutrient Agar (NA) for 48 hours, were prepared at a concentration of 10^8 cells ml^{-1}. Bean seeds (1000 seeds) were added to this suspension and shaken at 120 rpm for 30 minutes. Subsequently, they were dried in the laminar cabinet overnight (Mirik and Aysan, 2005; Kendi and Baştaş, 2011).
Copper sulfate, copper oxychloride, copper hydroxide, and streptomycin sulfate were added to the seeds in sterile distilled water at commercial dosages and shaken at 120 rpm for 30 minutes (Mirik and Aysan, 2005).

In vitro Experiments

Following the applications of copper compounds, the population densities in the seeds were determined using the formula:

Bacterial cell count (cells per ml) = CFU x DSD x 10
(CFU; colony-forming units, DSD; dilution series factor)

This formula was used to calculate the bacterial cell count in the seeds after the application of copper compounds (Klement et al., 1990).

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In vivo Experiments
To determine the germination rates, 30 vials were planted with bean seeds that had been treated with copper compounds, antibiotics, and *Xanthomonas axonopodis* pv. *phaseoli*.

Re-isolation of the Pathogen from Bean Seeds and Diagnosis of the Pathogen
To avoid any influence of environmental conditions on bacterial populations, re-isolations were carried out from seeds that had been dried in an environment with 70% relative humidity for one day. Suspensions diluted at a ratio of 10^{-3} were spread onto Petri dishes (Koch, 1884). Petri dishes were incubated at 27°C for 24-48 hours, and the bacterial population densities that developed were determined according to Klement et al. (1990). The experiment was conducted with three replications.
The diagnosis of the pathogen was performed based on biochemical, morphological, physiological, and molecular criteria according to Schaad et al. (2001) (Table 3). For the molecular diagnosis of the pathogen, X4c/X4e primers (5'-GGCAACACCCGATCCCTAAACAGG-3' and 5'-CGCCCGGAAGCACGATCCTCGAAG-3') were used, and the following PCR protocol was employed: 94°C for 3 minutes (1 cycle), followed by 94°C for 1 minute, 65°C for 1 minute, 72°C for 2 minutes (30 cycles), and a final extension at 72°C for 5 minutes (1 cycle) (Audy et al., 1994). The obtained PCR products were evaluated using agarose gel electrophoresis (Sigma) and a Prizma imaging device (Russell and Sambrook, 2001).

Statistical Analysis
The data obtained from the study were subjected to variance analysis using MINITAB version 14 software, and statistical evaluations were performed using the MSTAT program with the Tukey multiple comparison test to determine the interactions between chemicals and the pathogen (Düzgüneş et al., 1987).

Results and Discussion

Bean bacterial blight disease has started to become increasingly prevalent in our dry bean cultivation areas in the Central Anatolia Region, especially in areas where overhead irrigation is practiced and due to rising temperature conditions caused by the climate crisis.
In this study, the effectiveness of different copper compounds was compared to antibiotics in preventing bean bacterial blight disease and reducing economic losses, using the seeds of Tezgeldi (Sarıkız), Saltan (Magnum), and Göynük-98 dry bean varieties.
According to the findings obtained from experiments conducted under *in vitro* and *in vivo* conditions, statistically, the highest efficacy was achieved with copper sulfate, while the lowest efficacy was observed with copper oxychloride ($p < 0.05$) (Figure 1, Table 2).
At the variety level, after the use of copper compounds, the highest bacterial growth was observed in the Saltan (Magnum) and Göynük-98 bean varieties. The Tezgeldi (Sarıkız) variety was identified as the most successful combination in preventing the disease in bacterial x variety x copper interactions (Table 2).

Table 2. Effects of Different Copper Compounds on Bacterial Populations in Seed Trials

Applications	Saltan (Magnum)	Tezgeldi (Sarıkız)	Göynük-98
Control (Xap 1)	0,469 x 10^6A	0,88x 10^5 A	0,41x 10^6 A
Copper sulfate	0,02 x 10^5 B	0,023 x 10^5 C	0,20 x 10^5 B
Copper oxychloride	0,12 x 10^5 B	0,47 0,02 x 10^5 B	0,72 x 10^5 B
Copper hydroxide	0,04 x 10^5 B	0,053 x 10^5 C	0,73 x 10^5 B
Streptomycin sulfate	0.033 x 10^4 B	0,01 x 10^5 C	0,09 x 10^5 B

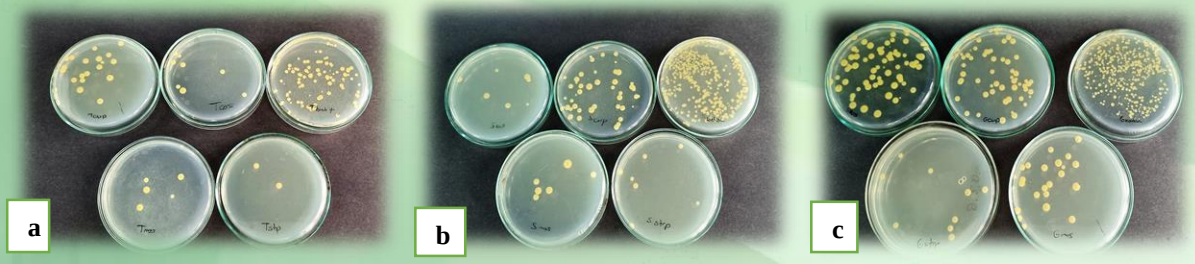


Figure 1. Results from Seed Trials with Different Copper Compounds and Streptomycin through Re-isolation

Table 3. Germination Rates (%) of Bean Seeds Treated with Copper Compounds and *Xanthomonas axonopodis* pv. *phaseoli*

Applications	Saltan (Magnum) (%)	Tezgeldi (Sarıkız) (%)	Göynük-98 (%)
Control (Xap 1)	77	92	61,9
Copper sulfate	94,4	66,66	85
Copper oxychloride	72	26,66	90
Copper hydroxide	88,8	60	28,57
Streptomycin sulfate	85,5	85,71	85

Table 4. Results of Biochemical, Physiological and Morphological Tests for the Re-isolated Pathogen

Tests	Isolate used in experiments (Xap1)	Re-isolation
Gram reaction	-	-
Growth at 35°C	+	+
Formation of fluorescent pigment on KB agar	-	-
Production of H2S from cysteine	+	+
Levan formation	+	+
Esculin test	+	+
Catalase test	+	+
Oxidase test	-	-
Tobacco hypersensitivity reaction (HR) test	+	+
Production of H_2S from cysteine	+	+

(+)Isolate yielding a positive test result"; (-) Isolate yielding a negative test result

In Table 3, the effects of different copper compounds used in trials on the prevention of bacterial blight disease in beans and their effects on the emergence rates of bean varieties are given. Accordingly, at the variety level, streptomycin sulfate application resulted in the lowest damage to seed emergence rates for all varieties, while other applications caused significant differences at the variety level. It has been observed that copper sulfate applications against the disease have the least impact on seed emergence rates.

Re-isolations were conducted to confirm the presence of the pathogen in seeds and plants after seed treatments and to fulfill Koch's postulates. The pathogen re-isolated through X4c/X4e specific primers and confirmed through biochemical, physiological, morphological tests, and molecular diagnostics was identified as *Xanthomonas axonopodis* pv. *phaseoli* (Table 4).

The chemical control of the disease is generally carried out through antibiotic application to seeds, foliar spraying with antibiotics and other chemicals, and, especially in recent years, through the application of certain chemicals that stimulate systemic acquired resistance in plants (Bozkurt, 2009; Öztürk, 2014).

Liang et al. (1992) applied three different antibiotics (streptomycin, tetracycline, and chlorotetracycline) to bean seeds infected with *X. a.* pv. *phaseoli* and reported that it significantly inhibited the pathogen but also caused phytotoxic effects. In countries where the use of antibiotics is banned or restricted, copper-based preparations are commonly used for the control of bean bacterial diseases.

Balcık and Baştaş (2021) investigated the effectiveness of different copper compounds under field conditions against common bacterial blight disease on the Alberto variety of dry beans grown in Konya and Afyonkarahisar provinces with different climatic characteristics. The most effective copper compound was determined to be Copper oxychloride. However, in our study, it was found that Copper sulfate was the most effective compound for seed treatments in preventing the disease.

The development of resistance to antibiotics and copper preparations has been reported. Therefore, the selection of chemicals with the lowest harm rate to human and environmental health, along with choosing the most successful variety against plant bacterial diseases, would be the most appropriate approach (Kotan, 2002).

Furthermore, minimizing the use of the most effective copper preparation in disease control should also be considered as an essential strategy to reduce the issue of pathogen resistance.

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ID: 184

Antimicrobial And Biogenic Synthesis Of Selenium Nanoparticles By *Lactobacillus Casei*

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Abstract

Lactic acid bacteria have long been consumed by people in several fermented foods such as dairy products. Selenium has a great potential such as supporting immune system, fertility, antimicrobial and anticancer agent. This study is aimed at characterization, and investigation of the antimicrobial activity of Selenium nanoparticles synthesized by *Lactobacillus casei*. Selenium nanoparticles was biosynthesized using *L. casei* and was characterized using Visual detection, UV-Visible spectrophotometry, Fourier Transform Infra-red spectrophotometry (FTIR), Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Energy Dispersive X-ray (EDX) and X-ray Diffraction (XRD) analysis. The antimicrobial activity of the synthesized selenium nanoparticles using *Lactobacillus casei* (LC-SeNPs) was done using agar well diffusion method. There was a change in colour from light yellow to ruby red. The broad band for LC-SeNPs ranged from 250 - 450 nm and a strong plasmon resonance peak was at 350 nm. Hydroxyl, esters, aldehyde, amine, phenol, and alkyl aryl, ether are present and responsible for the efficient stabilization and bio-reduction. The SeNPs were spherical and aggregated with varying shapes and size ranged from 20 – 100 nm. The XRD reveals that the SeNPs was crystallographic. LC-SeNPs exhibited an effective inhibitory activity ranging from 10 – 25 mm. Also, biosynthesized SeNPs by *L. casei* is ecofriendly, nontoxic and highly applicable in medicine.

Key Words: *Lactobacillus casei, Selenium nanoparticles, Biosynthesis, Zone of inhibition, Energy Dispersive X-ray*

ID: 185

Challenges and mitigation opportunities for the development of climate resilient cotton

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Abstract

Cotton has global importance, due to its status as a major fiber crop with high commercial value. It has a significant contribution in Pakistan's economy. Cotton plant faces various biotic and abiotic stresses from environment but, high temperature along with drought is a limiting factor to cotton productivity. It is reported that, the average temperature in Pakistan increased by 1.6 °C during the current century as compared to 0.89 °C globally which indicates that the increase in temperature in Pakistan is approximately two fold. Up to 2050, it is predicted to rise by 2.5 °C. Due to this increase in temperature, numerous morphological and physiological characters of cotton plant are adversely affected because of climate change and in response, yield of seed cotton is reduced significantly. Every growth stage of the cotton plant is susceptible to heat stress, but the squares, buds, flowers, and bolls are particularly vulnerable to high temperature. Besides, infestation of insect pests has also been increased due to change in temperature patterns. Likewise, prolonged stress causes pollen sterility, which results in the loss of unfertilized floral buds and ultimately yield loss. Keeping in view the losses, domestic agricultural production needs to be improved. In near future, the development of new agriculture strategies will be helpful to cope the problems of climate change. Various breeding and biotechnological tools can be used to develop heat-tolerant cotton cultivars. Diversity in population is a key feature for breeders but it may have been lost in elite gene pools. The crop can be protected against new biotic and abiotic challenges with the help of genes from exotic germplasms. These exotic germplasms may represent significant genetic diversity with improved production stability and resilience to stressful environment.

ID: 192

Determination of Sulfites by UV-Vis Spectrophotometry in Red Wine and White Wine

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Abstract

Sulphites are natural or synthetic additives widely used by the food industries. They are used to improve and preserve the stability and quality of the organoleptic characteristics of food. Due to potential serious cases of hypersensitivity beyond a threshold, the presence and content of sulphites must be monitored in food, and more particularly in wine, in order to thus preserve the health of consumers. To do this, it is essential to develop reliable methods for the quantification of sulphites in wine and this is the subject of this study. UV-Visible spectrophotometry programmed at 565nm was used to determine the sulfite concentrations (µg/mL) in a sample of commercially purchased white and red wine. The results showed that the method used was linear (range of linearity ranging from 0.05 µg/mL to 5 µg/mL with a coefficient of determination of R^2 = 0.9969), accurate (CV ranging from 0.823% to 1.976% for intra-day precision and 1.229 to 1.487 for inter-day precision) and accurate (average recovery rate of 98.59%) in accordance with Agency guidelines French Standardization. The application of this method for the determination of sulphites revealed respective levels of 57.271 mg/L and 136.063 mg/L for red wine and white wine, levels in accordance with European regulations which set the maximum limit at 150 mg /L for red wine and 200 mg/L for white wine. This method could therefore make it possible to determine the quality of wines on the market and prevent the harmful effects of sulphites on the health of consumers.

Keywords*: sulphites, white wine, red wine, dosage, UV-visible spectrophotometry.*

Introduction

Food additives are substances added to preserve or improve the safety, freshness, taste, texture or appearance of food (Joint FAO/WHO Codex Alimentarius Commission, 2018). Among these substances, sulfur dioxide and its salts occupy a prominent place in the industry due to their broad application. They are added to a wide range of food products such as fruit juices, fruit and vegetables, pastries, seafood or wine (S. L. Taylor et al, 1986). However, since the 1980s, serious cases of hypersensitivity have been reported in individuals following consumption of sulfite-treated foods (R Carballo et al, 2003). The US Food and Drug Administration then required the presence of sulfites to be mentioned on labels for concentrations greater than or equal to 10 mg/kg or 10mg/L (Food and drug administration, 2018). This initiative is followed by the European Union, which even requires limit values for sulfites in different types of food (European Commission, 2002). So, in the particular case of the wine industry, where the taste, color and stability of wine depend on the presence of sulfites (S. L. Taylor et al, 1986), it is vital to develop sensitive and reliable methods for monitoring sulfites in wine.
The aim of the present work is to develop an effective method for the determination of sulfites in wine for the food industry.

Materials And Methods

Materials

Sampling
The wine samples (red and white) chosen for this study were 750mL bottles of wine with the words "CONTAINS SULFITES" written on their packaging. These wine samples came from the same manufacturer. The samples were coded as follows: VR for red wine and VB for white wine.

Reference substance and chemicals used
Sodium bisulfite with a purity of 92% and a dosage of 1000mg from the manufacturer Acros Organics, batch number RK-88229-25, was used as the reference substance.
Tous les produits chimiques utilisés étaient de qualité analytique : EDTA (100%, SIGMA) ; Chlorure de para rosaniline (90%, Alfa Aesar) ; Acide chlorhydrique (37%, Carlo Erba) ; Solution de formaldéhyde 0,1% (35%, officinale).
Distilled water was used to prepare the various reagents.

Equipment

We used a DENVER INSTRUMENT SI 403 analytical balance, accurate to 0.0001g, for weighing, a NEUATION TD1605AB1350 vortex mixer for mixing solutions, and a spectrophotometer (JENWAY 7315) combined with a desktop computer running the relevant software driver for the determination of sulfites in wine.

Methods

Preparation of the reference substance (RS)

A mass of 0.1 g of sodium bisulfite solution powder was taken into a 100 mL volumetric flask and dissolved with distilled water up to the mark.

Preparation of sample solutions

10 mL of wine was withdrawn and inverted into a beaker into which 30 mL of distilled water was added. The filtrate obtained from the mixture (wine and distilled water) was made up to 100 mL with distilled water and measured according to the modified para rosaniline-formaldehyde variant protocol (Yongjie Li and Meiping Zhao. 2006). According to this protocol, 2.5 mL of the para rosaniline-formaldehyde mixture was placed in a 10mL test tube, then 2.5 mL of SR or 2.5mL of wine sample was added. The resulting mixture was thoroughly homogenized by vortexing.

Preparation of working solvents

A 0.001mol/L EDTA solution was obtained by dissolving 0.19 g EDTA powder in a 500 mL volumetric flask of distilled water.

Para-rosaniline Chloride solution of concentration 0.001g/mL was prepared by dissolving 1g of para-rosaniline chloride powder in 10mL of absolute ethanol contained in a 100mL volumetric flask, then distilled water was added up to the mark.

Formaldehyde Solution 0.1% (1.2 mol/L) was obtained by diluting a 0.71mL volume of the 37% purity formaldehyde solution in a 250mL volumetric flask.

Storage of SR and working solvents

SR and the para rosaniline-formaldehyde mixture solution are stored at 4°C. The other solutions are stored at room temperature.

Determination of validation parameters

These parameters (linearity, precision, accuracy) were determined in accordance with the guidelines of the Agence Française de Normalisation (AFNOR) in standard NF V 03-110 (Norme NF V03-110, AFNOR, 2010), which covers assay methods in the food industry.

Linearity

Linearity was assessed by preparing a standard range from 0.05 µg. mL-1 to 5 µg. mL-1 by successive dilutions of the reference solution (SR) with respective intermediate concentrations of 0.05; 1.25; 1.67; 2.5; 3.33 and 5µg. mL-1 (ICH Harmonised Tripartite Guideline. 2005). The calibration curve was established from the absorbances obtained for each concentration, then the coefficient of determination (R2) and the equation of the line were deduced. However, before determining linearity, a spectral scan (from 400 to 700 nm) was performed to determine the wavelength of maximum absorption λmax (Figure 1) and plot the calibration curve (Figure 2).

Reliability

Intra-day precision or repeatability was determined by taking eighteen readings for each chosen concentration level (1.25 µg. mL-1 ; 1.67 µg. mL-1 and 2.5 µg. mL-1), i.e. three series of six successive readings, each concentration level having been prepared six times. Spectrophotometer readings were taken on the same day, with a four-hour interval between them.

Intermediate or inter-day precision was determined by performing eighteen readings (i.e. three series of six successive readings) of three respective concentration levels (1.25 µg. mL-1 ; 1.67 µg. mL-1 and 2.5 µg. mL-1), on the spectrophotometer over three successive days by the same operator.

The mean absorbance of the three series of readings and the coefficients of variation (CV) were calculated for each test, and the data reported in Tables I and II.

Accuracy

The accuracy test was carried out by adding a 1 mL volume of the reference solution to a 1 mL volume of the unfortified sample contained in a 10 volumetric flask. The mixture was made up to the mark with distilled water (1/10 dilution). The absorbances obtained after reading were converted to µg. mL-1 using the straight line equation. Recovery percentages (PR) were calculated according to the following formula (ICH Harmonised Tripartite Guideline. 2005) (Eq.1):

$$PR=(QF-QI)/QA\times100 \quad \text{(Eq.1)}$$

Where PR represents the Recovery Percentage; QF, QI and QA represent the Fortified, Initial and Added Quantities respectively.

Fortified Quantities (QF) are determined from the absorbances obtained and the equation line. By multiplying the concentration X (obtained from the equation line) by the dilution factor α = 10, we obtain QF.

Determining sulfite levels in wines

The average absorbances for each wine sample were used to determine the molar sulfite concentrations of each preparation (C1) from the equation of the straight line: y = ax +b C1=x=(y-b)/a (Eq.2).

Results And Discussion

Validation of the method for determining sulfites in wine

Before studying the validation parameters, we determined the absorption spectrum of sulfites by performing a spectral scan in the UV-visible range from 400 nm to 700 nm. This spectral scan enabled us to detect the maximum absorption wavelength λmax of sulfites, which is 565 nm as shown in Figure 1. This result is different from that obtained by Yongjie Li and Meiping Zhao (2006), who found a wavelength of 575 nm. This difference could be explained by the absence of a spectral range to detect maximum absorbance.

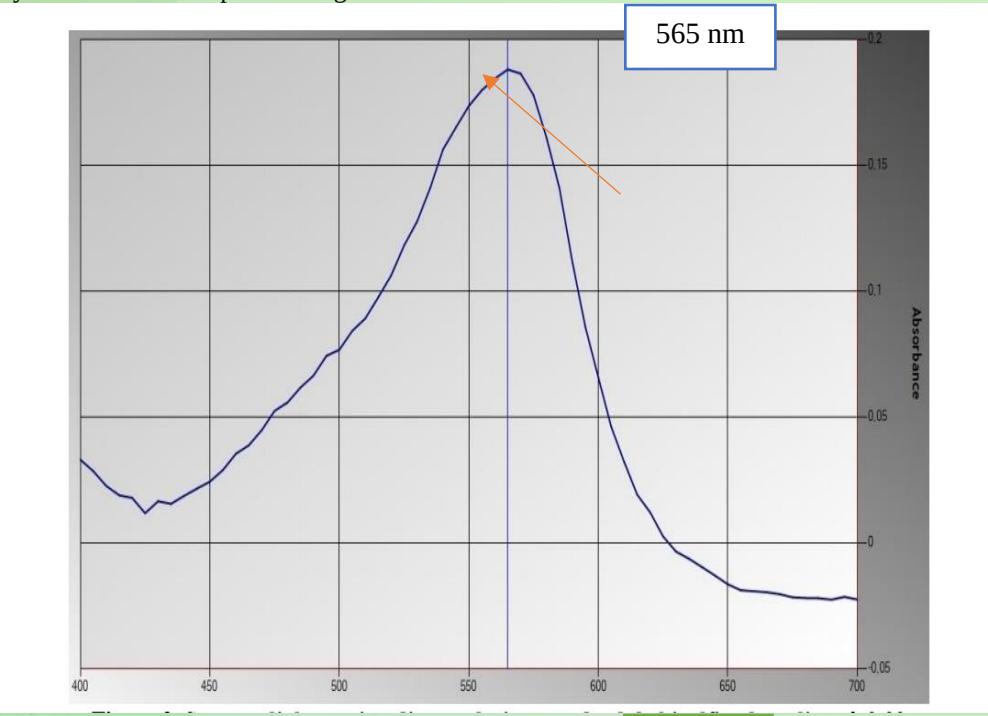


Figure 1. Absorption spectrum of sulfite n

Spectral data from the standard solution were used to plot the sulfi curve at 565 nm (Figure 2).

565nm

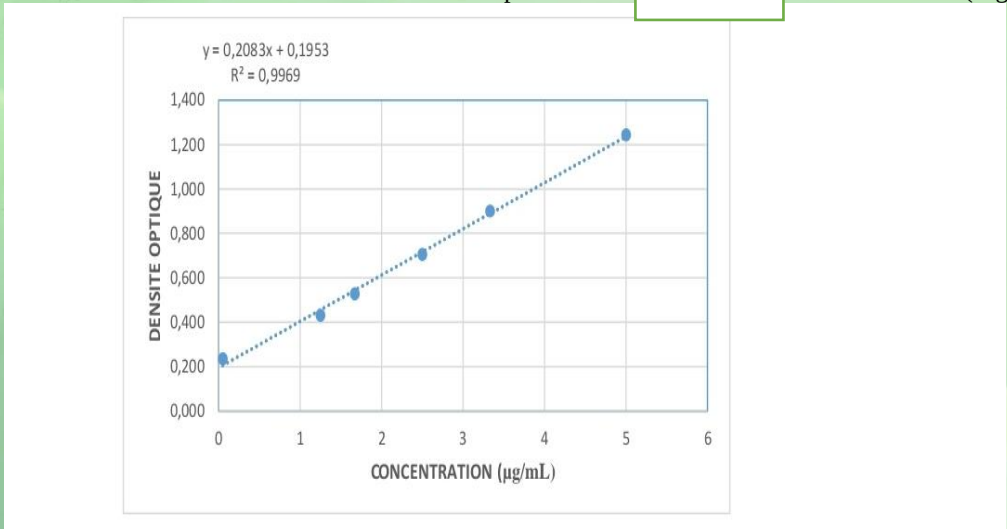


Figure 2. Calibration curve for sulfites at 565 nm

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The linearity of the method was determined by assessing the coefficient of determination R2 obtained from the calibration curve. Our result complies with Pharmacopoeia USP 38 NF 33 version 2015 (USP 38 - NF 33, Version 2015), which states that the coefficient of determination must be greater than 0.9950. The coefficient of determination of our study, which was 0.9969, is significantly close to 0.9993 obtained by Yongjie Li and Meiping Zhao (2006).
The fidelity of our method gave CVs of 0.823%; 0.953% and 1.976% at 8, 12 and 16 hours respectively for intra-day fidelity and 1.430%; 1.229% and 1.487% for inter-day fidelity. Our method complies with the CVs given by Pharmacopoeia USP 38 NF 33 version 2015 (USP 38 - NF 33, Version 2015), which stipulates that the CVs for intra-day and inter-day fidelity must be less than 2% respectively. Our method is therefore accurate.

Table 1. Repeatability (intra-day precision) of analysis by the modified method

Concentrations (µg/mL)	Optical density	Mean	Standard deviation	Coefficient of variation (%)
2,5	0,696	0,699	0,00471	0,823
	0,705			
	0,703			
	0,692			
	0,694			
	0,702			
1,67	0,535	0,530	0,00406	0,953
	0,537			
	0,528			
	0,527			
	0,530			
	0,524			
1,25	0,439	0,4242	0,00417	1,976
	0,415			
	0,425			
	0,419			
	0,427			
	0,420			

Table 2. Intermediate repeatability (inter-day reliability) of analysis using the modified method

Concentration (µg/mL)	Day 1	Day 2	Day 3	Coefficient of variation (%)
2,5	0,696	0,687	0,691	1,430
	0,705	0,685	0,688	
	0,703	0,688	0,668	
	0,692	0,689	0,689	
	0,694	0,698	0,670	
	0,702	0,687	0,668	
1,67	0,535	0,522	0,534	1,229
	0,537	0,518	0,520	
	0,528	0,511	0,521	
	0,527	0,517	0,520	
	0,530	0,521	0,515	
	0,524	0,516	0,523	
1,25	0,439	0,436	0,468	1,487
	0,415	0,432	0,429	
	0,425	0,427	0,412	
	0,419	0,430	0,442	
	0,427	0,436	0,442	
	0,420	0,436	0,427	

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Accuracy gave an average recovery rate of 98.59%, in line with the specifications given by Pharmacopoeia USP 38 NF 33 version 2015 (USP 38 - NF 33, Version 2015), which recommends that the average recovery rate be contained within the acceptability range of 98% to 102%. Our method is therefore accurate. The 98.59% rate obtained in our study is also close to the 98% rate obtained by Yongjie Li and Meiping Zhao (2006).
The results of the validation criteria obtained justify the application of this method to the quantitative determination of sulfites in wine.

Determination of sulfite levels in wines

Sulfite levels in 750 mL bottles of red and white wine were 57.271 mg. L-1 and 136.063 mg. L-1. These concentrations were in line with standards, as European regulations (Council Regulation (EC) No. 1493/1999) set the maximum limit for sulfite concentration at 150 mg. L-1 for red wines and 200 mg. L-1 for white wines.
However, a concentration of 12.9 mg. L-1, lower than those found in our study, was determined by Yongjie Li and Meiping Zhao (2006). This discrepancy could be explained by the fact that different food samples were used. Indeed, Yongjie Li and Meiping Zhao, (2006) used preserved almond (solid food) whereas we used red and white wine (liquid food).

Conclusion

At the end of this study, the aim of which was to develop an analytical method for the determination of sulfites in wine, we concluded that the modified para rosaniline-formaldehyde method of determination by UV-VISIBLE spectrophotometry is reliable, with satisfactory validation criteria. It can be validly used for routine control of sulfites in wine. The sulfite concentration obtained complies with European regulations for wine products. However, short- and long-term studies of sulfite stability in wine will be required.

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Genetic Variability and Character Associated Studies in *Pisum sativum* L.

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Abstract

Peas (*Pisum sativum* L.) are the second most significant crop in leguminous family. It is consumed as green and dry peas in various regions around the globe. Due to changes in climatic conditions yield of pea varieties has decreased in previous years. So, it is necessary to evaluate genetic diversity present in existing pea accessions and to search for various pea genotypes having the potential to flourish in such changing climatic conditions. For this reason, twenty pea genotypes were field-tested using RCBD during 2022-23. After the vegetative stage, data was collected for nine morphological traits. Genotypic variance, phenotypic variance and principal component analysis were used to evaluate the variability among the genotypes. Significant variation among the studied accessions were shown by ANOVA. Most of the traits exhibited high heritability coupled with high genetic advance, indicating that these traits were governed by additive gene action. Hence hybridization and selection would be fruitful for these traits. Whereas pod width showed low values of heritability and genetic advance. For all the studied traits magnitude of phenotypic coefficient of variance was greater than genotypic coefficient of variance, which revealed that these traits had additive environmental effect. According to correlation analysis, plant height, the number of pods per plant, and pod diameter were negatively correlated with the days to 50% of the flowering stage. Pod width showed no significance correlation with any other trait. While there was a strong negative correlation between seed diameter and seeds per pod. Yield was largely attributed to plant height and seed diameter. PGRI-44 and PGRI-42 were observed to be the most diverse genotypes in terms of studied morphological traits. Whereas V20 and 19723 were almost genetically identical genotypes. This study would assist in selecting genotypes with diverse genetic background for use in the future pea breeding programs.

ID: 194

Biochemical Characterization and *In Vitro* Detection of Promising Hepatoprotective Effects of *P. viviparum* through Liver Slice Culture Assay

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Abstract

Medicinal plants have been used from ancient times as therapeutic agents and these are precious for improving our health care system. That's why in this study persuasive beneficial effects of *P. viviparum* were explored. *P. viviparum* belongs to class Polygonaceae, its common name is Anjbar. Its methanol extracts were used for biochemical characterization through LC-MS and then hepatoprotective effects at different concentrations were studied through measuring lactate dehydrogenase in terms of percentage cytotoxicity. Moreover its antioxidant, hemolytic and anti-thrombolytic activities were also measured. The impressive results of *P. viviparum* were observed. In LC-MS Caffeic acid, natural iridoid sweroside and glycoside Morroniside at 180.08, 381.25 and 428.25 m/z were identified with positive mode of ESI. Likewise with negative ESI presence of Gallic acid, Quinic acid and Chlorogenic acid were observed at 169.08, 191.08 and 353.25 m/z respectively. In liver slice culture assay results, at 1000 µg/mL *P. viviparum* exhibited maximum hepatoprotective potential in terms of minimum 9% cytotoxicity. In antioxidants activities at 500 µg/mL maximum potential of DPPH redical scavanging activity and FRAP were detected**.** Moreover maximum anti-thrombolytic in terms of clot lysis and hemolytic activity were also seen at 500 µg/mL. The present *In vitro* findings of *P. viviparum* showed that it could be used as a hepatoprotective agent to overcome the liver diseases and oxidative stress due to the presence of marvelous active constituents.

Key words: *Lactate dehydrogenase, percentage cytotoxicity, oxidative stress, LC-MS, anti-thrombolytic*

ID: 195

Comparative analysis of *Annona muricata* Linn (soursop) leaf and fruit extracts against selected pathogens

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Abstract

Multidrug resistance to antibiotics has necessitated the need for natural products which are alternative method of antimicrobial stewardship. The use of plants, which provide safe and cost effective remedies can be properly harnessed and regulated provided there are scientific-based evidences. This study compared the bioactivity of soursop leaf and fruit extracts against selected pathogens. Extract yield as well as analysis of inherent phytochemicals of soursop fruit and leaf were estimated using standard methods. Agar well diffusion method was used for antimicrobial screening and minimum inhibitory concentration (MIC) against test isolates. 24g and 33g extract was obtained from 60g dried soursop leaves and fruits, resulting in approximately 40% and 55% yield, respectively, using methanol as extraction solvent. Qualitatively, saponins, tannins, flavonoids, terpenoids, alkaloids and phenols were present in both samples however, cardiac glycosides, anthraquinones and steroid was absent in the fruit. Quantities of the compounds ranged from 43 to 940 mg/100g (leaves) and 18 to 560 mg/100g (fruit), respectively. The fruit extract inhibited the growth of *Staphylococcus aureus* (15±0.15 mm), *Pseudomonas aeruginosa* (20±0.12 mm), *Bacillus alvei* (30±0.47 mm) and *Escherichia coli* (12±0.52 mm) while the leaf extract inhibited only *S. aureus* (14±0.91 mm) and *B. alvei* (15±0.76 mm). 200 mg/mL was the minimum inhibitory concentration of the extracts against *S. aureus* and *B. alvei* and *E. coli.* Conclusively, the findings of this study indicated that soursop leaf and fruit have varied phytochemicals. The fruit extract however showed higher antimicrobial inhibitory effects when compared to the leaf extract.

Key Words: *Plant extract, Antimicrobial, Solvent extraction, Pathogens, Soursop.*

Introduction

Annona muricata is known generally as Soursop (Atawodi, 2011). It is from the family of custard apple tree (Annonaceae), a species of a genus known for its edible fruits called Annona. The tree, with low branches is about 5–10 m tall and 15–83 cm in diameter (Orwa et al., 2009). The creamy flesh of the fruit which has a slightly acidic taste when ripe consist of 80% water, 1% protein, 18% carbohydrates and a good amount of vitamins B, B2 and C, as well as potassium and dietary fiber (Anibasa, 2014). The leaves of soursop have a dark green colour while the young leaves have a yellowish green colour, which measures up to 8-16×3-7 cm and are elliptical with short pointed tip, glossy surface, flat edges with a stalk length of about 3-7 mm (Ameta et al., 2018). Its use in medicine has come to fore as Researchers claims that it has inhibitory potential against common pathogens. In the last decades, soursop has been widely studied due to its therapeutic potential and ever since, it has attracted attention due to its bioactivity (Coria-Tellez et al., 2018). Aside having nutrients and minerals that are beneficial to the body, soursop have been proven to possess compounds that exhibited anticancerous, antitumor and antimicrobial effects (Anibasa, 2014; Ameta et al., 2018). Findings revealed that *Annona muricata* had shown antibacterial activities against species of pathogenic bacteria indicating that the antibacterial properties of this plant can be used in the prevention of diseases caused by pathogenic bacteria (Okeke-Nwolisa et al., 2023). There are natural compounds present in the stem, bark, leaves, roots, seeds and fruits of soursop, with the leaf being the most studied part of the plant, followed by the roots (Silva et al., 2022). This study was aimed at comparing the efficacy of soursop fruit and leaf extracts against *Staphylococcus aureus, Pseudomonas aeruginosa, Bacillus alvei* and *Escherichia coli,* pathogens that have been widely reported to be antimicrobial resistant.

Materials and Methods

Samples and culture collection

The leaves and fruits of *Annona muricata* was collected from a household garden in Oyo State, Nigeria and identification/authentification was done at the herbarium of the Botany Department of University of Ibadan. Test isolates (*Staphylococcus aureus, Pseudomonas aeruginosa, Bacillus alvei* and *Escherichia coli*) used for the antimicrobial analysis were obtained from the Department of Medical Microbiology, University College Hospital (UCH), Nigeria.

Sample extraction

Samples were air-dried for two weeks then blended with a laboratory blender (Rico, India) and stored in a clean container at room temperature.

Extraction was done according to the modified standard procedures of Olugbuyiro et al., (2017). 60 g of each sample was added to 700 mL methanol and shaken intermittently for 48 hours. Extract was strained and filtered over anhydrous sodium sulphate and then evaporated in vacuo at 45°C. The concentrated fractions were dried in desiccator and kept for further analysis.

Estimation of extract yield

The total yield of the extracts were calculated using the formula: $\%Yield = \frac{W1}{W2} \times 100$

where W1 = weight of the extract and W2 = weight of the dry blended samples (Adam et al., 2019).

Phytochemical Screening of plant extracts

Qualitative and quantitative phytochemical screening was carried out on *A. muricata* extract to determine the presence and estimation of bioactive compounds according to the methods of Harborne, (1998) and Dohou et al. (2003).

Antimicrobial activity

The antimicrobial potential of the extracts against four test organisms (*Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli and Bacillus alvei*), using the well diffusion assay was done according to the method of Yusuf et al. (2021), while the minimum inhibitory concentration of the extracts was also analyzed (Usman et al., 2013).

Results and Discussion

24g and 33g extract was obtained from 60g dried soursop leaves and fruits, resulting in approximately 33% and 55% yield, respectively, using methanol as extraction solvent as indicated in table 1. The fruit was more fibrous and this could have accounted for a higher extract yield. Steroid and Cardiac glycoside and anthraquinone were not detected in the fruit extract while only steroid was negative in the leaf. Compounds like alkaloid, phenol, tannin, flavonoid, saponin and terpenoid were all detected in both the leaf and fruit of soursop (Table 2). Similar findings were established by Olugbuyiro et al. (2017) and Hasmila et al. (2019). These compounds have been reported to have biomedical relevance (Ana-Paola et al., 2020). Qantitatively, phyto-compounds were higher in the leaf than the fruit, except for terpenoid and tannin. Alkaloids, however, was the most abundant in both samples with 940 and 560 mg/100 mL, as indicated in figure 1.



Plate 1. *Annona muricata* (soursop) leaves and fruits (Source: Britannica, 2016)

Table 1. Percentage yield of *A. muricata* leaf and fruit extract using methanol as extraction solvent

Sample	Dry weight (g)	Weight of extract (g)	% yield	Characteristics features
Fruit	60	33	55	Creamy jelly-like extract
Leaf	60	24	33	Dark green jelly-like extract

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Table 2. Qualitative analysis of phytochemical *compounds in A. muricata* leaf and fruit extracts

Phytochemical compounds	Soursop Fruit Extract	Soursop Leaf Extract
Alkaloid	+ve	++ve
Phenol	+ve	++ve
Cardiac glycoside	-ve	++ve
Tannin	+ve	+ve
Flavonoid	+ve	+ve
Saponin	+ve	+ve
Anthraquinone	-ve	++ve
Terpenoid	+ve	+ve
Steroid	-ve	-ve

Key: +ve = present; ++ve = abundantly present; -ve = absent

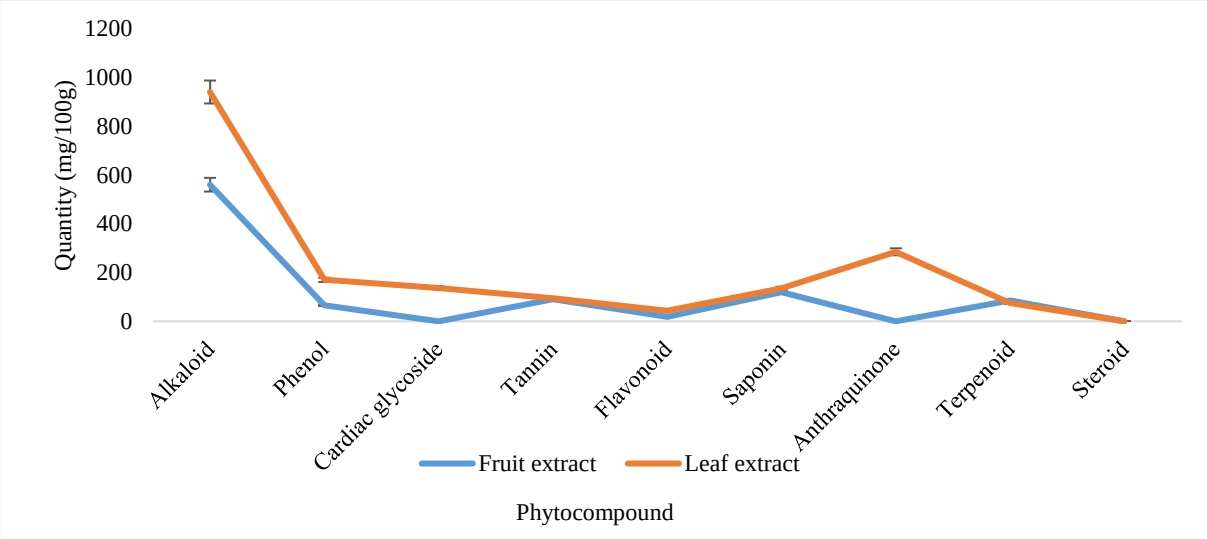


Figure 1. Quantitative analysis of phytochemical *compounds in A. muricata* leaf and fruit extracts

Antimicrobial inhibition zones ranged from 12 mm to 30 mm for the fruit extract and 14 mm to 15 mm for the leaf extract indicating that the fruit showed higher antimicrobial activity against wider range of test isolates (table 3). Both extracts had highest inhibition zones against *Bacillus alvei* however, the fruit extract showed the least zone (12 mm) against *E. coli* while the leaf extract did not inhibit the growth of *E. coli.* Iyanda-Joel et al. (2019) reported 17 ± 0.58 and 16 ± 0.58 as inhibition zones of soursop fruit ethanol extract against *S. aureus and P aeruginosa*, respectively, considering that *S. aureus* has been reported as one the most susceptible bacteria to plant extracts (Melendez and Capriles, 2006). Susceptibility of some clinical isolates (fungi and bacteria) to fruit pulp extract was also reported by Okeke-Nwolisa et al. (2023) where the growth of *E. coli., S. aureus, Candida albicans, Aspergillus niger, Klebsiella* sp. *and Proteus* sp.were inhibited with zones ranging between 20 to 36 mm. However, the zones reported in the current study were lower than the range in the studies conducted by Olugbuyiro et al. (2018) and Okeke-Nwolisa et al. (2023), using extracts from the fruit. Positive activity of the leaf extract against *S. aureus* was also demonstrated by Pinto et al. (2017), attributing reason for such to the presence of alkaloids. *E. coli* and *P. aeruginosa* were however resistant to the leaf extract in this study.

Upon reduction in the extract concentration ustilized, it was observed that the zones of inhibitions significantly reduced (table 4), even though, concentrations below 200 mg/ mL did not inhibit the isolate's growth. This is an indication that a more increased concentration could further lead to higher inhibition zones.

Table 3. Antimicrobial sensitivity of test isolates to the leaf and fruit extracts of *A. muricata*

Test isolates	Extract (250 mg/mL) / Diameter zone of inhibition (mm)	
	Fruit	Leaf
Staphylococcus aureus	15 ± 0.15	14 ± 0.91
Pseudomonas aeruginosa	20 ± 0.12	-
Bacillus alvei	30 ± 0.47	15 ± 0.76
Escherichia coli	12 ± 0.52	-

Values reported are means ± standard deviation of three replicates; Key: - = Resistance

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Table 4. Minimum Inhibitory Concentration (MIC) of methanol extracts of soursop leaf and fruit against selected pathogens

Test isolates	Extract Concentration (mg/mL) / Extract / Diameter zone of inhibition (mm)					
	100		150		200	
	Leaf	Fruit	Leaf	Fruit	Leaf	Fruit
Staphylococcus aureus	-	-	-	-	12 ± 1.15	14 ± 0.75
Pseudomonas aeruginosa	-	-	-	-	-	05 ± 0.12
Bacillus alvei	-	-	-	-	10 ± 0.23	14 ± 0.69
Escherichia coli	-	-	-	-	-	03 ± 1.00

Key: - resistant

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The Effect of Heating and Wetting Applications During Storage on Weight Loss, Hatchability and Gosling Quality Traits in Goose Eggs

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Abstract

In the study, 4 different groups covering the applications in the storage process; Heating (A), Wetting (B), Wetting+Heating (C) and Control (D) were created. After the goose eggs were collected every day, they were divided into 4 groups in equal numbers and the applications were made to all eggs, including the eggs of the previous day, during the storage period (9 days). The storage temperature was adjusted to be 16 ºC and 75% humidity and the D group was kept under these conditions. Group A eggs were taken back to the warehouse by keeping them at 35 ºC for half an hour every day, group B eggs were taken back to the warehouse by spraying with 25 ºC water once a day, and the storage process was continued by applying these two applications one after the other to group C eggs. A total of 1080 eggs were used, 270 goose eggs in each group. According to the study results, there was a difference between the groups in terms of storage weight loss ($p<0.05$), while there was no difference in weight loss during incubation (0-18 and 0-27 days) ($p>0.05$). While the highest weight loss throughout the storage was in group A, the lowest weight loss was calculated in group B. In terms of pip time averages, group A was the earliest with 695th hour of incubation, while group C was the latest with 699th hour. There was no difference between the groups in terms of hatch time. While there was no difference between the experimental groups in the mean quality of the gosling quality score, gosling weight, gosling length and shank length, the mean shank diameter was calculated in the lowest C group. In the study, the general average of fertility rate was 86.28%, while the highest average in terms of hatchability was calculated in group A with 86.80%, groups B, C and D had similar averages as 80.88, 79.41 and 79.01%, respectively. Early embryo death rate was highest in groups C and D, mid-term group A, late death rate was highest in group B. While the contamination was not high in the wetting only (B) group, it was highest in the wetting+heating (C) group. As a result, while group A was the best group in terms of hatchability, group B was the group with the least loss in terms of storage weight loss.

Keywords: *Incubation, Hatchability, Gosling Quality, Heating, Wetting*

Kaz Yumurtalarında Depo Süresince Isıtma ve Islatma Uygulamalarının Ağırlık Kaybı, Kuluçka Sonuçları ve Palaz Kalite Özelliklerine Etkisi

Özet

Çalışmada depo sürecindeki uygulamaları kapsayan 4 farklı grup; Isıtma (A), Islatma (B), Islatma+Isıtma (C) ve Kontrol (D) oluşturulmuştur. Kaz yumurtaları her gün toplandıktan sonra 4 gruba eşit sayıda bölünmüş ve uygulamalar depo süresi boyunca (9 gün) önceki gün yumurtaları da dahil tüm yumurtalara yapılmıştır. Depo sıcaklığı 16 ºC ve %75 nem olacak şekilde ayarlanmış ve D grubu bu şartlarda bekletilmiştir. A grubu yumurtalar her gün yarım saat süre ile 35 ºC'de bekletilerek depoya geri alınmış, B grubu yumurtalar günde 1 defa 25 ºC'lik su ile spreyleme yapılarak depoya geri alınmış ve C grubu yumurtalara bu iki uygulama peş peşe yapılarak depo sürecine devam edilmiştir. Her grupta 270 kaz yumurtası olmak üzere toplam 1080 adet yumurta kullanılmıştır. Çalışma bulgularına göre depo ağırlık kaybı bakımından gruplar arasında fark bulunurken ($p<0.05$) kuluçka boyunca (0-18 ve 0-27 gün) ağırlık kaybı bakımından fark bulunmamıştır ($p>0.05$). Depo boyunca en yüksek ağırlık kaybı A grubunda olurken en düşük ağırlık kaybı ise B grubunda hesaplanmıştır. Pip zamanı ortalamaları açısından A grubunda kuluçkanın 695. Saati ile en erken olurken 699. Saat ile C grubu en geç olmuştur. Çıkım zamanı bakımından gruplar arasında fark belirlenmemiştir. Deneme grupları arasında palaz kalite skoru, palaz ağırlığı, palaz uzunluğu ve incik uzunluğu ortalamalarında fark bulunmazken incik çapı ortalaması en düşük C grubunda hesaplanmıştır. Döllülük oranı genel ortalaması %86.28 olan çalışmada, çıkış gücü bakımından en yüksek ortalama %86.80 ile A grubunda hesaplanırken B, C ve D grupları sırasıyla %80.88, 79.41 ve 79.01 olarak benzer ortalamaya sahip olmuştur. Erken dönem embriyo ölümü C ve D gruplarında, orta dönem A grubunda, geç dönem oranı B grubunda en yüksek bulunmuştur. Sadece ıslatma (B) yapılan grupta kontaminasyon yüksek olmazken ıslatma+ısıtma (C) grubunda en yüksek bulunmuştur. Sonuç olarak A grubu çıkış gücü oranı bakımından en iyi grup olurken depo ağırlık kaybı bakımından B grubu en az kayıp yaşayan grup olmuştur.

Anahtar Kelimeler: *Kuluçka, Çıkış Gücü, Palaz Kalitesi, Isıtma, Islatma*

ID: 198

Effect of Poultry Manure Rate and NPK 15:15:15 on the Perfomance and Nutritional Content of Sweet Potato (*Ipomoea batatas* l.)

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Abstract

A field experiment was carried out to determine the effect of different rate of poultry manure and NPK 15:15:15 on vine length, number of leaves, plant height, number and weight of harvested tubers with the Proximate contents of sweet potato. The experiment was laid out in a Randomized Complete Block Design (RCBD) with five treatments replicated three times. The treatments were 0 kg/ha of poultry manure (PM) (no treatment), 15 kg N/ha PM, 30 kg N/ ha PM, 45 kg N/ha PM and NPK 15:15:15. Poultry manure rates were applied to the soil two weeks before planting while NPK 15:15:15 was applied two weeks after planting. The result showed that, application of Poultry manure at 45 and 30 kg N /ha had a positive response significantly on vine length than other treatments. Nitrogen sources also favoured production of leaves and number of tubers but 45 kg N/ha of PM produced tubers with more weight comparable to 30kg N/ha than other rates and sources. Treatment with NPK 15:15:15 gave high value of ash content, crude protein, crude fat and crude fibre which also increases with increase in the rate of Poultry manure application. However, increase in Nitrogen rate or source decreased carbohydrate and moisture content of the crop. Application of poultry manure at the rate of 30 kg N /ha is therefore recommended for best growth, yield and dry matter content of sweet potato since it also increased its quality in terms of crude protein. NPK 15:15:15 can be used to obtain good quality in sweet potato in the absence of poultry manure.

Key words: *poultry manure, tubers, proximate, quality, sweet potato*

Introduction

Sweet potato (Ipomea batata) is one of the major food crops in the world, and it rank second to yam in Nigeria as a major important tuber crop, contributing to the people food requirement. Karam *et al.* (2009). The crop is particularly important crop for subsistence farmers in Africa and other developing countries. Sweet potato is a very important food security crop due to its
relatively short growing period, tolerance to drought and high yield from poor soils. It is used as a famine reserve for many of these households (Ofor, 2011).

Sweet potatoes possess many positive health benefits including sources of anthocyanins, phenolic compounds and other bioactive compounds (Alum *et al.*, 2013). The vegetable crop also possesses antioxidant activities. Sweet Potatoes is highly rich in nutrient elements. A 100g edible portion of sweet potatoes yield 360kj energy, 20.1g carbohydrate, 3.0g dietary fibre, 0.1g fat, 1.6g protein, 30.0mg calcium, 0.6mg iron, 25.0mg magnesium, potassium 337mg, thiamine 0.1mg, riboflavin 0.1mg, phosphorus 47.0mg, sodium 55mg, zinc 0.3mg, folate 11Ng, pantothenic Acid 0.8mg, Niacin (B3) 0.61mg, 79.8% Water, about 2.4mg vitamin C is reported in sweet potato and 0.25mg Vitamin B6. In spite of these, the nutrient compositions as documented by several authors have been revealed to vary from cultivar to cultivar. Eleazu and Ironua (2014) after evaluation of the composition of an unnamed sweet potato cultivar reported that, "the flour was observed to have good functional properties with a pH of 5.32±0.01, high percentage moisture content, indicative of poor shelf life characteristics and high chances of being attacked by microbes, low percentage dry matter, lipid, crude fibre and ash contents but a promising source of starch (20.78±0.02%), carotene (5.0±0.04 µg/g), protein (2.67±0.59%), carbohydrate (40.77±3.05%), energy (179.61±20.97 kcal/100 g), polyphenols, in addition to containing significant quantities of reducing sugar (1.58±0.53%)". In a study by Gebreegziabher et al. (2014) titled "Chemical Composition and In Vitro Dry Matter Digestibility of Vines and Roots of Four Sweet potato (Ipomoea batatas) Varieties Grown in Southern Ethiopia", root and vine proximate compositions were shown to vary with sweet potato cultivars.

The tuber also contains significant amount of vitamins A, B1, B2 and C and minerals such as K, Na, P and Ca. The young leaves are also rich in protein, minerals and vitamins (Onwueme and Sinha., 2011). The crop is efficient in the production of carbohydrates, proteins, vitamins and cash income per unit area of land and time (Magagula *et al*., 2010). The yellow-and orange-fleshed varieties of sweet potatoes are high in beta-carotene, which can be

converted into vitamin A in the intestines and liver. It has been shown that even small amounts of these sweet potatoes as a regular part of the diet will eliminate vitamin A deficiency in adults and children.
Poultry manure contains all 13 of the essential plant nutrients that are used by plants. Using poultry manure as a fertilizer for crops or trees may provide a portion, or all, of the plant requirements. The amount of nutrients provided depends on the nutrient content of the manure (lb of nutrient / ton of manure) and the amount of manure applied (ton of manure / acre) (Zublena *et al*., 2006). Because of the high nutritional and economic value, it is necessary to improve yield and its related traits that can be achieve through balance availability of all the nutrients in the crop. This work is therefore targeted to examine the effect of different rate of poultry manure application on the yield and nutritional composition of sweet potato.

Materials and Method

The experiment was conducted behind the Horticultural Unit Experimental Site of the Federal College of Agriculture, Moor Plantation, Ibadan, Nigeria. The experimental plot size of 19 m x 11 m (209 m^2) was laid out in a Randomized Complete Block Design (RCBD) with five treatments replicated three times. The size of each replicate was 19 m x 3 m. each replicate was divided into five plots measuring 3 m x 3 m. The replicates were separated by 1 m alley in between while the plots were separated by 0.5 m. The treatments were 0 kg/ha (no treatment), 15 kg N/ha poultry manure, 30 kg N/ ha poultry manure, 45 kg N/ha poultry manure and NPK 15:15:15

Cultural practices

Potato vine cuttings were obtained from a commercial farm in Ibadan. The variety used was Kenspot 4 (orange flesh with cream colour).
The land was cleared mechanically with the use of tractor, stumping was done manually using hoe and Cutlass, packed of debris and tilled. Heaps were made at a spacing of 1 m 1 m then the cuttings were planted at a space of 1 m by 1 m. The treatment poultry manure at specified rates were applied before planting (2 weeks before planting and was heavily watered for quick mineralization). NPK 15:15:15 was applied two weeks after planting. Weeding was done manually by hoeing before the establishment of the crop.

Data Collection

Data collection commenced 4 weeks after planting (WAP) and continued until eight weeks. Four plants were tagged on each plot for data collection. Growth and yield parameters measured were; Vine length, Number of leaves, Number of tubers per plot and weight of tubers per plot.
Vine length of each sample plant was measured using a calibrated ruler. The number of fully expanded leaves of each tagged plant physically counted. Then tuber of sweet potato harvested on each plot was weighted using the weighting scale in kilogram.
Harvesting was carefully done twelve (12) weeks after planting, by careful uprooting of the tubers with cutlass and hand. After harvesting, yield parameters were taken by weighing the harvested tubers and taken the samples to the laboratory for proximate analysis after air drying the sliced samples.

Soil and Poultry Manure Analysis

Core soil sample were collected prior to the commencement of the experiment at random from the site at a depth of 0.15 cm using soil auger soil samples collected were sir dried and sieved through 2mm sieve for both physical and chemical analysis.
The poultry manure used for the experiment was air dried and taken to the laboratory for analysis before incorporated into the soil.

Data Analysis

Data collected was subjected to Analysis of Variance (ANOVA) to test for significance of treatment on the crop and the significant means were separated using Least Significant Difference (LSD) $p<0.05$.

Result and Discussion

Pre-cropping physical and chemical properties of the soil

The result of the physical and chemical properties of the soil used for the experiment is presented in Table 1. It showed that the soil was slightly acidic with a pH of 6.8. total nitrogen was at no rmal range (1.05 $mgkg^{-1}$) which falls within the normal standard value of 1-1.5, available phosphorus 12 $mgkg^{-1}$ compared to the standard value of 7-20 was high and organic carbon 1.42 $mgkg^{-1}$ compared to the standard value of 1.0 -1.4 was slightly high (FFD, 2021), Exchangeable base: potassium, calcium, magnesium and sodium were 0.30, 1.53, 0.41 and 0.31(cmol/kg) respectively. The textural class of the soil was sandy soil with sand (914 g/kg), silt (56 g/kg) and clay (30 g/kg)

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The Chemical properties of the Poultry Manure used for the Experiment

The result of the analysis of the Poultry manure used for the experiment is shown in table 1 and it revealed that the Nitrogen content is 18 %, Phosphorus is 24 % and Potassium is 0.90 %

Effect of different rates of poultry manure and NPK 15:15:15 on vine length and number of leaves of sweet potato

The result of effect of different rates of poultry manure and NPK 15:15:15 on vine length of sweet potato was presented in Table 2. At 4WAP, crops treated with 30kg N/ha poultry manure Produced vine length 25.00cm which was significantly longer than vine length of other treatments but not significantly different from those of 45 kg N/ha poultry manure (23.50cm). At 6 WAP, vine length of 30kg N/ha poultry manure was significantly longer (33.75cm) that control (20.50cm), 15kg N/ha poultry manure (20.67cm) and NPK 15:15:15 (22.42cm) but not significantly different from that of 45 kg N/ha poultry manure (30.42cm) in length. At 8 WAP vine length produced by application of 45 kg N/ha poultry manure (48.58cm) was at par with those of 30kg N/ha poultry manure (45.33cm) but statistically different from those of control (31.42cm), 15kg N/ha poultry manure (30.33cm) and NPK 15:15:15 (33.08cm).

Table 1. Pre-planning soil and Poultry manure chemical properties and particle size distribution

Parameters	Units	Values
Ph		6.8
Organic carbon	gkg^{-1}	1.42
Total Nitrogen	gkg^{-1}	1.05
Available Phosphorus	$mgkg^{-1}$	12
Exchangeable bases	cmol/kg	
Ca^{2+}		1.53
Mg^{2+}		0.41
K^{+}		0.30
Na^{+}		0.31
Exchangeable acidity	cmol/kg	3.91
Particle Size Distribution	g/kg	
Sand		914
Silt		56
Clay		30
Textural class		Sandy soil
Chemical properties of Poultry manure		
Parameters	Values (%)	
Total nitrogen	18	
Total Phosphorus	24	
Total Potassium	0.90	

Source: Authors

Table 2. Effect of poultry manure rates and NPK 15:15:15 on vine length (cm) and number of leaves of sweet potato

Treatment :Vine length (cm)	4 WAP	6 WAP	8 WAP
0 kg/ha (control)	16.01bc	20.50c	31.42b
15kg N/ha poultry manure	16.95bc	20.67c	30.33b
30kg N/ha poultry manure	25.00a	33.75a	45.33a
45kg N/ha poultry manure	23.50ab	30.42ab	48.58a
NPK 15:15:15	15.83c	22.42bc	33.08b
LSD (P=0.05)	7.53	8.48	7.71
Number of leaves			
0 kg/ha (control)	9.58b	11.33c	19.33c
15kg/ha poultry manure	11.33a	13.00bc	23.83bc
30kg/ha poultry manure	11.50a	19.17a	28.17ab
45kg/ha poultry manure	11.83a	15.33b	31.50a
NPK 15:15:15	10.17ab	12.00c	23.50bc
LSD P0.05	1.68	3.23	5.03

Significant means were separated by LSD P<0.05

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Effects of different rates of poultry manure and NPK 15:15:15 on number of leaves of sweet potato

The result of effects of different rates of poultry manure and NPK 15:15:15 on number of leaves of sweet potato is presented in Table 2. At 4WAP 45 kg N/ha poultry manure produced more leaves (11.83) which were not significantly different from those of other treatments except control. (9.58).

At 6 WAP more leaves were produced from crops treated with 30kg N/ha poultry manure (19.17) than all the other treatments. At 8 WAP 45kg N/ha poultry manure produced leaves (31.50) significantly more in number than other treatments but at par with those that received 30kg N/ha poultry manure (28.17).

Effects of different rates of poultry manure and NPK 15:15:15 on number of tubers and tuber weight of Sweet potato

The result of effects of different rates of poultry manure and NPK 15:15:15 on number of tubers and tuber weight of sweet potato was presented in Table 3. The result revealed that, sweet potato that received poultry manure of 30 kg N/ha produced more tubers (11.33) which are comparable to those of 45 kg N/ ha (10.67), 15 kg N/ha and NPK 15:15:15 but significantly more in number than control. However, potatoes tubers of 15 kg N/ha and NPK 15:15:15 are not statistically different from each other in number (9.67 and 9.67 respectively) but are significantly higher than that of control (6.00) which is the lowest.

The result of tuber weight also showed that 45 kg N /ha of poultry manure produced tubers which are higher in weight (410.00) significantly than others except those that received 30 kg N/ha. Also, potato that was treated with 15kg N/ha poultry manure produced tubers which were statistically similar in weight (281.33) with those that received NPK 15:15:15 (271.00). but were significantly lower than control (95.77).

Effects of poultry manure rate and NPK 15:15:15 on the Nutritional content of sweet potato

The result of effect of poultry manure rate and NPK 15:15:15 on the nutritional composition of sweet potato is presented in Table 4. It was observed that sweet potato treated with NPK 15:15:15 gave significantly high value of ash content (2.30%), crude protein (8.60), crude fibre (7.21) and crude fat (3.15) than other treatments while control gave the least value significantly in all.

Furthermore the highest moisture content (25.00%) and carbohydrate content (69.93) was observed in sweet potato treated with zero application of poultry manure which was decreasing as poultry manure rate was increasing while the least moisture content and carbohydrate was observed in sweet potato treated with NPK 15:15:15.

The result also shows that, NPK 15:15:15 gave high value of protein content significantly than Other treatments however, the quantity of protein increasing as poultry manure rate was increasing. Sweet potato treated with 30kg/ha poultry manure had the highest value off dry matter (79.00%) and was significantly higher than the other treatments.

Table 3. Effect of different rates of poultry manure on number of tubers and tuber weight of sweet potato

Treatment	No of Tubers	Tuber weight (kg/ha)
0 kg/ha (control)	6.66b	95.77c
15kg/ha poultry manure	9.67ab	281.33b
30kg/ha poultry manure	11.33a	408.33a
45kg/ha poultry manure	10.67a	410.00a
NPK 15:15:15	9.67ab	271.00b
LSD(P=0.05)	3.67	71.11

Significant means were separated by LSD P<0.05

Table 4. Proximate analysis of sweet potato

Treatment	Ash	Crude protein	Moisture content	Crude Fibre	DM	Crude fat	Carbohydrate
0 kg/ha (control)	1.03e	1.90e	25.00a	2.09e	68.93c	1.05c	69.93a
15kg/ha poultry manure	2.15c	3.50d	24.00b	4.15d	76.00d	2.60c	64.60b
30kg/ha poultry manure	2.10d	4.95c	23.00c	5.05c	79.00a	2.45d	64.59b
45kg/ha poultry manure	2.25b	7.70b	23.00c	6.10b	77.00c	2.80b	58.15c
NPK 15:15:15	2.30a	8.60a	22.00d	7.20a	78.00b	3.15a	56.75d
LSD(P=0.05	0.34	0	0	0	0.27	0.48	0

Significant means were separated by LSD P<0.05

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Discussions

The increase in vine length and number of sweet potato leaves with in this experiment with application of high rate of PM is an indication that, Nitrogen is needed for vegetative growth of crops since according to Brady and Weil (2008), poultry manure mineralizes fast hence it releases its nutrients for plant uptake and utilization rapidly and this also buttresses the work of Zelalem *et al*., (2009) who opined that Nitrogen in poultry manure is essential for increasing vine length plant height, leaf area index, shoot dry matter and tuber yield. Izunobi had also opined that poultry manure provides large number of absorbable nutrient for crop growth.

Number of tubers responds positively to application of nitrogen from all the sources and rate. The result probably explains the fact that nitrogen is one of the essential nutrients that can affect the growth and the yield of potato. It is also an indication that potato is highly responsive to N-fertilization and that N is usually the most limiting essential nutrient for potatoes growth and development according to Mohammed *et aL* (1998).This result corroborates the work of Izunobi (2002) who reported that poultry manure, especially those provided from deep litter or battery cage house are the richest known farm yard manure supplying greater amounts of absorbable plant nutrient for optimum tuber growth and yield.

The result obtained regarding tuber weight which was observed to increase with increase in PM application and low with application of NPK 15:15:15 could be because, potato responds positively to nitrate content in PM for large tuber production. Other researchers like Maier *et al.* (2002) and Ahmad *et al.* (2009) have also observed increase in yield of potato when N was supplied in Nitrate form. Nitrogen has also been reported to improve the yield of potato hence the result obtained in this study. Ahmad *et al.* (2009) also observed increase in tuber weight of potato when PM rates were increased

NPK 15:15:15 gave high value of crude protein significantly compare to other treatments this is because, Sweet potato although needs nitrogen but application of excess nitrogen affects the quality of the tubers. This also corroborates the work of Ahmad Ahmed *et al.* (2009) who also observed decline in some quality parameters of potato with increase in nitrogen rate. However, the fact that the nitrogen content in Sweet potato was increasing with increase in PM rate also signify the importance of Nitrogen in nitrate form to the crop. Lin *et al*. (2005) also observed increase in nitrogen content of potato var.'Atica' with increase in rate of PM.

The moisture content of any food is an indication of its water activity in the food and it is used to determine how stable and how susceptible the food is to microbial contamination (Howarth *et al*. 2001). The high moisture content recorded at zero application of Poultry manure implies that with increase in PM, concentration of other nutrients in the crop will decrease when dehydration occurs. This result corroborates the work of Idowu *et at*. (2023) who reported increase in the moisture content of eggplant, with increase application of PM.

Fat is known to help the body to achieve satisfaction after eating and helps the body to absorb vitamin A, D and E (Agbenafle and Bart- Plange, (2015) and Vishruta (2014). It was observed however that, increase in application of PM was decreasing the crude fat in the crop. This could be because, sweet potato being a carbohydrate food, the normal N in NPK 15:15:15 is enough for the crop. Idowu *et al* (2023) also observed that increase in PM leads to decrease in the crude fat in egg plant. Idowu *et al*. (2023) also observed that control experiment gave the highest value for carbohydrate when different rate of PM was applied to the soil for planting eggplant.

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Ohmik Evaporasyon İşlemiyle Elde Edilen Dut Pekmezinin Renk Değerlerinin İncelenmesi

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Özet

Evaporasyon işlemi sıvı gıda ürünü içerisinde buluna suyun fiziksel olarak uzaklaştırılmasıdır. Evaporasyon işleminde geleneksel ısıtma teknikleri sonucunda istenmeyen bileşen oluşumu, kalite kaybı ve aroma kayıpları meydana gelmektedir. Bu nedenle gelişen teknoloji ile geleneksel gıda işlemi uygulamalarının yerini alternatif teknikler almaktadır. Bu tekniklerin başında ohmik ısıtma işlemi gelmektedir. Ohmik ısıtma işlemi iki elektrot arasında alternatif akım geçirilerek ürünün ısınma prensibine dayanmaktadır. Mevcut çalışmanın ana amacı 3 farklı voltaj gradyanı kullanılarak elde edilen dut pekmezinin renk değerlerinin detaylı olarak incelenmesi olarak belirlenmiştir. Ohmik evaporasyon işlemi 3 farklı voltaj gradyanında atmosferik koşullar altında %22.2 Suda Çözünür Kuru Madde (SÇKM) içeriğinden %65 SÇKM değerine kadar evaporasyon işlemine tabi tutulmuştur. Renk ölçümü *L**, *a**, ve *b** değerleri minolta renk cihazı ile ölçüm yapılmış ve 10 ml örnek karanlık kap içerisinden alınarak ölçülmüştür. Geleneksel ve voltaj gradyanı arasındaki farklılığı belirlemek için SPSS paket programı kullanılmış ve %95 güven aralığında Duncan test ile yöntemler arasındaki farklılıklar tespit edilmiştir. Ohmik evaporasyon işlemi sonucu pekmez örneğinin renk değerlerinden *L**, *a** ve *b** değerlerinin taze dut suyundan istatistiksel olarak anlamlı olduğu tespit edilmiştir. Beyazlaşma (WI) ve kahverengileşme indeksi (BI) incelendiğinde en yüksek beyazlaşma ve kahverengileşme indeksinin geleneksel yöntemde elde edilirken en düşük WI ve BI indeksi ise 15 V/cm voltaj gradyanında elde edilmiştir. Toplam renk değişimleri değerlendirildiğinde, renk değişim değerinin 3.7-8.9 arasında değiştiği en az renk değişiminin geleneksel yöntemle elde edildiği ve artan voltaj gradyanına bağlı olarak renk değişiminin arttığı tespit edilmiştir. Sonuç olarak renk değişimleri incelendiğinde genel anlamda voltaj gradyanın artmasından olumsuz etkilendiği tespit edilmiştir. Fiziksel kalitelerin başında bulunan renk değerleri incelendiğinde ohmik ısıtma destekli evaporasyon işlemi kullanılabileceği düşünülmektedir.

Anahtar kelime: *Ohmik, evaporasyon, renk, fiziksel kalite*

ID: 200

Evaluation of Adaptability and Performance of Yellow Maize *(Zea mays L.)* under Busogo Environmental Conditions in Rwanda

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Abstract

Variations in environmental conditions like temperature, rainfall and humidity are responsible to Maize development and production. This study was conducted within two seasons (Season 2020A and 2020C) with overall objective of evaluating the adaptability and performance of yellow maize under Busogo environmental conditions in Rwanda. Four yellow varieties were used as test plants, and one white variety as a control. The experiment was prepared in a Completely Randomized Block Design (CRBD) with Five treatments and Three replications. The plant management practices were undertaken as per the recommendation for good growth and development. To analyze the collected data (Analysis Of Variance & Means), GENSTAT Software was used to and the mean comparison was done by DUNCAN Method. The results have showed a significant increase in both growth and yield in winter season (Season A) rather than summer season (Season C). Hybrid has more adapted than other varieties in most of parameters with highly yielding. The three varieties originated in the experiment site surrounding areas have showed almost the same performance which might be owing to the almost similar environmental conditions which might be owing to the almost similar environmental conditions.

Key Words: Yellow Maize, growth, yield, adaptability

Introduction

Maize or Corn (*Zea mays*) is a cereal originated under warm, seasonally dry conditions of Mesoamerica and grown widely throughout the world in a range of agro ecological environments. It is one of the three most important cereal crops in the world in terms of area of production. In comparison to different cereals, maize is higher yielding, lower danger, less complicated to manner, and extra flexible with the capacity to develop across agro-ecological conditions (Pulat Batirbaev et al., 2013). Different factors such as genotypes, tillage, nitrogen levels, and climate (temperature and precipitation) impact remarkably on the boom and grain yield of maize amongst others plants (Roshani et al., 2018). The global maize production area is 176 million hectares (Kumar et al., 2012).

Maize has been introduced in Africa, and its cultivation expanded rapidly later in other tropical countries because of its wide climatic adaptability.(Wade H.,2008). Maize production in Africa was around 75 million tons in 2018, representing 7.5% of world maize production. Maize occupies approximately 24% of farmland in Africa and the average yield stagnates at around 2 tons/hectare/year (Nafziger et al.,2013).

Maize was introduced in Rwanda in 1960 and identified as a priority stable crop by the government due to its potential production and use such as playing role in food security, contribution to poverty reduction, used in the production of animals, poultry and fish feed, good crop for fighting hunger as its easier to store (Nafziger et al.,2013). In Rwanda, almost all of the country's agro-climatic zones are highly suitable for maize production (Umutoni J. 2013), with highest average grain yield (around 4.5 t/ha) compared to other cereals grown in Rwanda, such as wheat (2.1 t/ha) and rice (3/ha). In terms of cultivated area and output, maize ranks third (14%) in production in Rwanda, followed by bean (21,2%) and banana (21,2%) production (19.6 %) (Ngabitsinze, 2015).

Rwanda has experienced a problem of insufficient quantity and quality of maize through local production. There is a need of importation from outside country. The estimated quantity of maize requested (marketed) in Rwanda amounts to 55,000 tons per year, of which only about 30,000 tons are from domestic production, suggesting a deficit of about 25,000 tons per year, which is met by imports from Uganda and Tanzania (Pulat et al, 2013).

To serve the growing demand for maize while reducing the current reliance on imported maize grain, the Government of Rwanda has adopted the policy of stimulating the significant growth of maize production through its support and focus on replacing Open Pollinated Varieties (OPV) including yellow maize varieties with high-performance white maize hybrids (Lead, 2016), and this has resulted the decline of yellow maize varieties whiles those are wholesome and high in nutritious value than the ordinary white maize, because of its higher levels of lutein, carotenoids and vitamin A (Kaul et al., 2019).

Yellow maize is a very healthy treat for us all, which is why it is a staple food in many parts of the world. It is an excellent source of fiber and proteins whilst being low in fat and salt. Yellow maize contains lots of minerals

which are important for us and that too in a great quantity (USAID, 2016). The stalks of Yellow maize might be utilized as grain for creatures like cows, sheep, goats, ponies or some other kind of animals. They may likewise be given to poultry, to improve the chicken egg yellowness (Kaul et al., 2019). It is the reason this study was conducted to evaluate the adaptability and performance of yellow maize under Busogo environmental conditions in Rwanda.

Materials and Methods

Experimental site

The experiment was carried out in the model farm of University of Rwanda-College of Agriculture, Animal Sciences and Veterinary Medicine, Busogo Campus located in BUSOGO Sector, Musanze District, in Northern Province, Rwanda. The study site is characterized by the average temperature of about 15.6oC, 2200m of altitude, 1 0C33' of South latitude, 29 0C33' of East longitude and rain fall of 1400mm per year with the volcanic highland soil (Busogo Meteorological station, 2015). The soil of Busogo is the volcanic highland at 2200m absl. The climate is temperate with mean temperature of 17°C.

Plant materials and experimental design

Four yellow maize plant materials namely BYM1, BYM2, BYM3 and BYM4 (Busogo Yellow Maize) originated from Uganda, Kinigi, Nyabihu and Rubavu, respectively, and one white hybrid namely Pan53 as a control were used in our study.

The trials were prepared in a Completely Randomized Block Design (CRBD) with five treatments and three replications. The seeds were sown during two agricultural seasons namely 2020A(September-February) and 2020C(June-September) at 40 cm x75 cm as spacing with 2 seed per hill, twelve seeds per row (Six hills per row), four rows per plot and twenty-four hills per plot in the prepared plots with the size of 3 m x 3m. The plots were separated at 0.5 m x 0.5 m of distance. For good growth and development, plant management practices like are land preparation, sowing, fertilization, watering, earthing-up and weeding were taken as per the recommendations. Fertilizers were applied at the rate of 1000kg/ha of FYM (Farm Yard Manure) by localized placement method, 100kg/ha of DAP (during sowing) by localized placement method and 50kg/ha of Urea (during weeding and earthling up, six weeks after sowing) by side dressing method.

Data collection

Four plants per plot were used for data collection and harvested at maturity. Individual plant base data as well as plot base data were recorded once a month from 30 to 120 days after sowing on all variates. Collected data on individual plant basis from all randomly selected plants were plant height, length of leaves, length and diameter of cobs which were recorded by measuring with measuring tape and expressed in centimeter (cm); number of leaves, number of ears, number of lines per cob, number of kernels per line recorded by counting their number; total grain yield, weight of cobs, weight of 100 kernels by weighting with balance and expressed in grams.

Data analysis

Microsoft Excel was used for data and table processing. GENSTAT Software was used to analyze the collected data (ANOVA & Means) and the mean comparison was done by DUNCAN method (Duncan Multiple Range Test).

Results and Discussion

Plant height

The study showed a significant effect of environmental factors on all parent materials in season A, and no effect in season C. This is due to favorable environmental conditions in season A as (Lead, 2016) stated that maize in Rwanda benefits from two rainy season, the short rain from September/October to December (season A) and the long rains from February/March to May. In season A, BYM4 manifested as a higher performer with 196.6cm of length. However, BYM2, BYM3 and BYM4 are classified in the same performance group (homogeny); to mean almost the same length of plant. Their source/origin are the surrounding areas of the experiment site, with almost the similar environmental conditions. So, with the agreement of (Lamidi & Michael, 2017) in his statement that those growth/vegetative parameters like plant height might be influenced by environmental/climatic conditions. Our finding might be governed by environmental conditions. In the season C which was featured by high temperature, low relative humidity and low rainfall, the study has showed a non-significant difference (no effect of environmental factors) between varieties with low performance in plant height. This is in conformity with the statement of (Singh *et al*., 2012) that maize grows well in winter season with low temperature and enough rainfall rather than summer season.

Number of leaves

The study shows a significant difference between all plant materials in season A, with white maize hybrid as a higher performer in number of leaves with 13 leaves per plant. Actually, the number of leaves relates to the number of internodes. According to (Bos *et al.*, 2000), Leaf-appearance rate significantly increased well with temperature varies between 18 and 23°C, although less pronounced above. In agreement with him, the findings of our study might be governed by the climate factors. Besides, in season C, no environmental factors effects expressed which is in the agreement with (Singh *et al.*, 2012) who stated that the vegetative parts of maize develop well in the winter season rather than summer season.

Length of leaves

In season A, the study showed a significant difference between all plant materials that express the effect environmental factors on our maize length leaf. BYM4 has highly performed with 100.89 cm and BYM1 as a lowest performer with 81.92 cm of leaf length in the season A. The three plant materials BYM2, BYM3 and BYM4 originated from the surrounding areas (Kinigi, Nyabihu and Rubavu) of the experiment site and white maize hybrid as well, showed almost the similar and high performance. That might be due to the similar environmental conditions of those varieties' origin regions and the experiment site that might have resulted from their adaptation to environmental factors which feet with the statement of both (Padilla, 2005), where he reported that a final leaf initiation and elongation depend upon the environmental conditions like temperature, sunlight and relative humidity and (Mananze & Pôças, 2019), who has stated that the leaf length and area depend on the climatic condition especially the temperature. In contrast, there was no significance difference between all plant materials in season C. Actually, maize grows well in winter season with low temperature and enough rainfall rather than summer season (Singh *et al*., 2012).

Number of ears

Both seasons of our study have showed a non-significant difference between plant materials in number of ears per plant, as justified by the homogeneity in group performance classification. In other words, there was no effect of environmental conditions on maize in terms of number of ears per plant. In the agreement with (Roshani *et al.*, 2018) who stated that different factors such as genotypes, tillage, nitrogen levels, and climate (temperature and precipitation) influence remarkably on the growth and grain yield of maize among others crops, the number of ears were governed by the varieties' genetic characteristics. The performance of season A is greater than the season C which might be due to most favorable climatic conditions of season A than season C in terms of maize climatic conditions requirements as (Sindhupalchok, 2016) has concluded in his study that the suitable climate for maize growth and development is in warm weather with moderate rainfall.

Table 1. Plant height for four yellow maize varieties and one white maize hybrid

T	Record frequency							
	30DAS		60DAS		90DAS		120DAS	
	Season A	Season C	Season A	Season C	Season A	Season C	Season A	Season C
Hybrid	84.2b	47.1c	88.7c	66.1c	178.8b	100.0b	194.6bc	132.3b
BYM1	64.2b	86.1b	121.2c	123c	155.2b	156.5a	155.6c	194.2a
BYM2	137a	130.5a	152a	147a	222.8a	201.5a	230.2ab	212.9a
BYM3	117.8a	112.9ab	137.8b	134.2b	238.8a	178.9a	248.1a	203.2a
BYM4	119.9a	124.4a	163.2a	152a	220.1a	186.6a	235.6ab	208.4a
	p=0.004	p=0.003	p=0.001	p=0.002	p=0.008	p=0.005	p=0.004	p=0.018
	CV%=12.6	CV%=18	CV%=12.6	CV%=15.2	CV%=10.7	CV%=14.1	CV%=10.1	CV%=12.5
	LSD=24.878	LSD=34.00	LSD=26.278	LSD=36.689	LSD=40.860	LSD=43.593	LSD=40.467	LSD=45.302

T: Treatments; BYM: Busogo Yellow Maize, DAS: Day After Sowing

Table 2. Number of leaves for four yellow maize varieties and one white maize hybrid

T	Recordfrequency							
	30DAS		60DAS		90DAS		120DAS	
	Season A	Season C	Season A	Season C	Season A	Season C	Season A	Season C
Hybrid	11.42a	9.00b	12.25a	10.25a	13.50a	11.67a	14.08a	12.17bc
BYM1	9.83c	10.42a	10.58c	11.17a	12.00a	11.75a	12.67a	12.75ab
BYM2	11.25ab	10.17ab	12.00ab	11.33a	12.17a	11.36a	13.42ab	11.50c
BYM3	10.83ab	10.25ab	11.42b	10.58a	13.00a	11.58a	13.67ab	12.00bc
BYM4	10.67b	10.75a	11.50b	11.25a	13.00a	12.33a	13.75a	13.17a
	p=0.006	p=0.078	p=0.005	p=0.174	p=0.164	p=0.623	p=0.091	p=0.021
	CV%=3.5	CV%=6.4	CV%=3.1	CV%=5.2	CV%=5.8	CV%=6.6	CV%=4.0	CV%=4.0
	LSD= 0.703	LSD=1.218	LSD= 0.709	LSD=1.072	LSD=1.398	LSD=1.460	LSD=1.011	LSD= 0.918

T: Treatments; BYM: Busogo Yellow Maize, DAS: Day After Sowing.

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Table 3. Length of leaf for four yellow maize varieties and one white maize hybrid

T	Record frequency							
	30DAS		60DAS		90DAS		120DAS	
	Season A	Season C	Season A	Season C	Season A	Season C	Season A	Season C
Hybrid	89.18a	83.47b	93.73a	86.67a	93.23a	93.73a	100.8ab	99.60a
BYM1	73.91b	88.40ab	77.73b	90.41a	82.17b	92.73a	89.4b	94.50c
BYM2	95.08a	90.34ab	95.30a	91.44a	96.79a	95.30a	110.9a	99.50a
BYM3	94.87a	87.75ab	95.20a	89.19a	96.89a	96.20a	102.4ab	99.42a
BYM4	94.58a	92.85a	96.84a	93.65a	99.64a	94.67a	105.8a	96.67b
	p=0.022	p= 0.223	p=0.039	p=0.402	p=0.039	p=0.439	p= 0.059	p=0.001
	CV%=8.3	CV%=5.1	CV%=7.1	CV%=5.7	CV%=5.3	CV%=5.7	CV%=7.1	CV%=1.3
	LSD=14.102	LSD=8.448	LSD=12.618	LSD=9.744	LSD=9.146	LSD=9.813	LSD=13.696	LSD=2.174

T: Treatments; BYM: Busogo Yellow Maize, DAS: Day After Sowing.

Table 4. Yield parameters for four yellow maize varieties and one white maize hybrid.

P	Treatments															
	HYBRID		BYM1		BYM2		BYM3		BYM4		P Value		CV%		LSD	
	SA	SC	SA	SC	SA	SC	SA	SC	SA	SC	SA	SC	SA	SC	SA	SC
P1	1.5a	1.3a	1.5a	1.6a	1.1a	1.5a	1.5a	1.5a	1.5a	1.0a	0.217	0.440	15.1	31.8	0.4166	0.854
P2	18.71a	18.32a	16.18a	17.63a	16.43a	15.07a	18.7a	17.88a	18.81a	17.68a	0.318	0.215	11.0	9.5	3.689	3.088
P3	4.807a	4.81a	3.537c	4.107c	4.43ab	4.307bc	4,547ab	4,55ab	4,22b	4,707a	0.001	0.001	5.0	3.1	0.4069	0.263
P4	13.43a	14a	13.1b	12.33a	12.31b	11.85a	12.28b	12.83a	11.9b	13.92a	0.057	0.421	4.6	12.1	1.087	2.970
P5	39.9a	30.64a	27.86a	25.66a	26.95ab	24.1a	30.69ab	27.12a	27.31b	27.27a	0.006	0.363	9.2	13.9	5.203	7.066
P6	8.45a	6.3a	3.69d	4.21a	6.8bc	4.76a	7.91ab	5.11a	6.22c	5.21a	0.001	0.661	9.6	32.9	3.492	3.171
P7	233.9a	218a	75.3c	70.2c	156.2b	145.6b	175.7b	163.7b	137.5b	128.1b	0.001	0.001	15.7	15.9	46.53	43.541
P8	39.8a	25.33a	22.28b	29.3a	41.23a	39.43a	42.2a	37.5a	42.33a	37.47a	0.063	0.182	21.3	21.5	15.06	13.734

P: Parameters; P1: Number of ears per plant; P2: Length of ear(cm); P3: Diameter of cob (cm); P4: Number of lines per cob; P5: Number of kernels/line; P6: Total gain yield(t/ha); P7: Total weight of cob(g); P8: Weight of 100kernels(g); BYM: Busogo Yellow Maize, SA: Season A, SC: Season C

Total weight of 100 kernels and Length of ear

Both seasons of our study have showed a non-significant difference between all varieties in weight of 100 kernels and length of cobs. In other words, there was no effect of environmental conditions on the maize in terms of 100 kernels weight and length of cobs. In the agreement with (Roshani *et al.*, 2018) who stated that different factors such as genotypes, tillage, nitrogen levels, and climate (temperature and precipitation) influence remarkably on the growth and grain yield of maize, the weight of 100 kernels and length of cobs were governed by the varieties' genetic characteristics. Similarly to (Sindhupalchok, 2016), who has stated that the suitable climate for maize growth and development is in cool weather with moderate rainfall, the performance of season A which was characterized by the succession of short rainy season (October-November), and short dry season (December-February) is greater than the season C which was featured by sunny weather (Table 4). However, BYM4 variety showed a little difference in performance in both seasons.

Diameter and weight of cob

Both seasons of our study have showed a significant difference between plant materials in both diameter and weight of cob. In other words, there was an effect of environmental conditions on the maize in terms of cob diameter and weight. However, the performance of season A is greater than the season C which might be due to most favorable climatic conditions of season A which was characterized by alteration of short rainy season (October-November), and short dry season (December-February) than season C which was characterized by sunny weather in regard of maize environmental requirements. In addition, white maize hybrid has more performed than other varieties which might be due to its high performance in vegetative parts development. This is in the agreement with the statement of (Lamidi & Afolabi, 2017) that to increase the yield for maize or/ and other crops, various parameters that make up growth rate like the leaf broadness, leaf length, number of leaf at the particular time and maize stem girth must be well established. Yellow maize variety, BYM1 originated from Uganda adapted well in sunny season(C) than rainy season(A), this might be owing to the high temperature of Uganda compared to Rwanda. Ministry of agriculture animal industry and fisheries in Uganda, stated that maize in Uganda adapts well in warm condition with optimum temperature for plant growth ranges of 30°C – 34°C (MAAIF,2017).

Number of lines per cob

Both seasons of our study showed a non-significant difference between treatments in terms of number of line per cob. In other words, no effect of environmental conditions on the maize in terms of number of line per cob. According to (Dawadi & Sah, 2012), the number of kernel line per cob is significantly influenced by the varieties' genotype. The higher number of kernel rows/ear in his study, all varieties' number of line per cob might be due to its genetic characters. Similarly, to (Roshani *et al.,* 2018), hybrid can be a good option to increase the total production of maize grains with high input in mid-hills and open pollinated varieties as well. The same, our experiment showed white maize hybrid as a highest performer in number of line per cob. Therefore, this variate might be governed by genetic characteristics.

Number of kernels per line

Our experiment has showed a significant difference between treatments in number of kernels per line which means the effect of environmental conditions on our maize in season A and non-significant difference in season C. According to (Struik et al., 1986), the Environmental factors have a great impact on the number of male and female florets of maize, which determine the number of kernels. The same, (Singh *et al*., 2012) has stated that the productivity level of winter grown maize is higher as compared to summer sown maize because of comparatively favorable environmental conditions relating to the maize requirements in terms of such conditions. Also, according to (Andrade & Sadras, 2003), the gain yield was significantly increased as long as water availability increases. For our study, the rainfall in season A(943.9mm) was greater than that of season C (659.4mm). Therefore, the number of kernels per line were affected by rainfall. However, the 4yellow varieties which were originated from the nearest area of the experimental site with of course the almost similar environmental conditions, have showed almost the similar performance with the same group of performance and white maize hybrid as the higher environmentally affected with 37.9 of number of kernels per line. On other hand, in the season C, no significant effect of environmental manifested on our maize due to unfavorable environmental conditions in season C (sunny season).

Total grain yield (t/ha)

There was a significant difference between treatments in the total grain yield in season A. This defines a significant effect of environmental conditions on maize in terms of total grain yield per hectare. However, the white maize hybrid which was a higher performance in both vegetative growth and number of kernels per line, has also showed a high performance in total yield with average yield of 8.46t/ha and 6.30 t/ha in season A and C respectively. This is in conformity with (Ashraf *et al.,* 2015), who stated that an increase in plant growth has eventually yielded more total grain yield. According to the study of (Singh *et al.,* 2012), the total yield gained during winter season was invariably (> 6t/ha) than the summer season yield (2-2.5t/ha).

Conclusion & Recommendations

According to the obtained results from this study, there is a significant increase in both growth and yield in season A (Umuhindo: September-January) rather than season C (Impeshyi/Icyi: June-September). Research has proved that yellow corn, the three yellow plant materials originated from the experimental site surrounding areas have almost the same adaptability. Besides, the yellow plant materials from outside the country is less adaptive, whereby its adaptability is particularly greater in season C than season A. In general, our all plant materials are adaptive in Busogo area.

People may be encouraged to grow the yellow maize and reinforce their consumption as source of vitamin A that may help he government to achieve one of MDGs' goals of hunger and malnutrition eradication. Farmers should grow the maize in season A (September- February) whereby short rainy season (October-November), and short dry season (December-February) are alternating so that good adaptability and productivity. UR-CAVM should plan such experiments for further seasons for accurate evaluation and results and provide further relative researches for evaluating other many OPV varieties' adaptability in the area.

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Evaluation of Nutritional Value of Yellow Maize (*Zea mays* L.) Grown under Busogo Environmental Conditions in Rwanda

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Abstract

This study was conducted within two seasons (Season 2020A and 2020C) with aim of evaluating β-carotene content of yellow maize grown under Busogo environmental conditions in Rwanda. Four yellow varieties were used in our study as test plants, and one white variety as a control. The experiments were prepared in a Completely Randomized Block Design (CRBD) with Five treatments and Three replications. The plant management practices were undertaken as per the recommendation for good growth and development. Laboratory analysis was used to evaluate the quantity of β-carotene present in maize. The results have showed a β-carotene content in yellow maize for both seasons and the quantity differs according to level of the maize kernels 'yellowness. The found β-carotene varies between 0.9992 µg/g and 3.0124 µg/g.

Key Words: Yellow Maize, β-carotene, kernels, nutrition

Introduction

Maize or Corn (*Zea mays*) is an important staple food consumed by millions of people in many countries. It contributes 34% of the protein and 35% of energy in Africa, with a 43 kg per capita for human consumption (Norsuzila Y. et al., 1989), and identified as a priority stable crop by the government of Rwanda due to its potential production and use such as playing role in food security, contribution to poverty reduction, used in the production of animals, poultry and fish feed, good crop for fighting hunger as its easier to store (Nafziger et al.,2013).

Due to its high nutritional significance enriched with an abundance of macronutrients such as starch, fiber, protein and fat along with micronutrients such as vitamin B complex, ß-carotene and essential minerals, i.e. magnesium, phosphorus, copper, and extra flexible with the capacity to develop across agro-ecological conditions, maize is regarded as the queen of cereal crops as the third leading cereal grain worldwide due to its high yield and nutritional value conditions (Pulat Batirbaev et al., 2013).

Maize is present in different colors according to the composition. Yellow maize which is rich in β-carotene, a yellow/orange pigment that gives vegetables and fruits their yellow color, is a sound treat for us and staple food in numerous pieces of the world. It is a great wellspring of fiber and proteins while being low in fat and salt. The standard kernel composition on a dry matter basis for the commodity yellow dent corn is 71.7% starch, 9.5% protein, 4.3%oil, 1.4% ash, and 2.6% sugar (Kaul et al., 2019). However, the quality of maize products depends upon the agronomic practices and climatic conditions (Norsuzila Y. et al., 1989).

Yellow maize is a very healthy treat for us all, which is why it is a staple food in many parts of the world. It is an excellent source of fiber and proteins whilst being low in fat and salt. Yellow maize contains lots of minerals which are important for us and that too in a great quantity (USAID, 2016). The stalks of Yellow maize might be utilized as grain for creatures like cows, sheep, goats, ponies or some other kind of animals. They may likewise be given to poultry as it is a rich source of β-carotenes and xanthophyll conferring yellow color for coloration of egg yolk, poultry fat and skin when it is used at 30% and above in the diet (Kaul et al., 2019). Yellow kernelled cultivars are are also used in supplementary nutritional programmes to feed the malnourished children and to improve their health status (Norsuzila Y. et al., 1989).

Rwanda has experienced a problem of insufficient quantity and quality of maize through local production. There is a need of importation from outside country. The estimated quantity of maize requested (marketed) in Rwanda amounts to 55,000 tons per year, of which only about 30,000 tons are from domestic production, suggesting a deficit of about 25,000 tons per year, which is met by imports from Uganda and Tanzania (Pulat et al, 2013).

To serve the growing demand for maize while reducing the current reliance on imported maize grain, the Government of Rwanda has adopted the policy of stimulating the significant growth of maize production through its support and focus on replacing Open Pollinated Varieties (OPV) including yellow maize varieties with high-performance white maize hybrids (Lead, 2016), and this has resulted the decline of yellow maize varieties whiles those are wholesome and high in nutritious value than the ordinary white maize, because of its higher levels of lutein, carotenoids and vitamin A (Kaul et al., 2019).

It is the reason this study was conducted to evaluate the quantity of β-carotene content in yellow maize grown under Busogo environmental conditions in Rwanda.

Materials and Methods

Experimental site

The experiment was carried out in the model farm of University of Rwanda-College of Agriculture, Animal Sciences and Veterinary Medicine, Busogo Campus located in BUSOGO Sector, Musanze District, in Northern Province, Rwanda. The study site is characterized by the average temperature of about 15.6°C, 2200m of altitude, 1 ^{0}C33' of South latitude, 29 ^{0}C33' of East longitude and rain fall of 1400mm per year with the volcanic highland soil (Busogo Meteorological station, 2015). The soil of Busogo is the volcanic highland at 2200m absl. The climate is temperate with mean temperature of 17°C.

Plant materials and experimental design

Four yellow maize plant materials namely BYM1, BYM2, BYM3 and BYM4 (Busogo Yellow Maize) originated from Uganda, Kinigi, Nyabihu and Rubavu, respectively, and one white hybrid namely Pan53 as a control were used in our study.

The trials were prepared in a Completely Randomized Block Design (CRBD) with five treatments and three replications. The seeds were sown during two agricultural seasons namely 2020A(September-February) and 2020C(June-September) at 40 cm x75 cm as spacing with 2 seed per hill, twelve seeds per row (Six hills per row), four rows per plot and twenty-four hills per plot in the prepared plots with the size of 3 m x 3m. The plots were separated at 0.5 m x 0.5 m of distance. For good growth and development, plant management practices like land preparation, sowing, fertilization, watering, earthing-up and weeding were taken as per the recommendations. Fertilizers were applied at the rate of 1000kg/ha of FYM (Farm Yard Manure) by localized placement method, 100kg/ha of DAP (during sowing) by localized placement method and 50kg/ha of Urea (during weeding and earthling up, six weeks after sowing) by side dressing method.

Data collection and analysis

At maturity after harvesting, four plants per plot were selected and on individual randomly selected plant 100 seeds were collected. β-carotene analysis was done in laboratory through sample extraction by acetone, decantation with petroleum and reading by a UV spectrophotometer and expressed in micrograms per grams (µg/g).

Results and Discussion

β-carotene is a yellow/orange pigment that gives vegetables and fruits their rich colors. The plant yellowness and /or orangeness increases as much as this pigment is present in it. Yellow maize shows the highest abundance of β-carotene (Muzhingi *et al*., 2011). In conformity with our study materials, apparently, by looking with necked eyes, their yellowness level was different. One which was too much yellow (BYM4), showed a high quantity of beta-carotene and progressively.

Table 1. β-carotene content (µg/g) for four yellow maize varieties and a white maize hybrid

Season	Treatment				
	HYBRID	BYM1	BYM2	BYM3	BYM4
A	0.4863	0.9992	1.2246	1.9826	2.9722
C	0.5021	1.0302	1.3864	1.9987	3.0124

BYM: Busogo Yellow Maize.

Conclusion & Recommendations

According to the obtained results from this study, there is a Research has proved that yellow corn, has a higher nutritional value than the ordinary white maize, because of its higher levels of β-carotene. BYM4 is the highest holder of β-carotene, and BYM3, BYM2 and BYM1 respectively. The quantity of β-carotene corresponds to the level of kernels' yellowness. As long as kernels are too much yellow, the β-carotene content is higher. The three yellow plant materials originated from the experimental site surrounding areas have almost the same adaptability. Besides, the yellow plant materials from outside the country is less of β-carotene container. Therefore, for the aim of nutrition richness especially in Vitamin A, BYM4 variety is more suitable. In general, our all four yellow plant materials contain β-carotene. Recommendations go to the government to influence and encourage people to grow the yellow maize and reinforce their consumption as source of vitamin A that may help to achieve one of MDGs' goals of hunger and malnutrition eradication. Farmers should grow yellow maize as source of vitamin A so that decrease of malnutrition problems.

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Assessment of Youth's Perception and Participation in Agricultural-Based Livelihoods in Shendam Local Government Area of Plateau State, Nigeria

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Abstract

This study assessed youths' perception and participation in agricultural-based livelihoods in Shendam Local Government area of Plateau State. Multistage sampling technique was used to select 180 respondents for the study. Descriptive statistics, four point Likert scale and Logit regression were used to achieve the objectives of the study. Findings from the study showed the youths were 27 years on average. About 59% of the youths were males and 80% of them married. 44% of the youths had secondary education and a mean farming experience of 8 years. About 74% of the youths participated in agricultural livelihoods as majority (72%) of them reside in the rural areas. Majority of the youths had positive perception of agricultural-based livelihoods. The agriculture-based activities the youths participated in were; crop farming (54%), livestock farming (32%), agricultural product marketing (12%), agricultural products processing (9.4%), fish farming (7%) nursery raising (3.3%) and honey making (2%). Age, educational status, marital status and parents' occupation were significant factors that influenced youths' participation in agricultural-based livelihoods. The major constraints to youths' participation in agricultural-based livelihoods included inadequate credit facilities (43.3%), lack of effective agricultural insurance policy (39.4%), insufficient initial capital (36%) among others. The study recommends an urgent need to stimulate the interest of the youths in agriculture early in life through career guidance. Grants should be provided to agriculture graduates who want to embark on commercial agriculture shortly after graduation. Incentives such as input supply, good market outlet and attractive price of agricultural produce should be put in place to encourage youth and make them know that agriculture can be profitable. Policies should be designed to encourage suitable access to credit facility since it was found to be a strong factor that prevents youth from embarking on large scale agricultural production.

Key words: *Assessment, youths', perception, participation, agricultural-based, livelihoods.*

Introduction

Agriculture is an important sector for the economic sustainability and social wellbeing of all developing countries across the globe (Alawa *et al.*, 2020; Kwenye and Sichone, 2016). It remains a vital sector in many African countries to promote food security and to alleviate poverty (Diao *et al.*, 2010; Dercon and Gollin, 2014; Sakketa and Gerber, 2020). According to the Food and Agriculture Organisation of the United Nations (FAO, 2019), the sector provides for over 85% of all rural revenue streams, generates over 70% of rural employment, and accounts for nearly 25% of Nigeria's GDP. Therefore, if properly utilised, agriculture could play a significant role in supplying stable employment and income for the continent of Africa's rapidly increasing youth population, especially in Nigeria, where approximately 69 percent of the youth live in rural areas and depend on agriculture as their main source of subsistence. However, in most developing countries bulk of the agricultural production efforts are still left in the hands of aged farmers who presently constitute the major farming population (Adefalu *et al.*, 2009). It is worrisome that the agricultural productivity level of older people cannot meet the speedily growing population's food and fibre needs (Kwenye and Sichone, 2016). Additionally, the new ideas and techniques used to improve agricultural production are not user- friendly for older people most of whom are not learned. As a result, encouraging adolescent participation in agriculture becomes essential to economic development in the majority of emerging nations. The youth continue to be a crucial and significant component of the human resources that can shoulder the burden of development, including agriculture, and get over some of the major obstacles to increasing agricultural productivity in emerging nations (Adeogun, 2015; Isaac, *et al*., 2014)
Although the United Nations defines youth as individuals aged between 15 and 24 years old, the Federal Government of Nigeria and the National Youth Policy (NYP, 2009) defines youth as Nigerian citizens between 18 and 35 years old. For the purposes of this study, a youth is defined as an individual within the age range of 18 to 35 years. United Nations Department of Economic and Social Affairs (UDESA, 2011) indicates that population around the globe is projected to reach 9 billion by 2050. Population for young people (aged 15 to 24 years) is also expected to increase to 1.3 billion, accounting for almost 14 per cent of the projected global population. According

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to Food and Agriculture Organization (FAO, 2014) and the International Fund for Agricultural Development (IFAD, 2014), rural youth are the future of food security, yet around the world, few young people see a future for themselves in agriculture. Africa is faced with the problem of inadequate involvement of rural youth in agricultural-based livelihoods (Leavy & Smith, 2010; Anyidoho *et al*., 2012). Young people and mainly the rural youth face many challenges in trying to earn a livelihood yet agriculture offers a lot of opportunities. The low participation of rural youth in agricultural livelihoods raises concerns for the future of agriculture (Mapila, 2014). IFAD (2011) attributes this to lack of lucrative incentives in smallholder subsistence farming in many third world countries. Amadi (2012) opined that the rapid decline in agricultural production is connected to the continuous decline in agricultural labour which he attributed to the continued efflux of the youth and school leavers from the rural farming communities in search of employment in fields other than agriculture. Alliance for Green Revolution in Africa (AGRA, 2015) specifies limited access to arable land, credit, markets, and many other productive resources necessary for agriculture as major problems worldwide. Older farmers are less likely to adopt the new agricultural technologies, and ultimately feed the growing world population while sustainably utilizing the environment (Mapila, 2014). Hence, there's need to engage youth in agriculture. According to International Labour Organization (ILO, 2021), the observed global increase in the youth population and unemployment have become a source of concern and currently attracts considerable attention in many discussions on international development. With a national population of about 200 million, Nigeria is the most populated country in Africa and has a high proportion of young people and an increasing rate of youth underemployment and unemployment (Adesugba and Mavrotas, 2016). According to the National Bureau of Statistics (NBS, 2012), the youth population (15–35 years of age) in Nigeria is approximately 64 million. More than half (54 percent) of youth are unemployed, with more females being unemployed (52 percent) than males (48 percent). More importantly, many of these youth are also highly educated, and some are graduates of higher institutions. It is reported that about 1.5 million youth graduate every year (Adesugba and Mavrotas, 2016). The NBS (2012) reported that a sizeable percentage of young adults who graduate each year and are unemployed typically choose employment that increase their likelihood of being underemployed. The Federal Government of Nigeria's recent agricultural policy agenda has therefore made addressing young unemployment a top priority in order to find a long-term solution to this issue. The key sector to rely on to address these difficulties, according to the numerous continuing discussions regarding youth unemployment, is agriculture. As a result, youngsters must find enough incentives to enable their active involvement in the sector as part of any plans to resuscitate the agricultural sector in Sub-Saharan Africa.

Statement of the Problem

Nigeria's economy, just like in many developing countries, is predominantly agricultural. One of the key limitations to the attainment of improved agricultural productivity and food security in the country is inadequate involvement and consideration of youth in the agricultural sector. According to Naamwintome and Bagson (2013), youths are a very valuable resource for all countries, particularly for maintaining agricultural output which is a crucial industry for development. The average age of farmers in the nation is a significant hindrance to the nation's efforts to achieve food security since ageing farmers have a negative impact on the agricultural industry, which has seen a recent fall in crop yield. The youths were once heavily active in agriculture as a source of income though the type of agriculture practice was small scale agriculture which deals with crop production and livestock production on a small piece of land without using advanced or expensive technologies. However, in recent years, youth participation in agriculture has decreased nationwide, particularly in rural areas, leaving farming to the elderly. Despite government initiatives to increase youth participation in agriculture through policy assistance, only a small number of young people actively engage in this sector. As a result, farming is now performed by elderly and young individuals who seldom have the energy to complete difficult tasks. Cook (1996) stated that because these elderly farmers are expected to be phased out due to advancing age, their production level is insufficient to meet the population's fast rising needs for food and fibre. According to Ovwigho and Ifie (2009), Nigerian young have the potential to promote agriculture, but the majority of them are not motivated to venture in to it. Given their increased aptitude and willingness to accept innovations and technology which are crucial to altering the agricultural sector, the youths' are the ideal catalysts for agricultural transformation and developmental change compared to the elderly population (Kwenye and Sichone, 2016).Youths in Shendam Local Government Area of Plateau State are not an exception as majority of them are at the periphery of the agricultural value chain participating as primary producers whose main aim is subsistence. The rural youth do not fully exploit the investment opportunities that exist along the agricultural value chain. The low participation of rural youth in agricultural livelihoods raises concerns for the future of agriculture since the youth form more than fifty percent of Nigeria's population. Kimaro *et al.* (2015) suggested that to foster a country's economic development, youth should be encouraged to participate in agricultural activities because they constitute an important component in society and are the greatest assets of any country globally. According to Kwenye and Sichone (2016), in order to

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maintain growth and avert danger in the industry, the majority of agricultural production efforts shouldn't be left in the hands of elderly subsistence farmers who currently make up the majority of the farming community.
Agriculture has huge and diverse opportunities potentials that cannot only transform the national economy but also, tremendous impact on the personal lives of the farmer, particularly the youths. Although, the participation of youths in agriculture is fundamental for economic development and poverty reduction, the factors influencing the willingness of youths to participate in agricultural activities are not clearly comprehended in Nigeria and particularly in Shendam Local Government Area of Plateau State. Consequently, to address this knowledge gap, an investigation to determine the factors influencing the participation of youths in agriculture becomes pertinent. The broad objective of the study is to assess the youth's perception and participation in agricultural-based livelihoods in Shendam Local Government Area of Plateau State, Nigeria. The specific objectives are to;

- describe the socio- economic characteristics of the youths in the study area;
- examine youths perception of agricultural-based livelihoods in the study area;
- access youths participation in agricultural-based livelihoods in the study area;
- identify the various agricultural-based livelihoods engaged in by the youths in the study area;
- determine the factors influencing youths participation in agricultural-based livelihoods in the study area and
- identify the constraints to youth participation in agricultural-based livelihoods in the study area.

Materials And Methods

Shendam Local Government is one of the seventeen local government areas of Plateau State. It has four districts namely: Dorok, Derteng, Dokan Tofa and Shendam. The LGA occupies a total land area of 2,477km2 with a population of 208,017 people consisting of 109,519 males and 98,498 females (NPC, 2006). It lies on latitude 8053´N and longitude 9032´E with mean annual rainfall of 57in and annual average temperature of 220C. Shendam LGA is bounded in the north by Mikang LGA, Quan Pan LGA in the west, Langtang South in the east and Taraba State in the south. The hottest months are normally March and September while the coldest months occur between December and January with a lot of harmattan haze. The rainy season is normally between the months of May to October while the other months remain dry. The population within the LGA is majorly agrarian. Rice and yam form the major food crops produced within this lower Benue basin having soils ranging from rich silt deposits to a sandy-loamy texture.

Sampling Technique

Multi-stage sampling technique was used to select the sample size for this study. The first stage involved the selection of the three districts in the Local Government for the study. They are Shendam, Dakan Tofa and Dorok districts. The second stage involved a purposive selection of three communities from each of the districts giving a total of nine communities for the study. The communities in Shendam districts are Derlit, Guras and Dungba. In Dakan Tofa district, the communities selected are Katai, Kirgangan and Tok Doka while in Dorok district, the communities selected are Gonvel, Kuka and Makera. The purposive selection is based on high volume of agricultural production in the areas. The third stage will involve random selection of twenty (20) youths from each of the communities selected. This will give a total of one hundred and eighty (180) respondents for the study. Data for this study was obtained through primary source. The primary data was generated through the administration of structured questionnaire designed in line with the objectives of the study.

Method of Data Analysis

Both descriptive and inferential statistics were used to analyze the data. Descriptive statistics such as frequency counts, percentages and mean was used to achieve objective i, ii, iii and vi. Four point Likert scale was used to achieve objective iv while Logit regression was used to achieve objective v.

Four point Likert Scale

Youths perception of agricultural livelihoods was measured using a 4-point rating scale of: Strongly Agree (SA) = 4; Agree (A) = 3; Strongly Disagree (SD) = 2 and Disagree (D) = 1. Based on the 4- point scale, a mid-point of 2.50 was established thus: 4+3+2+1 ÷ 4 =2.5. Decision rule was therefore made that any mean score greater than or equal to 2.50 suggests a positive perception of agriculture as a veritable means of livelihood amongst the youths, while any mean score less than 2.50 suggests negative perception.

Logit Regression Specification

The logit regression model is a unit or multivariate technique which allows for estimating the probability that an event occurs or not by predicting a binary dependent outcome from a set of independent variables. The logit model

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is based on cumulative logistic probability function and it is computationally tractable. According to Gujarati and Porter (2009), it is expressed as:

$$P_i = E(Y = 1\|Xi) = B_1 + B_2X_2 \ldots \ldots + B_3X_3 \ldots \ldots \ldots B_nX_n \quad (1)$$

For ease of estimation, equation (1) is further expressed as:

$$Pi = \frac{1}{1 + e^{-zi}} = \frac{e^{-z}}{1 + e^{-zi}} \quad (2)$$

Where:
P_i = probability of an event occurring
$P_i = B_i + B_2 X_i$

The empirical model of the logistic regression for study assumed that the probability of the farmers' participation in Agricultural livelihoods is expressed as:

$$Pi = \frac{e^{b}_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_5 X_{5+} b_6 X_6 + b_7 X_7 + b_8 X_8}{_1 + e^{b}_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + \ b_5 X_5 + b_6 X_6 + b_7 X_7 + b_8 X_8} \quad (3)$$

P_i ranges between zero and one and it is non-linearly related to Z_i, . Z_i is the stimulus index which ranges from minus infinity to plus infinity and it is expressed as:

$$Z_i = In \left(\frac{P_i}{1 - P_i} \right) = b_0 + b_1 X_1 + b_2 X_2 \ \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots + b_8 X_8 + u \quad (4)$$

To obtain the value of Z_i, the likelihood of observing the sample was formed by introducing a dichotomous response variable. The explicit logit model was expressed as:

$$Y = b_0 + b_1 X_1 + b_2 X_2 \ \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots + b_8 X_8 + u \quad \ldots \ldots \ldots \quad \ldots \ldots \ldots \quad \ldots \ldots \quad (5)$$

Where:
Y = dichotomous response variable (1 for farmers who participated in agricultural-based livelihoods, 0 otherwise)
X_1 = Age of respondent (Years)
X_2 = Gender (1 if male, 2 female)
X_3 = Marital status (Yes= 1, No= 0)
X_4 = Educational level (Years of formal education)
X_5 = Household size (number of persons)
X_6 = Participation experience (years)
X_7 = Parents occupation (1 if farming, 0 if otherwise)
X_8 = Locality (rural= 1, urban= 0)
b_1 – b_8 = Coefficients to be estimated
b_0 = Constant term
u = error term

Results And Discussion

Socio-economic Characteristics of Farmers

The result in Table 1 shows that 46% of the youths were within age category of 26-30 years, 22% were between 21-25 years, 20% were above 30 years while 12% were between 15-20 years. The mean age of the respondents was 27 years. This is an indication that most of the youths were within their prime and formative age where their energies could be harnessed for productive ventures. At this age, they have the strength needed for agricultural activities in which without proper orientation, they may develop the usual negative perception of agricultural-based livelihoods. This is consistent with the findings of Abebo and Sekumade (2013) who stated that this age group was an active, productive age that could be explored in the growth of the agricultural industry and the economy as a whole.

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Gender of the respondents reveals that 59.0% of the youths were males while 41.0% were females. This shows a great deal of gender balance in which both sexes had opportunity of being selected for the study. This result conforms to the view of Chikezie *et al.* (2012) that gender is no barrier to active involvement in agriculture production activities. However, the result is contrary to the views of Akpan (2010), that males are often more energetic and could readily be available for energy demanding jobs/activities.

The result further reveals that 80% percentages of farmers in the study area were married, while 20% of respondents were single which shows the level at which people in this study area regard family and marriage ties. Being a married youth will increase the necessity to engage in one or more income generating activities so as to provide for the family and to ensure availability of food and shelter for the family. Married youths are more likely to farm than unmarried youths.

Farmer's educational attainment shows that 44% of the farmers had secondary education, 27% had primary education, 18% had tertiary education, while 11 % had no formal education. It is obvious that most of the respondent had low educational qualifications and ultimately there is a considerable level of illiteracy among the youths in the study area. The implication of this result is that the respondents stand low chances of accessing agricultural information than otherwise. Akpan, (2010) noted that education will likely enhance the adoption of modern farm technologies by youth and thereby sustain a strong farming population, but low level of education amongst these youth will likely result in low adoption of modern agricultural techniques and thereby causing a low level of output from their activities.

The result also revealed that 48% of the farmers had household size of 6-10 members, 24% had household size of 1- 5 persons, 20% had household size of 11-15 while the remaining 8% had household size above 15 persons. The mean household size of the respondents was nine (9) persons. These are peculiar situations in rural areas as most household heads especially farmers believe that it is better to have more children who would work on the farm than hiring external labour. This may influence participation in agricultural-based ventures since whoever may choose farming as a career may have family as a source of labour and encouragement.

The result indicated that 62% of the youths' parents were farmers, 24% were civil servant, while 14% were business people. The respondents were mostly from the farming background who should understand the value of agriculture as a means of livelihood. The background of these respondents' parents may thus influence the choice of agriculture-based ventures for self-employment.

Table 1. Socio-economic Characteristics of the Youths

	Frequency	Percentage	Mean
Age			
15-20	21	12.0	
21-25	40	22.0	
26-30	83	46.0	
>30	36	20.0	27
Sex			
Male	107	59.0	
Female	73	41.0	
Marital status			
Married	144	80.0	
Single	36	20.0	
Educational status			
Primary	44	27.0	
Secondary	70	44.0	
Tertiary	29	18.0	
Non formal	17	11.0	
Household size			
1-5	39	22.0	
6-10	77	43.0	
11-15	42	23.0	
>15	22	12.0	9
Occupation			
Farming	112	62.0	
Civil servant	43	24.0	
Business	25	14.0	
Locality			
Rural	129	72.0	
Semi urban	51	28.0	

Source: Field survey, 2023

The result also indicated that 72% of the youths' were residing in the rural areas where agriculture is predominantly practiced. The remaining 28% resides in semi urban communities within the study area. The study area is mostly rural and characterized with a heavy concentration of farming activities both for subsistence and commercial purposes. The locality of the respondents has direct influence on their occupational choice. It is usual that respondents residing in the rural areas will take to farming as their occupation since the major activity or occupation in the rural setting is farming.

Youths Perception of Agricultural-based Livelihoods

Youths perception of agricultural livelihoods was measured using a 4-point rating scale of: Strongly Agree (4), Agree (3), Strongly Disagree (2) and Disagree (1). From the result presented in Table 2, the youths unanimously agreed and perceived the following statements as true having scored above the weighted cut off mean of 2.5. They include: agriculture is an economically viable sector that can address the problem of youth unemployment and food security (3.0), agricultural activities can fulfill rural youth's socio-economic needs (2.76), better access to extension services could attract participation of youth in agriculture (2.76) and better access to production resources like land, credit and farm inputs could attract more youth in agriculture (3.17). The interpretation of this result is that majority of the youths viewed agricultural-based livelihoods in a positive manner and accepted that all these statements are true. On the other hand, the respondents also disagreed with the following statement having scored less than the cut off mean of 2.50: Agriculture as an occupation has less prestige (1.73), agriculture is an occupation characterized by low income and less economic returns (1.76), agriculture is an occupation for the elderly in rural areas and uneducated (1.83). By implication, majority of the respondents did not have a negative perception of agriculture. It is worthy to know that many youths have now realized the immense importance and contribution of agriculture as a veritable means of earning and have as can be seen by the massive involvement of youths into agriculture. The notion that agriculture is meant for the poor and old has been erased most especially amongst the youths who constitute the major workforce

Table 2. Distribution of Respondents based on perception of Agricultural-based livelihoods

Statement	Youth perception of agricultural-based livelihoods					
	SA(4)	A(3)	SD(2)	D(1)	Sum	Mean
Agricultural activities can fulfill rural youth's socio-economic needs	204	198	66	30	496	2.76*
Agriculture as an occupation has less prestige.	28	33	178	73	312	1.73
Better access to production resources like land, credit and farm inputs could attract more youth in agriculture	260	264	42	6	572	3.17*
Better access to extension services could attract participation of youth in agriculture	216	183	66	32	497	2.76*
Agriculture is an occupation characterized by low income and less economic returns	44	54	138	82	318	1.76
Agriculture is an occupation for the elderly in rural areas and uneducated	36	69	154	71	330	1.83
Agriculture is an economically viable sector that can address the problem of youth unemployment and food security	244	237	2142	19	542	3.0*

Note: SA=strongly agreed, A= agreed, SD= strongly disagree, D = disagree

Youths' Participation in Agricultural-based livelihoods

The result in Table 3 shows that majority (74%) of the respondents indicated that they participate in agricultural based enterprises while the remaining 26% do not participate in agricultural-based activities. The predominant rate of participation in agricultural-based ventures could be attributed for the availability of farmland and the dependence on land for existence by rural dwellers.

Table 3. Distribution of Farmers based on Participation in Agricultural-based livelihoods

Participation	Frequency	Percentage
Yes	133	74.0
No	47	26.0
Total	180	100

Source: Field survey, 2023

Years of Participation (Farming experience)

Farming experience as used in this study refers to the number of years spent in practicing farming. The more experienced a farmer is the more efficient his decision making processes and the more he will be willing to take risks associated with adoption of innovation to increase his production**.** Table 4 reveals that 61% of the respondents have been into farming for about 1-5 years. 31% have been into farming for 6-10 years, while 8% had farming

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experience of 11-15 years. The mean years of farming experience was 8 years. This indicates that most of the youths have been practicing farming for moderate period. The accumulated years of experience may help farmers to be more efficient in the use of productive resources. This is in agreement with the findings of Bamire *et al.* (2010) and Mignouna *et al.* (2011) who asserted that, with adequate experience, farmers are expected to improve their skills in production and be able to evaluate the advantages of improved technologies.

Table 4. Distribution of Farmers based on their Years of Farming Experience

Years of farming	Frequency	Percentage
1-5	35	22.0
6-10	97	61.0
11-15	28	17.0
Total	160	100
Mean	8	

Source: Field survey, 2023

Agricultural-based Livelihood Activities Youth Participate in the Study Area

The results of the agriculture-based activities youth participate in are presented in Table 5. Crop farming ranked 1st with 54% followed by livestock farming (32%). This was followed by agricultural product marketing with 12%, agricultural products processing (9.4%), fish farming (7%) nursery raising (3.3%) and honey making (2%). Crop farming and livestock farming are the predominant agricultural-based activities being carried out by the youths in the study area. The overall result indicates that youths in the study area are significantly engaged in agriculture-based activities.

Table 5. Distribution of Farmers based on the Type of Agricultural-based livelihood practiced

Participation	Frequency	Percentage	Rank
Livestock Farming	57	32.0	2nd
Crop Farming	98	54.0	1st
Agricultural products marketing	21	12.0	3rd
Fish Farming	13	7.0	5th
Nursery raising	6	3.3	6th
Agricultural products processing	17	9.4	4th
Honey Production	3	2.0	7th

Source: Field survey, 2023

Determinants of Youths' Participation in Agricultural-Based Livelihoods.

The Logit model was used in estimating factors that influenced youths' participation in agricultural-based livelihoods in the study area. The log-likelihood function (-76.08) shows that the estimated model including a constant and the set of explanatory variable fit the data better. This implies that all the variables included in the Logit model are jointly significant in influencing youth participation in agricultural-based livelihoods. According to the results presented in Table 6, four out of eight predicators namely; age, educational status, marital status and parents' occupation were statistically significant factors that influenced youths' participation in agricultural-based livelihoods. The regression coefficients were all positive indicating that an increase in these variables holding others constant, will lead to an increase in youths 'participation in agricultural-based livelihoods.

Age (X_1) coefficient is significant and positive (8.6964) at 5% level of probability implying a direct relationship with youth participation in agricultural-based livelihoods. The result implies that a unit increase in ages of the youths increases the probability of participating in agricultural-based livelihoods by 8.69%. The higher the age of the youth the higher the predicted probability of participating in agricultural based enterprises. This could be attributed to increasing consciousness and self-realization of the importance of agriculture with age based on experience. This finding is in consonance with the finding of Sunday *et.al* (2015) and Akpan (2010). This indeed is the practical situation in Nigerian Agriculture. This trend does not portend a bright future for agriculture in Nigeria because agricultural production will remain in the hands of the ageing farmers whose productivity and efficiency are relatively low.

Coefficient of marital status (X_6) was positive (1.2086) and significant at 5% level. This implies a direct relationship with participation in agricultural-based livelihoods. The implication of this result is that an increase in the number of married youths will lead to more participation in agricultural-based livelihoods. The predicted probability of participating in agricultural based livelihoods is higher for married youths. This could be related to increasing concern for household welfare and food security following marital responsibilities.

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The coefficient of educational status (X_4) was positive (.0958) and significant at 10% level of probability. This means that an increase in the years of formal education of the youths would lead to an increase in participation in agricultural-based livelihoods. This confirms the *a priori* expected sign.
Coefficient of parents occupation (X_7) was found to be positive (2.0490) and significant at 1%. This means that with a unit increase in parents' engagement in farming as an occupation, the probability of youths participating in agriculture increases by 2.04%. This supports the generalization that youths' whose parents are farmers have greater probability of participating in agriculture than youths whose parents are not farmers. The background and orientation of the youths by virtue of their parents' occupation would influence their desire and interests to participate in such occupation.

Table 6. Logit regression results on Factors Influencing Youth Participation in Agricultural-based Livelihoods

Variable	Coefficient	Std Error	Z	P value
Constant	16.8951	6.6256	2.55	0.011
Age (X_1)	8.6964	3.4680	2.51	0.012**
Gender (X_2)	-.3138	2302	-1.36	0.173
Marital status (X_3)	1.2086	5732	2.11	0.035**
Educational status (X_4)	.0958	.0562	1.70	0.088*
Household size (X_5)	.0107	.5669	0.02	0.985
Parents occupation (X_6)	2.0490	.6040	3.39	0.001***
Participation experience (X_7)	2.5581	1.6822	1.52	0.128
Locality (X_8)	.4421	.4351	1.02	0.310
No. of observations	=	180		
LR Chi2 (7)	=	30.17		
Log likelihood	=	-76.0870		
Pseudo R^2	=	0.1654.		

Note: ***, ** and * Significant at 1%, 5% and 10%

Constraints to Youth Participation in Agricultural Livelihoods

Constraints limiting youth participation in agricultural-based livelihood activities in the study area are presented in Table 7. The major constraints include, inadequate credit facilities (43.3%) followed by no agricultural insurance (39.4%), insufficient initial capital (36%), insufficient land (43.4), poor investment on return (28.3%), Inadequate credit facilities limit the involvement of youths in agriculture-based livelihood activities in the study area. Since majority of the youths have low formal education, they are most likely not aware of loan acquisition organization and process which may affect their productivity in the long run as they are limited to the level of production at which their capital can afford. Lack of agricultural insurance is another problem that hinders youth in venturing into agriculture due to it risky nature. The youths in the study area do not have any form of insurance covering their agricultural assets; this can also be linked to their low level of education. Table 7 further revealed insufficient initial capital is another limitation to youth's participation in agricultural-based livelihoods. This result shows that youths in the study area are limited by lack of capital to increase production which will enhance output and increase food security in the area. Land tenure system is another obstacle to youth participation in agriculture. The common means of land tenure is through inheritance and rent which is not sustainable for large scale production. Poor investment on returns also limits youth involvement in agriculture-based activities. This becomes pertinent in view of the low pricing of agricultural goods and services, after putting in so much efforts in production but the income generated from the sales of those goods marginally return profit and the profit is lesser compared to the efforts put into the production process.

Table 7: Constraints to Participation in Agricultural-based Livelihoods

Constraints	*Frequency	Percentage	Rank
Insufficient initial capital	65	36.0	3rd
Inadequate credit facility	78	43.3	1st
Poor returns to investment	51	28.3	5th
No agricultural insurance	71	39.4	2nd
Insufficient land	62	34.4	4th

*Multiple responses

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Conclusion

Findings from the study revealed that majority of the farmers were young, married and had low level of formal education. They had many years of farming experience even though they operated on small scale holdings with low to moderate annual incomes. Many of the youths were involved in agricultural livelihoods such as crop farming, livestock farming, agricultural product marketing, agricultural products processing, fish farming, nursery raising and honey making. The youth's perception of agriculture was positive as majority of the youths expressed positive responses on their perception of agricultural-based livelihoods. Age, educational status, marital status and parents' occupation were statistically significant factors that influenced youths' participation in agricultural-based livelihoods. The regression coefficients were all positive indicating that an increase in these variables holding others constant will lead to an increase in youth's participation in agricultural-based livelihoods. Inadequate credit facilities, lack of agricultural insurance, insufficient initial capital, insufficient land and poor investment on return were the major constraints to youths' participation in agricultural-based livelihoods.

Recommendations

Base on the findings of this study, the following recommendations were made;

- There is an urgent need to stimulate the interest of the youths in agriculture early in life through career guidance.
- Agriculture should be made compulsory at the primary and secondary levels, to inculcate the importance of the profession, and the spirit of farming in youths. Scholarships should be awarded to students who indicate interest in pursuing agricultural profession in tertiary institutions.
- Grants should be provided to Agriculture graduates who want to embark on commercial agriculture shortly after graduation.
- Access to land by youth should be enhanced through government land acquisition and review of Land Use Decree of 1978.
- Incentives such as input supply, good market outlet and attractive price of agricultural produce should be put in place to encourage youth and make them know that agriculture can be profitable.
- Policies should be designed to encourage suitable access to credit facility since it was found to be a strong factor that prevents youth from embarking on large scale agricultural production.

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Antimicrobial Activity of Some Essential Oils Against Agricultural Phytopathogenic Fungi and Bacteria

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Abstract

Essential oils (EOs) are gaining attention as eco-friendly alternatives to synthetic pesticides for the management of phytopathogenic fungi and bacteria. In this study the in vivo antimicrobial activities of juniper (*Juniperus communis*), rosemary (*Rosmarinus officinalis*), cumin (*Cuminum cyminum*), sage (*Salvia officinalis*), dill (*Anethum graveolens*) and oregano (*Origanum onites*) essential oils were investigated against 2 phytopathogenic fungi (*Fusarium solani* and *Rhizoctonia solani*) and 2 bacteria species (*Erwinia caratovora* and *Streptomyces scabies*) causing high economic losses in potato. Experiment was conducted in a completely randomized factorial design with three replicates at greenhouse conditions. EOs were sprayed at 0, 100, 250, 500 and 1000 µl/l concentrations to aerial parts of potato plants with a manually operated sprayer for 3 times at 15 days intervals starting from the 4-5 true leaf. The application of EOs showed low to high efficiency in suppressing fungal and bacterial diseases of potato tubers and the effectiveness of EOs applications varied depending on the application dose. *R. solani* infection severity, which was over 17% in the control, decreased to 4.5% with the application of 500 ppm and above sage essential oil, and *F. solani* infection severity, which was over 19% in the control, decreased to 8.4% and 3.6% at 1000 ppm juniper and oregano essential oil applications, respectively. Oregano, dill and cumin essential oils showed higher antibacterial activity than other essential oils. *E. carotovora* infection severity, which was above 16% in the control, decreased to 3.3%, 5.0% and 5.0% with the applications of oregano, dill and cumin essential oil at a dose of 1000 ppm, respectively. The highest antibacterial activity on *S. scabies* infection severity was again observed at 1000 ppm oregano essential oil. It has been concluded that the phytopathogens discussed in the research can be suppressed by leaf application of essential oils on the potato plant and that these applications can make a significant contribution to the sustainability of agricultural production.

Key Words: *Potato, essential oil, antimicrobial activity, diseases severity*

Bazı Uçucu Yağların Tarımsal Üretimde Sorun Olan Fitopatojenik Fungus ve Bakterilere Karşı Antimikrobiyal Etkileri

Özet

Uçucu yağlar, fitopatojenik fungus ve bakterilerin mücadelesinde sentetik pestisitlere çevre dostu alternatif aktif maddeler olarak dikkat çekmektedir. Bu çalışmada ardıç (*Juniperus communis*), biberiye (*Rosmarinus officinalis*), kimyon (*Cuminum cyminum*), adaçayı (*Salvia officinalis*), dereotu (*Anethum graveolens*) ve kekik (*Origanum onites*) uçucu yağlarının patateste yüksek ekonomik kayıplara neden olan 2 fitopatojenik fungus (*Fusarium solan*i ve *Rhizoctonia solani*) ve 2 bakteri (*Erwinia caratovora* ve *Streptomyces scabies*) türüne karşı in vivo antimikrobiyal aktiviteleri araştırılmıştır. Çalışma sera koşullarında tesadüf parselleri deneme deseninde faktöriyel düzenlemeye göre üç tekerrürlü olarak yürütülmüştür. Uçucu yağlar 0, 100, 250, 500 ve 1000 µl/l konsantrasyonlarda patates bitkilerinin toprak üstü kısımlarına 4-5 yapraklı dönemden başlanarak 15 gün aralıklarla 3 kez sprey şeklinde uygulanmıştır. Uçucu yağ uygulamaları fungal ve bakteriyel hastalıkların baskılanmasında düşük ila yüksek derecede etkinlik göstermiş ve uygulamaların etkinliği uçucu yağ dozlarına bağlı olarak değişmiştir. Ardıç ve kekik uçucu yağları *F. solani*, adaçayı uçucu yağı ise *R. solani* üzerine en yüksek antifungal aktiviteye sahip uygulamalar olmuştur. Kontrolde % 17'nin üzerinde olan *R. solani* enfeksiyon şiddeti, 500 ppm ve üzeri adaçayı uçucu yağı uygulamasıyla % 4.5'e, kontrolde %19'un üzerinde olan *F. solani* enfeksiyon şiddeti ise 1000 ppm ardıç ve kekik uçucu yağı uygulamaları ile sırası ile % 8.4 ve % 3.6'ya düşmüştür. Kekik, dereotu ve kimyon uçucu yağları diğer uçucu yağlardan daha yüksek antibakteriyel aktivite göstermiştir. Kontrolde ortalama %16'nın üzerinde olan *E. carotovora* enfekiyon şiddeti 1000 ppm dozunda yapılan kekik, dereotu ve kimyon uçucu yağı uygulamaları ile sırasıyla % 3.3, % 5.0 ve % 5.0'e düşmüştür. *S. scabies* enfeksiyon şiddeti üzerine en yüksek etki yine 1000 ppm kekik uçucu yağında gözlenmiştir. Patates bitkisinde yapraktan yapılan uçucu yağ uygulamaları ile araştırmada ele alınan fitopatojenlerin baskı altına alınabileceği ve bu uygulamaların tarımsal üretimin sürdürülebilirliğine önemli katkı sağlayabileceği sonucuna varılmıştır.

Anahtar Kelimeler: *Patates, uçucu yağ, antimikrobiyal aktivite, hastalık şiddeti5*

Giriş

Patates (*Solanum tuberosum* L.) zengin besin kompozisyonu ile dünyada giderek büyüyen açlık sorunu ve dengeli beslenme ihtiyacına cevap verebilecek en önemli bitkilerin başında gelmektedir. Ülkemizde 2022 yılı verilerine göre 138 bin ha alanda yaklaşık 5.1 milyon ton patates üretimi yapılmış, birim alan verimi ise 3.671 kg/da olarak gerçekleşmiştir (Anonim, 2022). Tarlada üretim ve sonrasında depolama sırasında patatesler mantar ve bakteri gibi çok sayıda toprak mikroorganizmasına maruz kalabilmekte ve bu da önemli derecede ekonomik kayıplara neden olabilmektedir. Türkiye gibi gelişmekte olan ülkelerde böcek, yabancı ot ve hastalıklar nedeniyle patateste yıllık % 32.4 oranında verim kaybı söz konusu olduğu, bu kaybın % 21.8'inin ise sadece hastalıklardan kaynaklandığı bildirilmiştir (Eken ve ark., 2000).

Dünyanın en önemli 10 bitki bakteriyel hastalık etmenleri arasında bildirilen Pectobacterium (*Erwinia carotovora*) ve Dickeya spp. (*Erwinia chrsanthemi*) türleri patates üretiminde Bakteriyel Yumuşak Çürüklük ve Karabacak Hastalığına neden olmaktadır (Czajkowski ve ark., 2011; Mansfield ve ark. 2012; Nabhan ve ark., 2012). Söz konusu patojen fide döneminde olduğu kadar bitkinin ilerleyen dönemlerinde de ortaya çıkarak yumrularda çürümelere ve önemli derecede verim kayıplarına neden olabilmektedir (Öztürk ve ark., 2018). Patateste yaygın görülen diğer bir bakteriyel hastalık patates uyuzu (*Streptomyces scabies*) olup, yaygın olarak patates yumrusunun kabuğu yüzeyinde ten rengi ile kahverengi mantarımsı lezyonlar şeklinde ortaya çıkmakta ve yumru kalitesini düşürmektedir (Powelson ve ark., 1993). Siyah siğil (*Rhizoctonia solani*) ve kuru çürüklük (*Fusarium solani*) hastalıkları patates üretiminde ekonomik kayıplara neden olan en önemli fungal fitopatojenler arasında yer almaktadır. *R. Solani*, yumru üzerinde siyah siğiller, çatlamalar ve şekil bozukluklarına neden olarak pazar değerinin azalmasına, bitkinin stolon ve gövdesinde çürüklüklere yol açarak da bitkide besin maddelerinin organlara taşınmasının engellenmesine neden olmaktadır (Arora, 2008; Kulkarni ve Chavhan, 2017). Fusarium türleri patates yumrusunda kuru çürüklük (Bayona ve ark., 2011) ve bitkide solgunluk hastalığı oluşturmaktadır (Mahdavi-Amiri ve ark., 2009). Her iki fungal hastalık da yumru verimi ve kalitesini önemli ölçüde azaltmakta ve yumruların pazar değerini düşürmektedir. Toprakta sklerotia veya organik maddede miselyum olarak uzun yıllar hayatta kalabilen her iki patojenin kontrolü kültürel uygulamalar ve fungusit kullanımı ile sağlanabilmektedir (Cooper ve Williams, 2004). Bakteriyel hastalıklar ile en etkili mücadele yöntemleri ise yumru sterilizasyonu, sertifikalı tohumluk kullanımı ve hastalığa dayanıklı çeşit seçimi olup, günümüzde etkili bir kimyasal mücadele yöntemi bulunmamaktadır. Bakırlı prepertaların bakteriyel patojenlere karşı kısmen etkili olduğu bilinmekle birlikte bu uygulamalar bitki gelişimini de olumsuz yönde etkilemektedir.

Sentetik pestisitler tarım ürünlerindeki hastalık ve zararlıların savaşımında etkinlikleri yüksek kimyasal maddelerdir. Bununla birlikte, uzun süreli ve bilinçsiz pestisit kullanımı biyolojik olarak yavaş parçalanmaları nedeniyle çevre kirliliği başta olmak üzere hedef dışı organizmalar için toksisite, çeşitli fungisit türlerine karşı yaygın direnç gelişimi ve üründe kalıntı bırakması gibi birçok soruna neden olmaktadır. Pestisitlerin bu olumsuz etkileri ve daha güvenli maddelerden üretilen ürünlere olan talebin artması, yeni tip doğal alternatif mücadele yöntemlerinin geliştirilmesine olan ilgiyi artırmıştır. Bazı bitkilerin uçucu yağlarının in vitro ve in vivo biyolojik aktivite gösterdiği ve biyo-pestisit bileşikler olarak kullanıldığı birçok çalışma ile ortaya konmuştur (El-Mougy ve Alhabeb 2009; Mfarrej ve Rara, 2019). Uçucu yağların hastalık kontrol mekanizmaları üzerine yapılan çalışmalar, biyolojik olarak aktif bileşenlerinin ya doğrudan antimikrobiyal aktiviteye sahip olabileceğini ya da konukçu bitki savunma tepkisini tetikleyerek hastalık gelişiminin azalmasına neden olabileceğini ortaya çıkarmıştır (Schneider ve Ullrich, 1994).

Uçucu yağlarda bulunan L-carvone, citronellol, p-mentha-3,8-diol, minenon (terpenoid sınıfı) ve metil eugenol (fenilpropanoid sınıfı) biyopestisit olarak tescil edilmiş aktif maddelerden bazılarıdır. Amerika Birleşik Devletleri Çevre Koruma Ajansı'nda 299 kayıtlı biyopestisit aktif maddesi bulunmakta olup, toplam 1401 aktif biyopestisit ürün kayıtlıdır. Farklı uçucu yağların bazı patates patojenlerini in vitro koşullarda inhibe ettiği rapor edilmiştir (Prabuseenivasan ve ark., 2006; Seema ve Devaki, 2010; Galvão ve ark., 2012; Badar ve ark., 2012). Bununla birlikte, uçucu yağların in vivo etkinliği ve pratik kullanımları üzerine yapılan çalışma sayısı oldukça sınırlı kalmıştır (Quintanialla ve ark., 2002; El-Kot, 2008; El-Moughy, 2009). Tarımda kullanılan pestisitlere alternatif olabilecek veya yeni bileşiklerin geliştirilmesine katkıda bulunabilecek uçucu yağlar üzerine yapılan araştırmalar son derece önemli görülmektedir. Bu çalışmada, bazı uçucu yağların patateste sorun olan fungal (*R. solani* ve *F. solani*) ve bakteriyel (*Erwinia carotovora* subsp. *carotovora* ve *Streptomyces scabies*) fitopatojenlere karşı etkinliklerinin belirlenmesi amaçlanmıştır.

Materyal ve Yöntem

Çalışmada, ülkemizde yoğun olarak tarımı yapılan, orta geççi özellikteki Agria çeşidine ait yumrular ile kekik (*Origanum onites* L.), biberiye (*Rosmarinus officinalis* L.), dereotu (*Anethum graveolens* L.), kimyon (*Cuminum cyminum* L.), adaçayı (*Salvia officinalis* L.) ve ardıç (*Juniperus communis*) bitkilerinin etken madde taşıyan kısımlarından elde edilen uçucu yağlar materyal olarak kullanılmıştır. Patates yumruları, Afyon ili Sandıklı ilçesinde fungal ve bakteriyel hastalıkların yoğun olarak görüldüğü tarlalarda üretilerek kontrolsüz koşullarda

saklanan yerel üretici depolarından temin edilmiştir. Depolanan patateslerden yumru üzerinde kuru çürüklük, siyah siğil, yaş çürüklük ve patates uyuzu belirtisi olan yumrular seçilmiştir.
Adaçayı ve biberiye bitkilerinin yaprakları, kekik bitkisinin yaprak ve çiçekleri, kimyon, dereotu ve ardıç bitkilerinin ise meyve uçucu yağları Clevenger tipi hidro-distilasyon cihazında 3 saat süre ile damıtılarak elde edilmiş ve koyu renkli cam saklama şişelerine konularak +4°C sıcaklıkta karanlık şartlarda saklanmıştır (Council of Europe, 1980). Türlere ait uçucu yağların bileşenleri Süleyman Demirel Üniversitesi Deneysel ve Gözlemsel Araştırma ve Uygulama Merkezi'nde bulunan GC/MS (Gas chromatography/Mass spectrometry) cihazında (QP-5050 GC/MS, Quadrapole detektörlü) belirlenmiştir (Stein, 1990). Cihazın çalışma koşulları: Kapiler kolon: CP-Wax 52 CB (50 m × 0,32 mm, 0,25 µm), Fırın sıcaklık programı: Dakikada 10°C artarak 60°C'den 220°C'ye ulaşmış ve 220°C'de 10 dakika kadar bekletilmiştir, Toplam koşturma süresi: 60 dakika, Enjektör sıcaklığı: 240°C, Detektör sıcaklığı: 250°C, Taşıyıcı gaz: Helyum (20 ml/dak.).
Çalışma, 2023 yılında sera koşullarında (16-30 ºC gece ve gündüz sıcaklığı) Tesadüf Parselleri Deneme Planında Faktöriyel Düzenlemeye göre 3 tekerrürlü olarak kurulmuştur. Farklı enfeksiyon belirtilerini taşıyan ortalama ağırlıkları 80-90 g patates yumruları 3m uzunluğunda 4 sıradan oluşan parsellere 15 cm derinlikte 70 x 30 cm mesafe ile Mart ayının ilk haftasında dikilmiştir. Yumrulara dikimden önce herhangi bir tohum ilaçlaması yapılmamıştır. Dikim öncesinde dekara saf 10 kg azot, fosfor ve potasyum gelecek şekilde 15-15-15 kompoze gübresi, boğaz doldurma ile birlikte de 10 kg/da saf azot hesabı ile Nitro Power (%33 azot) gübresi uygulanmıştır. Bitkilerin ihtiyaç duyduğu su damla sulama sistemi ile karşılanmıştır. Her bir uçucu yağın farklı konsantrasyonları (0, 100, 250, 500 and 1000 µl/l) su kullanılarak hazırlanmış, uçucu yağların su içerisinde homojen karışımın sağlanması amacıyla emilgatör olarak Tween-80 (su hacminin %0,1'i kadar) kullanılmıştır. Çalışmada hiçbir uygulama yapılmayan bitkiler kontrol olarak değerlendirilmiştir. Her bir türe ait uçucu yağlar belirtilen konsantrasyonlarda 3-4 yapraklı dönemden sonra başlanmak üzere 15 gün arlıklar ile üç kez bitki üst aksamına püskürtme şeklinde uygulanmıştır. Uygulamalar otomatik el pülverizatörü kullanılarak her parsele 40 L/da ilaçlama normunda yapılmıştır.
Bitki hasadı, dikimden yaklaşık 100 gün sonra Haziran ayının ikinci haftasında her parseldeki tüm bitkilerin sökülmesi ile yapılmıştır. *R. solani* ve *S. scabies* için enfekteli yumru oranı ve enfeksiyon şiddeti değerlendirmeleri hasat edilen yumrular üzerinden, *F. solani* ve *E. carotova* için enfeksiyon oranı ve enfeksiyon şiddeti değerleri ise hasattan yaklaşık 2 hafta önce parsellerdeki tüm bitkiler dikkate alınarak bitkideki hastalık belirtilerine göre belirlenmiştir.
Tüm fitopatojenler için de enfeksiyon oranı değerleri aşağıdaki formül kullanılarak hesaplanmıştır.

EO (%) = (A/B) x 100

EO (%) = Enfeksiyon Oranı; A: Enfeksiyonlu yumru (bitki) sayısı; B: Enfeksiyonsuz yumru (bitki) sayısı

R. solani için enfeksiyon şiddeti Naz ve ark. (2008)'in belirttiği 1-5 skalasına göre değerlendirilmiştir; 0: Sağlıklı yumru 1: Enfekteli yumru alanı < % 1, 2: Enfekteli yumru alanı % 1-10, 3: Enfekteli yumru alanı % 11-20, 4: Enfekteli yumru alanı % 21-51, 5: Enfekteli yumru alanı > % 50. Elde edilen skala değerleri üzerinden hastalık şiddeti aşağıdaki formüle göre hesaplanmıştır.

HŞ (%) = (Skala değeri toplamı) / (En yüksek skala değeri x Toplam yumru sayısı) x 100

F. solani için bitkilerde enfeksiyon şiddeti, yaprak hasarının yoğunluğuna bağlı olarak hasattan yaklaşık 2 hafta önce 0-5 skalası kullanılarak belirlenmiştir; 0: asemptomatik yapraklar (% 0), 1: Yaşlı yaprakların sararması (% 10), 2: Yaşlı yaprakların sararması ve solması (% 25), 3: İki veya birkaç dalın solması (% 50), 4: Apikal sürgün hariç tüm dalların solması (% 75) ve 5: Tüm bitkinin solması ve ölmesi (% 100) (Chandra ve ark., 1983).

EŞ (%) = (∑ R x T) / N x 4 x 100

T: Her kategorideki toplam bitki sayısı, R: Hastalık derecelendirme ölçeği (R = 0, 1, 2, 3 ve 4), N: Test edilen toplam bitki sayısı

E. carotovara için bitkilerde enfeksiyon şiddeti Hélias ve ark. (2000)'in belirttiği yönteme göre 0-4 skalası kullanılarak hesaplanmıştır; 1: Sağlıklı bitki (R = 0), 2: Küçük klorotik semptom gösteren bitki (R = 1), 3: Klorotik ve karabacak semptomu gösteren bitki (R = 2), 4: Solmuş bitki ve bazı ölmüş sürgünler (R = 3), 5: Ölü bitki (R = 4). Bitkilerde enfeksiyon şiddeti aşağıdaki formüle göre hesaplanmıştır.

HŞ (%): (∑ R x T) / N x 4 x 100

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S. scabies için yumrularda enfeksiyon şiddeti Loria and Kempter (1986)'in belirttiği 0-4 skalasına göre değerlendirilmiştir; 0: Sağlıklı yumru 1: Kahverengi kabuk veya lentisel, 2: Siyahlaşmış doku, 3: Çatlamış sihaylaşmış kabuk, 4: Oldukça derin çukur. Elde edilen skala değerleri üzerinden hastalık şiddeti aşağıdaki formüle göre hesaplanmıştır.

HŞ (%) = (Skala değeri toplamı) / (En yüksek skala değeri x Toplam yumru sayısı) x 100

Çizelge 1. Araştırmada kullanılan uçucu yağların önemli bileşenleri

Origanum onites		*Juniperus communis*		*Salvia officinalis*		*R. officinalis*		*A. graveolens*		*C. cyminum*	
Bileşen	%	Bileşen	%	Bileşen	%	Bileşen	%	Bileşen	%	Bileşen	%
γ-terpinene	5.8	α-pinene	42.7	1.8-Cineole	15.4	β-pinene	6.9	α-pinene	2.2	α-pinene	3.8
p-cymene	5.5	Sabinene	8.4	α-thujone	19.5	1.8-Cineole	66.5	D-carvone	4.4	γ-terpinene	4.8
Linalool	6.4	β-myrcene	16.8	Camphor	47.8	Camphor	5.9	(S)-Carvone	68.4	Cuminal	24.1
Thymol	2.2	Limonene	4.9	Borneol	4.9	Borneol	5.1	D-Limonen	21.3	2-caren-10-al	51.7
Carvacrol	74.6	Germacrene D	6.6	1.8-Cineole	15.4	α-terpineol	6.1	α-Phellandren	1.2	P-mentha-1.4	8.7

Ölçüm ve analizler sonucu elde edilen veriler tesadüf parsellerinde faktöriyel düzenlemeye göre SAS (2009) istatistik paket programında General Linear Model (GLM) prosedürü kullanılarak standart varyans analizi tekniğinde (ANOVA) analiz edilmiş olup ortalamalar arasındaki farklılıklar LSD testine göre belirlenmiştir.

Bulgular ve Tartışma

Uçucu yağ uygulamaları *F. solani* ile enfekteli bitki oranı ve enfeksiyon şiddetini önemli derecede etkilemiş, uygulamaların etkinliği uygulama dozlarına göre önemli derecede değişim göstermiştir. Çalışmada en düşük enfeksiyon oranı ve şiddeti değerleri 500 ppm ve üzeri dozlarda yapılan ardıç ve kekik uçucu yağı uygulamalarında belirlenmiştir (Çizelge 2). *F. solani* enfeksiyon oranı ve şiddeti kontrol ile karşılaştırıldığında ardıç uçucu yağı uygulamaları ile yaklaşık sırasıyla %45.8 ve %55.8, kekik uçucu yağı uygulamalarıyla ise sırasıyla %50.7 ve %79.0 oranında azalmıştır (Çizelge 2). Adaçayı uçucu yağı uygulamaları 500 ve 1000 ppm dereotu ve kimyon uçucu yağı ise sadece 1000 ppm dozunda *F. solani* enfeksiyon oranını azaltıcı etki gösterirken. enfeksiyon şiddeti değerleri her üç uçucu yağda da 500 ppm dozunda önemli derecede azalmıştır (Çizelge 2). Biberiye uçucu yağı uygulamaları *F. solani* üzerine herhangi bir etki göstermemiştir.
Uçucu yağ uygulamaları *R. solani* enfekteli yumru oranı ve enfeksiyon şiddeti değerlerini istatistiki anlamda önemli derecede azaltmıştır. Ardıç uçucu yağında 100 ppm, kekik uçucu yağında 500 ppm, adaçayı, dereotu, biberiye ve kimyon uçucu yağlarında ise 250 ppm ve üzeri dozlarda yapılan uygulamalar *R. solani* enfekteli yumru oranını kontrole göre önemli derecede azaltmıştır. *R. solani* enfeksiyon şiddeti ardıç uçucu yağında 1000 ppm, biberiye hariç diğer uçucu yağ uygulamalarında ise 500 ve 1000 ppm dozlarda daha düşük olarak belirlenmiştir. Çalışmada *R. solani* üzerine en yüksek antifungal aktivite 500 ve 1000 ppm dozlarında adaçayı uçucu yağı uygulamalarında belirlenmiş, adaçayı uygulamaları ile kontrolde ortalama % 35.1 olan enfekteli yumru oranı % 12.8'e, % 17.5 olan enfeksiyon şiddeti ise % 4.4'e kadar düşmüştür (Çizelge 2). Adaçayı uçucu yağından sonra en yüksek antifugal etki 1000 ppm kimyon uçucu yağı uygulamalarından elde edilmiş, bu uygulama ile enfekteli yumru oranı kontrole göre % 29.4, enfeksiyon şiddeti ise % 60.7 oranında daha düşük olmuştur.
Uçucu yağ uygulamalarının *E. carotovora* enfeksiyon oranı üzerine etkileri istatistiki açıdan önemli bulunmuş, adaçayı, dereotu, biberiye ve kekik uçucu yağı uygulamalarında 250 ppm, kimyon uçucu yağında ise 100 ppm ve üzeri dozlarda enfekteli bitki oranları kontrole göre önemli derecede azalmış, ardıç uçucu yağının ise herhangi bir etkisi olmamıştır. En düşük enfekteli bitki oranları 1000 ppm dereotu (% 5.0) ile 500 ve 1000 ppm dozlarında yapılan kekik (sırasıyla % 6.0 ve % 5.5) ve kimyon (sırasıyla % 7.2 ve % 5.3) uçucu yağı uygulamalarında belirlenmiştir. Adaçayı ve kimyon uçucu yağları 500 ppm ve üzeri dozlarda, dereotu ve kekik uçucu yağları ise 250 ppm ve üzeri dozlarda *E. carotovora* enfeksiyon şiddetini önemli derecede azaltmış, ardıç ve biberiye uçucu yağlarının enfeksiyon şiddetine etkileri önemsiz bulunmuştur. Çalışmada en düşük enfeksiyon şiddeti değerleri 1000 ppm dozunda yapılan kekik (% 3.3), dereotu (% 5.0) ve kimyon (% 5.0) uçucu yağı uygulamalarından elde edilmiştir, bu uygulamalar ile enfeksiyon şiddeti kontrole göre yaklaşık % 71.1-79.6 oranında azalmıştır (Çizelge 3).
Uçucu yağ uygulamalarının *S. Scabies* üzerine antibakteriyel etkileri istatistiki açıdan önemli bulunmuş, ardıç ve kimyon uçucu yağları hariç diğer uygulamalar enfekteli yumru oranı ve enfeksiyon şiddetini kontrole göre azaltıcı etki göstermiştir. Adaçayı uçucu yağında 100 pmm ve üzeri, dereotuna 250 ppm ve üzeri, biberiyede 500 ppm ve üzeri, kekik uçucu yağında ise 1000 ppm dozunda enfekteli yumru oranları daha düşük olarak belirlenmiştir (Çizelge 3). Çalışmada en düşük enfekteli yumru oranı değerleri 1000 ppm kekik uçucu yağı (% 3.7) uygulamasından elde edilmiş, bunu 500 ve 1000 ppm dereotu (% 11.8 ve %9.6) ve biberiye (% 10.7 ve % 9.2) uygulamaları takip etmiştir. Kekik ve dereotu uçucu yağlarında 100 ppm ve üzeri dozlarda, biberiyede 250 ppm ve üzeri, adaçayı uçucu yağında ise 500 ppm ve üzeri dozlarda yapılan uygulamalar enfeksiyon şiddetini önemli derecede azaltıcı etki göstermiştir. En düşük enfeksiyon şiddeti 1000 ppm kekik uçucu yağı uygulamasından elde edilmiş, kontrolde % 18.3 olan enfeksiyon şiddeti bu uygulama ile %1.70'e kadar düşmüştür (Çizelge 3).

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Çizelge 2. Uçucu yağ uygulamalarının *F. solani* ve *R. solani* üzerine antifungal etkileri

Uygulamalar	Dozlar (ppm)	*F. solani*		*R. solani*	
		Enfeksiyon Oranı (%)	Enfeksiyon şiddeti (%)	Enfekteli Yumru Oranı (%)	Enfeksiyon şiddeti (%)
Ardıç	0	14.4	19.0	36.2	21.8
	100	11.3	18.5	31.7	20.4
	250	10.1	14.4	30.2	18.5
	500	8.7	8.9	31.4	14.4
	1000	7.8	8.4	28.2	10.6
Adaçayı	0	15.2	17.0	35.1	17.5
	100	14.1	15.9	31.0	14.4
	250	14.3	16.7	22.8	14.0
	500	12.7	14.7	16.8	4.5
	1000	12.4	11.3	12.8	4.4
Dereotu	0	13.0	17.5	35.3	23.4
	100	12.6	16.2	30.7	22.4
	250	12.3	15.6	28.8	19.0
	500	11.6	11.5	23.8	15.5
	1000	10.0	9.4	20.1	12.3
Biberiye	0	14.2	17.5	34.4	21.5
	100	14.2	16.9	31.1	20.5
	250	13.9	17.2	24.8	19.5
	500	13.9	15.6	25.8	20.2
	1000	13.7	15.6	24.2	18.8
Kekik	0	13.2	17.2	34.9	20.2
	100	13.1	15.2	33.9	18.9
	250	12.9	11.9	30.5	18.2
	500	8.6	7.8	27.0	16.6
	1000	6.5	3.6	29.2	16.8
Kimyon	0	13.1	16.8	33.7	21.4
	100	13.4	16.5	29.0	18.4
	250	13.2	15.1	26.7	13.5
	500	11.7	12.0	23.4	11.5
	1000	10.2	10.6	23.8	8.4
CV (%)		11.0	11.4	11.8	12.2
LSD $_{int}$:		2.18	2.64	5.47	3.36
F değeri		2.34**	4.10**	2.01*	4.73**
Uygulamalar					
Ardıç		10.5 c	13.9c	31.9 a	17.8 b
Adaçayı		13.7 a	15.1b	23.7 c	12.3 d
Dereotu		11.9b	14.0bc	27.7 b	18.5 b
Biberiye		14.0a	16.6a	28.0 b	20.1 a
Kekik		10.9c	11.1d	31.1 a	18.1 b
Kimyon		12.3b	14.2bc	27.3 b	14.6 c
F değeri					
Dozları (ppm)					
0		13.9a	17.5a	35.3 a	21.5 a
100		13.1ab	16.6a	32.2 b	19.7 b
250		12.8b	15.2b	27.3 c	17.2 c
500		11.2c	11.8c	24.7 d	13.8 d
1000		10.1d	9.8d	23.1d	12.4 d
F değeri					

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Çizelge 3. Uçucu yağ uygulamalarının *E. carotovora* ve *S. Scabies* üzerine antibakteriyel etkileri

Uygulamalar	Dozlar (ppm)	*E. carotovora*		*S. Scabies*	
		Enfeksiyon oranı (%)	Enfeksiyon şiddeti (%)	Enfekteli Yumru Oranı (%)	Enfeksiyon şiddeti (%)
Ardıç	0	15.4	16.7	19.5	16.3
	100	15.4	16.7	18.1	17.3
	250	14.8	17.0	20.6	15.7
	500	14.2	15.3	18.9	16.6
	1000	15.2	15.7	20.4	16.9
Adaçayı	0	15.1	16.5	18.2	17.9
	100	13.2	16.2	15.6	16.0
	250	10.8	16.0	16.0	16.6
	500	11.0	12.7	16.4	15.0
	1000	8.0	8.7	14.4	12.7
Dereotu	0	15.7	17.2	18.6	17.0
	100	14.3	17.2	14.6	14.4
	250	11.3	14.7	12.3	11.4
	500	8.3	7.7	11.8	10.5
	1000	5.0	5.0	9.6	10.0
Biberiye	0	15.9	16.5	20.3	17.0
	100	15.7	16.3	18.9	15.5
	250	13.1	16.7	16.4	12.3
	500	14.0	15.3	10.7	10.7
	1000	12.8	15.7	9.2	9.40
Kekik	0	14.4	16.2	20.3	18.3
	100	13.0	15.3	16.5	12.6
	250	8.3	12.7	10.6	10.4
	500	6.0	6.7	8.0	5.70
	1000	5.5	3.3	3.4	1.70
Kimyon	0	14.2	17.0	18.4	17.6
	100	11.8	16.7	16.7	16.2
	250	10.0	16.2	17.6	16.5
	500	7.2	10.7	16.2	16.1
	1000	5.3	5.0	16.8	15.5
CV (%)		11.2	11.3	11.5	12.4
LSD $_{int}$:		2.16	2.56	2.91	2.84
F değeri		5.12**	7.65**	7.90**	5.58**
Uygulamalar					
Ardıç		15.0a	16.3a	19.5 a	16.6 a
Adaçayı		11.6b	14.0b	16.1bc	15.6 a
Dereotu		10.9b	12.3c	13.3 d	12.7 b
Biberiye		14.3a	16.1a	15.1 c	13.0 b
Kekik		9.4c	10.8d	11.7 e	9.80 c
Kimyon		9.7c	13.1bc	14.1 b	16.4 a
Dozları (ppm)					
0		15.1a	16.7a	19.2 a	17.3 a
100		13.9b	16.4ab	16.7 b	15.3 b
250		11.4c	15.5b	15.6 b	13.8 c
500		10.1d	11.4c	13.6 c	12.4 d
1000		8.6e	8.9d	12.3 d	11.0 e

Çalışmada ardıç ve kekik uçucu yağları *F. solani* üzerine kuvvetli antifungal aktivite göstermiş, bu uygulamalar ile enfeksiyon oranı % 45.8-55.8, enfeksiyon şiddeti ise % 50.7-79.0 arasında azalma göstermiştir. *R. solani*'ye karşı en etkili uygulama adaçayı uçucu yağı olmuş, adaçayı uçucu yağı uygulamaları *R. solani* enfeksiyon oranı ve şiddetini kontrole göre sırasıyla % 63.5 ve % 74.8 oranında azaltmıştır. Uçucu yağların antifungal aktiviteleri uygulama dozlarına bağlı olarak değişim göstermekle birlikte genellikle 500 ve 1000 ppm dozları daha yüksek

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etkinliğe sahip olmuştur. Uçucu yağların *E. carotovora* üzerine antibakteriyel aktiviteleri düşük-yüksek arasında değişmiş, ardıç uçucu yağının herhangi bir etkisi bulunmazken, adaçayı ve biberiye yağları orta, dereotu, kekik ve kimyon uçucu yağları ise yüksek derecede antibakteriyel aktivite göstermiştir. Kontrol ile karşılaştırıldığında, kekik, dereotu ve kimyon uygulamaları patojenle enfekteli bitki oranını % 61.8 ile % 68.2, enfeksiyon şiddetini ise % 70.6 ile % 79.6 oranında azaltmıştır. *S. Scabies* üzerine en kuvvetli antibakteriyel aktivite kekik uçucu yağından elde edilmiş, 1000 ppm kekik uçucu yağı uygulanan bitkilerde enfekteli yumru oranı % 83.2, enfeksyion şiddeti ise % 90.7 oranında daha düşük olmuştur.

Uçucu yağların antimikrobiyal aktiviteleri, yüksek lipofilik doğaları ve düşük molekül ağırlıkları nedeniyle yağların içerdiği terpen/terpenoidlerin hücre zarını parçalayabilme, hücre ölümüne neden olabilme veya fungal sporların çimlenmesini ve sporolasyonunu engelleyebilme özelliklerinden kaynaklanmaktadır (Taweechaisupapong ve ark., 2012; Nazzaro ve ark., 2017). Uçucu yağ ve bileşenlerinin antifungal aktivite mekanizmaları fungal mitokondrilerinin fonksiyonunu kaybetmesi, hücre zarı bozulması, hücre duvarı oluşumunun değiştirilmesi ve engellenmesi, efflux pompasının engellenmesi ve Reaktif Oksijen Türlerinin (ROS) üretimi şeklinde açıklanmaktadır. Uçucu yağlar fungal patojenlerde biofilm gelişimini engelleme, çevreyi algılama sisteminin engellenmesi, hücre gelişimi ve morfolojisine etki, fungal misel gelişimini engelleme, hücre zarı/duvarına etki ve ergosterol ve fumonisin biyosentezini engelleme gibi faklı şekillerde antifungal aktivite göstermektedir (Nazzaro ve ark., 2017). Birçok araştırmacı, uçucu yağlarda görülen antifungal aktivitenin direkt olarak fungal miselyumu etkilemesinden kaynaklandığını ileri sürmüştür. Bu bağlamda, fungal hiflerin sitoplazmik içeriğinin boşaldığı görülmüş ve uçucu yağların lipofilik özellikleri nedeniyle, fungal hücre zarının lipid bileşiminde değişime neden olduğu bildirilmiştir (Soylu ve ark., 2006). Dolayısıyla, uçucu yağlar, membran lipid çift tabakasını oluşturan lipid zincirleri arasına nüfuz ederek, fungal membranın lipid yapısını bozmakta ve membran akışkanlığını değiştirerek hücre geçirgenliğini etkilemektedir (Taweechaisupapong ve ark., 2012). Diğer taraftan, uçucu yağların antibakteriyel aktivitelerinin bitkilerde sinyalizasyon ağında olumlu etki göstererek patojen gelişimini baskılama ve bitki dayanıklılığını arttırma şeklide ortaya çıktığı bildirilmiştir (Umarusman, 2018). Bazı araştırmacılar ise, uçucu yağların antimikrobiyal bileşenlerinin hücre zarı enzimleri ve proteinleri ile etkileşerek hücre yapısının bozulmasına yol açtığını ve hücre ölümünü arttırıcı özellik gösterdiğini ortaya koymuştur (Pane ve ark., 2011). Uçucu yağlarla yapılan diğer çalışmalarda da uçucu yağ bünyesinde bulunan bileşenlerin, hücre yağ asitlerinin kimyasal bileşiminin ve ortam pH'sının değişmesine, membran bütünlüğünün bozulmasına neden olduğu ve zar fonksiyonunda değişikliğe yol açtığı bildirilmiştir (Pohl ve ark., 2011).

Yapılan çalışmalarda çok sayıda bitki uçucu yağının fungisit olarak değerlendirilme potansiyeli araştırılmış ve bazıları için etkili sonuçlar elde edilmiştir. Konu ile ilgili olarak, *Syzygium aromaticum, Salvia triloba, Thymus vulgaris, Laurus nobilis, Cuminum cyminum* L., *Juniperus communis* L. *Eucaliptus* sp., *Allium sativum* ve *Echinophora tenuifolia* L., türlerinin farklı fitopatojenlere karşı antifungal etki gösterdiği ve uygun dozlarının fungusit olarak kullanılabileceği belirtilmiştir (Boyraz ve Koçak, 2006; Erdoğan ve ark., 2014; Sharma ve ark. 2017; Er, 2018). Tarçın (*Cinnamomum verum*), kekik (*Thymus vulgaris*), adaçayı (*Salvia fruticosa*), nane (*Mentha piperita*), karanfil (*Syzygium aromaticum*) ve limnotu (*Cymbopogon citratus*) yağlarının *R. solani*'ye karşı kuvvetli antifungal aktivite gösterdiği bazı araştırmacılar tarafında da ortaya konmuştur (Zambonelli ve ark., 2004; Vaillant ve ark., 2009; Amini ve ark., 2012; Khaledi ve ark., 2014).

Uçucu yağların *Erwinia* spp. üzerine etkilerine yönelik yapılan çalışmalarda bazı uçucu yağların hastalık gelişimini baskıladığı, bazılarının ise engelleyici etki gösterdiği bildirilmiştir (Kokoskova ve Pavela, 2007; Kokoskova ve ark., 2011; Salem ve ark., 2014; Doukkali ve ark., 2018). Diğer taraftan, bazı uçucu yağların birçok fitopatojen üzerinde antibakteriyel etki gösterdiği, özellikle timol, karvakrol ve sinnamaldehit aktif maddelerinin güçlü antibakteriyel aktiviteye sahip olduğu, karvakrol ve timol'ün bakteri membranını parçaladığı, fenilpropanoid ve terpenoidlerin ise lipofilik yapısından kaynaklı bakteri duvarına zarar verdiği rapor edilmiştir (Halender ve ark., 1998). Aktepe ve ark. (2019), *Allium sativum, Mentha arvensis, Cinnamomi ceylanici, Thymus vulgaris, Lavandula officinalis, Syzygium aromaticum* ve *Cymbopogon citratus* uçucu yağlarının *Erwinia amylovora*'nın gelişimini in vitro koşullarda engellediğini ve *Cymbopogon citratus* hariç diğer etkili uçucu yağların streptomisin antibiyotiğinden bile güçlü antibakteriyel aktivite gösterdiğini bildirmişlerdir. Erwinia amylovora'ya karşı in vitro koşullarda denenen *Mentha arvensis, Thymus vulgaris* ve *Origanum vulgare* (Kokoskova ve Pavela, 2007; Kokoskova ve ark., 2011), *Thymbra spicata* (Basım ve ark., 2000) uçucu yağlarının patojeni baskılama üzerine olan olumlu etkileri daha önceki çalışmalarla ortaya konmuştur.

Tarımsal üretimde yapılan yoğun kimyasal pestisit kullanımının olumsuz etkileri göz önünde alındığında, hastalıklara karşı alternatif mücadele yöntemlerinin araştırılması ve bu yöntemlerin kullanımının yaygınlaştırılması insan ve çevre sağlığını koruyarak tarımsal üretimin sürdürülebilirliğine katkı sağlayacaktır. Tıbbi ve aromatik bitkilerden elde edilen uçucu yağlardan doğal pestisitler olarak aktivite gösterenlerin bitki fungal ve bakteriyel hastalıklarının mücadelesinde entegre mücadelenin bir parçası olarak kullanılması umut verici bir alternatif olarak görülmektedir. Uçucu yağlar, içerdikleri farklı yapı ve özelliklere sahip aktif maddeler nedeniyle yeni doğal pestisitlerin geliştirilmesi açısından büyük potansiyel taşımaktadır. Çalışmadan elde edilen veriler dikkate alındığında; antifungal aktivitesi yüksek olan ardıç, kekik ve adaçayı uçucu yağları ile kuvvetli

antibakteriyel aktiviteye sahip kekik, dereotu ve kimyon uçucu yağlarının ya da bu uçucu yağlardan geliştirilecek olan formülasyonların araştırmaya konu olan fitopatojenlerin mücadelesinde pratik olarak kullanım potansiyeline sahip olabileceği sonucuna varılmıştır.

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Technological And Probiotic Effects Of Lactobacilli Isolated From Honeys

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Abstract

In recent years, there has been renewed interest in lactic acid bacteria, particularly the genus Lactobacillus, due to their usefulness in biotechnology. The aim of the present study was to evaluate the probiotic characteristics and technological aptitudes of six strains of Lactobacillus plantarum isolated from different Algerian honeys. The classification of these bacteria as belonging to the Lactobacillus genus was essentially based on macroscopic observation, the catalase test and Gram staining. A number of parameters linked to the technological aptitudes of the strains studied were evaluated, notably: acidifying power, texturizing power, aromatizing power, proteolytic activity, lipolytic activity, and exo-polysaccharide production. The probiotic effects of the strains studied and their antibacterial power were also determined. The results showed that some of the Lactobacillus plantarum strains studied had significant acidifying and coagulating properties. Their probiotic abilities were also remarkable. The results of the present study deserve to be confirmed for a possible use of these bacteria in the agri-food industry, in particular milk processing.

Key words: *Lactobacillus plantarum*, technological skills, probiotic effects, honey.

ID: 210

Influence Of Mulching Materials On Yield And Economic Returns Of Potato (*Solanum tuberosum l.*) In Gisesero And Muhira Sites Of Rwanda

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Abstract

A study on"Influence of mulching materials on yield and economic returns of potato (*Solanum tuberosum L.*) in Gisesero and Muhira sites of Rwanda" was conducted from 20th February to 10th July, 2022 with the main objective of investigating the influence of different mulches yield of Irish potato and to identify the effective mulching materials for potato producers recommendation. Water shortage, lack of irrigation facilities, high cost of weeding as well as high weed infestation were the problem found in the potato production at farm level. To find out the efficiency of different mulching materials, a field experiment was conducted in Randomized Complete Block Design (RCBD) with five treatments: Control (T1), Dead mulch made of bean stalk (T2), Live/*Mucuna pruriens*(T3), Live/ *Desmodium uncinatum*(T4) and Live/ *Lablab purpureus* (T5) replicated four times. The data on different physical growth and yield parameters were taken over agricultural season before and at harvesting. Data entry and analysis was done using MS- Excel and OPSTAT software. The ANOVA was performed followed by the Duncan's multiple range tests for separation of means into homogenous groups using the Least Significant Difference (LSD) at various levels of significance. From the experiment it was found that the highest tuber yield was obtained in bean stalk mulch for both Gisesero and Muhira sites, 31.92 tha^{-1} and 30.5 tha^{-1} respectively, which was followed by live/*Desmodium uncinatun* (27.31 tha^{-1}) for Gisesero site and live/*Lablab purpureus* (27.31 tha^{-1}) for Muhira site, Live *Mucuna pruriens* for both Gisesero and Muhira sites, 21.63 tha^{-1} and 19.96 tha^{-1} respectively, Live *Lablab purpureus* (18.28 tha^{-1}) at Gisesero site and *Desmodium uncinatum* (18.13 tha^{-1}) at Muhira site, and lowest tuber yield was obtained in control condition for both Gisesero and Muhira sites,15.59 tha^{-1} and 15.88 tha^{-1} respectively. In case of economics, the highest benefit cost ratio was found in bean stalk mulch (3.49) for Muhira site and 3.57 for Gisesero site. Thus, this practice is the most effective mulching material for the high production of potato at Gisesero and Muhira sites of Rwanda.

Keywords: *Solanum tuberosum*, Mulch, tuber, stalk, *Mucuna*, *Desmodium*, *Lablab*

Introduction

Agriculture, the most important sector of Rwanda's economy, accounts for one-third of the country's GDP. However, the sector is characterized by low production as a result of increasing soil fertility reduction over time, which is mostly due to constant cropping without proper nutrient input (Turamyenyirijuru et al., 2019). The potato (*Solanum tuberosum L.*) is a popular crop that is grown in more than 160 countries across the world (Farzana, et al., 2021)**.** It is the fourth most produced crop in the world, behind wheat, rice, and corn (Rajesh *et al*, 2018).

Irish potatoes are one of Rwanda's primary value chains, and they are huge in the north and northwest, but not so much in the rest of the country. The potato is a priority crop for Rwanda's Crop Intensification Program (CIP), which aims to assure a steady supply of fertilizer and better seed to small-holder farmers in order to increase productivity (Mugabo et al, 2018). Although potato is grown throughout the country, the majority of it is grown in four districts in the north-west: Rubavu, Musanze, Nyabihu, and Burera (Shimira *et al*, 2020).

Soil fertility is maintained in permanent agricultural systems by using organic and mineral fertilizers. In many regions of the world, particularly in Sub-Saharan Africa (SSA), inorganic fertilizer supply, use, and profitability have remained poor, despite increasing intensification of land use and expansion of crop cultivation onto marginal soils. Intensive soil cultivation is common in potato farming, which can lead to soil erosion. Erosion control has been explored using a variety of ways. Reduced tillage and mulching, for example, have proven to be effective (Du *et al*, 2022).

Living mulches are usually a legume intercrop placed between the rows of another crop that is growing at the same time. Although living mulch may provide some nitrogen to the crop, their major function is to conserve soil. The crop's roots help to keep the soil in place, while the stem and leaves aid to lessen the impact of rainfall. Living mulches require water and nutrients to grow, and if not maintained properly, they can compete with the main crop thus reducing yields (Stein*et al*., 2022). A wide range of crops have been successfully cultivated with living mulches. Crops that serve as a cover slow erosion, improve soil, smother weeds, increase nutrient and moisture availability, aid in pest control, and provide a slew of other advantages to the farm. At the same time, they can cut expenses, boost profitability, and even generate new revenue stream (Rupali.&Sandeep. 2017). For the above facts, two parallel field trials were conducted at Gisesero and Muhira sites of Rwanda to test the impacts of the various mulches on growth, yield and economics of potatoes.

Materials and Methods

The first field experiment took place at the University farm Busogo in the Busogo Sector, Gisesero Cell, Musanze District, Northern Province. Musanze is Rwanda's most mountainous district, with a volcanic soil type, which is loose and well aerated. Its climate has a mean temperature of 16.7°C and a large amount of rainfall ranging from 1400 to 1800 mm. It is located at 1°33'26" S and 29°32'39"E; Musanze-Rubavu road.
Light dry season from end-December to mid-February, heavy rainy season from mid-February to June, heavy dry season from June to end-August, and light rainy season from end-August to end-December are the four seasons in Busogo Sector. The majority of people in Busogo Sector live in rural areas and work in agriculture; potatoes, maize, wheat, beans, and vegetables are the main crops grown there (Uwiringiyimana, 2019).
The second field experiment took place in the field of COFAR (Cooperative defacilitateurs de Rubavu) which is located in Rugerero Sector, Muhira Cell, Rubavu District, Western Province.
It is on the Musanze-Rubavu road, at 1°41'27" S and 29°18' 2"E. Rugerero has an equatorial climate and is situated at an average altitude. The average temperature is 15 degrees Celsius on the vertices, with night time temperatures ranging from 6 degrees Celsius to 20 degrees Celsius near Lake Kivu's boundaries. The annual rainfall in the Rugerero sector ranges from 1200 to 1500 mm. The Land of Northwest Sector has a very rich soil, but it is shallow due to volcanic ash and lava decomposition, whereas the Land of Southeast Sector has deep soils, but they are poor, typically acidic, sandy clay, and are easily leached due to severe erosion. The Rugerero sector has suitable land for maize, coffee, and potato farming (Anon., 2018).
For both sites, field experiments were set up in one season, 2022A.Experiments were laid out in randomized complete block design with four replications each having five treatments, to make a total of twenty treatments (20). The area of the plot was 10.5 m^2 (3.5m length and 3m width). The spacing between plots and replications were 0.5m and 1m, respectively.T_1 was the control with no mulch,T_2 was dead mulch(bean stalk),T_3 was living *Mucuna pruriens*, T_4 was living *Desmodium uncinatum*, and T_5 was living *Lablab purpureus*.
Dead (bean stalk) mulch were locally collected and placed on the soil by hand at the rate of 10t/ha with 10cm thickness after soil preparation and potato planting to completely cover the soil (Lalit *et al*, 2019) Potato plants were able to grow through it.Living mulches such as *Desmodium uncinatum, Mucuna pruriens* and *Lablab purpureus* were planted after potato emergence between rows to avoid competition. *Mucuna pruriens* and *Lablab purpureus* were planted at 20cm spacing in rows while *Desmodium uncinatum* were spread in lines between Irish potato rows.
The seeds of living mulches were purchased from Rwanda Agriculture and Animal Resources Development Board (RAB). Hand hoeing was done in three and seven weeks following planting. Ridomil fungicide was applied 2 weeks after emergence two times for prevention at weekly basis. Fungicide Mancozeb (Dithane M_{45}) and insecticide Cypermethrin were applied in case of disease and insects appearance. A knapsack sprayer was used to apply those chemicals.
Potato seed of cultivar Kinigi from a well-recognized and certified seed multiplier were planted with a spacing of 30 cm between plants and 80 cm between rows during the 2022A season. At planting, Farmyard manure (FYM) as organic fertilizer were used at a rate of 20t/ha. At the first weeding and earthing up phases, a chemical fertilizer $NPK17^3$ was applied at a rate of 300kg.ha^{-1} in two splits.

Data collection and analysis

The five plants were tagged randomly from each plot for data collection. The data regarding to plant height, leaves number and stem diameter were taken at 45, 60, 75, 90 and 105 days after sowing. Yield and tuber grading have been taken at 135days after planting. The data collected were entered in MS-Excel and then analyzed by using OPSTAT software. The means were compared at 5% level of significance.

Results and Discussion

Number of leaves is one of the major growth attributing parameter in terms of biomass production. The leaf number per plant was found very significantly higher in mulch condition as compared to control condition. At 45 DAP the highest number of leaves was found in bean stalk mulch for both Gisesero and Muhira sites: 9.4 and 32 respectively. The lowest number of leaves was found in control condition for both Gisesero and Muhira sites: 8.05 and 22.1 respectively. At 60 DAP the number of leaves was found higher in bean stalk mulch (15.1 and 85 respectively) while the lowest number of leaves per plant was found in control condition for both Gisesero and Muhira sites: 12.05 and 49.8 respectively. At 75 DAP the number of leaves was found higher in bean stalk mulch for Gisesero and Muhira sites (37.85 and 185.5 respectively) while the lowest number of leaves per plant was found in control condition with 29.25 for Giseser site and in *Desmodium uncinatum* with 109.4 for Muhira site.

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At 90 DAP the number of leaves was found higher in bean stalk mulch for both Gisesero and Muhira sites (57.05 and 219.7 respectively) while the lowest number of leaves per plant was found in control condition for Gisesero with 43.9 and in *Mucuna pruriens* with 134.4 for Muhira site. At 105 DAP the number of leaves was found higher in bean stalk mulch for both Gisesero and Muhira sites (54.22 and 108.1 respectively) while the lowest number of leaves per plant was found in control condition for both Gisesero and Muhira sites: 38.51 and 66.25 respectively. The higher number of leaves in bean stalk mulch could be attributed to the organic matter from it after decomposition, penetration of nutrients deep into the roots of potato, soil erosion reduction and soil born diseases reduction. Similar observations were made by Santosh, et al., 2020.

Table 1. The potato leaf number as influenced by different types of mulche sat various dates of observation (number of days after plantation, DAP) The number of leaves after mulching experiment has been presented in the table below:

Site	Gısesero Ste					Muhıra Sıte				
DAP	45	60	75	90	105	45	60	75	90	105
Treatments										
Control	8.05a	12.05a	29.25a	43.95a	38.51a	22.1b	49.8b	112.8b	143.6b	66.25b
Bean stalk mulch	9.4a	15.1a	37.85a	57.05a	54.22a	32a	85a	185.5a	219.7a	108.1a
Mucuna(live)	8.7a	13.7a	33.15a	45.8a	46.67a	23.3b	57.25b	113.5b	134.4b	70.95b
Desmodium(live)	8.85a	14.9a	34.55a	47.95a	52.87a	22.06b	56.8b	109.4b	138.8b	68.5b
Lablab (live)	8.85a	12.45a	32.7a	45.35a	46.71a	27.5c	62.2b	146b	171.8b	86.15b
S.Em.±	0.54	1.41	6.32	7.31	7.36	1.97	7.21	9.27	10.76	5.6
C.D.	N/A	N/A	N/A	N/A	N/A	6.14	22.46	28.9	33.55	17.45

T_1:Control(no mulch),**T_2**:Dead mulch(beanstalk),**T_3**:Living mulch of *Mucuna*,**T_4**:Living mulch of *Desmodium*&**T_5**:Living mulch of *Lablab*

Table 2. The plant height as influenced by different types of mulches at various dates of observation (number of days after plantation, DAP) The plant night after mulching experiment has been presented in the table below:

Site	Gısesero Ste					Muhıra Sıte				
DAP	45	60	75	90	105	45	60	75	90	105
Treatments										
T1	20.9a	34.8a	36.1a	63.65a	67.35a	39.8a	50.31a	70.15c	81.23b	77.93b
T2	23.3a	44.1a	44.6a	78.25a	84.8a	48.46a	63.63a	85.75b	101.3a	99.08a
T3	21.7a	35.9a	37.25a	67.45a	73.45a	41.6a	61.13a	78.82c	91.95b	88.65b
T4	22.8a	37.8a	39.2a	74.65a	76.3a	41.4a	55.52a	78.35c	91.17b	87.87b
T5	21.4a	34.85a	37.05a	66a	69.15a	43.46a	62.4a	81.5c	94.25c	91.85c
S.Em.±	1.77	2.62	3.14	4.55	6.27	2.11	3.52	2.6	3.09	3.12
C.D.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.1	9.63	9.72

T_1:Control(no mulch),**T_2**:Dead mulch(beanstalk),**T_3**:Living mulch of *Mucuna*,**T_4**:Living mulch of *Desmodium*&**T_5**:Living mulch of *Lablab*

Plant height is one of growth attributing parameter. Potato height was found very significantly higher in bean stalk mulch for both Gisesero and Muhira sites: (23.3,44.1,44.6,78.25,84.8 and 48.46,63.63,85.75,101.3,99.08) and at 45, 60, 75,90 and 105 DAP respectively which was found significantly at par with *Desmodium uncinatum* (22.8,37.8,39.2,74.65,76.3) for Gisesero site and with *Lablab purpureus* (43.46,62.4,81.5,94.25,91.85) for Muhira site and at 45, 60, 75,90 and 105 DAP respectively.

The increased potato height in bean stalk mulched potatoes was possibly due to better availability of soil moisture and optimum soil temperature provided by the mulches. Changes in the plant height of potato have been observed by using different live mulches and bean stalk mulch increased the potato height than other mulches. Mulch materials created favorable condition for the growth of potato. Such response was mainly due to the physio-chemical and biological improvement occurred in the soil including favorable temperature and moisture regimes, nutrient availability and microbial activity in mulch condition. Among the different mulch materials bean stalk mulch was more effective, which ensured maximum vegetative growth with maximum foliage coverage, these result is in agreement with the findings of (Arash *et al*, 2012).

Stem diameter of plant is one of the major contributing parameter on the vigor of the potato plant. The stem diameter of plants was found highest in bean stalk mulch for both Gisesero and Muhira sites (2.96,3.96,41.16,3.36,2.66and 4.36,4.61,4.72,4.7,3.12) and at 45, 60, 75,90,105 DAP respectively which was found significantly at par with *Desmodium uncinatum* (2.88,3.88,4.08,2.61) at 45,60,75and 105DAP respectively and *Mucuna pruriens* (3.28) at 90DAP for Gisesero site and with *Lablab purpureus* (4.3,4.5,4.7,4.68,2.87) for Muhira site and at 45, 60, 75,90 and 105 DAP respectively. The mulching condition produced significantly higher stem diameter of plant as compared to the control condition and in case of mulching material, highest stem diameter of plant was found in bean stalk mulch. Mulch materials created favorable condition for the growth of plant which led to production of big stem; this result is in accordance with the findings of Namarata *et al*, 2021.

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Table 3. Potato stem diameter as influenced by different types of mulches at various dates of observation (number of days after plantation, DAP) The stem diameter of potato after mulching experiment has been presented in the table below:

Site	Gisesero Site					Muhira Site				
Day After Planting	45	60	75	90	105	45	60	75	90	105
Treatments										
T1	2.8a	3.6a	3.8a	3a	2.52b	3.96a	4.17b	4.28a	4.17b	2.63b
T2	2.96a	3.96a	4.16a	3.36a	2.66a	4.36a	4.61a	4.72a	4.7a	3.12a
T3	2.82a	3.82a	4.025a	3.28a	2.6b	4.18a	4.35b	4.52a	4.42b	2.84b
T4	2.88a	3.88a	4.08a	3.16a	2.61c	4.16a	4.33b	4.47a	4.32b	2.69b
T5	2.74a	3.74a	3.94a	3.22a	2.57b	4.3a	4.5c	4.7a	4.68c	2.87b
S.Em.±	0.17	0.18	0.18	0.13	0.02	0.1	0.05	0.1	0.08	0.06
C.D.	N/A	N/A	N/A	N/A	0.06	N/A	0.16	N/A	0.26	0.21

T_1:Control(no mulch),**T_2**:Dead mulch(beanstalk),**T_3**:Living mulch of *Mucuna*,**T_4**:Living mulch of *Desmodium*&**T_5**:Living mulch of *Lablab*

Table 4. Potato tuber grading as influenced by different types of mulches at various size of observation (Big size, Medium size and Small size) The potato tuber diameter after mulching experiment has been presented in the table below:

Site	Gisesero Site			Muhira Site		
Parameters	Grading/Big Size(Cm)	Grading/Medium Size(Cm)	Grading/Small Size(Cm)	Grading/Big Size(Cm)	Grading/Medium Size(Cm)	Grading/Small Size(Cm)
Treatments						
T1	35.15b	24.43b	21.23a	34.05b	25.13b	21.13a
T2	43.3a	28.88a	14.17a	41a	28.27a	16.17b
T3	37.37b	26.10b	16.68a	35.57b	26.32b	20.4c
T4	35.73b	26.26b	15.9a	33.83b	25.75b	20.33c
T5	37.86b	26.03b	17.45a	36.46b	26.62b	17.43b
S.Em.±	1.201	0.35	1.53	1.2	0.35	0.62
C.D.	3.74	1.09	N/A	3.74	1.09	1.94

T_1:Control(no mulch),**T_2**:Dead mulch(beanstalk),**T_3**:Living mulch of *Mucuna*,**T_4**:Living mulch of *Desmodium*&**T_5**:Living mulch of *Lablab*

In case of large size tubers (>30cm) the maximum number of large tubers were found in bean stalk mulch for both Gisesero and Muhira sites: 43.3 and 41 respectively while the minimum number were found in control condition (35.15) for Gisesero site and *Desmodium uncinatum* (33.83) for Muhira site which was statistically at par with Lablab purpureus for Gisesero and Muhira site 37.86 and 36.46 respectively. Medium sized tuber (25 -30cm) were found significantly higher in mulch condition as compared to the control condition. In bean stalk mulch the maximum numbers of medium sized tubers per plant were found for Gisesero and Muhira site: 28.88 and 28.27 respectively. The minimum number of medium sized tubers was found in control condition for Gisesero and Muhira sites: 24.43 and 25.13 respectively which was statistically at par with *Desmodium uncinatum* 26.26 for Gisesero site and *Lablab purpureus* 26.62 for Muhira site.

The highest numbers of small sized tubers were found in control condition for both Gisesero and Muhira sites, 21.13 and 21.23 respectively which was statistically at par with *Mucuna pruriens* (20.4) for Gisesero site and *Lablab purpureus* (17.45) for Muhira site. The minimum numbers of small sized tubers were found in bean stalk mulch for Gisesero and Muhira sites, 16.17 and 14.17 respectively. The higher yield of large sized tubers and medium sized tubers with mulch was due to the less resistance of soil and more uptake of water and nutrients which might have led to better development and growth of individual tuber and hence large-sized potato. The results were more pronounced in case of bean stalk mulch compared to other mulches and control condition because of optimum soil moisture and nutrient retention due to lesser weed competition and maintenance of soil cover; this is in line with the findings of Farzana *et al*, 2021.

Mulch materials showed significant difference on yield of potato. The maximum yield was recorded from bean stalk mulch for both Gisesero and Muhira, 31.92 tha^{-1} and 30.5 tha^{-1} respectively while the lowest yield was recorded in control condition for Gisesero and Muhira sites: 15.95 tha^{-1} and 15.88 tha^{-1} respectively which was statistically at par for *Desmodium uncinatum* (27.31 tha^{-1}) for Gisesero site and for *Lablab purpureus* (27.31 tha^{-1}) for Muhira site. Mulch materials created favorable condition for the growth of plant which led to the production of maximum yield per hectare. Mulch application resulted in a significant maintenance of soil temperature in the root zone and the conservation of soil moisture. The number and weight of tubers and tuber yield in the mulched treatment were significantly greater than on plots without mulching. Similar result with application of mulches was reported by Santosh, *et al*., 2020.

Table 5. The total potato tuber yield as influenced by different types of mulches at the harvest. The yield in tha^{-1} after mulching experiment has been presented in the table below:

Site	Gisesero Site	Muhira Site
Parameters	Yield(tha^{-1})	Yield(tha^{-1})
Treatments		
T1	15.95b	15.88b
T2	31.92a	30.5a
T3	21.63b	19.96b
T4	27.31b	18.13bc
T5	18.28bc	27.31b
S.Em.±	1.120	1.081
C.D.	3.488	3.275

T_1:Control(no mulch),**T_2**:Dead mulch(beanstalk),**T_3**:Living mulch of *Mucuna*,**T_4**:Living mulch of *Desmodium*&**T_5**:Living mulch of *Lablab*

Benefit-Cost Ratio

Benefit Cost Ratio is the discounted benefits divided by the discounted capital costs and the discounted net operating costs. The BCR will be greater than 1 whenever discounted benefits exceed discounted costs. A project with a BCR above 1 provides a net economic gain and can be considered economically justified. For both sites, the highest BCR were found in bean stalk mulch practices. In a budget constrained environment, projects should be prioritized according to their BCRs. A project with a higher BCR provides a greater benefit per dollar invested and should receive priority in the allocation of funding. This will ensure the efficient allocation of scarce resources (Anon., 2015). The economic returns after mulching experiment conducted at Muhira site have been summarized in the table below:

Table 6. Potato economics as influenced by different types of mulches from Muhira site

Treatments	Production cost(RWF)	Gross returns(RWF)	Benefit(RWF)	BCR
T1	3749524	5957143	2207619	1.59
T2	3273333	11439000	8165667	3.49
T3	4035238	7485714	3450476	1.86
T4	4130476	6800000	2669524	1.65
T5	4320952	10242857	5921905	2.37

T_1:Control(no mulch),**T_2**:Dead mulch(beanstalk),**T_3**:Living mulch of *Mucuna*,**T_4**:Living mulch of *Desmodium*&**T_5**:Living mulch of *Lablab*

Mulch materials showed high benefit cost ratio of potato compared to the control. The maximum BCR was recorded from bean stalk mulch (3.49) while the lowest BCR was recorded in control condition (1.59). The highest benefit cost ratio in bean stalk mulched treatment was due to the highest yield from it and the lowest production cost. The lower BCR from the no mulched treatment was due to low yield from it and high cost of production registered from it (Chanda *et al*., 2019; Solomon *et al*., 2019). The economic returns after mulching experiment conducted at Gisesero site have been summarized in the table below:

Table 7. Potato economics as influenced by different types of mulches from Gisesero site

Treatments	Production cost(RWF)	Gross returns(RWF)	Benefit(RWF)	BCR
T1	3654286	5664637	2010351	1.55
T2	3178095	11334034	8155939	3.57
T3	3940000	7681524	3741524	1.95
T4	4035238	9698194	5662956	2.40
T5	4225714	6491429	2265714	1.54

T_1:Control(no mulch),**T_2**:Dead mulch(beanstalk),**T_3**:Living mulch of *Mucuna*,**T_4**:Living mulch of *Desmodium*&**T_5**:Living mulch of *Lablab*

Mulch materials showed high benefit cost ratio of potato. The maximum BCR was recorded from bean stalk mulch (3.57) while the lowest BCR was recorded in control condition (1.55). The highest benefit cost ratio in bean stalk mulched treatment was due to the highest yield from it and the lower production cost. The lowest BCR from the no mulched treatment was due to low yield from it and high cost of production registered in this practice (Chanda *et al*., 2019; Solomon *et al*., 2019).

Conclusion And Recommandations

Soil fertility decline, Low soil moisture content, weed infestation are among the major constraints of potato production and its economic returns in Rwanda. To address on these issues, a study on the influence of different mulching materials on yield and economic returns of potato have been conducted. The experiment was conducted in Randomized Complete Block Design (RCBD) with five treatments such as control (T1), Dead mulch made of

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stalk bean (T2), Live *Mucuna pruriens* (T3), Live *Desmodium uncinatnum* (T4) and *Live lablab purpureus* (T5) replicated four times on Both Gisesero and Muhira sites. Bean stalk mulch was found to be more suitable mulching material for both sites compared to the live mulches such as *Mucuna pruriens*, *Desmodium uncinatum* and *Lablab purpureus* for potato crop productivity increase. The maximum yield was obtained from bean stalk mulch which was followed by *Desmodium uncinatum* at Gisesero site and *Lablab purpureus* at Muhira site, *Mucuna pruriens* at both Gisesero and Muhira sites, *Lablab purpureus* at Gisesero site and *Desmodium uncinatum* at Muhira site, the control condition as the least among other practices for both sites. The production of potato with the use of bean stalk mulch was found economical at both Gisesero and Muhira sites of Rwanda.Therefore, the farmers for these two sites are recommended to use bean stalk mulch for potato mulching to increase productivity and economic returns.

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Yield and Grading of Potato (*Solanum tuberosum* L.) as influenced by different Mulch Materials**.** Agrotechniques in Industrial Crops. 1(1): 1-10.

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Chemical Constituents in the Essential oil of the Endemic plant *Prangos platychlaena* from the Lakes Region of Turkey

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Abstract

The fruits of *Prangos platychlaena* (Endemic), growing wild in Lakes Region in Turkey, were collected at seed maturing stage from different localities to study the essential oil composition. Fruit samples of the species were collected from two different locations (Isparta, Sütçüler/Çandır and Burdur, Bucak/Kızılkaya) during the yellow ripening period, the essential oils of the fruits were determined in the hydrodistillation apparatus, and the essential oil components were determined in the GC-MS. The fruit essential oil rate in plants grown in the Çandır location was determined as 0.16±0.02%, and in the Kızılkaya location it was determined as 0.25±0.06%. It was determined that the fruits taken from the Çandır location consisted of 54 components, and the fruits taken from the Kızıkaya location consisted of 44 components, and a total of 73 different components identified in the fruits of the species. Major qualitative and quantitative variations of some compounds were determined with respect to localities of collection. The major components were germacrene-d (17.08%-20.24%), β-bisabolene (7.53%-17.83%), beta-copaene (0.92%-11.70%), caryophyllene oxide (%6.3-6.23%), β-farnesene (3.21%-5.66%), δ-cadinene (3.5%-3.87%) and ledane (3.35%-3.22%). It has been understood that the ecological factors of the region, especially the altitude, have a significant effect on the essential oil ratio and components.

Key Words: *Prangos platychlaena (Endemic), Essential oil content and composition, Location*

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Yenilebilir Film Kaplamada Uçucu Yağ Kullanımının Gıdaların Fizikokimyasal ve Duyusal Özelliklerine Etkisi

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Yenilebilir kaplamalar, gıdalarda gaz giriş-çıkışı ile ürün nemindeki değişiklikleri sınırlandırmak için ürün yüzeyine ince bir katman halinde uygulanan materyal olarak tanımlanmaktadır. Yenilebilir filmlerde kaliteyi koruyan, ürünün yaşlanmasını geciktiren en kullanışlı kaplama materyallerinden bazıları kitosan, sodyum aljinat ve gamlardır. Uçucu yağlar, yenilebilir filmlerin antimikrobiyal özelliklerinin geliştirilmesinde yaygın olarak araştırılan katkı maddeleridir. Uçucu yağların, aromalarının yoğun olması ve maliyetlerinin yüksek olması nedeni ile gıdaların muhafazasında doğrudan kullanımları mümkün olmamaktadır. Gıda güvenliğinde ve muhafazasında yeni bir eğilim olarak uçucu yağları içeren yenilebilir filmlerin kullanımı gittikçe artmaktadır. Özellikle meyve ve sebzelerde yenilebilir film kaplama ile uçucu yağların kullanımı son yıllarda önem kazanmaktadır. Yapılan birçok çalışmada yenilebilir kaplama materyalleri ile uçucu yağların birlikte kullanımının gıdaların kimyasal, mikrobiyolojik ve duyusal özellikleri ile raf ömrüne olan etkisi incelenmiştir. Bu derlemede, farklı kaplama materyalleri ile uçucu yağların birlikte kullanılmasıyla hazırlanan yenilebilir filmlerin çeşitli meyve ve sebzelere uygulanmasıyla ürünlerin kimyasal, fiziksel, mikrobiyolojik ve duyusal özelliklerinde meydana gelen değişimler incelenmiştir..

Anahtar kelimeler: *Gıda, yenilebilir film, uçucu yağ, kitosan, raf ömrü*

Giriş

Biyolojik olarak parçalanabilen ambalaj materyalleri içinde, fiziksel ve oksidatif baskılara karşı bariyer oluşturma kabiliyetleri son derece yüksek olan yenilebilir film ve kaplamalar son yıllarda odak noktası haline gelmiştir. Tarihi aslında çok eskilere dayanan bu uygulamar ilk olarak 12. yy.'da Çin'de kullanılmaya başlanmıştır. Turunçgiller mumdan yapılan bir malzemeyle kaplanarak daha uzun ömürlü olması sağlanmıştır (Pavlath, A.E. ve Orts, W., 2009). Yenilebilir film ve kaplamalar günümüzde gıdaların kalite özelliklerinin arttırılması ve raf ömrünün uzatılması amacıyla kullanılmaktadır. Geçirgenlik özellikleri olduğu için aroma bileşikleri, antioksidanlar, antimikrobiyal maddeler, vitaminler gibi bileşiklerin tutulmasını sağlarlar. Taze meyve ve sebzelerde en çok karşılaşılan sorunlar; tazeliğin korunamaması, raf ömrünün kısa olması ve mikroorganizma gelişiminin kontrol edilememesidir. Yenilebilir film kaplamalar bu sorunların en büyük çözüm kaynağı olarak görülmektedir. Yenilebilir ambalajlar; yenilebilir filmler, yenilebilir kaplamalar, yenilebilir tabakalar ve yenilebilir torbalardan oluşmaktadır (Tural, S. ve ark., 2017). Uçucu yağlar, yenilebilir filmlerin antimikrobiyal özelliklerinin geliştirilmesinde yaygın olarak araştırılan katkı maddeleridir. Uçucu yağların, aromalarının yoğun olması ve maliyetlerinin yüksek olması nedeni ile gıdaların muhafazasında doğrudan kullanımları mümkün olmamaktadır. Yapılan birçok çalışmada farklı kaplama materyalleri ile birlikte uçucu yağların kullanımının gıdaların raf ömrüne olan etkisi bulunmuştur. Bu derlemede, meyve ve sebzelerin raf ömrünü arttırmak amacı ile kullanılan yenilebilir film ve kaplamaların duyusal, fiziksel, kimyasal ve mikrobiyolojik özelliklerinin değişimlerini ele alan çalışmalar incelenmiştir.

Yenilebilir Film ve Kaplamaların Özellikleri

Kaplamaların işlevi ve geçirgenliği büyük oranda hangi kökenden geldiğine, kullanılan çözeltinin konsantrasyonlarına bağlı olarak değişmektedir. Genellikle hayvansal ve bitkisel kaynaklardan hazırlanan kaplama materyalleri, çevre dostu olmasıyla ilgi çekmektedir (Caner, C. ve Küçük, M., 2004). Yenilebilir kaplamanın başarılı olduğunu gösteren başlıca özellikler şunlardır (Dhall, RK., 2013, Aday, M.S., 2008):

- -Yüksek nemde şartlarında stabil kalmalıdır.
- -Ürünü tam olarak kaplayabilmelidir.
- -O_2 ve CO_2 bariyeri etkili bir şekilde işlev görmelidir.
- -Renksiz ve kokusuz olmalıdır.
- -Su buharı geçirgenliğini en aza indirgemelidir.
- -Mekaniksel özellikleri bakımından iyi olmalıdır.
- -Biyoaktif maddeleri (antioksidanlar, vitaminler, vb.) ve uçucu bileşenleri muhafaza etmelidir.

Yenilebilir film ve kaplamalar 3 kategoriye ayrılmaktadır. Bunlar proteinler, polisakkaritler ve lipitlerdir. Bu sınıflandırmaya ek olarak kompozit polimerler de eklenmiştir.
1- Polisakkaritler: Nişasta (patates, mısır, buğday, pirinç ve diğer türevleri), selüloz (pamuk, odun ve diğer türevleri), gumlar (guar, keçiboynuzu, aljinatlar, karragenan, pektinler ve diğer türevleri), kitin/kitosan gibi maddelerden oluşmaktadır.
2-Proteinler: Bitkisel kökenli proteinler (mısır zeini, buğday gluteni, soya proteini, yer fıstığı proteini) ve hayvansal kökenli proteinler (keratin, kollajen, jelatin, kazein ve peynir altı suyu proteini) olarak iki gruba ayrılmaktadır.
3-Lipitler (yağlar): Hayvansal ve bitkisel yağlar, çapraz bağlı trigliseridler ve vakslardan oluşmaktadır (Yıldız Oğuzhan, P. ve Yangılar, F., 2016).
Bitkilerden elde edilen uçucu yağların antibakteriyal, antifungal, antienflamatuar, antiseptik, antioksidan ve antitoksijenik özellikleri bulunmaktadır. Uçucu yağlar, su distilasyonu, buhar distilasyonu, vakum distilasyonu, çözücü ekstraksiyonu, mikrodalga destekli ekstraksiyon, ses dalgaları destekli çözücü ekstraksiyonu gibi farklı yöntemlerle elde edilmektedir (Avcı, G., 2019). Yatırım maliyeti düşük ve verim açısından avantajlı olan su destilasyonu ve buhar destilasyonu en yaygın olarak kullanılan yöntemlerdir.

Meyve ve Sebzelerde Yenilebilir Film ve Kaplamanın Uygulanması Üzerine Yapılan Çalışmalar

Naeem ve ark. (2018) tarafından yapılan çalışmada, 1.5 g guar gam, 2 ml gliserol, 0.2 ml farklı esansiyel yağlar(rezene, kişniş ve defne yaprağı), 97.8 ml distile suda çözündürülmüştür. İki farklı test grubu hazırlanmıştır. İlk grupta %1.5 guar gam ve %2 gliserol solüsyonu yer alırken, diğer grupta kaplama malzemesi kullanılmamıştır. Mango meyveleri bu solüsyonlara daldırılıp, 10^0C'de ağzı kapalı poşetlerde bekletilmiştir. Antioksidan, fenolik madde miktarı ve diğer kimyasal analizler ile mikrobiyolojik analizler yürütülmüştür. Esansiyel yağ ile kaplanmış meyveler yüksek oranda antimikrobiyal özelliğe sahip olarak çok düşük miktarda bakteri tespit edilmiştir.
Yasser Shahbazi (2018) tarafından yapılan çalışmada, nane yağıyla birlikte Karboksimetil selüloz ve kitozan ile ayrı ayrı muamele edilmiş çilekler 12 gün boyunca depo edilmiş ve çok iyi sonuçlar elde edilmiştir. Mikrobiyal olarak 3.69 ile 3.92 log arasında Listeria monocytogeneslerde bir düşüş görülmüştür. Aktif paketleme ile birlikte kaplamanın taze çilekleri muhafaza etmede en etkili yöntem olacağı belirtilmiştir.
Guerra ve ark. (2015) tarafından yapılan çalışmada nane uçucu yağı ile birlikte kitosan kullanımının çeri domateslerdeki küflere olan etkisi incelenmiştir. 25^0C'de 12 gün ve 12^0C'de 24 gün depolama yapılarak fizikokimyasal ve duyusal analizler de yapılmıştır. Duyusal analiz için 60 kişilik bir test grubu oluşturulmuştur. Bu kişilerden renk, görünüm, tekstür, aroma ve sertlik olarak puanlandırma istenmiştir. Kaplanmış ve kaplanmamış domatesler arasında puanlandırma yapan kişiler, kaplanmış domateslerin 12 gün sonunda hala yenilebilirliğinin olduğunu söylemişlerdir. Antimikrobiyal analizler için Aspergillus niger, Botrytis cinerea, Penicillium expansum ve Rhizopus stolonifer küfleri incelenmiştir. Esansiyel yağ ve kitosan ile kaplanmış domateslerin küflenme zamanı 24 günden fazla sürerken, kaplanmamış olan kontrol grubunun küflenmesi 9 gün sürmüştür.
Buendia ve ark. (2019) tarafından yapılan çalışmada β-siklodekstrin ile birlikte 3 farklı esansiyel yağ ile kaplama maddesi hazırlanıp çeri domateslere uygulanmıştır. Aktif paketleme ile birlikte kaplama maddesinin çeri domatesin raf ömrünü nasıl değiştireceği gözlemlenmiştir.Karvakrol, kekik ve tarçın esansiyel yağları 70:10:20 oranında karışım şeklinde kullanılmıştır. Ağırlık kaybı, Kuru madde miktarı, pH, titrasyon asitliği ve renk indeksine bakılmıştır. Ayrıca puantaj sistemi ile duyusal analizler de yürütülmüştür. Kaplama yapılmamış kontrol grubunda 12.günden sonra %3-4 aralığında mikrobiyal çürüme olurken, kaplama yapılmış grupta 20. Günün sonunda %4.5 oranında mikrobiyal çürüme görülmüştür. Mikroorganizma grubu olarak maya, küf, mezofiller ve psikrofiller seçilmiştir. Duyusal analizler sonucunda 12.güne kadar kaplanmış olan domateslerin kabul edilebilirlik seviye puanı ortalama 10 üzerinden 8.2 olurken, 24.gün sonunda bu seviye 10 üzerinden 6.4'e gerilemiştir. Kabul edilmeyen özellik sertliğinin azalması olarak söylenmiştir.
Jo-Kwon ve ark. (2017) tarafından yapılan başka bir çalışmada, kekik esansiyel yağı ve polivinil alkolden bir film kaplama materyali oluşturulmuş ve aktif paketleme ile çeri domateslere uygulanmıştır. Film kaplamanın Salmonella enterica, toplam küf-maya ve mezofilik bakterilerdeki etkisi incelenmiştir. 4^0C ve 22^0C'de, 0, 1, 3, 5, ve 7 günlerde duyusal, kimyasal ve mikrobiyolojik analizler yapılmıştır. Analiz sonuçlarına göre, kaplanmış olan çeri domateslerde S. enterica için 4.7 log düşüş, küf-maya için 3.8 log düşüş, mezofilik bakteriler için 1 log düşüş olduğu söylenmiştir. Duyusal analizler sonucunda tekstürel olarak kontrol ve kaplanmış domatesler arasında bir fark görülmediği söylenmiştir. Aynı şekilde kaplanmış olan domateslerin renklerinde de önemli bir fark görülmediği belirtilmiştir.

Sonuç

Bu derlemede farklı yenilebilir film ve kaplama materyallerinin uçucu yağlarla birlikte kullanımının raf ömrü ve kalite parametreleri üzerine olan etkisini inceleyen çalışmalara yer verilmiştir. Tüketicilerin gıda satın alırken ve

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depo ederken daha da bilinçlenmesiyle birlikte farklı toksik olmayan ve çevre dostu gıda katkılarına yönelime artmıştır. Bu çalışmaların ışığında meyve ve sebzelerin herhangi bir kimyasal kullanılmadan doğal öğelerle saklanınca raf ömrünün uzayacağı anlaşılmıştır. Farklı kaplama materyalleri ve uçucu yağların kullanımıyla gıdalara uygulama gelecek vaad eden bir konu olacaktır.

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ID: 217

In silico genome-wide comparative analysis of Auxin Response Factors (ARFs) from *Brassica oleracea* and *Arabidopsis thaliana*

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Abstract

Auxin, a crucial phytoharmone, governs gene expression via plant-specific Auxin Response Factors (ARFs) which regulate diverse processes. Auxin profoundly shapes growth from embryogenesis to senescence. At molecular level auxin prompt gene transcription shifts within cell nuclei, steering particular gene activation or suppression. These changes steer auxin-governed developmental plants. The auxin response factor gene family in *Brassica oleracea* is poorly understood, unlike in other species. For comparison, 17 non-redundant genes of *Brassica oleracea* (BolARF) and 22 genes of *Arabidopsis thaliana* were analyzed from a total of 49 genes. Phylogenetic revealed auxin response factor relation across *Brassica* species and *Arabidopsis thaliana*. Chromosomal mapping showed 17 genes spread over *Brassica oleracea*'s 9 chromosomes, with 3 genes on chromosome 5 and 8. Intron/exon and domain analyses offered insights into auxin response factor homology along comparative phylogenetic trees and synteny analysis also echoed homology. Promoter analysis uncovered 44 cis-elements, with 11 displayed. Conserved domains showed three auxin response factor transporting proteins. This study deepens *Brassica oleracea* auxin response factor gene family understanding.

Key Words: *Auxin, Auxin response factor, Brassica oleracea, Comparative analysis, Phylogenetic analysis, Promotor analysis*

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Studies of LASER effects for screening of resistant plant type against brown rust in wheat

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Abstract

Wheat (*Triticum aestivum)* is a staple food in Pakistan and is an important crop at global scale as well. It is an important source of basic nutrition for masses of dependents in the country. It is highly nutritious food and a good source of carbohydrates, proteins and dietary fibers. In 2021 nearly 27 million tons of wheat was predicted to produce in Pakistan. In 2020-2021, global wheat production was 622.2 million tons. Since, wheat crop is cultivated on a very large area of the country to fulfill the needs of the people. But still a number of diseases and pests, negatively impact the yield of the crop. Fungal diseases are considered as the main problem in this crop, for instance brown rust alone is responsible for more than 50% yield losses. The brown or leaf rust, results in low production and inferior quality grain. Leaf Rust is a fungal disease caused by *Puccinia triticina* and this pathogen is well adapted. Due to diverse nature of this pathogen and lack of complete resistance in wheat, often directs to think out of the box for creation of variability in the existing germplasm. In the current study, two wheat varieties Arooj and Subhani were treated with LASER treatment. The LASER treatment was further divided into different time intervals. Three different time points, 1.5, 2.5 and 3.5 minutes were used to treat seeds of these two wheat varieties. The treated seeds were sown in 3 kg earthen pots. The other agronomic applications were made as per recommendations. The treated and control plants were subjected to leaf rust scoring as per Cob's scale. The data for other plant parameters like chlorophyll contents, germination rate, disease severity, leaf characters, spike characters and agronomic characters were calculated and subjected to statistical software for analysis and drawing valid inferences. Our findings show remarkable resistance in the treated seed after evaluation.

Keywords*: Wheat Production, LASER Technology Effect, Brown Rust, Morpho-physiological traits, Data Analysis*

ID: 220

Hava Kalitesinin Niğde Örneğinde İncelenmesi

Orhun Soydan

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Özet

Hava kirliliği, çeşitli kimyasal işlemler sonucu açığa çıkan, başta yakıt kalıntıları olmak üzere gaz hveya partikül halindeki maddelerin canlıların hayatına zarar verecek miktarlarda atmosferde birikmesi olarak tanımlanmaktadır. Hava kirliliğinin artmasında hızlı kentleşme, sanayileşme, motorlu taşıt sayısının artması, meteorolojik koşullar, ısınmada kullanılan yakıtlar, sanayi kuruluşları ve termik santrallerin yaygınlaşması önemli rol oynamaktadır. Hava kirliliği hem gelişmiş hem de gelişmekte olan ülkelerde insanları etkileyen önemli bir çevre sorunu olup, özellikle gelişmekte olan ülkelerin mega kentlerinin ve dünya nüfusunun dörtte birinin sağlıksız konsantrasyonlarda hava kirleticilere maruz kaldığı tahmin edilmektedir. Dış hava kirliliğinin yüksek olduğu şehirlerde yaşayan insanlar, temiz havaya sahip kentsel alanlarda yaşayan nüfusa göre daha fazla kalp hastalığı, solunum sorunu ve akciğer kanserine yakalanmaktadırlar. Yarısından fazlası gelişmekte olan ülkelerde olmak üzere, her yıl 1,3 milyon kişinin hava kirliliğinden öldüğü tahmin edilmektedir. Daha uzun sürelerde görüldüğünde, büyük şehirlerdeki kirlilik, inşaat aşamasında artma eğiliminde olup, maksimuma ulaşmakta ve azaltım stratejileri geliştirildikçe yeniden azalmaktadır. Sanayileşmiş batı dünyasında, kentsel hava kirliliği, bazı bakımlardan son aşamada olup SO_2 ve is düzeylerinde etkili bir düşüş yaşanmaktadır. Ancak son yıllarda artan trafik, dikkatleri nitrojen oksitlere, organik bileşiklere ve küçük parçacıklara yöneltmiştir. Özel araç sayısının artması yeni ortaya çıkan bir sorundur. Gelişmekte olan ülkelerin çoğunda hızlı kentleşme şu ana kadar kontrolsüz büyümeye ve çevrenin bozulmasına neden olmuştur. Buradaki hava kirliliği seviyeleri hâlâ birçok şehirde artmaktadır. Bu çalışmada Niğde ilinin en yoğun kullanım alanlarından biri olan Dr. Sami Yağız Caddesi boyunca hava kalitesi ölçülmeye çalışılmıştır. Caddenin her iki tarafında eşit aralıklarla 22 noktada H_2S, O_2 ve CO ölçümleri yapılmıştır. Ölçümler günde toplam 4 farklı zaman diliminde yapılmıştır. Elde edilen değerler ArcGIS 10.3 yazılımına aktarılarak haritalar üretilmiştir. Cadde boyunca belirlenen gazların ölçümünün homojen bir şekilde dağılmadığı, özelikle oksijen miktarında değişimin diğer gazlara oranla daha fazla olduğu tespit edilmiştir.

Anahtar Kelimeler: *Hava, Hava Kalitesi, Coğrafi Bilgi Sistemleri, Peyzaj, Niğde*

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Peyzaj Planlamada Konfor Bölgelerinin Niğde Örneğinde Belirlenmesi

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Özet

Çoğu planlı bir gelişme göstermeyen şehirlerimiz, artan insan ve yapı yoğunluğu, yanlış arazi kullanımı gibi birçok çevre sorunu sonucunda doğal ve kültürel çevrenin canlı yaşamını tehdit eden ekosistemlere dönüşmektedir. Bu olumsuz durum, kentin fiziksel yapısının dengeli olduğu kentsel planlama ve kentte insan ve çevre sağlığına olumlu katkıları olan açık ve yeşil alanlar oluşturacak peyzaj planlarıyla çözülme imkanına sahiptir. Son yıllarda yoğun kentleşmenin bir sonucu olarak ortaya çıkan kentsel ısı adası etkisi kent sakinleri için sorun yaratmaktadır. Ne yazık ki dünyadaki çoğu şehir bu olumsuz iklim olgusuyla karşı karşıyadır. Özellikle yapılaşma yoğunluklarının bilinçsizce arttığı kentlerde ısı adası etkisiyle mücadele etmek zorlaşmaktadır. İklim kuşağına ve şehirlerin yapısal yoğunluklarına bağlı olarak ısı adasının etkisi farklılık gösterebilmektedir. Ekolojik planlama bu sorunların gelecekte önemli çevre sorunlarına dönüşmesini engelleyecek bir faktör olarak karşımıza çıkmaktadır. Ekolojik planlamada dikkate alınması gereken en önemli bileşen iklimdir. Hava ve iklimin, insanların davranışları ve fizyolojik durumları üzerinde önemli bir etkisi vardır. İnsan performansı ve konforu iklim değişikliklerine göre ayırt edilebilir. İklim durumu veya termal konfor, insanın ruh hali ve dolayısıyla insan memnuniyeti için sağlıklı ve dinamik hava koşullarını ifade eder. İklim faktörlerinin 6 önemli parametresi vardır. Bu parametreler ortalama sıcaklık, bağıl nem ve ortalama rüzgar hızı gibi iklim koşullarıyla ilgilidir. Bu çalışmada Niğde ilinin en yoğun kullanım alanlarından biri olan Dr. Sami Yağız Caddesi boyunca termal konfor alanları belirlenmeye çalışılmıştır. Caddenin her iki tarafında eşit aralıklarla 22 noktada sıcaklık ve nem ölçümleri yapılmıştır. Ölçümler günde farklı günlerde ve gün içinde 4 farklı zaman diliminde yapılmıştır. Elde edilen değerler ArcGIS 10.3 yazılımına aktarılarak haritalar üretilmiştir. İklim verilerinin değerlendirilmesinde evrensel lineer uzatma sistemi kullanılmış olup caddede iklim faktörleri ve biyoiklimsel olarak uygun alanlar belirlenerek konfor düzeyi açısından değerlendirilmiştir. Çalışma alanında özellikle nem oranının ölçüm saatlerine göre çeşitlilik gösterdiği, sıcaklık derecesinde ise önemli bir değişimin olmadığı tespit edilmiştir.

Anahtar Kelimeler: *İklim, İklimsel Konfor, Coğrafi Bilgi Sistemleri, Peyzaj, Niğde*

ID: 223

Kinetic modeling of quality changes in couscous cooked with ohmic heating at various times

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Abstract

Couscous, a type of pasta, should be consumed after cooking. Therefore, it is aimed to develop a mathematical model to predict the changes in quality properties of couscous cooked with ohmic heating (OH) as a function of different cooking times (0, 4, 8, 12, and 16 min). The current, total energy, and average power values during the cooking process of dried couscous using OH were also determined. For this purpose, couscous samples were cooked in a 0.1% salt solution to determine the effect of ohmic heating at a voltage gradient of 17 V/cm on different quality parameters (color, texture profile analysis, moisture content, cooking loss, and percent changes in weight increase (%)). The collected data in the present study were fitted to zero-order, first-order, and second-order kinetic models, and root mean squared errors (RMSE), coefficient of determination (R^2), and the Akaike information criterion (AIC) were then used to compare the models. Our finding revealed that the energy consumption raised with the increase in cooking time for the ohmic heating, but the efficacy of this heating system decreased with increase in cooking time. In addition, the second-order model was the best model to describe the changes in color parameters. Furthermore, the zero-order model was the most suitable model for fitting the experimental data observed for the cooking loss, moisture content, and weight increase (%). However, neither model produced the best fit for all TPA parameters.

Keywords: *Ohmic heating, couscous, cooking, kinetic, modeling*

ID: 225

Landscape Design in Hospital Gardens: The Example of Selcuk University Medical Faculty Hospital

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Abstract

Hospital gardens, located in urban open-green areas, are places created for patients who come to the hospital, their relatives and staff working in the hospital to spend time in an environment where they can renew themselves. The importance of these places is increasing day by day. The aim of this study is to examine the garden of the Selcuk University Faculty of Medicine hospital, located in Selcuk University Alaeddin Keykubad Campus, in accordance with the principles of landscape design. The main material of the research is the garden of the Selcuk University Medical Faculty hospital located in the Selcuklu district of Konya province. The findings show that the examined hospital garden was not designed exactly in accordance with the landscape design principles. With the suggestions developed, this hospital garden can be redesigned in accordance with the landscape design principles and can be made more comfortable for the people who use the hospital garden.

Key Words: *Hospital gardens, landscape architecture, landscape design, Selcuk University*

ID: 226

Investigation of Selcuk University of Alaeddin Keykubat Campus in Terms of Xeriscape Landscape Design

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Abstract

Drought and thirst are among the most important problems in today's world, where water resources are depleted more rapidly due to global warming and climate change. The use of plant species with high water needs in landscaping causes an increase in the need for irrigation and more water consumption. For this reason, the need for xeriscape landscape design in landscape areas has increased in recent years. The aim of this study is to examine and evaluate the xeriscape landscape arrangements in Selcuk University Alaeddin Keykubat Campus in line with the xeriscape landscape design principles. As a result of the examinations, it was determined that the xeriscape landscape design areas in the campus were generally created in accordance with xeriscape landscape design principles.

Keywords: *Drought, global warming, Selcuk University, xeriscape landscape design,*

ID: 227

Effect of castration on carcass characteristics and meat quality traits of Jamuna basin lambs

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Abstract

The study was conducted to evaluate the effect of castration on carcass characteristics and meat quality traits of Jamuna basin lambs. The selected twenty lambs were divided into two groups such as T_1 (Uncastrated) and T_2 (Castrated) having ten lambs of each group. The data were analyzed with independent t-test along with GLM procedure of SAS statistical package. The parameter studied were carcass characteristics, proximate components (dry matter, crude protein, ether extract and ash), physicochemical (Ultimate pH, cooked pH, cooking loss, drip loss, water holding capacity (WHC), sensory analysis (color, flavor, tenderness, juiciness, overall acceptability) and instrumental color values (CIE L*, a* and b*). Hot carcass wt., dressing %, blood, skin, leg, half carcass, pluck and neck were found significantly higher ($p<0.05$) in uncastrated group than castrated group. The ether extract (EE) was significantly higher ($p<0.05$) in castrated group than uncastrated group. The drip loss was significantly lower ($p<0.01$) and ultimate pH was significantly higher ($p<0.01$) in castrated group. Cooking loss was significantly lower and flavor was significantly higher ($p<0.05$) in castrated group. The CIE L*, a* and b* values showed non-significantly higher ($p>0.05$) in uncastrated lambs. It might be concluded that 12 months of uncastrated lambs showed better in productive performance and carcass characteristics but castrated lambs showed better in meat quality attributes as evidence from carcass traits, proximate components, physicochemical, sensory evaluation and instrumental color values.

Key Words: *Average daily gain, castration, carcass characteristics, Jamuna basin lambs, meat quality traits*

Introduction

Sheep belongs to third largest ruminant species in Bangladesh and is widely distributed throughout the world for providing meat and wool (Hashem et al., 2020; Haque et al., 2020). Good nutrition and management practices play a vital role on sheep rearing (Murshed et al., 2014; Sarker et al., 2017; Hossain et al., 2021a; Rahman et al., 1998). Sheep population increased 2.5 times since last twelve years, with 5% annual growth rate (Rana et al., 2014). Sheep rearing is a tool for poverty alleviation, employment generation, and it ensures year-round mutton production that helps to reduce malnutrition in rural poor. Lamb is more tender than mutton or chevon which digests efficiently (Haque et al., 2020). Most of the sheep of Bangladesh are indigenous and are capable of bi-annual lambing and multiple births (Sun et al., 2020; Rashid et al., 2013). The phenotypic characteristics of Jamuna basin sheep is smaller in body size (ram weight is 18.25 kg and the ewe weight are 15.22 kg). This type of sheep is mainly found at the both sides of Jamuna River in Bangladesh. Creamy white wools appeared throughout the body but the belly and head contain black wool. Also, less wool found in the belly and legs. Average daily gain (ADG) of Jamuna basin lamb is 46-55g in active growing phase and the suitable marketing or slaughtering age is 9-12 months, while it gains about 15-18 kg body weight (Hashem et al., 2020).

The adipose tissue deposition is synthesized by the adipogenesis and enhanced by breed, sex and age, body weight of lambs, the quality and quantity of feed consumed. The several management practices *viz.* castration, shearing and flushing were applied in finishing lambs to be increased production traits and improvement of meat quality traits those influence the commercial values of meat (Hashem et al., 2023; Hossain et al., 2022a, 2022b, 2023a & 2023b; Fisher et al., 2010, Habib et al., 2001). Castration reduces lamb aroma and flavor than that of non-castrated group. There were no statistical differences observed between uncastrated and castrated males on production performances, carcass characteristics and meat quality traits (Fogarty and Mulholland, 2012; de Vargas Junior et al., 2014). Uncastrated male lambs have some positive responses to faster body weights gain, increased growth rates, more feed efficiency and produce leaner carcasses than the castrated lambs (Purchas and Grant, 1995). The testicles of the ram lamb produce androgens and estrogens which enhances the muscle growth by increasing the retention of nitrogen in the muscle fiber. The testosterone is the primary testicular hormone that maintains male characteristics (Schanbacher, 1980). The testosterone and estrogen hormone synthesis are ceased when male lambs are castrated (Unruh, 1986). Bavera and Penafort (2005) found that bulls produce7-8% more muscle than that of steers (castrated male calf) which caused by the muscular hypertrophy triggered by the testosterone hormone. This

hormone enhances the collagen formation, accumulation and maturation of the muscular bundle, which might be responsible for meat production and making differences in tenderness between uncastrated and castrated males (Unruh, 1986).

The color of mutton plays a vital role in consumers purchasing decisions (Mancini and Hunt, 2005). The color of lamb meat is the most preferable criteria of consumers to buy fresh meat. The undesirable colors such as pale, discolored, bluish or darker meat is the least preferable by meat consumers (Hashem et al., 2013). Oxygen exposure causes bright red color of lamb meat by converting deoxymyoglobin into oxymyoglobin which is a red pigment. The consumers are willing to pay more to buy healthier and fresher lamb meat due to its better quality (Costa et al., 2011). Therefore, lamb meat is a good option for consumers (Cirne et al., 2018).

There is lacking research on the quality of castrated lamb meat in Bangladesh which is needed to be exposed. Moreover, most rural lamb farmers want to know whether they should castrate their lambs or not for increasing carcass traits and meat quality. More research is needed to evaluate the effect of castration on the meat quality of lamb in different production systems. And hence, the study was conducted to evaluate the effect of castration on carcass characteristics and meat quality traits of Jamuna basin lambs.

Materials and Methods

Experimental animals and management

The study was lasted for three months from October 2020 to December 2020. Twenty Jamuna basin lambs were selected based on age, same management and feeding systems with two grouped T_1 (Uncastrated) and T_2 (Castrated) having ten animals per group. The study was approved by the Animal Welfare and Ethical Committee of the Bangladesh Meat Science Association (BMSA). The diet was supplied uniformly for both the treatments of lambs. Green grasses and fresh water were supplied *ad libitum* with 1.5% concentrate feed of body weight containing 18% CP and 12 MJME/kg DM. The amount of feed ingredients of formulated ration for the lambs were: wheat crushed 68%, soybean meal 30%, di-calcium phosphate (DCP) 0.5%, vitamin-mineral premix 0.5% and common salt 1%, respectively that are provided twice a day to the lambs.

Slaughter procedure and carcass sampling

Twenty (20) lambs from both treatments were slaughtered at the end of the feeding trial. The experimental lambs were fasted for 24 h and slaughtered as per the rules of "Halal" method at Bangladesh Agricultural University slaughterhouse facilities. Live weights of the lambs were measured before slaughtering and the hot carcass weights were measured immediately after carcass preparation. Non-carcass components such as head, skin, liver, lungs, heart, spleen, kidney, viscera and shanks were removed and weighed. The gut contents were removed and the empty gut was washed and weighed. Dressing% was determined as hot carcass basis along with the fasted body weight. One hundred grams (100g) sample was taken from the longissimus dorsi (LD) muscle to analyze proximate, physicochemical, sensory and instrumental color values in the "Meat Laboratory" under the department of Animal Science, Bangladesh Agricultural University. The parameters like live weight gain, carcass characteristics and meat quality traits of lambs were recorded. The live weight of each lamb was recorded at the onset of the experimental trial and continuing it on monthly basis.

Proximate components

The proximate components such as dry matter (DM), ether extract (EE), crude protein (CP) and ash was measured as per the guideline of AOAC (2005).

Sensory evaluation

Various sensory attributes were evaluated in the study. All meat samples were evaluated by a trained of 8-members panel. The questionnaires on sensory were measured intensity on a 5-point balanced semantic scale for the attributes such as color, flavor, tenderness, juiciness, and overall acceptability. At least eight training sessions were held to familiarize the judges to be evaluated and the scale was used (Jahan et al., 2018; Saba et al., 2018). Before the evaluation of samples, all the participating panelists were familiarized with the attributes namely color, flavor, juiciness, tenderness, overall acceptability of lamb meat. The samples were supplied in the petri dishes for evaluating by the panelists.

Physicochemical properties measurement

Drip loss (DL)

The drip loss was measured according to the procedure of Rahman et al. (2020). For the DL measurement, 30 g sample was hung with a wire and kept it in an air tight plastic container for 24 h. After passing 24 h the sample was weighed and calculated the difference. The drip loss was expressed as percentage.

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$$\text{DL (\%)} = \frac{(\text{Weight of sample} - \text{weight after 24 hours chilling})}{\text{Weight of sample}} \times 100$$

Cooking loss (CL) measurement

Thirty grams (30 g) meat (lamb) sample was taken in a poly bag and heated it in a water bath until the temperature rose to 71ºC in sample. Lamb meat of 71ºC was taken out from the water bath and pressed it with tissue paper. Weight loss of the sample was measured during cooking lamb meat. The CL was calculated using following formula:

$$\text{CL (\%)} = \frac{(\text{Weight before cooking of sample} - \text{weight after cooking })}{\text{Weight before cooking of sample}} \times 100$$

Ultimate pH measurement

The ultimate pH of lamb meat was measured 24 h after slaughtering by using a digital pH meter. The pH was measured by inserting electrode at three different points of the lamb meat which was calibrated prior to use at pH 7.0 by pH meter (Hanna HI 99163). An average value of ultimate pH was measured from triplicate data at 1 cm depth on the medial portion of lamb meat.

Cooked pH

All the meat samples were cooked at 71°C for 30 minutes. Then the muscle samples were taken out after that cooled at ambient temperature. After cooling sample pH was determined as the same way.

Water holding capacity (WHC)

The WHC was measured according to the description of Choi et al. (2018). About one gram (1 g) of the thawed sample was wrapped in absorbent cotton and placed in a 1.5 ml centrifuge tube. The tubes with samples were centrifuged in a centrifuge machine (H1650-W Tabletop high speed microcentrifuge) at 10,000 rpm for 10 minutes at 4º C temperature, following which the samples were weighed. The following formula was used to express the water holding capacity (WHC):

$$\text{WHC (\%)} = \frac{(\text{Weight of sample after centrifugation})}{(\text{Weight of sample before centrifugation})} \times 100$$

Instrumental color measurement

Instrumental color measurement of lamb meat was identified from longissimus dorsi muscle obtained from the eye muscle area of lamb carcass. Color was measured 24 hours post-slaughtered using Konica Minolta Chroma Meter (CR 410, Konica Minolta Sensing, Inc., Osaka, Japan), a Miniscan Spectro colorimeter programmed with the CIE Lab, (International Commission on Illumination) L*, a*, and b* system, where L* represents lightness, a* redness and b* yellowness (CIELAB, 2014). The analysis was carried out on the medial surface (bone side) of the meat at 24 h post-mortem (Rahman et al., 2020).

Statistical analysis

Data obtained from castrated and uncastrated lambs were analyzed with unpaired t-test along with GLM procedure of SAS statistical package (Version 9.1.3). Duncan's Multiple Range Test (DMRT) was used to determine the significant differences between two treatments means at values (p<0.05).

Results and Discussion

Effect of castration on carcass traits of Jamuna basin lambs

It was found from the experiment that castration has a suppressing effect on average daily gain (ADG). A higher ADG was found in T_1 (65.94 g/d) compared to T_2 treatment (56.09 g/d) and this difference was significantly higher (p<0.05) (Table 1). The ADG and the weight of leg, pluck and neck were found significantly (p<0.05) higher in uncastrated compared to castrated lambs. Similar trend on ADG was found by Sultana et al. (2010). On the contrary, the ADG of the present study was found to be different from the results of Hashem et al. (2020). The higher ADG in ram-lambs compared to castrated lambs was very close in accordance with the findings of Fogarty and Mulholland (2012). The higher ADG in ram-lambs might be due to the testosterone hormone (Kiyma et al., 2000), which triggers the efficiency of dietary nitrogen and decreased fat deposition in muscle. Testicles of ram-lambs produce androgens and estrogens that enhance muscle growth by increasing the nitrogen retention (Unruh, 1986). Carcass weight (kg) and the dressing % of lamb were found significantly higher (p<0.05) in T_1 (8.33, 50.29) compared to T_2 (7.52, 47.46) treatment. Claffey et al. (2018) found an inverse trend in dressing percentage with the present study, they showed a higher dressing percentage (47.6%) in castrated lamb (wither) compared to uncastrated lamb (45.7 %) at 12 months aged lambs. The results of Polidori et al. (2017) and Gashu et al. (2017)

were also followed the results of Claffey et al. (2018). Mateo et al. (2018) found no significant differences in dressing percentage and half carcass between castrated and uncastrated lambs. The weight of head and skin were found significantly higher ($p<0.05$) in T_1 compared to T_2 treatment. The head and skin% of the present study were similar, but the blood was dissimilar to the findings of Rajkumar et al. (2017).

Table 1. Effect of castration on live weight and carcass traits of lambs

Parameters	Treatment (Mean ± SE)		Level of significance
	T_1	T_2	
Initial body wt. (kg)	$10.60^a \pm 0.16$	$10.75^a \pm 0.41$	NS
Final body wt. (kg)	$16.56^a \pm 0.17$	$15.80^a \pm 0.37$	NS
ADG (g)	$65.94^b \pm 1.51$	$56.09^a \pm 2.33$	0.0023
% of live weight basis			
Hot carcass wt. (%)	$8.33^b \pm 0.15$	$7.52^a \pm 0.34$	0.0420
Dressing wt. (%)	$50.29^b \pm 0.58$	$47.46^a \pm 1.03$	0.0280
Blood wt. (%)	$4.66^b \pm 0.14$	$4.02^a \pm 0.17$	0.0103
Skin wt. (%)	$10.83^b \pm 0.10$	$9.82^a \pm 0.29$	0.0033
Viscera wt. (%)	$15.18^a \pm 0.28$	$14.41^a \pm 0.33$	NS
Head wt. (%)	$5.78^a \pm 0.06$	$5.55^a \pm 0.13$	NS
Leg wt. (%)	$10.83^b \pm 0.09$	$10.20^a \pm 0.24$	0.0230
Half carcass wt. (%)	$4.16^b \pm 0.29$	$3.76^a \pm 0.52$	0.0277
Pluck wt. (%)	$7.20^b \pm 0.14$	$6.20^a \pm 0.35$	0.0161
Neck wt. (%)	$3.82^b \pm 0.03$	$3.56^a \pm 0.08$	0.0105
Shoulder wt. (%)	$9.07^a \pm 0.10$	$8.66^a \pm 0.20$	NS
Rack wt. (%)	$10.25^a \pm 0.11$	$9.79^a \pm 0.23$	NS
Loin wt. (%)	$5.96^a \pm 0.04$	$4.40^a \pm 0.03$	NS
Shank wt. (%)	$2.18^a \pm 0.03$	$2.15^a \pm 0.10$	NS
% of hot carcass weight basis			
Liver wt. (%)	$4.05^a \pm 0.10$	$3.83^a \pm 0.17$	NS
Heart wt. (%)	$0.86^a \pm 0.02$	$0.80^a \pm 0.04$	NS
Lung wt. (%)	$1.71^a \pm 0.04$	$1.62^a \pm 0.07$	NS
Kidney wt. (%)	$1.82^a \pm 0.05$	$1.72^a \pm 0.08$	NS
Spleen wt. (%)	$0.78^a \pm 0.02$	$0.74^a \pm 0.03$	NS

Mean in each row having same superscript did not differ significantly ($p>0.05$), mean in each row having different superscript varies significantly ($p<0.05$), T_1= Uncastrated group, T_2= Castrated group, NS= Non-significant.

Table 2. Effect of castration on proximate component of lamb meat

Parameters (%)	Treatment (Mean ± SE)		Level of significance
	T_1	T_2	
DM	$26.74^a \pm 0.39$	$27.16^a \pm 0.19$	NS
CP	$24.36^a \pm 0.33$	$24.18^a \pm 0.21$	NS
EE	$3.26^b \pm 0.14$	$3.83^a \pm 0.16$	0.0144
Ash	$1.15^a \pm 0.05$	$1.04^a \pm 0.05$	NS

Mean in each row having same superscript did not differ significantly ($p>0.05$), mean in each row having different superscript varies significantly ($p<0.05$), T_1= Uncastrated group, T_2= Castrated group.

Table 3. Effect of castration on physicochemical properties of lamb meat

Parameters	Treatment (Mean ± SE)		Level of significance
	T_1	T_2	
Drip loss %	$3.84^a \pm 0.09$	$2.72^b \pm 0.08$	<.0001
Cooking loss %	$30.76^a \pm 1.03$	$27.31^b \pm 0.76$	0.0149
Ultimate pH	$5.95^a \pm 0.05$	$6.19^b \pm 0.04$	0.0013
Cooked pH	$6.46^a \pm 0.04$	$6.41^a \pm 0.07$	NS
WHC %	$86.23^a \pm 0.07$	$89.42^a \pm 1.35$	NS

Mean in each row having same superscript did not differ significantly ($p>0.05$), mean in each row having different superscript varies significantly ($p<0.05$), T_1= Uncastrated group, T_2= Castrated group.

Effect of castration on proximate components of Jamuna basin lambs

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It was found in the Table 2 that a significant difference occurred in the ether extract content between uncastrated lambs (T_1) and castrated lambs (T_2). Increased fat deposition in castrated lambs might be explained by adipogenesis and lipogenesis in the muscular and liver tissues. Wang et al. (2019) found higher fat deposition and marbling in the steer carcass compared to bull carcass. Table 2 also shows that the dry matter, crude protein and ash % were found 26.74, 24.36, 1.15 and 27.16, 24.18, 1.04 in T_1 and T_2 treatments, respectively which was statistically not significant among the treatments. Higher DM was found in castrated than uncastrated lamb meat which was similar to the findings of Gkarane et al. (2017). A higher muscle development in uncastrated lambs compared to castrated lambs was enhanced (Economides, 1983) which can be occurred by androgens that stimulate the muscle growth. The CP was higher in uncastrated lamb which was not similar to the findings of Rajkumar et al. (2017) where they found higher CP% in castrated lamb compared to uncastrated lambs. Gashu et al. (2017) found a higher ash content in castrated compared to uncastrated lambs which was dissimilar with the present study.

Effect of castration on physicochemical traits of Jamuna basin lamb meat

Table 3 showed that the drip loss and cooking losses (%) were found 3.84, 30.76 and 2.72, 27.31 in T_1 and T_2 treatments, respectively in which were significantly higher ($p<0.001$ and $p<0.05$). The cooking loss was not similar with the results of Mateo et al. (2018) where they found the cooking loss 27.2 and 27.2% in Churra and Assaf lambs. Cooking loss occurred due to shrinkage of muscle during cooking. The amount lost due to shrinkage can be minimized by applying low-temperature during roasting. The ultimate pH and cooked pH were found 5.95, 6.46 and 6.19, 6.41 in T_1 and T_2 treatments, respectively in which ultimate pH was significantly differed ($p<0.05$). Ultimate pH found in the present study might be the optimum (5.95) in uncastrated group which was significantly differed ($p<0.05$) with the castrated lambs. This result was similar by Rajkumar et al. (2017) but not similar with the results of de Lima Junior et al. (2016). The observed ultimate pH was higher than that of the consumers acceptance level. The causes of higher pH might be due to the withdrawal of feed for a longer time. The pH is an important analytical measurement which is the key to the conversion of muscle into meat. During early post-mortem changes in muscles of slaughtered lambs, the pH of live animal is 7.0 to 7.2 that falls into 5.5 to 5.8 in the meat (Rahman et al. 2020). The acceptable range of pH was 5.4 -5.7. Stress from transportation also increases the pH of carrying lambs from a distant place to the slaughterhouse. These feed and transportation stress decreased the amount of glycogen present in muscle at slaughter resulting in higher ultimate pH. The differences in this pH will also be found between and within different breeds, sex, as well as castration state. The WHC % was found 86.23 and 89.42 in T_1 and T_2 treatments, respectively which was non-significant ($p>0.05$). The WHC% was higher in castrated group which supported to de Sousa et al. (2016) where they showed 82.05 and 84.48% WHC in uncastrated and castrated groups.

The effect of castration on sensory parameters of Jamuna basin lambs

Color, tenderness, juiciness and overall acceptability were 4.81, 4.87, 4.89 & 4.83 and 4.77, 4.91, 4.89 & 4.87 in T_1 and T_2 treatments, respectively. These parameters were not statistically significant (Table 4). The flavor was significantly higher ($p<0.05$) in T_2 (4.94) compared to T_1 (4.87) treatment. The causes of higher flavor in castrated lambs might due to increase the deposition of fat content in castrated lamb than that of uncastrated lamb. This finding was similar with the study of Watkins et al. (2013) where they found a higher flavor in castrated lamb meat. Gravador et al. (2018) found a pleasant flavor and tenderness from castrated lamb. An unpleasant taste and flavor were observed in meat of uncastrated lambs (ram) than that of castrated lamb but both meats were accepted by the consumers, which were similar to the present study. Yalcintan et al. (2017) found significant differences ($p<0.05$) of juiciness and overall acceptability which was not similar to the present study. They found a statistically non-significant effect of flavor and tenderness in both castrated and uncastrated lambs.

Table 4. Effect of castration on sensory attributes of lamb meat

Parameters	Treatments (Mean ± SE)		Level of significance
	T_1	T_2	
Color	$4.81^a \pm 0.02$	$4.77^a \pm 0.04$	NS
Flavor	$4.87^b \pm 0.02$	$4.94^a \pm 0.02$	0.0251
Tenderness	$4.87^a \pm 0.02$	$4.91^a \pm 0.03$	NS
Juiciness	$4.89^a \pm 0.02$	$4.89^a \pm 0.03$	NS
Overall acceptability	$4.83^a \pm 0.02$	$4.87^a \pm 0.04$	NS

Mean in each row having same superscript did not differ significantly ($p>0.05$), mean in each row having different superscript varies significantly ($p<0.05$), T_1= Uncastrated group, T_2= Castrated group

Table 5. Effect of castration on instrumental color values

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Parameters	Treatment (Mean ± SE)		Level of significance
	T_1	T_2	
L*	$48.81^a \pm 2.03$	$45.26^a \pm 0.74$	NS
a*	$15.03^a \pm 0.52$	$15.17^a \pm 0.58$	NS
b*	$9.40^a \pm 0.42$	$10.29^a \pm 0.48$	NS
Hue angle	$24.37^a \pm 1.48$	$22.28^a \pm 1.12$	0.28
Saturation index	$16.77^a \pm 0.55$	$18.14^a \pm 0.70$	0.14

Mean in each row having same superscript did not differ significantly ($p>0.05$), mean in each row having different superscript significantly differed ($p<0.05$), T_1= Uncastrated group, T_2= Castrated group.

Effect of castration on instrumental color values of Jamuna basin lambs

The Table 5 shows the CIE L*, a* and b* values were 48.81, 15.03, 9.40 and 45.26, 15.17, 10.29 in T_1 and T_2 treatments, respectively which were non-significant ($p>0.05$). Other studies (Hossain et al., 2021b; Rahman et al., 2020; Kamruzzaman et al., 2016) found almost similar results for CIE L*, a* and b* values to the findings of the present study. The higher CIE L* value in uncastrated lambs in the present study not supported to Gashu et al. (2017) where they showed higher CIE L* value in castrated group. The CIE a* and b* values were found higher in castrated group which was supported by Anneke et al. (2019), where they worked on Thai Native × Anglo Nubian goats to know the effect of castration on carcass traits and meat color. Torres-Geraldo et al. (2020) found CIE L* (36.1, 35.0), a*(14.6, 15.5) and b*(8.37, 8.28) values were higher except CIE a* value in uncastrated lambs than castrated lambs which was non-significant ($p>0.05$). These results (CIE L* and a* values) were agreed with the present study, but CIE b* value was not similar with the present study. The hue angle of uncastrated lambs was higher ($p>0.05$) compared to castrated groups but this difference was not significant, whereas saturation index of castrated group showed higher values compared to uncastrated lambs, which was also statistically non-significant. Nian et al. (2018) showed a lower saturation index (SI) in steer beef, whereas, bulls had comparatively higher SI value (darker muscle). They also found a similar hue angle value in bull and steer beef after 24 h. The hue angle and saturation index in the present study were not affected by the castration of lambs.

Conclusion

It can be stated from the study that 12 months aged of uncastrated lambs (T1) showed better productive performance and carcass characteristics like ADG, carcass weight, dressing percentage and color, but castrated lambs showed better meat quality traits such as higher tenderness, WHC (indicates juiciness), fat content (indicates marbling), flavor and lower drip loss. It needs to be established whether sensory attributes of castrated or uncastrated lamb meat accepted or not by the consumers in Bangladesh context. However, more studies will be needed on in-depth nutritional contents and the acceptability of consumers perception on Jamuna basin lamb meat.

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Declaration of Competing Interest

The authors declared that there were no competing financial interests or personal relationships to influence the work reported in this paper.

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Economic Impact of Ivermectin as Anthelmintic on Body Weight Gain of Goat in Bangladesh

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Abstract

Background & Objective: Goat is an important livestock animal in Bangladesh. To count the efficacy of selective anthelmintic for their treatment effects on body weight gain in Black Bengal goats. A field experiment was conducted at Kotalipara Upazila in Gopalgonj district of Bangladesh. *Materials & Methods:* The study was performed during the time from December 2020 to February 2021. The goats were selected randomly for this experiment and divided into two equal groups (treatment group and healthy control group) where each group consisted 30 goats and irrespective to age and sex under same rearing and feeding managements. One injectable Ivermectin (0.2mg/kg body weight, Sub-cutaneous route) preparations (Injection Vermic®, Techno Drugs Ltd. Bangladesh) were used for as treatment group. All goats were reared intensively and same feeding status. The efficacy of selected anthelmintic was recorded with measure live body weight from day 0 through day 14 and day 28 of the trial period. *Results:* Overall live weight gain recorded was 0.14 kg in goats of healthy control group whereas 0.76 kg weight recorded in goats of treatment group. The net return obtained by the day 28 of experimental study was Tk. 186 in goats of treatment group as against a profit of Tk. 46 obtained in goats of healthy control group. *Conclusion:* The administration of Ivermectin has a clear beneficial impact on live body weight in goat. More detailed studies are needed to explain the current status of the efficacy of anthelmintics, which are widely used in different agroecologies, animal species and livestock management in Bangladesh.

Key Words: *Anthelmintic, live weight, efficacy, Kotalipara Upazila, goat*

Introduction

The livestock is an important sub-sector which considered to be backbone of agriculture in Bangladesh (BBS, 2007) and approximately 80% people depend on it directly or indirectly for their subsistence. Among livestock, the population in Bangladesh is currently estimated to comprise 20.75 million goats (DLS, 2020). Black Bengal Goat rearing is very popular in Bangladesh and treated locally as 'cow of poor people''. Goats play vital role in the substance economy of smallholders in Bangladesh. There are about 38.1 million small ruminants (goats and sheep) in Bangladesh, which play an important role in rural economy and earn substantial amount of foreign currency by exporting skins and other by products (Kamaruddin, 2003). The domestic goat is a sociable, inquisitive, and intelligent species, which has been used for its meat, milk, and fur since, it was first domesticated 10,000 years ago (Genaro *et al*., 2010). The climatic condition of Bangladesh is favorable to the ecological conditions suitable for parasite of which the helminth parasite predominates. Parasitism has been considered as one of the main constrains of livestock production (Rehman *et al.*, 2009). Helminthiasis especially gastrointestinal nematodiasis overhelming a severe havoc on health and production (Sahlu *et al.*, 2009), through the world due to impacts on economy also (Silvestre *et al.*, 2000) and market value of the living animals with a high rate of anthelmintic resistance prevalence (Howell *et al.*, 2008). We can prevent and control the parasitic diseases by using a routine prophylactic anthelmintics measurement. The anthelmintic activities and therapy of Ivermectin, Levamisole HCl and albendazole have been studied (Dale and Haylett, 2004). Ivermectin produces flaccid paralysis of parasites by acting as an agonist of the neurotransmitter Gamma Amino Butyric Acid (GABA), thereby disrupting GABA mediated Central Nervous System (CNS) neurosynaptic transmission. The objective of this study was evaluated the impact of the Ivermectin on the weights of goats where there is no-prior diagnosed of infection. There are a number of factors that must be controlled within the study framework, such as differences in exposures, genetics and feeding regime, many of these factors are clustered at the level of herd and the village, hence a randomly controlled trial was used in which treatment with Ivermectin was randomly at the level of individual goat, and within each study herd some animals were randomly as-signed to treatment or to non-treatment.

Materials and Methods

Study areas and selection of study animals

The study was carried out at Kotalipara Upazila a small administrative area under Gopalgonj district of Bangladesh. Kotalipara is located in Bangladesh at 22.9833 °N, 89.9917 °E. It has 37,603 households and a total area of 362.05 km^2 (Banglapedia, 2022). Sixty (60) Black Bengal goats were selected randomly, irrespective to age and sex under same rearing and feeding managements. Goats were categorized into two groups (healthy control and treatment group) of equal number in different sexes.

Time and duration of the study

The study was conducted in winter season between December 2020 to February 2021.

Selection of Anthelmintic

Based on efficacy and pharmacokinetics, Ivermectin was selected and used in this study as anthelmintics.

Experimental design

Body weight measurement

Body weight (Kg) was determined and recorded on day 0 (pre-treatment), 14th and 28th days (post-treatment) with a measuring tape (Anon, 2020) following formula is given below-
Body weight in Kg = (Heart Girth x Heart Girth x Body Length) / 660

Administration of Anthelmintic, Observation and Recording

Goats of treatment group were treated with Vermic® injection. Details are given in following table (Table 1).

Table 1. Name, dose and route of administration of Anthelmintic (Ivermectin) used in the study animals.

Sl. No.	Generic name	Trade name	Company name	Dose/kg BW	R/A
01	Ivermectin	Inj. Vermic®	Techno Drugs Ltd. Bangladesh	0.2 mg	S/C

All the goats were kept under close supervision and data were recorded and analyzed.

Data Analysis

The collected data were checked for the integrity, filed and entered into Microsoft Excel spread sheet and analyzed using IBM SPSS (version 25) software. All categorical outcome were expressed in percentage at 95% confidence interval.

Calculation of Economic impact of Ivermectin anthelmintic in Goats Husbandry

The economic impact was calculated as per following law -
Gross Return (Tk.) = Weight gain x Dressing percentage x Chevon cost
Dressing percentage = 50% of live weight, approximately Chevon cost = 650 Tk./kg.
Net Return = Gross return (Tk.) – [Cost of medication (Tk.) + Gross return of healthy control (Tk.)]

Results

In this study, it is found that body weight gain in goats of treatment group is much higher than goats of healthy control group.

Body weight gain in goats of treatment group

In treatment group, body weight gain is much more high and significant ($p<0.05$) in castrated male goats particularly in male goats than female goats which is shown in (Table 2)

Table 2. Body weight (kg) gain in goats of treatment group

Sex	Pretreatment	Post-treatment		Individual gain (kg)
	0 days	14 days	28 days	
	(Mean ±SE)	(Mean ±SE)	(Mean ±SE)	(Mean ±SE)
Male (10)	16.42±2.9	16.87±3.00*	17.14±3.01*	0.73±0.12*
Female (10)	16.05±2.69	16.27±2.68*	16.72±2.77*	0.67±0.12*
Castrated male (10)	9.19±1.99	9.52±2.04*	10.07±2.18*	0.88±0.22

*= Significant at 5 percent level ($p<0.05$)

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Body weight gain in goats of healthy control group

In control group, body weight gain is also significant ($p<0.05$) and much more high in castrated male goats particularly in male goats than female goats which is shown in (Table 3).

Table 3. Body weight (kg) gain in healthy control group

Sex	Pre-treatment	Post-treatment		Individual gain (kg)
	0 days	14 days	28 days	
	(Mean ±SE)	(Mean ±SE)	(Mean ±SE)	(Mean ±SE)
Male (10)	16.44±3.62	16.57±3.62*	16.56±3.67*	0.11±0.09
Female (10)	11.57±1.43	11.69±1.45	11.68±1.42	0.10±0.02*
Castrated male (10)	10.09±1.68	10.31±1.68*	10.25±1.68*	0.20±0.11

*= Significant at 5 percent level ($p<0.05$)

Comparison of body weight gain in goats of both healthy control and treatment group

Comparatively body weight gain in goats of treatment group is significant ($p<0.05$) and much better than healthy control goats (Table 4).

Table 4. Comparative body weight (kg) gain in goats of both healthy control and treatment group

Total animal	Groups	Pre-treatment	Post-treatment		Individual gain (kg)
		0 days	14 days	28 days	
		(Mean±SE)	(Mean±SE)	(Mean±SE)	(Mean±SE)
30	Healthy control	12.70±1.45	12.85±1.45*	12.83±1.47*	0.14±0.05*
30	Treatment group	13.88±1.55	14.22±1.58*	14.64±1.61*	0.76±0.09*

*= Significant at 5 percent level ($p<0.05$)

Economic impact of using ivermectin as anthelmintic

Economic analysis shown that, the impact of using ivermectin as anthelmintic on body weight gain in treatment group goats is significant, which revealed mean daily weight gain (g) is 27±0.07 and Net return (Taka) 186±10 BDT.

Table 5. Economic impact of Ivermectin in goats on daily weight gain and net return (BDT)

Groups	Mean weight gain (kg)	Mean daily weight gain g/day	Gross return (Taka)	Cost of medication (Taka)	Net return (Taka)
Healthy control	0.14±0.05*	5±0.02	46±3	-	46±3
Treatment	0.76±0.09*	27±0.07	247±8	15±0.5	186±10

*= Significant at 5 percent level ($p<0.05$)

Discussion

In this study, the body weight of Black Bengal goats in treatment group increased significantly after use of ivermectin injection than healthy control group (Net return 186±10 Tk. From treatment group a Tk. From healthy control group and 46±3 Tk. in 28 days study period. To maintain good animal husbandry practices, the measurement of live body weight of absolutely essential for breeding, nutrition and health management (Stevens, 2009). Live weight may be estimated through several measurements but the measurement of heart girth and body length seems to be the simplest and most accurate technique.

In this study work reported that 5±0.02gm/day body weight gain in healthy control group and 27±0.07gm/day in treatment group. This result are almost similar findings by (Paul *et al.*, 2018) who reported that 26 gm/day weight gain in treatment group treated with anthelmintic.

The maximum individual live weight enhancement of 0.76±0.09 kg was recorded in treatment group and followed by 0.14±0.05 kg enhancement in healthy control group. That are statistically significant. Earlier research work found body weight gain by anthelmintic therapy (Pandit *et al.*, 2009).

The individual mean weight gain from Male 0.11±0.09 kg, female 0.10±0.02 kg and Castrated male 0.20±0.11 kg in healthy control group whereas 0.73±0.12 kg, 0.67±0.12 kg and 0.88±0.22 kg respectively in treatment group. In this study was shown the weight gain is higher in castrated male from both group of goats. This result support the earlier findings by (Chand-Thakuri *et al.*, 1994). The mean daily weight gain was recorded and presented in the descending order as 27±0.07 gm/day in treatment group and 5±0.02 gm/day in healthy control group. This result is almost similar to the earlier finding by (Zajac *et al.*, 1992), although there was different study area and

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climate condition. The net return obtained at the end of experimental study was higher (Tk. 186±10) in Ivermectin treated group when compared with healthy control group where gross return was Tk. 46±3.
Our findings are also consistent with the observations of above workers, as a net return of Tk. 186±10 over a period of 28 days. However, the gross return recorded in healthy control group was only Tk. 46±3.
In this present study mean weight gain of 0.76±0.07 kg was recorded in treatment group on 28 days post treatment. The observations of the present study corroborate well with findings of (Sathianesan, 1972), who recorded 1.7 kg weight gain in Tetramisole treated goats after 30 days of observation, this variation of result might be due to climate condition, management practices, anthelmintic choice and breed. Reduced weight gain in gastrointestinal nematode infected goats was also reported by (Howlader, 1997).
We analyzed individual levels of data without accounting for the household effect in this study. Therefore, the findings of the study should be considered carefully. As we conducted a field trial, unknown environmental factors might have influenced the data statistical analysis and thus influenced the results of the study.
More generally, animals need fewer resources to reach maturity, potentially making earing more much economical. Further analysis may consider the effect of anthelmintics on pregnancy and child development as they increase milk production. However, many of these variables should be evaluated in further studies involving measurements to assess the economics of goat production.

Conclusion

This study indicated that Ivermectin are highly effective to gain body weight in Black Bengal goats. The results of this study may help future researchers explore the detailed pharmacokinetics and toxicity of different types of drugs used for the treatment and control of parasitic diseases in goats in Bangladesh. More studies are needed to explain the efficacy of herbicides commonly used in different animal species and livestock management in Bangladesh. Further research on the pharmacokinetics and toxicity of anthelmintics would be beneficial.

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ID: 230

Impact of Foreign Labour Migration on Labour Dynamics in Relation to Household Agricultural Activities in Sindhuli Districts of Nepal

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Abstract

Around 66% of Nepal's population is involved in agricultural activities, which contributes a one-third portion of the country's GDP. Given its agricultural nature, a considerable number of young Nepali individuals opt for international labor migration as a means of sustaining their livelihoods. So this study aimed to examine the impacts of foreign labor migration on the labour dynamics of household agricultural activities in the Sindhuli district of Nepal. A mixed research design was used for this research. Where quantitative interview protocol was designed, pretested, modified, and deployed for quantitative data collection from 350 migrant households. After that checklist for key informants' interview and case studies were developed and used to generate qualitative data. At first, quantitative data were processed, analyzed, and interpreted with the support of qualitative findings. The survey findings revealed that in the research area, a total of 390 individuals migrated from 350 households. Of these migrants, slightly over 90% were male, leaving only 5.13% as females. In terms of household work, the workload of the father was found to be negligible, while the workload of the mother saw a significant decrease after migration. Concerning agricultural activities, livestock production and management, and social activities the workload of the father, mother, and siblings showed a statistically significant decrease. However, the workload of the spouse and children was found to significantly increase in all spheres after migration. The reduction in workload for migrants' fathers, mothers, and siblings can be attributed to the shift from a joint family structure to a nuclear family setup.

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ID: 231

Efficacy of different Plant Extracts and Essential Oils against *Rhizopus stolonifer* and *Aspergillus niger* causing Post Harvest decaying in Grapes

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Abstract

Grapes (Vitis vinifera.) is a widely consumed fruit in the world. In Pakistan, from an area of 16160 hectares about 87584.01 tons of grapes are produced annually. While transporting, storage, marketing and for common consumption Grapes are highly perishable fruit. Post-harvest losses of Grapes are up to 16- 23%. Several abiotic and biotic factors reduce the production and quality of grapes. In present study, samples of rotten grapes were collected from different fruit markets of district Pishin (Balochistan) and Faisalabad (Punjab). The samples were subjected to isolate the fungal pathogens, responsible for the post-harvest decay of fruits. The fungal pathogen isolated was identified as *Aspergillus niger* and *Rhizopus stolonifer* causing post-harvest decay of grape berries. The pathogenicity of the two isolated pathogens was evaluated on different temperatures (5, 20 & 30 °C) on Thompson seedless variety of grapes. The temperature 30°C was found conducive for infection and proliferation of fungi. Five organic origin chemicals namely Neem, cinnamon and Clove oils, with concentrations of (500, 1000, 2000 ppm) for each oil and Neem and Marigold Extracts with concentrations of (12.5, 25, 50%) of both extracts were used as antifungal agents. Among the tested organic compounds, Cinnamon and clove oil @ 2000 ppm was found better in delaying the decay process of both fungal pathogens. The decay was reduced up to 50% as compared to control. This study indicates that post-harvest application of essential oils can potentially enhance the storage life of grapes prior to marketing.

ID: 232

Evalution of Some Reproductive Performance of Ewes, Survivalability and Growth Traits of Lambs of Akkaraman Bred by Farmers in Niğde Region*

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Abstract

The research was carried out between 2018 and 2022 in order to evaluate the reproductive characteristics of sheep, the survivability of lambs (SR120) and growth characteristics within the scope of Sheep Breeding project in Public Hands in Niğde province. In the research, some reproductive characteristics of approximately 6000 sheep per year and the growth performance and survival characteristics of a total of 30051 lambs were examined. In the study, birth (LBW), 60th day (LW60), 120th day weight (LW120) and 120th day live weight gain (LWG120) in Akkaraman lambs were 4.14±0.20 kg, 18.58±0.03 kg, 31.31±0.02 kg and 246 ±2.23 g/lamb/day, respectively. In the study, the effects of gender on LWG120 and birth type on LW120 were found to be insignificant among the factors which effects on growth characteristics were examined for Akkaraman lambs. In the study, the litter size between 2018 and 2022 in Akkaraman ewes varied between 1.03 and 1.10. In the study, the highest SR120 was detected in 2018 (96.61%), 5-year-old mothers (95.53%), female lambs (92.96%) and singleton (92.04%) lambs. In the study, it was determined that SR120 was dependent on the birth year (X^2 = 982.3; P<0.001), maternal age (X^2 = 322.2; P<0.001), gender (X^2 = 48.4; P<0.001) and birth type (X^2 = 7.2; P<0.01) in Akkaraman lambs.

Keywords: *Akkaraman, lamb, fertility, growth performance, lamb survivability*

Özet

Araştırma, 2018 ile 2022 yılları arasında Niğde ilinde Halk Elinde Küçükbaş Hayvan Islahı kapsamında koyunların üreme özellikleri, kuzuların yaşama gücü (SR120) ve büyüme özelliklerinin değerlendirilmesi amacıyla yapılmıştır. Araştırmada yaklaşık yıllık ortalama 6000 baş koyunun bazı üreme özellikleri ile toplam 30051 baş kuzunun büyüme ve gelişme ile yaşama gücü özellikleri incelenmiştir. Araştırmada, Akkaraman kuzularda doğum (LBW), 60. gün (LW60), 120. gün ağırlığı (LW120) ve 120. gün canlı ağırlık artışı (LWG120) sırasıyla 4.14±0.20 kg, 18.58±0.03 kg, 31.31±0.02 kg ve 246±2.23 g/kuzu/gün olarak tespit edilmiştir. Araştırmada, Akkaraman kuzular için ele alınan gelişme özellikleri üzerine etkisi incelen faktörlerden sadece cinsiyetin LWG120 üzerine ve doğum tipinin LW120 üzerine etkisi önemsiz bulunmuştur. Araştırmada, Akkaraman koyunlarda 2018 ile 2022 yılları arasında doğuran koyun başına kuzu sayısı 1.03-1.10 arasında değişim göstermiştir. Araştırmada en yüksek SR120 2018 yılında (96.61%), 5 yaşlı analardan (95.53%), dişi (92.96%) ve tekiz (92.04%) doğan kuzularda tespit edilmiştir. Araştırmada Akkaraman kuzularda SR120 doğum yılı, (X^2 = 982.3; P<0.001). ana yaşı (X^2 = 322.2; P<0.001). cinsiyete (X^2 = 48.4; P<0.001), ve doğum tipine (X^2 = 7.2; P<0.01) bağımlı olduğu belirlenmiştir.

Keywords: *Akkaraman, Kuzu, Üreme, Büyüme Performansı, Kuzu yaşama gücü*

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ID: 233

Utilization of Two Essential Oil Bearing Plants as Adjunct in Annatto Based Food Seasoning Formulations.

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Abstract

Utilization of lesser known plants through value added processing will increase their cultivation, reduce post-harvest losses and conserve Africa's rich biodiversity heritage. Two essential oil bearing plants were added separately with annatto seeds in formulation of food seasoning. Each of the food seasoning was added to cooked rice and cooked noodles. The proximate composition and level of mineral elements were quantified in the seasoning and cooked food. An appropriate dosage of the seasoning for cooking rice and noodles was established by sensory evaluation using hedonic scale. Proximate analysis revealed that OGANNAT (*Ocimum gratissimum* + Annato seeds) and ECANNAT (*Eucalyptus citriodora* + Annato seeds) formulated seasoning contain crude protein; 35.00 ± 0.12, 31.21 ± 1.34; Crude fibre; 13.33 ± 1.15, 21.33 ± 2.31; Ash; 13.00 ± 3.61, 11.33 ± 1.15 and carbohydrate; 30.00 ± 3.00, 26.79 ± 2.97g/100g respectively. The levels of mineral elements were Iron; 198.90, 188.45; Potassium; 60.32, 66.02; Calcium; 22.39, 26.04; Sodium; 78.52, 73.24 and Manganese; 0.80, 0.90 ppm respectively. However, lead and cadmium were not detected in the formulated seasonings. OGANNAT was accepted for cooked rice and noodle at 5.6% and 2.78% respectively while 5.6% and 5.41% inclusion of ECANNAT was accepted for cooked rice and noodles respectively. Thus, it was shown that annatto based formulated seasoning could be a highly acceptable food enhancement product, a good source of nutrients, that could complement the existing seasoning of organic origin and replaced the chemical based food seasoning. This will promote sustainable agriculture and clean environment, promote good health and well-being (SDG3) and also responsible consumption and production (SDG12).

Keywords: *Annatto, Ocimum gratissimum, Eucalyptus citriodora, Food seasoning, nutrients, sensory evaluation.*

ID: 237

Insecticidal effect of *Thymus citriodorus* L. (Lamiaceae) essential oil on two important stored product pests

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Abstract

The aim of the present work was to evaluate the contact effect of essential oil of *Thymus citriodorus* L. (Lamiaceae) against adults of two important stored product pests, *Tribolium castaneum* (Herbst, 1797) (Coleoptera: Tenebrionidae) and *Sitophilus granarius* (Linnaeus, 1758) (Coleoptera: Dryophthoridae) under laboratory conditions. In the evaluation of contact toxicity, 2.5, 5, 10 and 15% (v/v) doses of plant essential oil were applied to test insects using a microapplicator (1 µl/adult). Pure acetone (1 µl/adult) was used as negative control and K-Obiol® EC 25 (Bayer AG, Germany) containing 25 g/l deltamethrin and 250 g/l piperonyl butoxide was used as positive control at the dose recommended on the label. Mortality was recorded at 24, 48, 72 and 96 hours after aplications. As a consequence of the investigation, the essential oil demonstrated contact activity at varied rates depending on the insects and doses. In general, the effect of *T. citriodorus* essential oil against adults of *T. casteneum* was low and the highest effect was 14.49% at 15% (v/v) dose at the end of 24 hours. The effect of the same dose at the end of 96 hours could only reach 15.32%. *S. granarius* adults were more sensitive to *T. citriodorus* essential oil. Doses of 10% (v/v) and 15% (v/v) of the essential oil caused over 95% mortality of *S. granarius* adults after 48 hours. The study's findings indicate that *T. citriodorus* essential oil has the potential to be used in the management of *S. granarius.*

Key Words: *Thymus citriodorus, Insecticidal effect, Tribolium castaneum, Sitophilus granarius*

Thymus citriodorus L. (Lamiaceae) uçucu yağının iki önemli depolanmış ürün zararlısı üzerine insektisidal etkisi

Özet

Bu çalışmanın amacı *Thymus citriodorus* L. (Lamiaceae) bitkisinden elde edilen uçucu yağın iki önemli depo zararlısı *Tribolium castaneum* (Herbst, 1797) (Coleoptera:Tenebrionidae) ve *Sitophilus granarius* (Linnaeus, 1758) (Coleoptera: Dryophthoridae)'un erginlerine karşı kontakt aktivitesini laboratuvar koşullarında test etmekdir. Uçucu yağın kontak tosisitesini değerlendirmek için 2.5, 5, 10 and %15 (v/v) olarak hazırlanan dozlar test böceklerine her ergin böceğe 1 µl olacak şekilde mikroaplikatör yardımı ile uygulanmıştır. Negatif kontrol grubunda saf aseton (1 µl/ergin), pozitif kontrolde ise 25 g/l deltamethrin ve 250 g/l piperonyl butoxide içeren K-Obiol® EC 25 (Bayer AG, Germany) etiketinde önerilen dozda kullanılmıştır. Uygulamadan 24, 48, 72 ve 96 saat sonra ölüm oranları kaydedilmiştir. Çalışma sonucunda uçucu yağ, uygulama yapılan böcek türüne ve doza bağlı olarak değişen oranlarda kontakt aktivite göstermiştir. Genel olarak, *T. citriodorus* uçucu yağının *T. casteneum* erginlerine karşı etkisi düşük kalmış ve en yüksek etki 24 saat sonunda %15 (v/v) dozunda %14.49 olarak gerçekleşmiştir. Aynı dozun 96 saatin sonundaki etkisi ancak %15.32'ye ulaşabilmiştir. *S. granarius* erginlerinin *T. citriodorus* uçucu yağına karşı daha hassas oldukları belirlenmiştir. Uçucu yağın 10 ve %15 (v/v) dozları 48. saatten itibaren *S. granarius* erginlerinde %95'in üzerinde ölüme neden olmuştur. Çalışmadan elde edilen bulgular, *T. citriodorus* uçucu yağının *S. granarius* mücadelesinde kullanılma potansiyelinin olduğunu göstermiştir.

Anahtar Kelimeler: *Thymus citriodorus, Insektisidal etki, Tribolium castaneum, Sitophilus granarius*

ID: 238

Biological activity of the *Schinus molle* L. (Anacardiaceae) essential oil on granary weevil, *Sitophilus granarius* (Linnaeus) (Coleoptera: Dryophthoridae)

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Abstract

Granary weevils, *Sitophilus granarius* (Linnaeus, 1758) (Coleoptera: Dryophthoridae) are important pest of stored grain worldwide. Larvae and adults cause weight and quality losses by feeding on grains. The aim of the study was to assess potential of the essential oil isolated from *Schinus molle* L. (Anacardiaceae) against adults of *S. granarius* under laboratory conditions. In the contact toxicity assays, five different concentrations, i.e., 5, 7.5, 10, 12.5 and 15% (v/v) were used. The doses of plant essential oil were applied to test insects using a microapplicator (1 µl/adult). Pure acetone was used in the negative control group (1 µl/adult). K-Obiol® EC 25 (Bayer AG, Germany) containing 25 g/l deltamethrin and 250 g/l piperonyl butoxide was utilized as a positive control group in the dose suggested on the label. After exposure, mortality of the adults was determined at 24, 48, 72 and 96 h. According to the results of the study, mortality rates increased with increase in the dose. After 24 hours, mortality rates of over 70% were observed at doses of 10, 12.5 and 15 % (v/v) (74.96, 94.90, 93.01%, respectively). At the end of 96th hour, the effects of the same doses were determined as 82.55, 95.56 and 97.49%, respectively. These results indicated that essential oil of *S. molle* has significant potential in the control of *S. granarius* as contact insecticide.

Key Words: *Schinus molle, Insecticidal activity, Sitophilus granarius*

Schinus molle L. (Anacardiaceae) uçucu yağının buğday biti, *Sitophilus granarius* (Linnaeus) (Coleoptera: Dryophthoridae) üzerindeki biyolojik aktivitesi

Özet

Buğday biti, *Sitophilus granarius* (Linnaeus, 1758) (Coleoptera: Dryophthoridae) dünya çapında depolanmış tahılların önemli zararlılarındandır. Larva ve erginler tahıllarda beslenerek ağırlık ve kalite kayıplarına neden olurlar. Bu çalışmanın amacı *Schinus molle L.* (Anacardiaceae) bitkisinden elde edilen uçucu yağın *S. granarius*' un erginlerine karşı kontakt aktivitesini laboratuvar koşullarında belirlemektir. Kontak toksisite deneylerinde, 5, 7.5, 10, 12.5 ve %15 (v/v) olmak üzere beş farklı konsantrasyon kullanılmıştır. Bitki uçucu yağının dozları bir mikroaplikatör kullanılarak test böceklerine uygulanmıştır (1 µl/böcek). Negatif kontrol grubunda saf aseton kullanılmıştır (1 µl/böcek). Pozitif kontrolde ise 25 g/l deltamethrin ve 250 g/l piperonyl butoxide içeren K-Obiol® EC 25 (Bayer AG, Germany) etiketinde önerilen dozda kullanılmıştır. Ölüm oranları uygulamadan 24, 48, 72 ve 96 saat sonra kaydedilmiştir. Çalışmanın sonuçlarına göre, doz arttıkça ölüm oranları da arttığı belirleniştir. 24 saat sonra 10, 12.5 ve %15 (v/v) dozlarında %70'in üzerinde ölüm oranları gözlemlenmiştir (sırasıyla, 74.96, 94.90, 93.01%). 96.saatin sonuna gelindiğinde ise aynı dozlardaki etki sırasıyla %82.55, 95.56 ve 97.49 olarak belirlenmiştir. Bu sonuçlar, *S. molle* uçucu yağının *S. granarius*'un kontrolünde kontakt insektisit olarak önemli bir potansiyele sahip olduğunu göstermiştir.

Anahtar Kelimeler: *Schinus molle, Insektisidal aktivite, Sitophilus granarius*

ID: 239

Scoring of leaf rust of two wheat varieties after magnetic treatment through seed

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Abstract

Wheat (*Triticum aestivum)* is a commercial food crop food in Pakistan and is also important in global trade and food security. The cereal mainly contains carbohydrates and proteins. It is considered the main food along with rice in the entire country. The crop is vulnerable to plant pathogens and insects. Weeds are also one of the main issues in the wheat crop. Among the plant diseases, leaf rust is a major constraint in the yield and provision of quality food. Due to multiple plant pathogens, and scarce diversity in the germplasm of wheat, there is a dire need to screen or generate disease-resistant wheat genotypes. In the current work, two commercial cultivars with excellent yield potential were used. These varieties have good yield but the issue was mild susceptibility to leaf rust. To address this issue, these varieties were treated with magnetic treatment. Seeds were grouped into two major groups, treated with magnetic rays and another group as control. In the first variety first treatment will be given 30 minutes time interval and second treatment will be given 60 minutes and the third treatment will be given 90 minutes. In the second variety first treatment will be given a 25-minute time interval and second treatment will be given 50 minutes and the third treatment will be given 75 minutes. These treated seeds were later sown in RCBD in the field and were provided with the inoculum of rust during favorable disease conditions. There were significant differences in the resistance gradient of magnetically treated and untreated groups. Data for disease associated and morph-physiological traits were recorded and subjected to statistical software. For this purpose statistics 8.1 software was used. It was statistically examined for analyses of variance technique and comparison with treatment using Least Significance Difference (LSD) at probability level of 5%.

Keywords: *Wheat Production, MAGNETIC Technology Effect, Brown Rust, Morpho-physiological parameters, Data Analysis*

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Evaluation of the Hygienic Quality of Cutting Counters in Some Restaurants Operating in Istanbul

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Abstract

This study was conducted to assess the microbiological quality of samples taken from 4 different colored cutting counters (white, red, green, brown) in ten restaurants operating in Istanbul, with the aim of evaluating possible cross-contamination. Surface samples were taken from the targeted areas of the cutting counters (100 cm²) using pre-moistened swabs and transferred to the laboratory under cold chain conditions (4°C). Microbial analyses of surface samples were conducted for total mesophilic aerobic bacteria (TAMB) and coliform bacteria counts, following ISO 4833-1 and ISO 4831, respectively, and the results were provided in cfu/cm² (colony forming units per square centimeter). Reference values indicating that the maximum acceptable bacterial count for cutting counters in contact with raw food is 100 cfu/cm², while for surfaces in contact with cooked food, it is 10 cfu/cm², with no coliform group bacteria present in 100 cm² of product-contact surfaces. According to the analysis results, cutting counters in contact with raw food had TAMB and coliform bacteria counts of $4.2x10^1$ - $4.5x10^2$ cfu/cm² and 4 - $4.5x10^2$ cfu/cm², respectively. In contrast, surfaces in contact with cooked food had TAMB counts of 2 - $5.5x10^2$ cfu/cm² and coliform bacteria counts of 0 - $1.3x10^2$ cfu/cm². It was determined that 50% of cutting counters in contact with raw food and 96.6% of cutting counters in contact with cooked products were unsuitable based on TAMB counts, while 100% of those in contact with raw food and 70%of those in contact with cooked products were unsuitable based on coliform bacteria counts. In conclusion, it is reported that the effectiveness of hygiene in food establishments is generally variable. Therefore, there is a need for proper cleaning protocols and control measures to prevent food contamination from cutting counters in the sampled restaurants.

Keywords: *Cutting Board, Food Safety, Hygiene*

İstanbul'da Faaliyet Gösteren Bazı Restoranların Kesim Tezgahlarının Hijyenik Kalitesinin Değerlendirilmesi

Özet

Bu çalışma, İstanbul'da faaliyet gösteren on restoranın kullanıma hazır beyaz, kırmızı, yeşil, kahverengi olmak üzere 4 farklı renk kesim tezgahlarından alınan örneklerin mikrobiyolojik kalitesini ve olası çapraz bulaşmayı değerlendirmek amacıyla gerçekleştirilmiştir. Kesim tezgahlarının 100 cm^2 hedeflenen alanlarından önceden nemlendirilmiş swap ile yüzey numuneleri alınarak, soğuk zincir (4°C) altında laboratuvara nakledilmiştir. Yüzey numunelerinin mikrobiyal analizleri için toplam mezofilik aerobik bakteri (TAMB) ve koliform bakteri sayımları sırasıyla ISO 4833-1 ve ISO 4831'e göre yapılarak sonuçlar kob/cm^2 cinsinden verilmiştir. Çiğ gıda ile temas eden kesim tezgahlarının maksimum kabul edilebilir bakteri sayısı 100 kob/cm^2, pişmiş gıdalar ile temas eden çalışma yüzeyleri için 10 kob/cm^2, ürünle temas eden yüzeylerin 100 cm^2 sinde koliform grup bakteri bulunmaması gerektiğini bildiren referans değerler kabul edilmiştir. Analiz sonuçlarına göre çiğ gıda ile temas eden kesim tezgahlarının TAMB ve koliform bakteri sayıları sırasıyla $4.2x10^1$ - $4.5x10^2$ kob/cm^2 ve 4 - $4.5x10^2$ kob/cm^2 olarak tespit edilmiştir. Pişmiş gıdalarla temas eden yüzeylerde ise TAMB 2 - $5.5x10^2$ kob/cm^2 iken koliform bakteri sayısı 0 - $1.3x10^2$ olarak saptanmıştır. Çiğ gıda ile temas eden kesim tezgahlarının TAMB yönünden %50'sinin, koliform bakteri yönünden %100'inin uygun olmadığı, pişmiş ürünle temas eden kesim tezgahlarının TAMB yönünden %96.6'sının, koliform bakteri yönünden ise %70'inin uygun olmadığı tespit edilmiştir. Sonuç olarak gıda işletmelerinde hijyen etkinliğinin genellikle değişken olduğu bildirilmekle birlikte ve örnek alınan restoranlarda kesim tezgahları kaynaklı gıdaların kontaminasyonunu önlemek amaçlı doğru temizlik protokollerinin sağlanması ve kontrolününe ihtiyaç duyulmaktadır.

Anahtar Kelimeler*: Kesim Tezgahı, Gıda Güvenliği, Hijyen*

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Spirulina in the Food Industry and Nutrition

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Abstract

Cyanobacteria, also known as blue-green algae, are described as microscopic organisms with the ability to photosynthesize. In contrast to algae, these organisms possess a prokaryotic structure. Cyanobacteria, owing to their photosynthetic capabilities, have played a crucial role in the foundation of human life by converting carbon dioxide into organic matter over millions of years. These bacteria encompass species such as Arthrospira platensis and Arthrospira maxima and constitute a significant portion of total microalgal biomass production. This resource also contains valuable compounds such as chlorophylls, carotenoids, and phycobiliproteins. These compounds are used not only for coloring purposes in the food industry but also offer health benefits. Microalgae have been incorporated into many food formulations. Most of this integration aims to utilize microalgae as a marketing strategy or as a colorant. However, spirulina and its derived compounds have the potential to serve as valuable ingredients in the creation of new functional foods, aligning with one of the major trends in the food industry. Spirulina can be used across a wide spectrum of food products, ranging from snacks to pasta, ice cream, yogurt, and milk. Rich in nutritional value, spirulina contains essential compounds such as proteins, essential amino acids, minerals, essential fatty acids, vitamins, and antioxidants. These components provide significant health advantages, including anti-hypertensive, anti-diabetic, anti-obesity, and antioxidant activities. Spirulina also plays a role in the development of functional foods and has a positive impact on health. It is expected that spirulina will play an even more significant role in the food industry in the future.In this paper, we assess the place of spirulina, an important microalga, in the food industry and its contributions to nutrition.

Keywords: *Nutrition, Functional food, Food industry, Spirulina*

Spirulinanın Gıda Endüstrisi ve Beslenmedeki Yeri

Özet

Siyano bakteriler, mavi-yeşil algler olarak da bilinen fotosentez yeteneğine sahip mikroskobik organizmalar olarak tanımlanmaktadır. Bu organizmalar, alglerden farklı olarak prokaryotik yapıya sahiptir. Siyano bakteriler, fotosentez yetenekleri sayesinde milyonlarca yıl boyunca atmosferdeki karbondioksiti organik maddeye dönüştürerek insan yaşamının temelini oluşturmuştur. Bu bakteriler, *Arthrospira Platensis* ve *Arthrospira maxima* gibi türleri içermekte ve toplam mikroalgal biyokütle üretiminin önemli bir bölümünü oluşturmaktadır. Bu kaynak aynı zamanda klorofiller, karotenoidler ve fikobiliproteinler gibi değerli bileşikleri içermektedir. Bu bileşikler, gıda endüstrisinde renklendirme amaçlı kullanılmanın yanı sıra sağlık açısından da faydalar sunmaktadır. Mikroalgler birçok gıda formülasyonuna entegre edilmektedir. Bu entegrasyonun çoğu, mikroalgleri pazarlama stratejisi veya renklendirici olarak kullanma amacı taşımaktadır. Spirulina ve onun türetilen bileşikleri gıda endüstrisindeki en önemli eğilimlerden biri olan yeni fonksiyonel gıdaların oluşturulmasında değerli bir içerik maddesi olarak potansiyel sunmaktadır. Spirulina gıda endüstrisinde atıştırmalıklardan makarnaya, dondurmaya, yoğurda ve süte kadar geniş bir gıda yelpazesinde kullanılabilmektedir. Besin değeri açısından zengin olan spirulina proteinler, esansiyel amino asitler, mineraller, esansiyel yağ asitleri, vitaminler ve antioksidanlar gibi önemli bileşikler içermektedir. İçerdiği bileşikler sayesinde antihipertansif, antidiyabetik, antiobezite, antioksidan aktivite gibi sağlık açısından önemli avantajlar sunmaktadır. Fonksiyonel gıdaların geliştirilmesinde de rol oynamakta ve sağlık üzerinde olumlu etkiler oluşturmaktadır. Spirulina'nın gelecekte gıda endüstrisinde daha da önemli bir rol oynaması beklenmektedir. Bu bildiride önemli bir mikroalg olan spirulinanın gıda endüstrisi ve beslenmedeki yeri değerlendirilmiştir.

Anahtar Kelimeler: Beslenme, Fonksiyonel besin, Gıda endüstrisi, Spirulina

Giriş

Siyanobakteriler, bakterilere yakın ancak fotosentez yeteneğine sahip mikroskobik organizmalar olarak bilinmektedir. Bu organizmalar genellikle "mavi-yeşil algler" olarak adlandırılmakta ve prokaryotik yapıları sayesinde alg adıyla anılan ökaryotik organizmalardan ayrılmaktadır. Siyanobakteriler, mikroalgler kategorisine dahil edilse de prokaryotik oldukları unutulmamalıdır. Siyanobakterilerin milyonlarca yıl süren fotosentetik

aktiviteleri sayesinde atmosferdeki karbondioksiti organik maddeye dönüştürme yetenekleri insan yaşamının temelini oluşturan önemli bir rol oynamıştır (Lafarga et al., 2020).
Spirulina, özellikle *Arthrospira Platensis* ve *Arthrospira maxima* olarak adlandırılan iki siyanobakteri türünü içeren ve ticari olarak yaygın bir şekilde kullanılan bir cinstir. Spirulina, dünya çapında en çok tanınan mikroalg türlerinden birisidir ve toplam mikroalgal biyokütle üretiminin %30' unun üzerinde bir kısmı Spirulina üretiminden gelmektedir (Costa et al., 2019).
Bu önemli kaynak aynı zamanda klorofiller, karotenoidler ve fikobiliproteinler gibi diğer değerli bileşikleri içermektedir. Bu bileşikler, gıda endüstrisinde potansiyel renk pigmenti uygulamaları olan renkli maddelerdir. Spirulina kökenli pigmentler, sentetik alternatifleri kadar uzun süreli stabiliteye sahip olmasa da tüketildiklerinde ek sağlık faydaları sunma potansiyeline sahiptir. Örneğin, karotenoidler provitamin A aktivitesine sahiptir ve bunların tüketimi gelişmiş bağışıklık sistemi, düşük dejeneratif kronik hastalık riski, kardiyovasküler hastalıklar ve belirli kanser türlerine karşı koruma ile ilişkilendirilmiştir (Rodriguez Concepcion et al., 2018).
Spirulina algleri toz, sıvı, yağ, tablet veya kapsül gibi çeşitli formlarda üretilebilmekte ve tatlı, atıştırmalık ürünlerden hamur işlerine kadar geniş bir yelpazede gıda endüstrisinde kullanılmaktadır. Bu çeşitlilik, pazarın farklı tercihlerini karşılamada yardımcı olmanın yanı sıra, son derece besleyici yiyecekler sağlayarak çocukların beslenmesini ve yetersiz beslenmeyle mücadeleyi desteklemek için de kullanılmaktadır (Gogna et al., 2023). Spirulina, sağlık açısından büyük önem kazanan meyve suları gibi fonksiyonel içeceklerin üretiminde yer almasının yanı sıra süt ürünleri, makarna, yağ türevleri ve besin maddelerinin üretiminde de kullanılmaktadır (Aljobair et al., 2021; Hossam El-Beltagi et al., 2020; ManjulaR et al., 2021). Spirulina, sadece gıda endüstrisinde renklendirici olarak değil aynı zamanda insan beslenmesi, hayvan yemi ve balık yemi alanlarında da oldukça geniş bir kullanım yelpazesine sahiptir (Bleakley & Hayes, 2017).

Spirulinanın Fonksiyonel Bileşikleri
Spirulina proteinler, esansiyel amino asitler, mineraller, esansiyel yağ asitleri, vitaminler ve yağda çözünen antioksidanlar (E vitamini ve karotenoidler) içeriği sayesinde yüksek besin değerlerine sahiptir (Finamore et al., 2017). Spirulina, geniş vitamin ve mineral yelpazesi içermektedir. Bunlar arasında B1, B2, B3, B6, B9, B12, C, D ve E vitaminleri ile K, Ca, Cr, Cu, Fe, Mg, Mn, P, Se, Na ve Zn gibi mineraller yer almaktadır. Ayrıca içeriğinde pigmentler (örneğin klorofil A, ksantofiller, β-karoten), ekinenon, miksoksantofil, zeaksantin, kantaksantin, diatoksantin, 3-hidroksikininon, β-kriptoksantin, osilakzantin gibi bileşikler ile C-fikosiyanin ve allofikosiyanin gibi fikobiliproteinler ve lipaz gibi enzimler de bulunmaktadır (Hosseini et al., 2013).

Spirulina İçeren Gıda Ürünleri
Spirulina içeren en yaygın besin örnekleri arasında makarna, ekmek veya bisküvi gibi tahıl temelli ürünler yer almaktadır (Niccolai et al., 2019). Spirulina ekşi mayalı crostini (kızarmış ekmek) ilave edilmiş ve özellikleri değerlendirilmiştir. Mikro alg içeren ekmeklerin protein ve polifenol içeriğinin artmış olduğu ayrıca spirulina ilave edilmemiş ekmeklere kıyasla daha yüksek antioksidan kapasite ile demir ve selenyum minerallerine sahip olduğu gözlenmiştir (Uribe-Wandurraga et al., 2019). Yapılan bir başka çalışmada makarnaya spirulina eklenmiş, makarnanın fenolik ve protein içeriğinin arttığı gözlenmiştir (Rodríguez De Marco et al., 2014). Beheshtipour ve ark. yapmış olduğu çalışmada spirulina yoğurda ilave edilmiş ve yoğurdun pH düşüşünün daha yavaş olduğu, *Lactobacillus acidophilus* ile *Bifidobacterium lactis'in* artan ve sürdürülebilir canlılık gösterdiği gözlenmiştir (Beheshtipour et al., 2012). Ayrana spirulinanın eklenmesi sonucunda probiyotik ve protein içeriğinde artış tespit edilmiştir (Çelekli et al., 2019). Yapılan bir başka çalışmada yoğurda ilave edilen spirulina sonucunda yoğurdun karotenoid içeriğinin arttığı gözlenmiştir (Golmakani et al., 2019).

Spirulinanın Gıda Endüstrisinde Çeşitli Gıda Ürünleri Formülasyonları

Atıştırmalık Yiyecek Formülasyonu
Bisküvi ve atıştırmalık endüstrisi, ürünlerini protein ve mineral açısından zenginleştirmek amacıyla spirulina gibi algleri kullanmaya yönelik artan bir ilgi göstermektedir. Bu endüstrinin atıştırmalık ürünlerinin besin içeriğini geliştirmek için tercih ettiği bir yöntem ürünlerine spirulina eklemektir. Yapılan çalışmalar farklı konsantrasyonlarda (%0, %2,5, %5, %7,5, %10 veya %12,5) spirulina ilavesinin ürünlerin protein (%9,43-18,11) ve kül yüzdesinde artış sağladığını göstermiştir. Mikrobiyolojik testler sonucunda tüm örneklerin güvenli olduğu belirlenmiştir (Haoujar et al., 2022).

Makarna Formülasyonu
Spirulina türü algler gelişmiş besinsel, duyusal ve tedavi edici faydaları içeren zenginleştirilmiş makarna üretimi için makarna imalat endüstrisinde kullanılmıştır. Aynı şekilde müşteri taleplerini karşılamak amacıyla suşi, kurutulmuş et ve makarna gibi çeşitli spirulina bazlı yeni gıda ürünleri geliştirilmiştir. Bu sayede spirulina temelli ürünler hem sağlık açısından zengin seçenekler sunmakta hem de gıda endüstrisine yenilikçi ürün yelpazesi katmaktadır (Grahl et al., 2018; Mostolizadeh et al., 2020).

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Pagnussatt ve ark. yaptığı çalışmada kuru makarnaya spirulina ve yulaf eklemenin ürünün besin içeriğinde artış sağladığını ve bu durumun makarnanın güçlendirilmesinin sonucu olduğunu gözlemlemiştir. Spirulina ilavesi makarnanın çözünebilir katı madde miktarını ve rengini etkilerken yulaf ilavesi makarnanın asitlik seviyesini etkilemiştir ve ham protein ve genel gıda aroması değerlerini arttırmıştır (%13,06). Bu eklemeler, ticari makarnalarda bulunan lif miktarıyla (%2,40) karşılaştırıldığında ilavelerin sağlıklı ve besleyici lif kaynakları olarak kabul edilerek ürünlere değer kattığı gözlenmiştir (Pagnussatt et al., 2014).

Dondurma

Algler, polikaroten fenoller gibi çeşitli antioksidanları içerdiği için serbest radikalleri etkili bir şekilde temizleme kapasitesine sahiptir. Yapılan çalışmalarda yosun ekstraktının dondurma ürününe katılması, antioksidan aktivitede belirgin bir artış sağladığı ve dondurma üretiminde alglerin kullanılmasının bireylerin sağlığı üzerinde olumlu etki yarattığı gözlenmiştir. *S. platensis* üretim sürecine dahil edilerek yüksek besin değerine sahip ve fonksiyonel özelliklere sahip bir dondurma elde etmek amaçlanmıştır. Optimal alg konsantrasyonunun %1,2 olduğu belirlenmiştir. Bu konsantrasyon, üründeki protein miktarını olumlu yönde etkileyerek tatmin edici duyusal ve fiziksel özelliklere sahip bir dondurma elde edilmesini sağlamıştır (Agustini et al., 2016; Szmejda et al., 2018).

Yoğurt ve Asidofilik Süt

Yapılan bir çalışmada farklı konsantrasyonlarda (%0,1, %0,2, %0,3 ve %0,5) kurutulmuş spirulina kullanılarak üretilen fonksiyonel yoğurtlar değerlendirilmiştir. Sonuçlar, %0,3 konsantrasyonunun besin değerini arttırma ve duyusal özellikleri geliştirme açısından en olumlu etkiyi sağladığını göstermiştir. Depolama süresi boyunca *S. thermophilus* ve *L. bulgaricus'un* hayatta kalma oranının kontrol grubuna kıyasla en yüksek olduğu tespit edilmiştir (Malik, 2011).

Probiyotik bakteriler olan *S. platensis, L. acidophilus (A), Bifidobacteria (B)* ve *Streptococcus thermophilus (T)* içeren bir başlatıcı (ABT-4), fermente edilmiş sütün içine eklenerek etkisi değerlendirilmiştir. Elde edilen sonuçlara göre bu karışımdaki bileşenlerin depolama süresi boyunca başlatıcı bakterilerin başarılı bir şekilde hayatta kalmasını arttırmada olumlu bir etkiye sahip olduğunu göstermiştir (Gouveia et al., 2008; Varga et al., 2002).

Spirulinanın Beslenmedeki Önemi

Spirulina'nın bileşimi yetiştirildiği alglerin kaynağına, üretim tesisinin çevresel koşullarına ve yılın mevsimine bağlı olarak değişkenlik gösterebilmektedir. Spirulina gövdesi, %55 ile %70 arasında protein, %15 ile %25 arasında karbonhidrat, %6 ile %8 arasında yağ, %7 ile %13 arasında mineral ve nem (kurutulmuş algler için) içermektedir. Diyet lifi miktarı %3 ile %7 arasında değişkenlik gösterebilirken bu oran %8 ile %10 arasında da olabilmektedir (Jung et al., 2019). Tablo 1'de Spirulina tozunun besin içeriği yer almaktadır (Lafarga et al., 2019).

Tablo 1 . *Spirulina* tozunun besin içeriği (Lafarga et al., 2019)

Kompozisyon *	100 gr başına	Kompozisyon *	100 gr başına
1. Makrobesinler		B2 Vitamini, mg	3.7
Kalori, kcal	290	B3 Vitamini, mg	12.8
Su, g	4.7	B6 Vitamini, mg	0,4
Toplam lipitler, g	7.7	E Vitamini, mg	5.0
Toplam protein, g	57.5	*4. Amino asitler*	
Karbonhidratlar, g	23.9	Triptofan, g	0,93
Kül, g	6.2	Treonin, g	2.97
2. Mineraller		İzolösin, g	3.21
Demir, mg	28.5	Lizin, g	3.02
Magnezyum, mg	195.0	Metiyonin, g	1.15
Fosfor, mg	118.0	Sistein, g	0,66
Potasyum, g	1.4	Fenilalanin, g	2.77
Sodyum, g	1.0	Tirozin, g	2.58
Çinko, mg	2.0	Valin, g	3.51
Bakır, mg	6.1	Arginin, g	4.15
Manganez, mg	1.9	Histidin, g	1.08
Selenyum, µg	7.2	Alanin, g	4.51
3. Vitaminler		Aspartik asit, g	5.79
A Vitamini, IU	570	Glutamik asit, g	8.39
K vitamini, µg	25.5	Glisin, g	3.09
B1 Vitamini, mg	2.4	Prolin, g	2.38
		serin, g	2,99

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Spirulina'da bulunan ve vitaminlerle yakından ilişkilendirilen önemli bileşiklerden biri karotenoidlerdir. Karotenoidler, mikroalgler tarafından doğal olarak sentezlenen bir pigment sınıfıdır ve bazı karotenoidler vücudumuzda in vivo A vitamini olarak dönüştürülebilmektedir. A vitamini genel büyümenin desteklenmesi, görsel fonksiyonların düzenlenmesi, epitel doku farklılaşmasının kontrol edilmesi ve embriyonik gelişim için gereklidir (Tang, 2010).
Yapılan araştırmalarda spirulinanın içeriğindeki besin değeri sayesinde sağlık üzerinde antihipertansif, antidiyabetik, antiobezite, antioksidan aktivite gösterdiği ve kilo kontrolüne yardımcı olduğu kanıtlanmıştır (Huang et al., 2018).

Sonuç

Spirulina, gelecekte gıda endüstrisinde önemli bir yere sahip olacaktır. Bu benzersiz kaynak her geçen yıl daha fazla yeni ürün formülasyonunda kullanılmaktadır. Nicelik olarak değil besleyici bileşenler açısından da oldukça zengin olan spirulina, çeşitli gıda ürünlerinde kullanılmakta bu durum pazarın farklı tercihlerini karşılamaya yardımcı olurken sağlıklı beslenmeyi de teşvik etmektedir. Spirulina'nın sağladığı pigmentler sentetik alternatifler olarak önemli avantajlar sunmaktadır. Bu pigmentler tüketildiğinde sağlık teşvik eden özelliklere sahip olmanın yanı sıra yeni fonksiyonel gıdaların oluşturulmasında çok yönlü bir bileşen olarak kullanılmaktadır.
Spirulina ilave edilen besinler sadece besin değeri bakımından değil aynı zamanda antihipertansif, antidiyabetik, antiobezite ve antioksidan gibi olumlu biyoaktivitelerin kaynağı olarak da önemli bir potansiyele sahiptir. Bu durum spirulina'nın yalnızca beslenme alanında değil aynı zamanda fonksiyonel gıda endüstrisinde de önemli bir rol oynadığını göstermektedir.

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ID: 247

Molecular Characterization of Deschampsia antarctica and Colobanthus quitensis and their Prospect in Sustainable Agriculture and Food Security

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Abstract

The Antarctic ecosystem is characterised by extreme unfavourable climatic conditions. Despite the unfavourable climatic extremities, some flora species still emerged with high adaptations and tolerance affinities for such environments. Among such flora species are the two vascular plants species: *Deschampsia antarctica* Desv. and *Colobanthus quitensis (Kunth)* Bartl, which are adapted to severe physiological stressors such as desiccation, low soil water availability, and high irradiance. The rare adaptive behaviours of these species triggered scientific interest on their morphological, physiological, and molecular mechanisms that confer such adaptive properties. The current climate dynamics is fast evolving and resulting in constant ecosystem modification with its adverse impact of harsh abiotic stress on agricultural crops. In such constantly changing climatic conditions and unpredictability of global climate dynamics, agricultural sustainability requires smart and resilient breeding approaches. Scientific studies in *D. antarctica* and *C. quitensis* morphological, physiological, and molecular mechanisms is a vital research goal for resistant and resilient plant breeding and sustainable agriculture. This study reviewed the molecular characteristics of the vascular plants in the Antarctic ecosystem. It also reviewed their application and prospect for resistant and resilient crop breeding for sustainable agriculture and food security. It is revealed that *D. antarctica* and *C. quitensis* are characterized by wide morphological and anatomical ecotypic variation and the possession of a unique ability to adapt to both the local mosaic microhabitats and to general climatic fluctuations in an unfavourable environment, being able to photosynthesize through their vascular system, with *C quitensis* having a wider geographical distribution than *D. antarctica.*

ID: 248

Investigation of the Role of Oxidative Stress and Endoplasmic Stress Pathway in the Protective Effect of Quercetin on 4-aminopyridine-Induced Neuronal Damage

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Abstract

Quercetin (QU) is a subtype of flavonoid that can be found in different fruits and vegetables. Many studies report that QU may have positive effects on neurological diseases. However, the effect and possible mechanisms of QU on 4-AP-induced neuronal damage remain unclear. In the present study, therefore, it was aimed to reveal the effects of QU on the hippocampal neuronal damage induced by 4-aminopyridine (4-AP) and the possible roles of oxidative stress and endoplasmic reticulum stress in this effect. The study was carried out using the HT-22 hippocampal neuronal cell line. The effect of pre-treatment with QU on cell viability after 4-AP-induced neuronal damage was determined by the XTT test. Cells were evaluated histopathologically for apoptotic nuclear change (ANC) using DAPI stain. The effects of QU on oxidative stress markers (total oxidant status (TOS) and total antioxidant status (TAS)) and endoplasmic reticulum stress markers (activating transcription factor 4 (ATF-4) and C/EBP homologous protein (CHOP)) were measured using colorimetric commercial kits and ELISA kits after neuronal damage. Treatment of hippocampal cells with 4-AP alone reduced cell viability, while pre-treatment with QU reversed this effect of 4-AP. In respect of histopathologically, treatment with 4-AP alone increased the number of ANCs, while pre-treatment of QU decreased the ANCs. In addition, in terms of biochemical evaluations, TOS, ATF-4, and CHOP increased after 4-AP in neuronal cells and QU suppressed this increase after neuronal damage. In addition, QU normalized the decreased TAS levels following 4-AP administration. As a result, it was found that QU prevents 4-AP-induced neuronal damage in hippocampal neuronal cells. It is thought that the neuroprotective effects of QU may be mediated by its suppressive properties on oxidative stress and endoplasmic reticulum stress. The use of QU supplementation may be beneficial in reducing the risks of diseases associated with neuronal damage.

Key Words: *Quercetin, 4-aminopyridine, Neuronal Damage, Oxidative stress, Endoplasmic reticulum stress*

ID: 249

Phosphorus solubilizing bacteria and cotton yield.

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Abstract

Plant nutrition is crucial for developmental stages and yield. Several macro and micronutrients are present in various layers of soils, but most of the micro and micronutrients are not available to roots. Amongst them, phosphorus (P) is utmost importance because it is a source of energy which is provided in the form of adenosine triphosphate (ATP). P intake is essential for the development of cotton like other crops. Besides, the fundamental genetic component that controls the plant development is phosphate. P aids in the formation of root architecture, and its lack might restrict plant growth and fibre development. While, P based fertilizers are more expensive due to its important role mentioned above. P is naturally present in the soil, but it is available if pH of soil is between 6.5-7 pH in the form of hydrogen phosphate and di-hydrogen phosphate. While, P is not available if pH goes high *i.e.* >7. There are several strategies to make them available, but Phosphorus Solubilizing Bacteria (PSB) is receiving more attention these days. It functions as a bio fertilizer and aids in improving P uptake by plant roots. Basically, PSB transforms mineralized phosphate into soluble organic phosphorus by plant roots. These bacterial colonies work directly or indirectly to increase the availability of P and operate under the symbiotic principle. P solubilizers are several species of the genera Pseudomonas, Rhizobium, Bacillus, and Penicillium. PSB implements three different strategies. Enzymes are released first, followed by P, and then organic acids, which hydrolyze minerals, and finally released into the soil. PSP has an essential role in cotton by increasing seed cotton output, chlorophyll content, and seedling growth, according to multiple research studies. It also promoted flowering and then boll development. Application of these bio stimulants also increased transpiration rate. So these microorganisms constitute a necessity for the future.

ID: 250

Farmer's Knowledge on Maize Pests, Their Management, and Cultivation Practices in Baitadi

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Abstract

The primary objective of this research was to assess farmer's knowledge on pests, their management practices adopted, and maize cultivation practices in Baitadi, Nepal. Four research locations were selected purposively, Dashrath Chand Municipality-2, Pancheswar-6, Patan-4 and Dashrath Chand Municipality-9, as they were hot region for maize production in the district. 75 Household interviews along with Focused Group Discussion and Key Informants Interview were performed. Statistical operations included; Mean, standard deviation, Chi-square test, ordinal logistic regression model. The study found that education status of the farmers was associated with Seed storage structures used, Chemical fertilizer usage, and Insect pest management knowledge. Agri-professionals' visit was associated with Modern seed storage structures used, Chemical fertilizer usage, Insect identification capacity, and Integrated Pest Management awareness among farmers. Access to cooperatives membership was associated with training experience. Fall Army Worm were the most severe insect pest followed by cutworms and White grubs in the study area. Education level, agriculture profession, Fall Army Worm identification capacity, and Insect pest management knowledge in a respondent increased the chances of perceiving Fall Army Worm attacks as "Highly severe". In the initial growth stages, Cutworm was more severe, but in the later stages Fall Army Worm was the most severe. Wild boar was the most severe animal pest followed by Porcupine, Monkey, Birds and Rodents. Maize weevil was the only prevalent post-harvest insect pest. 59.3%, 60.4%, and 73.9% of the respondents correctly identified Fall Army Worm, Cutworms and, White grubs, respectively from their Mark of identification. However, 96.4%, 93.8% and 56.4% of the respondents correctly identified the on-field symptoms caused by Fall Army Worm, Cutworm and White grubs, respectively. Thus, the study concluded that improving agriculture education through training, easier access to membership, and cultural practices are encouraged for policy makers to consider.

Introduction

Maize (Zea mays L.) is considered the second most important crop in terms of area and production in Nepal. Maize is being cultivated in 979,650 ha of land and the production of maize in the fiscal year 2076/77 was 2,997,733 m. tons with a productivity of 2.5 t /ha (ABPSD, 2021). Although there has been a rise in Maize production in the recent years, the increase in maize production is only due to an increase in the cultivation area of maize rather than an increase in yield (ABPSD, 2020/21). Sudurpaschim province, although contributing to only 4.1% of total maize production in Nepal, is heavily dependent on Maize as a staple crop. This situation exists majorly because of the uneven cultivable land along with dry and cold climate in most of 7 out of 9 districts in this province which is not suitable for Rice cultivation as a staple crop. Baitadi district lies in the Sudurpashim hills of Nepal with suitable climatic conditions for growing maize cultivated in 11,031 ha with a total production of 26,939 Mt, having a productivity of 2.44 Mt/ha in the year 2020/21 (ABPSD, 2020/21). Although 73.78% of the maize production area lies in the hilly belt (2.52) the productivity lags behind the Terai (2.87). (MOALD, 2021).

One of the major factors that limit maize cultivation is insects and pests, which can infest maize at any stage of crop development and storage (Ortega, 1987). In the current scenario, insect pests are contributing to a loss of about 40 Mega tonnes of Maize yield per year. This status does only seem to increase with time with increasing global temperatures in the following years. (Dunne, 2018). Among the insect pests, the moth group (which includes cutworms, armyworms, borers, and grain moths) is the most damaging to maize worldwide, followed by the beetles (rootworms, wireworms, grubs, grain borers, and weevils) followed by the sap-sucking bugs (hoppers and aphids) (Ortega, 1987). FAW, which was previously considered a minor pest, has seen unexpected global rise in number. The similar rise was expected in Nepal because it hosts favorable climatic condition for FAW growth and development. After the incidence of FAW in Nepal, this pest has been reported to have infested almost all maize-producing districts. Prior to the incidence of FAW, cutworms and maize borers were considered the major insect pests throughout the country. (PQPMC, 2019)

Initially, being a minor pest under the agroecological system of America, FAW didn't pose much of a threat to the global community. However, after being first reported in 2016 in Africa, it turned out to very destructive pest in sub-Saharan Africa and the whole of Africa. (Goergen G, 2016)

Fall Armyworm (FAW) was first identified in India in July 2018, followed by Sri Lanka, Bangladesh, Myanmar, Thailand and China in the year 2020 (FAO, 2020). The invasion of this pest was officially declared in Nepal in August 12 2019 by NPPO Nepal (MoALD, 2019). FAW was reported first time in Nawalpur district on May 9, 2019. After the first incidence, the pest has been reported in different districts, including Chitwan, Sindhupalchowk, Sindhuli, Ramechhap, Udayapur, Khotang, Okhaldhunga, Dolakha, Kavrepalanchowk, Lalitpur, Bhaktapur, Banke, Rolpa, Pyuthan, Salyan, Dailekh . (MoALD, 2019). The fecundity of this pest is high (more than 1000 eggs/moth); thus, there can be multiple pest generations per cropping season or year. (CABI, 2019) Its major impact is on maize crops. It affects the crop at different stages of growth, from early vegetative to physiological maturity. Almost every maize-producing district has been infested by FAW except eastern high hills. More severe cases are seen in western Terai and hill areas for maize production.

Maize stem borer (*Chilo partellus* Swinhoe) is also one of the major insect pests to maize production throughout the country. (Neupane, 1986). Dead hearts and not bearing fruits are the prominent symptoms of Maize stem borer. The attack of Maize stem borer lasts throughout the growth phase of maize, from the seedling to the harvest maturity stage. (Gyawali, 1978; Shivakoti & KC, 1978). Maize stem borer compromises both yield and quality of grain. (Pingali, 2001; James, 2003).

The oviposition of stem borer was observed 23 days after planting (Palikhe, 1982) and 27 days after planting (Shivakoti, 1978). Females lay eggs mostly on the upper surface of the leaves (61%), and the remaining 39% were laid under the lower surface at the mid-rib and margins of the leaves.

Larvae of scarab beetles (chafer beetles) are known as white grubs. These are soil insect pests. Both larvae and adult forms of scarab beetles may be destructive for the plant. (Mittal, 2000). These are usually recognized by their C- shaped body and white colour with a brown head. (Khanal et. al, 2018). White grubs feed on the root of almost all of the important crops in Nepal. The crops include maize, tomatoes, potatoes, capsicum, cauliflower, groundnut. However, these pests dislike legumes (Matheson, 1985). In Baitadi, White grubs are mostly encountered in vegetables (tomatoes, potatoes, capsicum, cauliflower, chilly etc.) followed by corn. The location in which white grubs prevail most is Dehimandu-1, Sideshor-7 and Sideshor-8 (Khanal et al., 2018). The same white grub from the season of vegetable production carries on to the next season of maize and incites damage to the roots of young to mature maize plants

In addition, post-harvest pests also inflict a significant damage to the crops. These are insect pests and animal pests (Bhandari et al., 2015). Maize weevil (*Sitophilus zeamais,* Motsch*)* is the most significant post-harvest insect pest in Maize cultivation in Nepal. This pest incites damage through quality degradation of grain by making porous holes inside and residing in them. (Trematerra, Ianiro, Athanassiou, & Kavallieratos, 2013). In store houses in Nepal, a significant grain weight and quality loss is observed. (Tiwari et al., 2018). The ground weevil (*Sitophilus zeamais* Motsch), also known as the large rice weevil, is a species of beetle in the family Curculionidae. The corn weevil is a small (2.5-4 mm long) reddish-brown weevil with a long snout and four reddish-brown spots on the forewing (2 spots on each elytra). The length of the head and thorax is approximately equal to the length of the wings. (Tiwari et al., 2018)

Moreover, the incidence of wild animals in rural Baitadi very high compared to that in urban maize cultivation areas. Some of the animal pests are: Wild boar (*Sus scrofa*), Rhesus monkey (*Macaca mullata), Porcupine (Erethizon dorsatum),* Birds (*Aves),* and Rodents (Field mouse *Mus musculus*). Due to their inquisitiveness, intelligence, and proximity to people, rhesus monkeys also caused the highest amount of crop damage in the surrounding Shivapuri National Park (Pandey et at., 2016) Langtang National Park (Regmi et at., 2013) and Chitwan National Park (Mishra, 1982) of Nepal. Primates are also the dominant pest for crop damage in Africa (Amador-Alcala, 2013). Wild Boar (*Sus scrofa*) is the most problematic animal pest in the regions near forest vegetation in Nepal. In shivapuri national park, the most problematic animal was regarded as Wild boar, followed by Monkey, Porcupine and Birds. (Pandey & Bajracharya, 2015). For management, Bio-fencing was practised by building a wall-like structure using *Euphorbia* and *Jatropa* in the areas near Shivapuri national park. (Pandey & Bajracharya, 2015).

In Baitadi, the major problems of pests in Maize arise due to similar cropping patterns every year leading to easy insect pest adaptation coupled with limited access to controlling mechanisms such as pheromone traps and scouting. Organic management methods, though easily accessible, the local farmers do not have any established knowledge-based system concerning the use of these methods. In addition, the controls to post-harvest animal pests have not yet been implemented in Baitadi. Similarly, the rudimentary cultivation practices only aggravate the problem in Maize production.

Despite all of these difficulties, the farmer's knowledge and perception of pest-damage has been heavily under-studied in Baitadi leading to a lean understanding of insect pest management in this area. This study will attempt to assess farmer's knowledge of insects and pests, their damage, control measures and cultivation practices in the maize production areas in the Baitadi district. More specifically, the research will study the pest infestation patterns as perceived by farmers, cultural practices, and suggest possible solutions to the problems found.

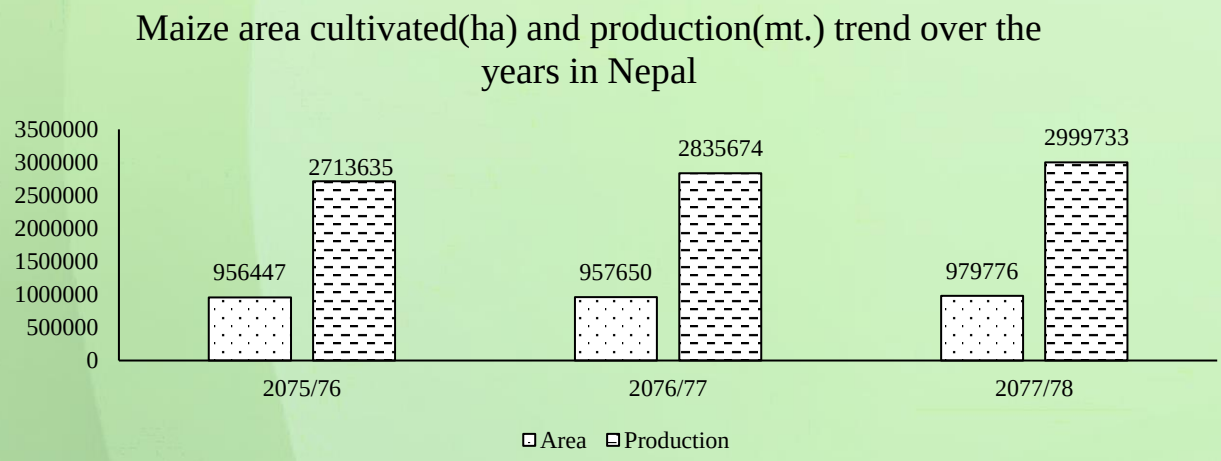


Figure 1: Maize area(ha) and production(mt.) in Nepal over the years
(Source: MOALD, 2077/78)

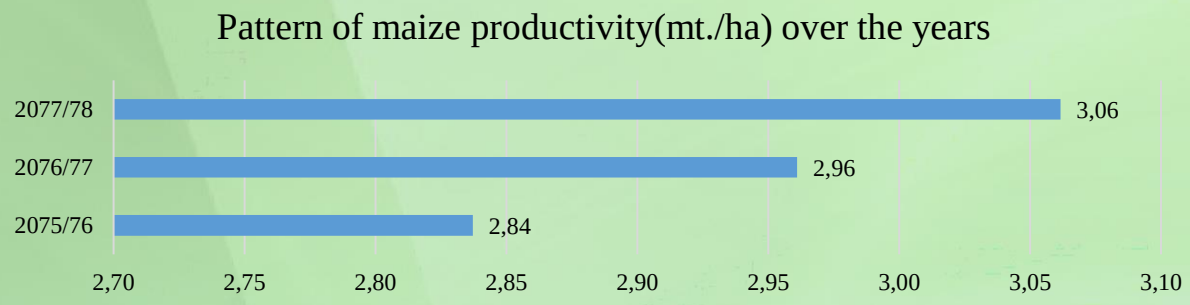


Figure 2. Pattern of maize productivity (mt./ha) over the years in Nepal

Materials and Methods

Learning through Entrepreneurial Experience (LEE) site and subsector

Learning through Entrepreneurial Experience is a program designed by the Agriculture and Forestry University, Chitwan, in collaboration with the Prime Minister Agriculture Modernization Project (PMAMP), Government of Nepal. Under this program, students enrolled in the university in the final semester are sent as interns to Super Zones and Zones in various districts of the country. The students were assigned a Terms of Reference (TOR) stating the work they were supposed to do in the office they get assigned. In addition, the students were also expected to carry out an action research/survey/case study during their tenure at the LEE site and present the results at the end of the semester. The commodity/sub-sector on which they carried out their study depended on which super zone or zone they got assigned. The site of my study is the Baitadi district. The assigned zone for the study of maize by PMAMP was Dashrathchand municipality-10, Dashrath Chand municipality-2, Pancheswar rural municipality-6, and Patan municipality-4, as peak maize-producing areas in the district.

Research site

The research was conducted in Dashrathchand municipality ward no. 2 Gurukhola, Patan municipality ward no. 6, Pancheswar rural municipality ward no. 6 . The field area was located at Latitude: 27.975700 / N 27° 58' 32.52" and Longitude: 83.755000 / E 83° 45' 17.999". The soil type was clay. The site was situated at 2000masl altitude.

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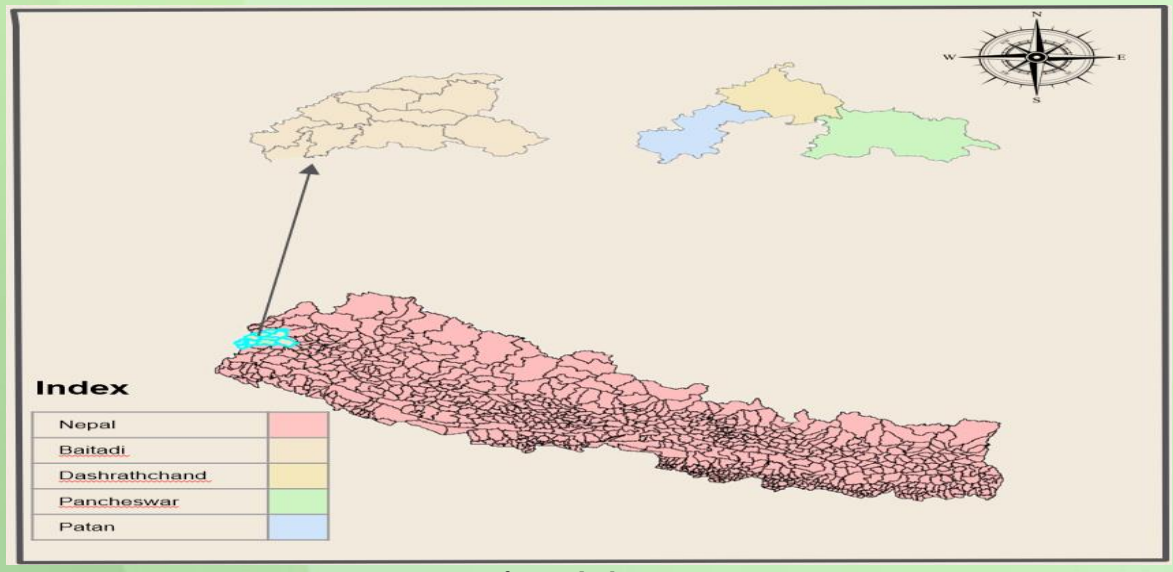


Figure 3: Map of Baitadi showing PMAMP zone

Sample and sampling technique

The sample of the study was drawn in two stages. First, four high maize producing locations in Baitadi district (Patan Municipality, Dashrathchand-2, Dashrathchand-9, and Pancheswor Municipality) and were selected on purpose as per the data available in PMAMP, Maize zone, Baitadi. The list of registered maize farmers from PMAMP Baitadi maize zone was then used to obtain a sample size of 81. The interview was carried out with 75 maize growing farmers with 6 being unable to attend the interview because of various reasons. The interviewees were informed of the fact that their personal information would not be disclosed in public and they were allowed to leave the interview at any time they felt being uncomfortable because of the questions.

To assist the data derived from the interviews, a detailed review of the following materials on the subject matter was done to obtain the necessary secondary data; Journals, Articles, Publications of DOA, NARC, AKC, VDC, PMAMP, Newspaper articles, Related references (textbooks, booklets, leaflets)

Key Informants' Interview: Key informants such as the village local leaders, DADO officer, and OVOT (One village, one technician) were asked a series of questions about the then-present scenario maize problem in the area, current yield statistics, number of people in the area involved in agriculture and maize cultivation.

Case studies: Detailed study about successful maize growers in and around the area, if any, was carried out to find out about methods that can be useful in overcoming the problems related on maize.

Research equipment/design

Data collection was done through a household survey. Based on the interview schedule and checklist, questions were asked with the selected respondents to gain the aimed information. Key Informant Interviews (KII) and Focus Group Discussions (FGD) were carried out primarily to generalize the data and information obtained from scheduled interviews and secondarily obtain additional qualitative information regarding our survey topic.

Household survey

A pre-tested questionnaire was used to collect information on the adoption of improved varieties of maize among maize growers in the the targeted site. The information collected from farmers included the socio-demographic factors, maize cultivation practices, knowledge and perception of farmers about improved variety maize, and extent of adoption of improved varieties in the proposed site.

Key informant interview

Key informants such as the village's local leaders, DADO officers, and OVOT (One village one technician) were asked a series of questions about the present scenario maize problem in the area, current yield statistics, and the number of people in the area involved in agriculture and the maize cultivation.

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Focus group discussion

One comprehensive Focus Group Discussion was conducted after completing the household survey to validate the collected data and information from the farmers. Participants in FGD included local farmers, all ethnic groups of the community and both male and female farmers.

Method of data collection

Both the primary and secondary sources of data collection was used. Maize growers were the major sources of primary data. Secondary information was collected from the document of the different institutions/organizations.

Data analysis technique

The collected data were arranged systematically and put forward for analysis. For data analysis, computer software like SPSS, Ms-Excel, and stata were used.

Descriptive analysis:

The demographic and economic characteristics of the sample were described using descriptive statistics in SPSS. Variables like gender, age, schooling, total farm size, economically active population, etc., were described using descriptive statistics like frequency, percentage, mean, standard deviation etc.

Association test:

Chi-square method was applied for association testing purposes among many dependent and independent variables.

$$\chi 2 = \sum \frac{(Oij-Eij)^2}{Eij}$$

Where $\chi 2$= chi-square

O_{ij} = observed frequency of each ij^{th} term

E_{ij} = indicates the expected frequency of ij^{th} term

i =1,2, 3.....r j =1,2,3.....K

This was tested at 0.05 or 0.01 level of probability for different degree of freedom.

Logit model

The ordinal logit model was built around a latent regression model represented as; $Y^{*}=\beta' X_i+\varepsilon$. The observed ordinal severity index *Y* is a function of Y^{*}, an underlying continuous unmeasured latent variable that indexes the level of contribution of selected variables to the respondents' decision-making on perception. β is the parameter vector to be estimated, *X* represents the demographics, farm, and ecological characteristics, and ε is the random error term

Model specification

Let the severity of FAW be an ordinal outcome with J(3) categories;

j {not severe (1), moderately severe (2) and very severe (3)}.

Y be an ordinal outcome (Severity of FAW)

$$logit\big(P(Y \leq j)\big) = \beta_{j0} + \beta_{j1}x_1 + \beta_{j2}x_2 + \beta_{j3}x_3 + \beta_{j4}x_4 + \beta_{j5}x_5 + \beta_{j6}x_6 + \beta_{j7}x_7$$

x_1= Education status above secondary (dummy; No=0, Yes=1)

x_2= Education status above lower secondary (dummy; No=0, Yes=1)

x_3= Source of income (dummy; Other=0, Agriculture=1)

x_4= FAW correctly identified or not (dummy; No=0, Yes=1)

x_5= Insect identification capacity (dummy; No=0, Yes=1)

x_6= Frequency of agriculture officer's visits (dummy; Rare=0, Frequent=1)

x_7= Insect pest management knowledge (dummy; No=0, Yes=1)

x_8= Variety of cultivation (dummy; Local=0, Improved=1)

***Constraints ranking and indexing*:**

Constraints will be assessed by group discussion and other participatory approaches. Indexing will be used to rank the problems faced by the farmers in the specific site. The scaling technique provides the direction and extremity attitude of the respondents towards any proposition. The formula below was used to find the index for the intensity of production problems faced by producers.

$$\mathbf{I}_{\mathbf{prob}} = \sum \frac{S_i f_i}{N}$$

Where,
I prob = Index value for intensity of problems
$\sum$ = Summation
Si = Scale value of ith intensity
fi = Frequency of ith response
N= Total number of observations

Results

Socio-economic character of the respondents, and corn yield

In the study area, 63.99% of respondents were male. 32% of the total respondents were illiterate, meaning they didn't know how to read or write. 22.66% had only primary education and a meagre 1.33% people had education above bachelors. In the study area, economically active population (29-59) was 66.68% of the total population, followed by older dependent population (>59) which constituted 23.98% of the total population. The source of income for majority of the household (57.68%) was agriculture followed by public service (21.29%), Remittance (9.33%), and business with a paltry 1.34% of people depending on it for income. The average yield of for the improved variety maize growers (3.32mt/ha) was considerably higher than the local maize variety growers (1.98mt/ha) in the study site. Furthermore, the majority of farmers in the study area were small land holders with total cultivable land to be 1243 ropani with an average landholding of 16.57 ropani per household with a standard deviation of 36.24 ropani.

Table 1. Socio-economic character of the respondents, and corn yield

		Bijula	Gurukhola	Gwallek	Patan	Weighted Mean (SD)	X^2value	P value
Education status (%)	Illiterate	25.0	30.8	37.9	29.4	32 (5.85)	29.015*	0.048
	Primary	50.0	0.0	20.7	17.6	22.66 (18.466)		
	L. Sec.	12.5	7.7	13.8	11.8	12.01(2.45)		
	Secondary	0.0	46.2	17.2	17.6	18.65(16.6)		
	Plus 2	0.0	7.7	10.3	0.0	5.31(5.54)		
	Bachelor	12.5	7.7	0.0	17.6	8(8.16)		
	Above bachelor	0.0	0.0	0.0	5.9	1.33(2.85)		
Age (%)	< 29	6.3	30.8	3.4	5.9	9.93(11.4)	10.348ns	0.111
	29 - 59	68.8	38.5	72.4	76.5	66.68(15.2)		
	>59	25.0	30.8	24.1	17.6	23.98(4.83)		
Gender(%)	Female	31.3	23.1	41.4	41.2	36.03(8.24)	1.661ns	0.646
	Male	68.8	76.9	58.6	58.8	63.99(8.25)		
Income source (%)	Agriculture	62.5	53.8	36	93.1	57.68	26.97	0.008***
	Remittance	12.5	15.38	0	17.64	9.33		
	Public Service	25	30.76	6.8	35.29	21.29		
	Business	0	0	0	5.9	1.34		
	Labour	0	0	0	11.77	2.67		
Yield(mt/ha)	Local Variety(mt/ha)	2.66	2.08	1.68	1.60	1.98(0.86)		
	Improved variety(mt/ha)	3.22	3.636	3.44	3.74	3.32(1.16)		

*, **and *** indicates level of significance at 10%, 5%, 1% respectively

Cultivation practices of Maize:

In the study area there was no irrigation facility available for cultivation practices of maize, and were completely dependent upon rain. On average, the sowing occurred on Jestha 7 (SD=3.37) throughout the study area, commensurate with the average monsoon arrival date. The earliest sowing date was found to be Jestha 1, and the latest sowing date was found to be Jestha 12. 98.6% cultivated Local maize seeds, 1.3% cultivated improved seed only, 38.7% households cultivated Local seeds only, 60% households cultivated both local and improved maize

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seeds and 61.3% cultivated improved maize seeds. 96% of households practiced intercropping in their maize fields. Among them 97.2% cultivated indigenous crop called *sotta*. Intercropping was done in the local maize variety fields only and not in improved maize variety cultivated fields.

Insect pest knowledge among farmers:

98.6% of farmers claimed that they could successfully identify the insect pests that infested their maize. However, upon interrogation about the pest's physical and symptomatic features, only 69.3% of farmers actually had the knowledge. 59.3%, 69.3%, and 73.9% of farmers could identify the FAW, Cutworms, and White Grubs, respectively, upon seeing it. And 89.3%, 93.8%, and 89.6% farmers could identify the symptoms correctly of FAW, Cutworms, and White Grubs, respectively, in their maize fields.

Fall army worm was the most problematic pest by far with a total rank index of 0.84 followed by Cutworms (0.78), White grubs (0.58), and Borers (0.30). FAW was the most severe pest in Vegetative growth stage, Tasseling stage, and physiological maturity stage of maize development among all the pests. While Cutworms were the most severe during Seedling and Knee-high stage, White grub severity was considerably low in comparison to other pests. Maize Borer, although seen occasionally, no damage was reported by farmers.

Furthermore, the study observed that the respondents with; an education level above lower secondary, agriculture as the primary source of income, the capacity of identifying FAW mark of identification, and insect pest knowledge had significant odds of 4.52, 5.55, 16.88, and 5.02, respectively, of perceiving FAW attacks as highly severe as compared to the odds of perceiving FAW attacks as not severe and moderately severe both combined. In contrast, respondents with insect identification capacity had significantly lesser odds of selecting High severity as compared to odds of perceiving FAW attacks as not severe and moderately severe.

While insect pests were the major nuisance, due to proximity of rural Baitadi to forests, animal pests were also significant in their impact. Among the animal pests, Wild boar (Sus scrofa) was ranked highest on the basis of damage severity followed by Porcupine, Monkey, Birds, and Rodents.

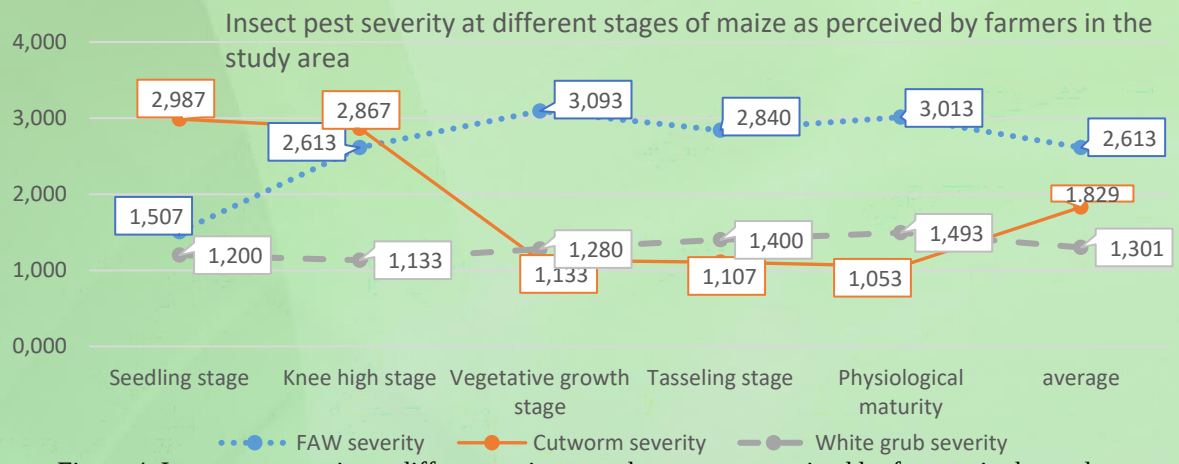


Figure 4. Insect pest severity at different maize growth stages as perceived by farmers in the study area

Table 2. Determinants of perception of farmers on the severity of FAW in the study site

FAW severity order	Coefficient	Std. err.	Odds ratio	Std. err.	P value
Above lower secondary education (above Lower Secondary =1, below Secondary = 0)	1.510	0.733	4.528**	3.317	0.039
Above Secondary education (above Secondary = 1, below Higher Secondary = 0)	-1.161	0.928	0.313	0.290	0.211
Sources of income (0=other, 1= Agriculture)	1.715	0.636	5.556***	3.532	0.007
FAW correctly identified or not (0=no, 1=yes)	2.827	0.766	16.900***	12.941	0.000
Insect identification capacity (0=no, 1=yes)	-2.106	0.762	0.122***	0.093	0.006
Frequency of agriculture officers' visits (1=frequent, 0=rare)	0.583	0.676	1.793	1.212	0.388
Insect pest management knowledge (0=no, 1=yes)	1.615	0.741	5.028**	3.725	0.029
Variety of cultivation (1=improved, 0=local)	-1.046	0.552	0.351*	0.194	0.058
/cut1	-0.322	0.841	-0.322	0.840	
/cut2	2.925	0.915	2.925	0.915	

*,**and *** indicates level of significance at 10%, 5%, 1% respectively

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Table 3. Ranking of animal pests prevailing in the study area based on their damage severity in maize production

	1	2	3	4	5		Rank index	Rank
Wild boar	44	18	1	12	0		0.85	I
Porcupine	0	52	23	0	0		0.73	II
Monkey	31	0	27	9	8		0.69	III
Birds	0	0	17	40	18		0.39	IV
Rodents	0	5	7	14	49		0.31	V

Ins
ect pest management knowledge among respondents:

77.33% of the farmers had the know how of insect pest management in the study area. When asked about what form of pest management strategy would they prefer if the resources were at their disposal, usage of chemical pesticides was ranked first for the highest number of times with a rank index of 0.73 followed by Physical management (0.63) and Biological management (0.61). For FAW, only 46.67% of the farmers reporting FAW infestation in their field tried to manage them culturally. The most popular cultural method was early plantation (62%) followed by application of ash (42.9%). On the contrary, 88% of the farmers didn't use any chemical management method at all.

Among post-harvest insect pests, to manage Maize weevil 65.3% of the farmers used "Celphos" even though it was partially banned in the study area. 56% of the farmers used sun curing and 38.7% of them used indigenous biological control methods such as Neem leaves, Walnut leaves, and Sichuan pepper.

Table 4. Fall Armyworm cultural management methods used in the study site

		Responses		Percent of Cases
		N	Percent	
Cultural method	Early Plantation	22	51.2%	62.9%
	Ash	15	34.9%	42.9%
	Deep Ploughing	6	14.0%	17.1%
Total		43	100.0%	122.9%

a. Responses percent denotes percentage out of total responses recorded
b. Cases percent denotes the percentage out of the total respondents involved.

Test of association between different independent and dependent variables

The study shows that education status is significantly associated with seed storage structures, chemical fertilizer usage, and insect pest management knowledge at 10%, 10%, and 5% of significance, respectively. Moreover, the study elucidates that the frequency of extension agent visits was significantly associated with Seed storage structures used, Chemical fertilizer usage, Insect identification capacity, and IPM awareness among the farmers at 1%, 1%, 5%, and 1% level of significance respectively. Furthermore, access to membership was significantly associated with Insect pest management knowledge at 10% levels of significance, respectively. In addition, provision of training to farmers was significantly associated with IPM awareness among them. (Table: 5)

Table 5. Association between dependent and independent variables

		LPDS	STS	SSS	CFU	III	IMK	MPU	PPE	IMP
Gender	X^2	1.339	2.365	6.234	.033	2.014	1.484	.412	1.432	1.140
	P(value)	.512	.500	.398	.856	.156	.223	.521	.231	.286
Education status	X^2	15.396	24.904	50.462	11.048	8.445	12.605	8.880	10.152	8.606
	P(value)	.220	.128	.055*	.087*	.207	.050**	.180	.118	.197
Frequency of Agri-visit	X^2	.651	1.464	52.045	8.042	6.351	1.491	2.366	.111	19.452
	P(value)	.722	.691	.000***	.005***	.012**	.222	.124	.739	.000***
Access to membership	X^2	8.937	2.127	5.386	.324	1.766	3.490	.289	.350	.744
	P(value)	.011**	.546	.495	.569	.184	.062*	.591	.554	.389
Provision of training	X^2	.571	4.327	5.866	.054	.232	.410	.182	.044	3.914
	P(value)	.752	.228	.438	.816	.630	.522	.669	.834	.048**

LPDS: Land preparation, days prior to sowing; STS: Sowing techniques; SSS: Seed storage structures; CFU: Chemical fertilizer usage; III: Insect identification; IMK: Insect pest management knowledge; MPU: Method of pesticide use; PPE: Possession of pesticide equipment; IMP: IPM awareness; *, **and *** indicates level of significance at 10%, 5%, 1% respectively

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Discussion

There were no prior research efforts concerning the pest problem in Baitadi, although being a burning issue among the maize farmers. Several findings, associations, and determinants were observed and inferred throughout the study. The majority of the respondents were male. This calls for the fact that in most households, decisions taken are male-dominated, whereas women task force is more perpetuated towards indoor activities. This pattern follows the common suit of male being decision dominant in agriculture and women's decision being dominant in household tasks in the Nepalese context. The majority of the respondents, with limited access to transportation, consequently devoid of education (1/5th of the surveyed population was still illiterate, and 44% of people with a secondary or above level of education.) and business schooling, it is no surprise that they were reliant on agriculture for their livelihood. The local variety of maize was largely more cultivated than improved varieties because of a lack of availability, knowledge etc. (Chete, 2021). The date of sowing was similar every year, with the average date of Jestha 7 varying from Jestha 1 to Jestha 12, barring some inconsistencies. 96% of the respondents would plant maize early because of Early rainfall. If late planted, 90% and 80% of the respondent would late plant if the dry weather spell was longer than usual and there was a lack of irrigation facilities, respectively. This portrays the insidious problem of lack of irrigation during the dry period in Baitadi.

Even though 99% thought they could identify the insect pests encountered in their fields, only 69% could actually identify them. The fall armyworm was the most severe insect pest, followed by Cutworms, White grubs, and borers. Fall armyworms being voracious feeders and the most recent insect pests in the area, are the most severe of the insect pests as farmers perceive. The novelty of the pest is one of the many factors that have increased its perceived severity.

59.3% and 96.4% of respondents correctly identified FAW from their Mark of identification and their infested symptoms. Symptoms were readily identified rather than a typical mark of identification of FAW as farmers tend to notice the damage caused by insects rather than the actual insect. This basic psychological tendency explains their insect pest identification pattern. Similarly, 60.4% and 93.8% correctly identified Cutworms from their Mark of identification and infested symptoms, respectively. However, 73.9% and 56.4% correctly identified White grubs from their Mark of identification and symptoms, respectively. This aberration is explained by the fact that most farmers could not distinguish if the damage in their plants was caused by white grub. The damage symptoms of White grubs are wilting and root damage of the maize plant. These symptoms are not clearly associated with White grub for the farmers as many other factors may cause wilting and root damage because White grub symptoms were less often identified than their Mark of identification. This provides new insight into how farmers perceive damage from White grubs.

For the initial seedling and knee-high stages, cutworm had the highest severity, closely followed by FAW, but at and after the Knee-high stages Severity of FAW peaked, and the severity of cutworm dropped significantly. In the initial stages of maize development, Cut worms are known for their behavior of cutting down seedlings, so their perceived severity is high than fall armyworms that only start to infest when the maize development reaches the phase of vegetative growth. As FAW larvae are voracious feeders, they affect most severely at the vegetative stage and later. This explains the perceived severity pattern observed among farmers. White grubs did not look threatening at any growth stage of maize in the area.

A respondent with an education level above lower secondary, a major source of income as agriculture, who correctly identified FAW from their mark of identification, who have insect pest management knowledge had significantly high odds of choosing FAW as highly severe in comparison to odds of choosing not severe or moderately severe. An educated farmer can better comply with the information provided to him/her, thus having a conscience of stating FAW as very severe. Those who had a major source of income in agriculture are more invested in the factors that may degrade their productivity than the farmers who did not have agriculture as their major profession. FAW infestation was a peril, so they were expected and found to perceive FAW attacks as highly severe. Those who could correctly identify FAW naturally perceived FAW as severe. Furthermore, those with better knowledge of insect pest management knew about the life cycle of FAW. AThus, they would know how severe the attacks can be at certain life cycle stages of FAW.

Wild boar was the most severe animal pest, followed by Porcupine, Monkey, Birds and
Rodents. (Field survey, 2022) Most villages were near forest areas; the wild animals were major perils from which the grains had to be preserved. Animal pests were one of the significant reasons behind farmers' focus not shifting towards damage caused by insect pests and the adoption reluctance of improved maize varieties. (Field survey, 2022). Most farmers prefer chemical methods for insect pest management if available abundantly. This can be directly linked to a lack of IPM awareness among farmers in the study area. 46.67% used cultural methods for FAW control. 88% did not use any chemical pesticides. Chemical pesticides were simply unavailable. 20% used Deep plowing as a cultural method for White grub control. Most did not use any method for Whitegrub control because symptoms were not seen as often as those of Cutworm and FAW.

For weevil control majority used celphos (65.3%). The majority of those who used biological methods (58.4%) used "Both Sichuan pepper and walnut leaves." The pungency of Sichuan pepper and Walnut leaves worked as repellents for Maize Weevils.



The association test results portrayed the relationship between Education status and; Seed storage structures used, Chemical fertilizer usage, and Insect pest management knowledge. Traditional seed storage structures were incapable of conserving grains, resulting in post-harvest losses. It can be inferences from the result above that those people with good education did know the consequences of traditional seed storage structures; thus, they moved on to modern seed storage structures. People with good education knew the importance of chemical fertilizers and were more equipped with insect pest management knowledge. Though having rare visits, the "Frequency of agri-professionals visits" was associated with Seed storage structures used, Chemical fertilizer usage, Insect identification capability, and IPM awareness among farmers. "Access to membership of cooperatives" was associated with "Insect pest management knowledge" among farmers. "Provision of training" was found to be associated.

Conclusion

Even though maize is the second most popular staple crop in this region and inherently etched in people's daily lives, lack of availability and implications of available technology and information has ensured that the level of maize cultivation does not improve from the one that is prevailing traditionally. Furthermore, the scale of urgency among farmers regarding pest damage is even more alarming. Most farmers have considered insect pest damage as normal and a factor that cannot be controlled, leading to consequence that they are not interested in insect pest management for anything other than FAW, because of its more visible symptoms and its alarming feeding rate. This has kept the practice of insect pest management confined to only FAW to a large extent. FAW being the most recent pest, a keen insight may be drawn from the results of the factors affecting farmers' perception concerning its severity. Education, their major source of income, Insect identification capacity, Insect pest management knowledge, and Improved variety cultivation positively affected the chances of FAW attacks being called severe, which they must be.

FAW was the most severe insect pest according to farmers, and cutworm was accepted as normality despite being detrimental at the initial stages as no management practices would be deployed against it. For white grubs, no insect pest management practices were adopted. Agriculture education is lacking in the community. This can be testified by the fact that 99% of farmers, although sure that they could identify the insect pests, only 69% could actually identify them.

Cultural practices are popular in the area, but without any systematic mechanism governing the practices. Among the cultural methods Deep ploughing, usage of ash and early plantation are the popular ones. The application is entirely informally spoken without any written or formal publications.

Management of animal pests was not considered possible and the infestation was inevitable. Although animal pests are causing damage in a similar intensity as insect pests and post-harvest pests, no management practices were observed. Without government-aided fencing, the locals were not able to follow through with any action.

This study suggests that farmers reach out for agricultural education opportunities. They should increase the usage of cultural methods for insect pest management which are the most applicable & readily available methods. Emphasis should be given to participating in agriculture cooperatives and participating in training. The adoption of improved variety is recommended for traditional local farmers. Likewise, for the future researchers the study suggests further explorations of the possibilities of study on the efficacy of locally accessible cultural practices FAW management in the region, and further study on reason behind certain pockets of maize cultivation area being FAW free.

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The Management Of Food At Rsud Haji Makassar

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Abstract

Food service is a service activity carried out by the hospital in providing food for customers or consumers in an institution. Hospital food services play an important role in the process of treating patients during hospitalization by providing nutritious food. Hospital food services are intended to provide patients with hygienic, safe and nutritionally balanced food that supports patient recovery. Hospital food service is a complex field and requires specialized skills. Nutritionists are required to provide services according to the type of patient, type of treatment, and minimize the occurrence of infection. The aim of providing food is to provide food that is of good quality, varied, meets nutritional adequacy, is acceptable to and satisfies consumers by observing high standards of hygiene and sanitation including the types of equipment and facilities used. This research is a type of qualitative research with a descriptive approach, which describes the implementation of management in food service activities at the Nutrition Installation at Haji Makassar General Hospital using in-depth interviews with installation staff and examination of documents/archives as secondary data. This research lasted six days starting from 15-20 May 2023. The results of the study were that all the prerequisites had been fulfilled except for food orders for 1 menu period and the existence of regulations on food additives (BTP).

Key Words: *Food services, Management of Food, Hospital*

Introduction

Food management is a series of activities carried out from menu planning to food distribution to consumers including recording, reporting and evaluation activities aimed at achieving optimal health status through providing appropriate food. (Widyastuti et al., 2018)

The aim of food management is to provide food that is of good quality, varied, meets nutritional requirements, is acceptable and satisfies consumers by paying attention to high standards of hygiene and sanitation including the types of equipment and facilities used. (Widyastuti et al., 2018)

The number of food processing staff is ideal because the number of students served is 135 people, food management generally runs well, except for processing because sometimes the menu served does not match the main menu, and changes to the menu are made after communication with the school and the menu that is replaced still meets needs. school child nutrition.(Kurniawan, 2016)

Materials and methods

This research is a type of qualitative research with a descriptive approach, namely describing the implementation of management in food service activities at the Nutrition Installation of Haji Government Hospital Makassar which includes the process of planning menus, planning food needs, procuring foodstuffs, receiving foodstuffs, storing foodstuffs, processing foodstuffs and food distribution. This research was conducted at the Haji Government Hospital Makassar and lasted six days starting from 15-20 May 2023.

The selection of informants in this study used a purposive sampling technique, which is a technique used to select informants who know the problem clearly, are able to express opinions well and correctly, can be trusted to be a good source of data and are willing and able to provide information related to the research topic.

The informant chosen by the researcher is someone who provides information about something they want to research. There are 2 types of informants, namely:

a. The key informant is the Head of the Nutrition Installation who is believed to be able to provide accurate information about planning activities and menu assessments for patients and is the policy maker and maker at the Nutrition Installation at Haji Government Hospital Makassar.
b. The main informants were staff at the Nutrition Installation who took part in ordering activities and distributing food to patients.

The data collection method used in this research is an in-depth interview method for officers at the Nutrition Installation at Haji Hospital Makassar and examination of documents/archives as secondary data regarding food management at Haji Government Hospital Makassar, and observations of a number of informants who were the source of data mining. this research.

In this research, the instruments are the writers as researchers, practicum guide modules, documentation, notebooks, cameras, voice recorders and other tools that can support the running of this research well.

Results and Discussion

Based on the provisions for a good kitchen according to the Ministry of Health 2018, Haji Government Hospital Makassar does not fully meet these characteristics, such as the completeness of the rooms, one of which is that there is no meeting room, and the janitor's room and milk room do not match the kitchen plan. The building area does not comply with the provisions of Minister of Health Regulation no. 24 of 2016, lighting is lacking, ventilation is also still lacking (it is recommended that the air exchange ventilation system in the kitchen should be able to provide 20-30 CFM/hour).

Table 1. Criteria for a good kitchen

No.	Criteria for a Good Kitchen	Suitability
1	The kitchen area is at least 40% of the dining room or 27% of the building area	X
2	The floor surface is made quite sloping towards the waste water drainage channel	√
3	The ceiling surface must cover the entire roof of the kitchen space, be a flat surface, be light in color and be easy to clean	√
4	Air conditioning is equipped with a device for releasing hot air and odors which is installed at a height of 2 (two) meters from the floor and its capacity is adjusted to the size of the kitchen.	√
5	Kitchen stoves are equipped with smoke hoods, smoke traps, chimneys, filters and channels as well as fat collectors.	√
6	All fireboxes are located under smoke hoods	√
7	The door connecting to the outer courtyard is made double, with the outer door opening outwards	√
8	The door connecting to the outer courtyard is made double, with the outer door opening outwards	√
9	The kitchen space consists of: a) Equipment washing area. b) Food storage area. c) Processing place. d) Preparation place. Administrative place.	√
10	The intensity of natural and artificial lighting is minimal 10 *foot candles*	√
11	Air exchange at least 15 times per hour to ensure comfortable working in the kitchen, eliminating smoke and dust	√
12	The kitchen area must be free from insects, mice and other animals	√
13	There is at least a compounding table, equipment, cold storage cabinets/facilities, equipment racks, washing tubs that are functional and well maintained	√
14	The words "Wash your hands before touching food and utensils" must be displayed in a place that is easily visible	√

Menu Planning

Menu planning is a series of menu preparation activities and combining dishes in harmonious, harmonious variations that meet nutritional adequacy that meets the principles of balanced nutrition, tastes that are adapted to consumer/patient tastes and institutional policies.

The menu planning at the Haji Government Hospital Makassar is in accordance with PGRS (Pedoman Pelayanan Gizi Rumah Sakit/*Hospital Nutrition Services Guidelines*), but in the seasoning standards section at the Haji Government Hospital Makassar are missing because the nutrition installation at the Haji Government Hospital Makassar is in the renovation stage so the seasoning standards are lost. However, the cooks have memorized the spice standards that have been set by the hospital and these spice standards are immediately updated by the nutrition installation.

Food Needs Planning and Determining Production Amounts

Food needs planning is a series of activities to determine the type and quantity of food ingredients with specified quality within a certain period of time. This planning is done by calculating the food requirements needed in terms of quality and quantity.

Food needs are differentiated between raw food and dry food. To find out what food ingredients are needed, you have to start from planning the menu first, then move on to calculating food ingredient needs and ordering, purchasing, receiving and storing. Then the food is processed according to the menu and plans that have been made and then distributed to the patient's room.

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Food Budget Planning

When preparing costs for food services, they must be prepared and planned as well as possible to maintain the smooth running of food operations and must be made in a flexible, realistic (implementable) manner and continuously monitored and carried out with full responsibility so as not to cause problems in the future.

Haji Government Hospital Makassar has fulfilled the prerequisites for implementing food budget planning, namely data on the type and number of consumers/patients, determining the type and number of consumers/patients, determining food prices based on market surveys, then determining the average price of foodstuffs, guidelines for the net weight of food used and converted to gross weight, the existence of a food price index per person per day, the existence of a yearly budget, the existence of budget reporting.

Table 2. Menu planning prerequisites

Menu Planning Prerequisites	Explanation
Hospital Feeding Regulations (PPMRS)	Guidelines set by hospital leadership as a reference in food service.
Portion standards Recipe standard Seasoning standards	Portion standards, recipe standards and seasoning standards are available in hospitals which are posted on the wall to make it easier for processors to see them. However, for the seasoning standards, due to the nutritional installation in the rehabilitation process, the seasoning standards have been lost but need to be improved.

Table 3. Prerequisites for food needs planning and determining production amounts

Food Needs Planning and Determining Production Amounts Prerequisites	Explanation
There is a list of menu cycles per 10 days	The menu cycle that has been recorded becomes the basis for the list of food ingredients they will order,
Prepare food ingredient specifications	They have all types of food ingredients, and their ordering times are different. For example, for wet food ingredients they order single use per day and dry food ingredients at the beginning of the month.
Price index and policy	There are decrees and SPOs related to price index, nutritional value and food supply policies, they are said to be good enough to meet food needs. All the provisions they carry out are guided by PGRS, the proof of which is in the documentation section
Contract for groceries	The budget for the Haji Government Hospital Makassar is calculated through the BLUD and APBD from the total number of beds in the hospital.If food items are damaged, they will be returned and re-weighed

Table 4. Steps for food budget planning activities

Steps for Food Budget Planning Activities	Explanation
Collect data about the type and number of consumers/patients in the previous year	The total number of patients in 2022 at Haji Government Hospital Makassar, both BPJS and general, is 35,812,474.
Determine the type and number of consumers/patients. Collect prices of food ingredients from several markets by conducting a market survey, then determine the average price of food ingredients.	Market surveys were carried out in 3 markets, namely 2 traditional markets, 1 modern market to compare the lowest and highest food prices and then include them in budget planning.
Create a guideline for the net weight of the food used and convert it to gross weight	Before ordering food ingredients, food ingredients can be seen in DKBM, from DKBM we can see how much gross weight, how much net weight. For example, the gross weight of a fish of 100 grams means that 70 percent is edible (BDD) and 30 percent is inedible, so the gross weight is reduced to 30 percent. After cleaning and cooking, it will shrink so that the net weight becomes 50 grams which is ready to be eaten by the patient.
Calculate the food price index per person per day	The daily food index for Super VIP is IDR. 124,000, VIP Rp. 114,855, Class 1 Rp. 100,015, Class 2 Rp. 70,600, Class 3 Rp. 54,853.
Calculate a year's food budget	1 year budget planning is obtained from 1 month budget for all patients with different classes then multiplied by 12 months.
The results of the budget calculation are reported to the decision maker	The results of budget calculations are reported to decision makers by the head of the nutrition installation and administrative staff.

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Grocery Order

Ordering food ingredients is the activity of preparing requests (orders) for food ingredients based on menus or menu guidelines and the average number of existing consumers or patients. The aim of this activity is to provide a list of orders for food ingredients in accordance with established standards or specifications (Ministry of Health, 2007).

From this table it can be seen that Haji Government Hospital Makassar has fulfilled all the prerequisites for ordering food ingredients except one, namely, ordering food ingredients for 1 menu period.

Food orders are made at the nutrition installation and orders are adjusted to the number of patients at Haji Government Hospital Makassar and according to patient needs.

Table 5. Prerequisites for Grocery Order

Prerequisites for Grocery Order	Explanation
There is a hospital policy regarding food procurement procedures	Haji Government Hospital Makassar in the nutrition installation already has procedures for procuring food ingredients and already has its own policies in accordance with SOP and PGRS.
Availability of funds for food	Haji Government Hospital Makassar has funds for food for patients and already has tenders through BLUD and ABPD.
There are specifications for food ingredients	There are food ingredient specifications that have been determined, but the reception section of Haji Government Hospital Makassar no longer sees the specifications printed on sheets of paper every time goods are received because the ingredient reception officers have memorized each ingredient specification.
There is a menu and the amount of food ingredients needed during a certain time period	The menu and the amount of food needed by the patient are available 3 times a day, morning, afternoon and evening. It is according to the menu, orders for food ingredients are ordered only for those needed by the patient or consumer and do not order food ingredients if they do not match the menu
There is an order for food ingredients for 1 menu period	None because the menu period is 1 year while wet food ingredients are ordered every day while dry food ingredients are ordered at the beginning of every month.

Grocery Receiption

Receiving food ingredients is a series of activities to research, check, record and report food ingredients that have been stipulated in the contract letter (Sales Purchase Agreement). The aim of receiving food ingredients is the availability of food ingredients to be distributed according to specified specifications, safe to use, durable and ready to be used according to demand.

Table 6. Steps for receiving food ingredients

Grocery Receiving Steps	Explanation
Checking food ingredients after they arrive	Food ingredients that are received and have been weighed are immediately taken to the processor for processing. If there are remaining materials, they will be stored in the storage warehouse
Provide marks on food purchase invoices as received	The food ingredients received will be marked on the invoice and adjusted to the specifications or purchase list and if there are food ingredients that are unsuitable, lacking, or rotten, they will be noted down for ordering the next day or brought on the same day.
Send the food ingredients received to the storage section if there are ingredients that are not used immediately	Food ingredients that are received and are suitable but do not want to be processed or have leftovers from processing will be immediately put into the food storage warehouse.

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Food Ingredient Storage

Food storage is a procedure for arranging, storing, maintaining dry and wet food ingredients as well as recording and reporting them. Once food ingredients that meet the requirements are received, they must be immediately taken to the storage room, warehouse or cold room.

Table 7. Food storage steps

Steps for Storing Foodstuffs	Explanation
Once food ingredients that meet the requirements are received, they are immediately taken to the storage room, warehouse or cold room.	After the food ingredients are received, they are immediately taken to a storage room such as a cupboard and also a freezer. However, if the food is processed directly, it is given to the processing place and if there is any leftovers, it is then stored back in dry food storage.
If food ingredients are to be used directly, after being weighed and checked, they are taken to the food preparation room.	After the food ingredients are received, they are weighed and if the food ingredients are suitable and want to be processed immediately, they will be immediately taken to the preparation room according to how much will be processed, and if there are any leftovers, they will be stored back in the storage warehouse. However, usually in Haji Government Hospital Makassar, ingredients are used for single use and cooked at that time, for example, in the morning when they are cooked, the ingredients will be used up that morning.

Food Processing

Food processing consists of preparing food, cooking food, to distributing food.

Food ingredients to be cooked are taken from the dry ingredients warehouse or wet ingredients according to the menu that day. According to the results of the researcher's observations, the food ingredients to be processed are cleaned/washed first according to the existing SOP. Standard portions, recipes, seasonings already exist. The menu and portion standards have been posted on the wall to make it easier to see.

Haji Government Hospital Makassar uses a 10 day menu cycle (plus 11 days for the 31st) and the menu is posted on the wall to make it easier for the staff on duty to see it. Food Additives (BTP) are not used because up to now there is no need for Food Additives.

Table 8. Food Ingredient Preparation

Prerequisites for Food Preparation	Explanation
Availability of food ingredients to be prepared	Food ingredients to be prepared are taken from dry warehouses and wet warehouses
Availability of preparation space and equipment	There is an equipment area, spice area, and filtered porridge area
Availability of fixed procedures	There are fixed procedures from the hospital (SOP)
Availability: • Portion standards • Recipe standard • Seasoning standards • Preparation schedule • Cooking schedule	Portion standards, recipe standards, seasoning standards, preparation schedules and cooking schedules for food ingredients are available in this hospital which are posted on the wall to make it easier for processing staff to see them.

Table 9. Prerequisites for cooking food

Prerequisites for Cooking Food	Explanation
Availability of menus, menu guidelines and menu cycles	Menus, menu guidelines and menu cycles are available and use a 10 day menu cycle (plus 11 days for the 31st)
Availability of cooked food	Food ingredients to be cooked can be taken from dry and wet warehouses. Food ingredients received that day can be taken directly to processing according to the menu
Availability of food cooking equipment	There is a place for cooking utensils and cutlery
Availability of rules for assessing cooking results	In assessing the results of cooking, patients are given a questionnaire which is distributed once a month
Availability of fixed cooking procedures	There are fixed procedures for cooking food that have been established in the hospital
Availability of regulations on the use of additional food ingredients (BTP)	Not yet available regulations on the use of Food Additives (BTP) because they are not needed

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Food Distribution

The distribution system used by the nutrition installation at Haji Government Hospital Makassar is a centralized system, where food is divided and served on cutlery (plates and boxes) in the production room (nutrition installation). Even though it does not comply with the SOP, patients on the 2nd and 3rd floors do not use rice cardboard plates because the lift is damaged and there are not enough distribution staff. This rice box is also used for infectious patients.

Table 10. Prerequisites for food distribution

Prerequisites for food distribution	Explanation
Availability of hospital feeding regulations	There are 2 SOPs, namely managing food processing and distribution, and handling food and cutlery for patients with infectious diseases
Availability of portion standards set by the hospital	There are staple food ingredients of animal, vegetable, nuts, vegetables and oil
There are rules for taking food	Using a centralized system
There is a list of patient food requests	In the form of a table containing the patient's name, class/room, date of birth, type of food.
Availability of equipment for food distribution and food equipment	The number of cutlery utensils is 120 plates, rice boxes are adjustable, and there are 3 push trolleys
There is a distribution schedule	The schedule is taped to the wall

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ID: 253

Molecular and Pomological Characterization of Blueberries and their Role in Hidden Hunger

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Abstract

Blueberries are commercially important fruit crops grown worldwide that belong to the genus Vaccinium L. section Cyanococcus characterized by diploid, tetraploid and hexaploid levels, and different colourization and pigmentations. They function in regulating and serving immune signalling and defence mechanism purposes against pathogenic invasions. They also help to maintain and improve cognitive functions in humans. They are characterized by high amounts of flavonoids, anthocyanin pigments among other phytochemicals which confer abiotic stress tolerance and beneficial human health promoting precursors. Peculiar to blueberries is their eminent role in hidden hunger and nutritional deficiencies alleviation especially in low income and developing economies. Despite the invaluable role of blueberries, there has been a major focus on the traditional horticultural crops to the neglect of blueberries. A research gap therefore exists in the morphological, physiological, molecular, and pomological studies of blueberries for optimum ecological and biodiversity balance and human benefits especially in the endemic areas of hidden hunger. This study extensively reviewed the molecular and pomological characterization of blueberries. It also reviewed their application and prospects for hidden hunger alleviation, mechanisms to increase their yield, abiotic stress tolerance and food security achievement. It was revealed that intake of blueberries improves weight, reduces risk of cardiovascular diseases, neuroprotection and maintenance, anti-inflammatory and antioxidant actions, beneficial effects on vascular and glucoregulatory function, contribute to host health and reduce socioeconomic burdens. This research laid the foundation and provided gaps for research focus to address the impounding effects of hidden hunger especially in developing nations. It concludes on the need for further and pragmatic actions to increase breeding and research efforts on blueberries especially in the endemic zones of hidden hunger.

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Seed priming through selected bio-control agents for the eco-safe management of leaf rust disease in wheat

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Abstract

Wheat (*Triticum aestivum*) is the staple food in Pakistan and is also one of the important crops in the world. It provides basic nutrition to a vast population as it is a good source of carbohydrates, proteins, and dietary fibers. In 2023, nearly 27 million tons of wheat were predicted to be produced in Pakistan. In Pakistan, fungal rusts are considered as major constrains in the wheat production. Wheat is affected by three types of rusts via; Leaf rust (Brown rust), Stem rust (Black rust) and Stripe rust (Yellow rust). Out of the three forms of rusts, leaf rust is the major fungal rust disease caused by *Puccinia triticina*. Under favorable environmental conditions, leaf rust causes yield losses up to 40%. The objective of the study was to investigate role of biocontrol agents (BCAs) in the control of leaf rust in wheat varieties. Natural and engineered resistance is reported in some of the famous wheat varieties which is compromised with time due to genetic changes in the rust pathogen for use of BCAs to enhance plant resistance against rust could be an interesting approach. In the current work, four wheat varieties were treated with different BCAs and were sown in the field conditions along with necessary control treatments. Seed of four different varieties were collected and seed priming with BCAs was carried out and seeds were sown by following randomized complete block design (RCBD) in the field conditions. Artificial inoculation of rust was applied by rubbing and spraying method at booting stage. Disease severity was measured with Cob's scale and other morpho-physiological plant characters were also recorded for comparison. Data for disease associated and morph-physiological traits were recorded and subjected to statistical software. For this purpose statistics 8.1 software was used. It was statistically examined for analyses of variance technique and comparison with treatment using Least Significance Difference (LSD) at probability level of 5%. The results showed significant impact of BCAs in the control of rust disease in commercial wheat cultivars. The results demonstrated that variety Akbar-19 showed highest resistance against leaf rust and application of *T. harzianum* led to maximum control of the disease. The present findings are a way forward for environment friendly management of leaf rust disease in wheat.

Keywords: *Wheat, Leaf rust, biocontrol agents, seed priming, disease severity, morpho-physiological parameters, crop management.*

ID: 256

Verification of Regcm Model with Observation Data for Çukurova Region

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Abstract

Çukurova region is one of the major agricultural production regions in Turkey. In addition to extreme weather conditions, such as drought and flood, lower and/or severe rainfall along with increased temperature due to global climate change affects agricultural production. The aim of this study is to predict the climate of Çukurova Region for the period between 2071 and 2100 and determine the effects of climate change on the first and second crop corn yields, using the regional climate model, RegCM3. Model applicability was tested by means of some test studies and verification processes. The RegCM model predicts mean maximum, mean minimum, maximum, and minimum temperatures with deviations ranging from 2.8 to -4.3, 9.2 to -7.5, 14.6 to -4.3, 8 to -8.3 and 14.3 to -5.4 ºC respectively compared to the observations for the reference period. Thus, RegCM3 has been found to be appropriate for climate change predictions in the Cukurova District. The results of rainfall simulation were closely related to topography.

Keywords: *RegCM, regional climate model, verification, Çukurova, temperature, precipitation*

Çukurova Yöresi Için Regcm Modelinin Gözlem Verileriyle Verifikasyonu

Özet

Çukurova Yöresi ülke ekonomisine önemli katkı yapan başlıca tarımsal üretim bölgelerinden biridir. Kuraklık, sel gibi ekstrem hava olaylarının yanı sıra iklim değişikliği nedeniyle daha az ve şiddetli yağışların artan sıcaklıkla birleşmesi tarımsal üretimi olumsuz etkilemektedir. Bu çalışmada bölgesel iklim modeli RegCM3 kullanılarak Çukurova Yöresi'nde 2071-2100 yılları arasındaki iklimi kestirmek ve iklim değişikliğinin 1. ve 2. ürün mısır verimine etkisini belirlemek amaçlanmıştır. Çalışmada RegCM modelinin Türkiye için kullanılabilirliği çeşitli test ve doğrulama çalışmalarıyla denenmiş ve modelin referans dönemi için ortalama, ortalama maksimum, ortalama minimum, maksimum, minimum sıcaklıkları sırasıyla 2.8 ile -4.3, 9.2 ile -7.5, 14.6 ile -4.3, 8 ile -8.3, 14.3 ile -5.4 (ºC) arasında değişen aralıklarda farklı benzeştirdiği gözlenmiştir. Yağış benzeşim sonuçlarının tutarlılığının topoğrafik yapıyla yakından ilgili olduğu belirlenmiştir.

Anahtar Kelimeler*: RegCM, bölgesel iklim modeli, verifikasyon, Çukurova, Sıcaklık, Yağış*

ID: 260

Analysis and Evaluation on Invasive Beetles (Insecta: Coleoptera) in Türkiye

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Abstract

Insects, which are the most crowded group among the creatures living on the world, have always been successful by adapting to changing environmental conditions. They are in balance in their natural habitat. However, they can cause significant problems if they are moved from their areas to other places. In the last fifty years, many biotic factors, including insects and fungi transported from other countries and even continents, have caused and continue to cause significant damage in Turkey. In this study, it is aimed to analyze and evaluate the insect taxa: *Phoracantha semipunctata* (Fabricius, 1775), *Phoracantha recurva* (Newman, 1840), *Cordylomera spinicornis* (Fabricius, 1775), *Xylotrechus stebbingi* (Gahan, 1906), *Phryneta leprosa* (Fabricius, 1775), *Anoplophora chinensis* (Forster, 1771), *Anoplophora malasiaca* (J. Thomson, 1865), *Batocera rufomaculata* (DeGeer, 1775), *Dendroctonus micans* (Kugelann, 1794), *Rhynchophorus ferrugineus* (Olivier, 1790), *Leptinotarsa decemlineata* (Say, 1824), *Harmonia axyridis* (Palias, l773), *Xylosandrus* ***Compactus*** (Eichhoff, 1875) which are recorded as invasive insects from Turkey

Keywords: *Fauna, Ecology, Invasion, Insecta, Coleoptera*

ID: 261

Agricultural Biodiversity and the Role of Insect Taxa of Derinkuyu District (Cappadocia:Nevşehir)

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Abstract

Biodiversity refers to the diversity of different forms of life, species, genes and ecosystems. This diversity includes the differing characteristics, structures and functions of all living organisms on Earth. Derinkuyu District, located in the Cappadocia Region, provides a suitable environment for the cultivation of various cultural and wild plant species in terms of geographical location, ecological - economic structure. This situation allows a rich agricultural biodiversity and various insect taxa can play the most important role here. Conservation of local biodiversity and agricultural biodiversity is of great importance because it contributes to the functioning of ecosystems, the food health of people, the production of medicines and many economic benefits. However, factors such as human activities, habitat loss, pollution, overfishing and climate change threaten biodiversity. In this context; the main purpose and content of this study; is to analyse the agricultural biodiversity of Derinkuyu district, which is located in the Cappadocia Region- Nevşehir province, in terms of interaction processes with various insect taxa.

Keywords: *Agriculture, Ecology, Sustainability, Biodiversity, Derinkuyu*

ID: 262

The Effects of L-carnitine Supplementation into Drinking Water on Growth Performance and Immunologic Parameters in Broilers

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Abstract

The aim of this study is to investigate the effects of the L-carnitine supplementation as liquid form into drinking water on broiler growth performance and serum immunoglobulin levels. In the study, a total of 240 one-day old Ross 308 chicks were randomly classified into two experimental groups as the control and L-carnitine supplementation group. Each experimental group was consisted of 4 pens, each consisting 30 chicks per pen. The L-carnitine in liquid form was added into drinking water as daily with an amount of 0.2 l liquid product per 100 l drinking water, for 3 days in each week until 35 days of age. At 35 days of age, final body weight was found to be higher in broiler treated with L-carnitine compared to the control group (2183.7 g vs. 2051.7 g, $P<0.05$). On the other hand, any significant differences observed for body weight, cumulative feed consumption and feed conversion rate. The broilers treated with L-carnitine had higher levels IgA, IgG and IgM than the broilers in the control group at 35 days of age (34.4 vs. 28.9; 118.9 vs. 108.6; 5.9 vs. 5.0 mg/dl respectively, P<0.01). Regarding with observed current findings, L-carnitine could be recommended as immunomodulatory additive with providing higher body weight gain in broiler production.

Key Words: *Broiler, L-carnitine, body weight, immunity, immunoglobulin.*

Introduction

Due to the rapid growth of human population around the world, poultry meat has increasingly gained importance as a major source of animal protein. At that point, one of the most important production options is poultry, especially poultry meat that is obtained from broiler and turkey production. This increased demand requires more efficient production with a rapid growth, better of feed efficiency, a bigger size of breast muscle, a decline in abdominal fat, a strong immunity with a lower risk of diseases in broilers (Ghoreyshi et al., 2019), with aiming to reduce production cost (Golzae Adabi et al., 2011).

To achieve the best performance in broiler production, some feed alternatives have become a recent topic in nutrition field, due to the banning of antibiotics in 2006 as growth promoters in animal nutrition (Fonseca et al., 2010; Ganan et al., 2012). At that point, some feed additives have been largely investigated for their beneficial effects on production parameters, pathogen control and better of health status of the birds. Therefore, the most effective tool could be use the feed alternative which could act as immune modulators, to provide a strong and well-functional immune system.

In recent time, L-carnitine that is the biologically active form of the carnitine, is synthesized from L-carnitine precursors (Borum, 1983; Feller and Rudman, 1988) including lysine and methionine, in the liver, kidney an brain (Cave et al., 2008). It is known that it takes important roles in many of metabolic processes, for example, lipid metabolism, energy utilizing, stimulation of immunity, enhancing of health status, improving feed efficiency and so on (Khatibjoo et al., 2016; Mirzapor Sarab et al., 2016). Some previous reports clearly found beneficial effects of L-carnitine in broiler nutrition as decline in feed consumption (Khatibjoo et al., 2016; Mirzapor Sarab et al., 2016), an increment in final body weight and improvement in feed efficiency and carcass characteristics (Hrncar et al., 2015). The aim of this study to investigate the potential effects of L-carnitine in liquid form which was supplemented into drinking water, on production performance and immune status of broilers.

Materials and Methods

The experiment was conducted at the farm of the Bursa Uludağ University of Agriculture Faculty, in Bursa (Turkey). A total of 240 one-day old Ross 308 broiler chicks were randomly placed in 8 floor pens with a floor space of 2.0 × 2.0 m to provide 4 replicated with 30 broilers (15 male/15 females) per pen. The chicks were weighed using a balance at ± 0.1 g precision, and then randomly allocated to the pens.

The chicks were classified into two experimental groups as control (no supplementation of L-carnitine) and supplementation of L-carnitine into drinking water. The content of L-carnitine was showed in Table 1. The L-carnitine in liquid form was added into drinking water as daily with an amount of 0.2 l liquid product per 100 l drinking water, for 3 days in each week during experimental period, according to the recommendation of

producer's company. The broilers received a standard crumbled starter feed (22.0% CP and ME 12.9 MJ/kg of diet, from day 1 to day14) and a grower feed (20.0% CP and ME 13.5 MJ/kg of diet, from day 15 to day 35), based a corn-soybean meal. Water and feed were offered ad libitum throughout the experiment.
Under controlled environmental conditions, house temperature was maintained 33°C at 1 days of age, gradually decreased by 3°C per each week, and then maintained at 20°C. The relative humidity was 50–60% until the end of the experiment. As litter material, wood shavings were laid at a thickness of 7–8 cm on the floor. The lighting schedule was applied according to the recommendations explained in the company's management guides.

Table 1. The content of L-carnitine (g/l)

Content	Amount
Sorbitol	250 g
L-carnitine	50 g
Magnesium sulfate	125 g
Sodium chloride	1 g
Aromatic compounds	10 g

Growth performance
The body weight and feed consumption of each pen were measured by weekly basis until the end of the 35 days of age. According to the measurements, body weight gain and cumulative feed consumption were also recorded as weekly basis. Feed conversion rate (FCR) was given as ratio between body weight gains and feed consumption as weekly basis.

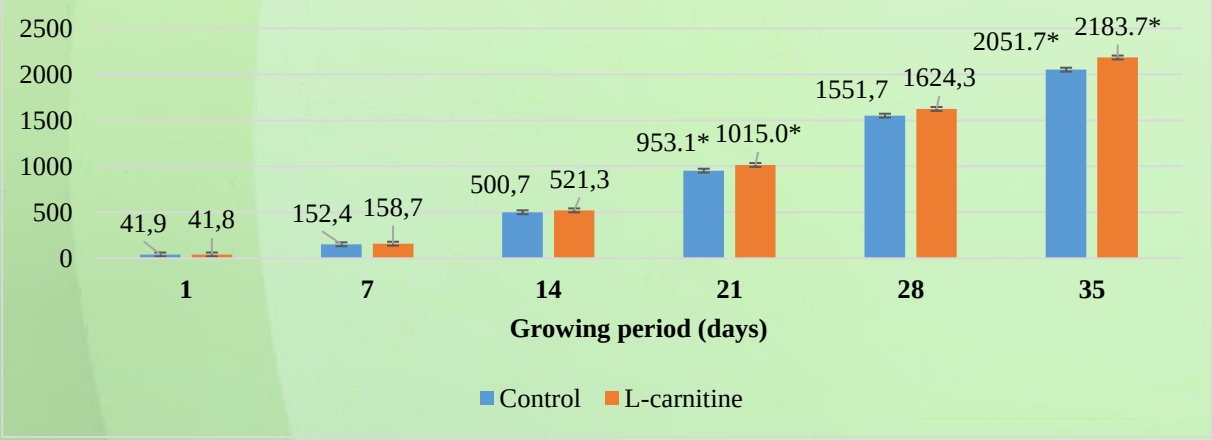
Plasma immunoglobulin levels
The level of plasma immunoglobulins (IgA, IgG, and IgM) was analyzed by using a commercial kit (Roche Cobas 6000 E601, Roche Diagnostics, North America) according to the method explained Mountzouris et al. (2010).

Statistical analysis
In the study, statistical analysis for significant differences was performed by the paired t-test in SAS program (SAS institute, 2002). The mean values of growth performance and serum immunoglobulin levels were compared between control and L-carnitine supplementation groups. For growth performance, each experimental pen was considered as a replicate, whereas each broiler was accepted as a replicate for serum immunoglobulin levels in the experiment. In all cases, a difference was considered significant at $P<0.05$.

Results and Discussion

The current results clearly showed that L-carnitine supplementation could enhance the final body weight and also show an immune-modulatory effect by increasing of serum immunoglobulin levels in broilers. The mean value of body weights of broilers was shown in Figure 1. The body was found to be similar at 1, 7, 14, and 21 days of age, whereas a higher body weight was observed in L-carnitine group than the control group at 21 (1015.0 g vs. 953.1 g) and 35 (2183.7 g vs. 2051.7 g) days of age ($P<0.05$).Similar findings for a higher final body weight were reported by Hrncar et al. (2015) and Kamal et al. (2019). Hrncar et al. (2015), the L-carnitine supplementation into drinking water with an amount of 1 ml per 1.2 l water caused an increment in the final weight, improvement in FCR. However, non-significant differences were observed feed consumption and FCR in this study. Contrarily to our results, other studies found a positive effect for reducing feed consumption and FCR (Ghoreyshi et al., 2019). Other performance parameters as body weight gain and feed consumption were given in Table 2. The body weight gain between 1-14 days and 14-35 days, cumulative feed consumption and FCR at 14 and 35 days of age was found to be similar for control and L-carnitine groups ($P>0.05$). Similar to our results, Parsaeimehr et al. (2014) found any effects for body weight during the 3 three weeks, but a significant effect for body weight between 21-42 days with L-carnitine supplementation (0, 150, 300, 450 and 600 mg/kg of L-carnitine). Besides, any significant effects were observed for feed consumption and FCR during the experimental period.
The serum immunoglobulin levels of broilers at 35 days of age were shown in Figure 2. As seen in the figure, L-carnitine supplementation was resulted in an increment for IgA, IgG, and IgM ($P<0.05$).
These results clearly showed that L-carnitine supplementation showed an immune-modulatory effect in broilers. Similarly, Azizi-Chekosari et al. (2021) investigated the different amounts (200 mg/kg and 400 mg/kg) of L-carnitine on immunoglobulin levels at 35 and 42 days of age in broilers. The broilers fed with 400 mg/kg L-carnitine has a higher level of total Ig and IgG at 42 days old compared to the broilers fed with 200 mg/kg L-carnitine. Similar results were also reported by Mast et al. (2000). The authors concluded that the dietary L-carnitine administration had an immune-modulatory effect on antigen-specific total Ig and IgG responses.

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value of body weight (g) of experimental groups during growing period. Each bar represents Figure 1. Mean mean ± SEM; * indicate significant differences at P < 0.05.

Table 2. Body weight gain and cumulative feed consumption of experimental groups

Experimental groups	Body weight gain (g/bird)		Cumulative feed consumption (g/bird)		FCR	
	Day 1-14	Day 14-35	Day 14	Day 35	Day 14	Day 35
Control	458.8	1627.0	578.3	3298.3	1.17	1.83
L-carnitine	479.5	1662.3	604.0	3161.3	1.16	1.72
SEM	11.0	68.8	15.2	66.1	0.05	0.14
P value	0.083	0.563	0.107	0.064	0.890	0.381

n: 4 experimental pens/experimental group.

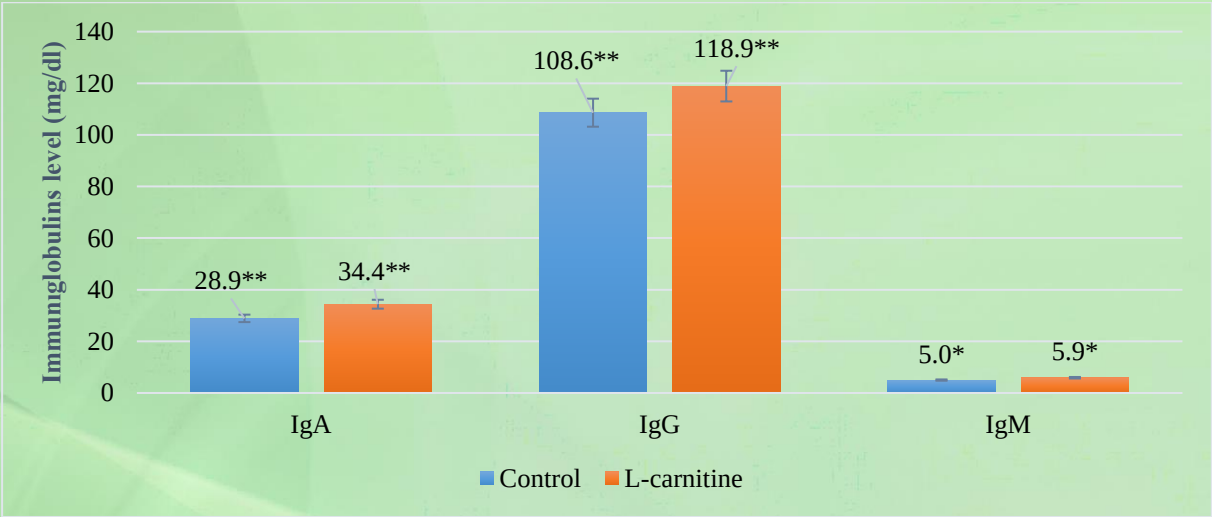


Figure 2. Mean value of immunoglobulin's of broilers at 35 days of age. Each bar represents mean ± SEM; *, ** indicate significant differences at P < 0.05, P < 0.01.

Conclusion

The L-carnitine supplementation into drinking water improved final body weight and immune status of broilers. The L-carnitine amount was applied as 0.2 l liquid product per 100 l drinking water, for 3 days in each week during experimental period. These evidences could be indicator for beneficial effects of L-carnitine supplementation for a strong immunity against diseases or stress factors under commercial production conditions.

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ID: 263

Exploration of two *Cucurbitaceae* fruit (muskmelon and watermelon) seeds for presence of phytochemicals, and antioxidant and antimicrobial activities

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Abstract

Cucurbitaceae family fruits, especially melons, offers significant quantities of minerals carotenoids and phenolic compounds, contributing to their antioxidant activity. However, seeds of these fruits are usually discarded as waste by products. In current study seeds of watermelon (*Citrullus lanatus*) and muskmelon (*Cucumis melo*) were separated, dried, grounded and extracted with 70% ethanol, to investigate total phenolic content (TPC), flavonoid content (TFC), carotenoid content (TC) contents and total antioxidant activity (TAA). Further antimicrobial activities of these extracts were tested against selected bacterial and fungus strains. Results showed that extracts of both cucurbits presented significant amounts of phytochemicals, with higher quantities presented by watermelon seeds. In watermelon seeds, TPC were found 156.50 mg/GAE 100 g, TFC 56.78 mg CE/100 g, TC 36.65 mg/100 g and TAA 71%, and these amounts were significantly lower than those found in muskmelon seeds. Antimicrobial study results showed that extracts of both seeds exhibited significant zone of inhibitions against two bacterial and two fungal species, and these values were very comparable to the reference antimicrobial drug used Ciprofloxacin. Findings of current research work provided significant grounds for presence of phytochemical bioactives in two melon fruits seeds, providing the basis for extraction and utilization of these bioactives, through processing and fortification different pharma foods.

Keywords: *Watermelon; Muskmelon; Seeds; Phytochemistry; Antimicrobial*

ID: 264

Visualization of interaction between Pochonia Chlamydosporia and Meloidogyne incognita and their impact on tomato crop

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Abstract

In present studies, the biocontrol potential of *Pochonia Chlamydosporia* was evaluated against *Meloidogyne incognita*. In *invitro* condition, *P. chlamydosporia* was tested for parasitism of eggs and females of *M. incognita*. The result indicated that this fungus parasitized 87% eggs and 82% females. Culture filtrate (CF) of *P. chlamydosporia* was tested for its larvicide activity at four different concentrations i.e., 25, 50, 75 and 100 % against *M. incognita* 2nd stage juvenile. The mortality of 2nd stage juvenile was directly proportioned to the concentration of the CF and to the duration of exposure. The maximum mortality was 97.3% at 100% concentration of the culture filtrate after 96 hours followed by 86.6% at 75% concentration. While minimum mortality was 7.3% in 25% concentration after 24 hrs. The result of the pot experiment proved that *P. chlamydosporia* has reduced the incidence of RKN and improved all tested agronomic growth parameters. The treatment with inoculated *M. incognita* alone reduced plant height, fresh shoot, and fresh root weight by 44.7%, 29.8%, and 32.8% respectively over uninoculated healthy control. *P. chlamydosporia* improved all the tested growth parameters in presence of *M. incognita*. Histopathological studies on the interaction of *Pochonia chlamydosporia* and *Meloidogyne incognita* on tomato roots revealed anatomical changes among treatments. Less number of galls with small in size and scarcer abnormalities in the vascular cylinder was observed in plants inoculated with *P. chlamydosporia* and *M. incognita* than the plants treated with nematode only. The fungus was seen in in the intercellular spaces of cortical and epidermal cells while the vascular bundles of the plant remain intact, inoculated only with *P. chlamydosporia*. The plants treated with both fungus and *M. incognita*, *P. chlamydosporia* was found in the vascular region affected by the nematode. In the infected roots, many mature females were seen which feed on giant cells. The findings also revealed that control healthy plants were not affected and no histological changes were noted.

Key words: Histopathology, *Pochonia chlamydosporia*, *Meloidogyne incognita*, tomato

ID: 266

Çağdaş Ofis Tasarımı Üzerine Bir Uygulama Projesi Örneği

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Özet

Ofis mekânları sürekli değişen, yenilenen ve yoğun bilgi akışının ön planda olduğu, farklı boyutlardaki hiyerarşik ilişkilerin kurulduğu ortamlardır. Gelişen teknoloji ile ofislerin sadece çalışma mekânı değil, aynı zamanda yaşama mekânı olarak da düşünülmesi günümüz ofislerinde iç mekân tasarım yaklaşımlarını değiştirmiştir. Bu çalışma kapsamında ofis kavramı ve gereksinimleri, çağdaş ofislerde iç mekân tasarım yaklaşımları tanımlamaları ile birlikte Konya'da yer alan bir mimarlık ofisi için yapılan iç mekân tasarımı ve uygulama süreci yapılacaktır. 1985 – 1990 yılları arasında Çınar Mimarlık olarak Konya'da aktif olan firma, 1995 yılından bu yana Kerimler Planlama İnşaat Danışmanlık Şirketi olarak halen Konya'da hizmet veren bir şirkettir. Şirketin taşınacak olan yeni yeri için bir iç mimari projelendirme istemiştir. Bulundukları ofis günümüz koşullarında eskime sürecine girmiş ve kullanıcıların yeterli fiziki imkânı sağlayamaz durumdadır. Yeni ofis için iç mekân tasarımında çalışan- işveren ayrımı gözetmeden esnek ve konforlu bir ortamda beraber çalışabilecekleri mekânlar öncelikli amaç edinmiştir. Proje Konya Meram Pirebi Mahallesinde bulunan Menekşe Apartmanının zemin katında cadde üstü dükkân olarak geçen, zemin + bodrumdan oluşan toplamda 280 m2 olan bir alandır. Yeni bir binada yer alan ofisin zemin katı 145 m2 olup güney, kuzey ve batı cephesi açık yere kadar camdır. Mekânda kolonlar duvarlara saklanmış oldukça geniş açıklık oluşturulmuş ve bu sayede mekânda girişten itibaren iki kat yüksekliği net bir şekilde algılanmaktadır. Bodrum katı 135 m2 olan ofisin arka kısmından merdiven ve asansörle bağlantı kurulmuş ve merdivene bağlı galeri boşluğu ile bodrumun doğal ışık alması sağlanmıştır. Mimarlık ofisinin, tasarım aşamasından sonra yaklaşık 6 aylık süreçte uygulanmıştır. Proje genelinde yenilikçi ve özgün fikirlerin ortaya çıkmasına olanak sağlayan, iş birliği içinde çalışmayı ön planda tutan dinamik bir çağdaş ofis çözümlemesi yapılmıştır.

Anahtar Kelime: *Çağdaş Ofis, İç Mekân Tasarımı, Uygulama Projesi.*

ID: 267

A New Approach: Ecological Well-Being: “One Health”

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Abstract

Although the history of the concept of "One Health", which is on the world agenda as a new approach, dates back to the 1800s, its development process goes back to Hippocrates (370-460 BC). It will play an important role in preventing the spread of contagious diseases originating from wildlife, especially protecting wildlife, with the understanding of health based on the concept of "One Health", which is an integrated health understanding to be created between humans, animals and ecosystems. Because at its core is the protection of “Wildlife and Ecosystem Health”. 'One Health' in the world until the 2000s, "One Medicine", between 2000-2008 "One World-onehealth / One World-One Health" has been on the agenda. In the international literature, after 2008, it started to be used as "One Health". Fundamentally and deeply, the single health approach; as we can express it as the state of ecological well-being or, in a broader perspective, as “Ecological Well-being”. Ecological well-being is important for maintaining health and preventing disease. While keeping the environment healthy helps people live a healthy life, reducing ecological problems such as environmental pollution, climate change and loss of biodiversity can prevent negative effects on human health. Therefore, the relationship between ecological well-being and health requires people to protect the environment and adopt a sustainable lifestyle for a healthy future. In this study, “One Health” approach will be examined with its different dimensions, based on the idea that the healthy continuity of the whole ecosphere is the basic requirement for the continuity of human health.

Keywords: *Ecology, Zoonosis, Ecosystem, Sustainability, Health*

ID: 269

Greyfurt Kabuğu Tozundan Ohmik Isıtma Yöntemi ile Pektin Ekstraksiyonun Optimizasyonu

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Özet

Ticari olarak pektin üretimi, elma ve/veya turunçgillerden yüksek sıcaklık değerlerinde ve uzun işlem sürelerinde ekstrakte edilerek elde edilmektedir. Ancak pektin üretimi sırasında yüksek sıcaklık ve uzun işlem süresi uygulaması ile elde edilen pektinin kalite özellikleri azalmaktadır. Ek olarak, uzun işlem sürelerine bağlı olarak ekstraksiyon işlemi için gerekli olan enerji miktarı da artış göstermektedir. Ticari pektin üretiminin sahip olduğu bu dezavantajlar, araştırmacıları yüksek basınç, mikrodalga ve ohmik ısıtma gibi alternatif ısıtma yöntemleri ile ekstraksiyon işlemlerine yöneltmiştir. Mevcut çalışma limon kabuğu tozu örneklerinden ohmik ısıtma destekli ekstraksiyon yöntemi ile pektim maddesinin ekstraksiyonunu optimize etmeyi amaçlamıştır. Greyfurt yerel bir marketten temin edilmiş ve laboratuvara getirilmiştir. Daha sonra greyfurt kabuğu, yıkama, soyma, kurutma ve öğütme işlemine tabi tutulmuştur. Bu çalışmada, sabit sıcaklık (80°C) ve sülfürik asit ile ayarlanmış pH (pH=1) değerinde, optimum ekstraksiyon yönteminin belirlenebilmesi için 3 farklı voltaj gradyanı (7, 9 ve 11 V/cm), 3 farklı katı:sıvı oranı (1:20 g/ml, 1:40g/ml ve 1:60 g/ml) ve 3 farklı bekletme süresinin (0, 90 ve 180 dak.) etkisi ve etkileşimleri araştırılmıştır. Optimizasyon prosedüründe incelenen faktörler ise pektin verimi, güç tüketimi ve enerji verimliliğidir. Optimum ohmik ısıtma destekli ekstraksiyon koşulunun 0.789 istenilirlik değeri ile 11 V/cm voltaj gradyanı, 1:40 g/mL katı:sıvı oranı ve 90 dakikalık bekleme süresinde elde edilmiştir. Elde edilen sonuçlar doğrultusunda pektin verimi, güç tüketimi ve enerji verimliliği değerlerinin ohmik ısıtma destekli ekstraksiyon işleminin verimliliğini etkileyen önemli parametreler olduğu belirlenmiştir. İleriki çalışmalarda farklı ürün grupları içinde optimizasyon prosedürünün uygulanarak farklı örneklere ait optimum çalışma koşullarının belirlenmesi önerilmektedir.

Teşekkür: Bu çalışma TÜBİTAK 218O135 nolu proje kapsamında finansal olarak desteklenmiştir.

ID: 270

Portakal Kabuğu Tozundan Ohmik Isıtma ile Pektin Üretiminin Termodinamik Kanunlarınca İncelenmesi

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Özet

Pektin, yeşil olmayan bitkilerin hücre duvarında ve hücreler arası bölgelerde doğal olarak bulunan kompleks yapıya sahip polisakkarit gruplardır. Ticari olarak, geleneksel pektin ekstraksiyonu işlemi pektince zengin ürünün belirli bir pH derecesi (0.7-1.5) ve sıcaklık (60 -100 °C) aralığında değişen çözgen içerisinde 1.5-3 saat süreye tabii tutularak ekstrakte edilmesi işlemidir. Geleneksel ekstraksiyon işlemi bazı dezavantajlara (ektin maddesinin yapısında bozulmalara veya pektinin kalite özelliklerinde önemli kayıplar) sahiptir. Bu nedenle alternatif güncel teknoloji uygulamalarının kullanımına yöneltmiştir. Bu bağlamda pektin ekstraksiyonu amacıyla ohmik ısıtma başta olmak üzere, ultrases, yüksek hidrostatik basınç, vurgulu elektrik alan, ılımlı elektrik alan ve mikrodalga ekstraksiyon uygulamalarının olduğu çalışmalar dikkat çekmektedir. Mevcut çalışmanın ana amacı ise 3 farklı voltaj gradyanı kullanarak portakal kabuğu tozundan pektin üretiminin yapılması ve ohmik ısıtma işleminde üretilen pektin üretiminin Termodinamiğin 1. ve 2. yasası göre değerlendirilmesi olarak belirlenmiştir. Portakal yerel bir marketten temin edilen portakal kabuğu, yıkama, soyma, kurutma ve öğütme işlemine tabi tutulmuştur. Ekstraksiyon işleminde ohmik ısıtma işlemi, 3 farklı voltaj gradyanında (7-11 V/cm), sabit sıcaklık (80°C) ve sülfürik asit ile ayarlanmış pH (pH=1) değerinde gerçekleştirilmiştir. Ekstraksiyon işleminde, endüstriyel atık kabuk toz örnekleri 1:20, 1:40 ve 1:60 g/ml 3 farklı katı:sıvı oranında karıştırılmış ve farklı bekletme sürelerinde (0-180 dak) ekstraksiyon işlemine tabii tutulmuştur. Elde edilen sonuçlara göre portakal kabuğu tozunun üretimi sırasında meydana gelen toplam enerji değişiminin 36.8-267.8 kJ arasında değiştiği enerji verimliliğinin ise %59.2-%84.5 arasında değiştiği belirlenmiştir. Burada özellikle işlem süresi arttıkça toplam harcana enerji değerinin arttığı ve enerji verimliliğinin ise artan toplam enerji değerine göre azalış gösterdiği belirlenmiştir. Termodinamiğin ikinci yasasına göre incelendiğinde ise IP değerinin artan voltaj gradyanına göre arttığı tespit edilmiştir. Özellikle performans özellikleri bakımından voltaj gradyanı ve bekleme sürelerinin önemli etkisi olduğu belirlenmiştir.

Teşekkür: Bu çalışma TÜBİTAK 218O135 nolu proje kapsamında finansal olarak desteklenmiştir.

ID: 271

Current Developments in Pomegranate Breeding and New Pomegranate Cultivars

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Abstract

Pomegranate (*Punica granatum* L.) is a member of the Punicacea family and has been cultivated since ancient times. It is known to be native to Iran, Afghanistan, Caucasus, Middle East and Anatolia. Today, it is cultivated not only in its native region but also in the Mediterranean basin, the southern coasts of Europe, the Americas, the Far East and Australia. Although it is one of the oldest known fruits, the consumption and production of pomegranate has increased since the 2000s due to its medicinal, industrial properties and healthy compounds. With the increase in pomegranate cultivation in the world, different problems have been identified. However, in recent years, many studies have been carried out on genetic resources, breeding, cultivation technique, plant protection, plant nutrition, irrigation, preservation and post-harvest. With the increasing demand for pomegranate production worldwide, many pomegranate varieties, including early, medium and late varieties, have been bred, registered and offered to producers. New pomegranate varieties have been developed especially in countries with intensive pomegranate cultivation such as India, Israel, Turkey and Spain.

***Key Words: Pomegranate**, breeding, cultivars*

Nar Islahında Güncel Gelişmeler ve Yeni Nar Çeşitleri

Özet

Nar (*Punica granatum* L.), Punicacea familyasının bir üyesidir ve çok eski zamanlardan beri yetiştirilmektedir. Narın anavatanı İran, Afganistan, Kafkaslar, Ortadoğu ve Anadolu olduğu bilinmektedir. Günümüzde sadece anavatan bölgesinde değil, Akdeniz havzasında, Avrupa'nın güney sahillerinde, Amerika kıtası, Uzakdoğu ve Avustralya da yetiştirilmektedir. Bilinen en eski meyvelerden biri olmasına rağmen, narın ilaç, endüstriyel özellikleri ve sağlıklı bileşikleri nedeniyle tüketimi ve üretimi 2000'li yıllardan sonra artmıştır. Dünya'da nar yetiştiriciliğinin artmasıyla birlikte farklı sorunlarda tespit edilmiştir. Bununla birlikte son yıllarda ıslah başta olmak üzere, genetik kaynaklar, yetiştirme tekniği, bitki koruma, bitki besleme, sulama, muhafaza ve hasat sonrası gibi konularda pekçok çalışma yapılmıştır. Dünya çapında, nar üretimine talebin artmasıyla birlikte erkenci, orta ve geççi olmak pek çok nar çeşidi ıslah edilmiş ve tescil edilerek üreticilere sunulmuştur. Yeni nar çeşitleri özellikle Hindistan, İsrail, Türkiye, İspanya gibi yoğun nar yetiştirilen ülkelerde geliştirilmiştir.

Anahtar Kelimeler: Nar, ıslah, çeşit

Giriş

Günümüzde nar yetiştiriciliği ABD, Afganistan, Çin, Fas, Filistin, Güney Afrika Cumhuriyeti, Hindistan, Irak, İran, İspanya, İsrail, İtalya, Kuzey Kıbrıs Türk Cumhuriyeti, Mısır, Suudi Arabistan, Şili, Tayland, Tunus, Türkiye ve diğer bazı ülkelerde yapılmaktadır. Dünya nar ticareti geçmiş yıllara göre daha da artmıştır. Türkiye, İran, Hindistan, İspanya, İsrail, Mısır, Tunus ve Afganistan nar ihraç eden ülkelerdir (Shokoohi and Asgari, 2021).

Dünya nar üretimi yaklaşık 8 milyon tondur. Ülkemiz bunun 2022 yılı itibariyle 681 bin tonunu üretmektedir (TUİK, 2023). Ülkemizin hemen hemen her bölgesinde nar yetiştiriciliği yapılmakla birlikte en yoğun nar yetiştirilen yerler Akdeniz, Ege ve Güneydoğu Anadolu Bölgeleridir.

Nar meyvesinin yenilebilir kısmı, daneler ve çekirdekten oluşur. Daneler su, başlıca fruktoz ve glukoz olmak üzere şekerler, pektin, askorbik asit, sitrik asit ve malik asit gibi organik asitler ve fenol, flavonoidler ve antosiyaninler gibi biyoaktif bileşikler içerir (Yılmaz, 2007).

Günümüzde meyvelerin kimyasal bileşimi ve antioksidan özelliklerine karşı olan ilgi artmaktadır. Tüketiciler biyoaktif bileşikler bakımından zengin gıdalar satın almak konusunda giderek daha fazla farkındalık kazanmaktadır. Bu yönüyle ilgili olarak nar, fonksiyonel bir gıda ve besleyici madde kaynağı olarak yaygın bir popülerlik kazanmıştır.

Ülkemizde son yıllara kadar TTSM kayıt listelerinde 43 tescilli nar çeşidi yer almaktaydı. Bununla birlikte son yıllarda BATEM ve Ege Tarımsal Araştırma Enstitüsü tarafından melezleme ıslahı ile yeni nar çeşitleri geliştirilerek tescil edilmiştir. Bu çeşitlerin bazıları nar üretim piyasasında yer bulmuştur. Günümüzde dünyadaki nar ıslah programlarının başlıca amaçları, kırmızı kabuk ve daneli, yumuşak çekirdekli, tatlı veya tatlı-mayhoş, iri

meyveli ve daneli, erkenci çeşitler geliştirmektir. Bu açıdan dünyada son yıllarda geliştirilen nar çeşitlerinin çoğu yumuşak çekirdekli olmakla birlikte çeşitlere göre yukarıdaki özelliklere sahip bulunmaktadır. Aşağıda son yıllarda dünyada ıslah edilen nar çeşitleri listelenmiştir (Chater ve ark., 2021).

Türkiye'de Islah Edilmiş Nar Çeşitleri
BATEM Esinnar
BATEM Hicrannar
BATEM Yılmaznar
BATEM Onurnar
Efenar 35
Tezeren 35
Dr. Ercan 35
Kamilbey 35

Afganistan'da Islah Edilmiş Nar Çeşitleri
Pand post:
Nazak post:

Azerbaycan'da Islah Edilmiş Nar Nar Çeşitleri
Bala Mursel
Girmiz Gabig
Valas
Azernaijan Guleyshasi
Mina Shirin (Şekil 1.)

Çin'de Islah Edilmiş Nar Nar Çeşitleri
Dabenzi
Dongyan

Hindistan'da Islah Edilmiş Nar Nar Çeşitleri
Mridula
Solapur lal

İran'da Islah Edilmiş Nar Nar Çeşitleri
Rabab-e-Neyriz
Malas-e-Saveh

İsrail'da Islah Edilmiş Nar Nar Çeşitleri
Acco (Şekil 2.)
Shani Yona
Emek

İspanya'da Islah Edilmiş Nar Nar Çeşitleri
Tendral
MR-100
Purple Queen
Kingdom
Iliana
Rugalate
Tastem

ABD'da Islah Edilmiş Nar Nar Çeşitleri
Blaze
Purple Heart
Parfianka
Ariana



Şekil 1. Mina Shirin nar çeşidine ait meyveler



Şekil 2. Acco nar çeşidine ait meyveler

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Complementary Food Produced from "*Atilla-Gan-Atilla*" Wheat, Sorghum and Groundnut Fortified with Baobab Fruit Pulp

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Abstract

The aim of this research work is to improve the nutritional quality of complementary food products by supplementing some percentage of the composite mixture with baobab fruit pulp powder. The baobab fruit (BF) pulp was added in different proportions (17%, 12%, 9%, 5% and 2%). Five different complementary formulations of wheat (*Atilla-gan-Atilla*), sorghum, ground nuts and baobab fruit pulp were prepared in different ratios, the following samples were obtained: ASG1, ASG2, ASG3, ASG4 and ASG5. The samples were analyzed for proximate composition, functional analysis and sensory evaluation. The results obtained show that ASG1 has a significantly higher value at $P<0.05$ of moisture content compared to the remaining samples, while sample ASG5 has significantly high amount of ash (1.22%), fat content (9.31%), fiber (3.40%) and protein (39.92%). The carbohydrates (74.68%) was found to be significantly higher in the control sample. As for the functional properties of the complementary food, the swelling index was significantly high in the control sample (100.35%), followed by sample AGS2 (94.72%). The lowest swelling index was observed for sample AGS3 (88.48%), while sample AGS4 had the highest significant level (97.30) which was close to the control sample. Sample AGS2 was found to have the highest water absorption capacity compared to all the remaining samples (76.7%). Bulk density of the sample AGS1, AGS2 and AGS3 were not significantly different ($P<0.05$). The scores obtained for the organoleptic test for the sample shows that, sample AGS2, AGS3 and AGS4 had no significant difference at $P<0.05$ for flavour, colour, taste and texture. Samples ASG3 and ASG4 had a 7.15 acceptance score in sensory analysis on a 9-point hedonic scale scorecard, which made them more acceptable than the other samples. The results showed that the addition of baobab pulp powder significantly increase the nutritional composition of the complementary food product and will as well help in decreasing the malnutrition in children.

Key Words: *Complementary food, Baobab fruit pulp, Wheat (atilla-gan-atilla)*

Introduction

The greatest meal for infants is breast milk, which provides them with all the nutrients they need for healthy mental and physical development. It offers all necessary minerals in an easily absorbed form, along with proteins, immunological and bioactive components, and polyunsaturated fatty acids (Ballard and Morrow, 2013). However, beyond 6 months of age, human milk is no longer enough to supply the growing newborns' nutritional needs (Hampson et al., 2019). A lot of mothers, particularly in developing nations, breastfeed for 12 months, while others continue up to 24 months. Weaning, also known as supplementary feeding, starts at 6 months and lasts until the child is 24 months old or older and is therefore necessary to meet their developing nutritional needs in addition to mother's milk (World Health Organization, 2019). It is the period between the children's regular family meals and their exclusive breastfeeding. Weaning, which involves giving newborns mashed or semi-solid adult meals, must be balanced and properly adapted nutritionally for the infants (Cichero, 2016; Koletzko et al., 2019).

Foods during weaning should be calorie-dense and high in quality protein, vitamins, and minerals. In order for newborns to readily swallow and digest these foods, they should be precooked or properly processed with low amounts of indigestible fiber (Abeshu et al., 2016). The key time around weaning is when many children first experience malnutrition, which greatly contributes to the high prevalence of malnutrition in children under the age of five. In low-income nations, 40% of children are malnourished, according to WHO (World Health Organization, 2018). According to the UNICEF study, global trends in child undernutrition, including stunting and wasting, shortages of crucial micronutrients, and childhood overweight and obesity, continue to be extremely concerning despite progress in some places (WHO, 2022). Estimates show that 45 million children under the age of five are underweight, 39 million children under the age of five are overweight, and 149 million children under the age of five have stunted growth and development as a result of a chronic lack of nutrient-rich foods in their diets (UNICEF, 2023).

Native to sub-Saharan Africa's semi-arid and sub-humid regions, the baobab (Adansonia digitata L.) is a multipurpose tree. More than 300 traditional uses are listed, with a long lifespan (a few hundred to thousands of years) (Dossa et al., 2023). Due to its high mineral and vitamins content, the pulp of the baobab fruit enhances the nutritional value of diets. Traditional uses of baobab products, such as their bark, fruits, seeds, and leaves, support the local populaces' ability to survive in Africa by providing them with a source of food, fiber, and medicine

(Kamatou et al., 2011), as well as serving as a significant source of revenue (Muthai et al., 2017). In addition, , the various plant parts have been utilized to cure a number of illnesses, including toothaches, fever, malaria, diarrhea, and dysentery (Monteiro et al., 2022).

Baobab pulp is typically dissolved in water or milk and used as a beverage, condiment, snack, or a fermenting agent in regional beers (Rahul et al., 2015). Fructose, saccharose, and glucose gives the pulp its sweetness, while organic acids including citric, tartaric, malic, succinic, and ascorbic give it its acidic flavor (Nouruddeen et al., 2014). After the European Union (EU) approved the sale of baobab dried fruit pulp as a novel food component in 2008 (OJEU, 2008), the scientific community's interest in baobab grew. Baobab fruit pulp was subsequently designated as GRAS (Generally Recognized as Safe) by the US Food and Drug Administration (FDA) in 2009 (FDA 2017). Recent research on the nutritional value of various baobab parts (leaves, pulp, and seeds) has found high phenolic compound concentrations (Ismail et al., 2019), high antioxidant capacity (Nouruddeen et al., 2014), and essential fatty acids, vitamins (A, D, E, and F) (Chepngeno et al., 2022), at levels that meet the daily recommended intake requirements. Baobab pulp is further characterized by a low water content, high ascorbic acid, procyanidins, flavonol glycosides, dietary fiber, calcium (Ca), and potassium (K) levels, as well as other properties (Ismail et al., 2019). Some natural product vendors refer baobab as a "superfood" due to its abundant chemical compounds thought to be good for human health, a claim that lacks any scientific backing beyond speculative health benefits. The word "superfood" is clearly more effective for its marketing potential than for giving the best nutrition, even when science supports the health benefits of some foods (such as quinoa, flax seed, and buckwheat), labeling them as "superfoods"(Chadare et al., 2009). Therefore, the rising tendency of baobab consumption may boost these meals in the near future. As a result, the current study's goal was to improve the nutritional composition and functional properties of the complementary foods with fatty acid levels, nutritional content, bioactive substances, mineral composition, vitamins and sensory acceptance.

Materials and Methods

Samples Collection

Atilla-gan-Atilla Wheat, Sorghum, Groundnut and Baobab fruit pulp were bought from Kano State Agricultural & Rural Development Authority (KNARDA). All chemicals and solvents used in this research were of analytical grade.

Preparation of the Sample

Figure 1 presents the flow chart of the sample preparation method for converting the grains into flour.

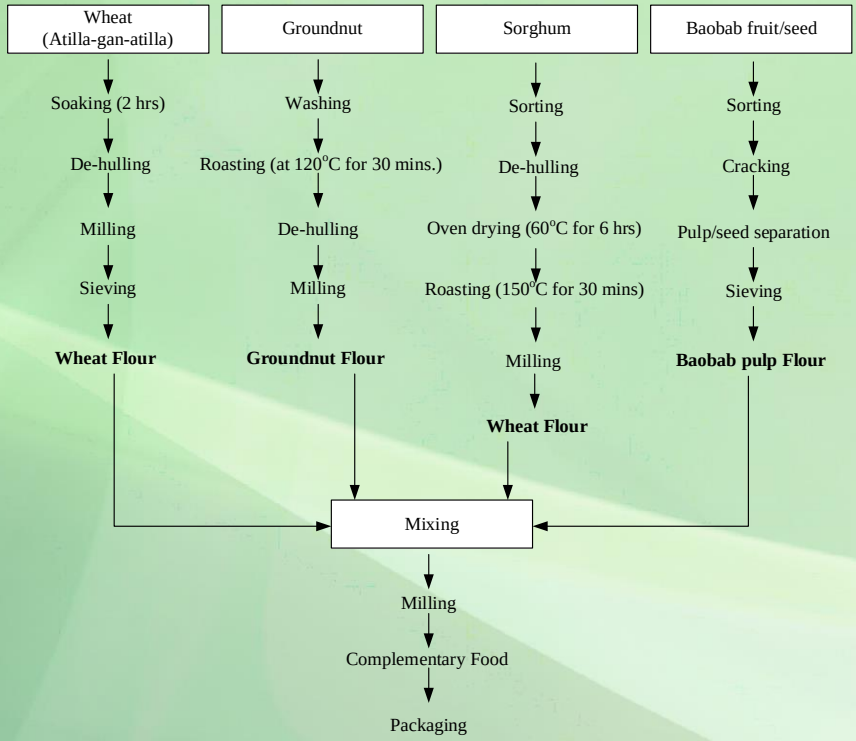


Figure 1: Flow Chart of the Flour Sample Preparation

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Experimental Design

Table 1 shows the five samples of the complementary food that were produced in this study.

Table 1. Formulation of Complementary Food

s/n	Sample Name	Wheat *(Atilla-Gan-Atilla)* (%)	Sorghum (%)	Groundnut (%)	Baobab Fruit Pulp (%)
1	Control	80	10	10	0
2	ASG 1	63	10	10	17
3	ASG 2	68	10	10	12
4	ASG 3	71	10	10	9
5	ASG 4	75	10	10	5
6	ASG 5	78	10	10	2

Methodology

Proximate of the Complimentary Food

The proximate composition of the complimentary food were analyzed using the AOAC official methods (1984) viz. moisture (method: 948.12), crude protein (method: 955.04), crude fat (method: 920.39C), ash content (B 920.117). Crude fiber content was determined using the methods described by Pearson (1976), while the total carbohydrate content was determined by difference.

Determination of Color and Bulk Density

The color and bulk density were determined according to the method described by Wan *et al*. (2014). For color, the measurement was done by placing the complimentary food sample in a transparent glass cuvette and transferred to a colorimeter (HunterLab, UltraScan Pro 1092, USA), which was equipped with a tri-stimulus software (EasyMatch QC) with coordinates L*, a*, and b*. L* (0 to 100) denotes dark (0-50) to bright (50-100). The a* denotes redness (+) to greenness (-) and b* denotes yellowness (+) to blueness (-). The machine was standardized with black and white tiles before the start of measurement.

For bulk density, a graduated glass tube was weighed (W_1) and was filled with a complimentary food sample which was tapped gently to reach the 10 mL mark until there was no further diminution of the particles. The tube containing the sample was weighed (W_2) and bulk density was calculated as the difference in weight (W_2-W_1).

Water Absorption Capacity

The water absorption capacity was determined using the method described by Rodriguez-Ambriz *et al*. (2005) with a slight modification. Complimentary food sample (1 g) was weighed into a 15 mL pre-weighed centrifuge tube and 10 mL of distilled water was slowly added to the tube under continuous stirring with a glass rod. The mixture was centrifuged at 2000 ×g for 20 mins. The supernatant was gently decanted, and the tube was reweighed. Water absorption capacity was calculated using equation (1):

$$\text{Water absorption capacity (\%)} = \frac{W_2 - W_1}{W_0} \times 100 \quad (1)$$

where W_0 is the weight of the dry sample (in g), W_1 is the weight of the tube plus the dry sample (in gr), and W_2 is the weight of the tube plus the sediment (in g).

Determination of Swelling Power

Swelling power of complimentary food sample was determined according to the method of (Sosulski. 1962). About 250 mg (W1) of the sample was taken in a centrifuge tube and weighed the centrifuge tube with sample (W2) and 10 ml (VE) of distilled water was added. Then it was allowed for 30 mins in a boiling water bath at 100 °C. The contents were cooled and centrifuged at 5000 rpm for 10 mins. The supernatant was carefully decanted in a test tube. The water adhering to the sides of centrifuge tube was wiped well and weight of the centrifuge tube was taken with swollen material (W3). The swelling power of seed flour per gram was calculated using equation (2):

$$\text{Swelling Power} = \frac{W_3 - W_2}{W_1} \quad (2)$$

Determination of Dispersibility

10g of each flour sample was weighed into a 150ml measuring cylinder. 100ml distill water was added and then vigorously stir and allowed to settle down for 3hours, (Onwuka, 2005). The volume of the settled particles was recorded and then subtracted from 100 to give a difference that is taken as percentage dispersibility.

Dispersibility (%) = 100 ml – volume of settled particles (ml).

Statistical Analysis

Triplicate sample preparations were used to obtain measurement values which were reported as mean ± standard deviation. One-way ANOVA was used to teste the statistical significance ($P<0.05$) using Turkey test. Minitab statistical software was used for the statistical analyses.

Results and Discussion

Table 2 displays the proximate compositions of the control and five supplemental food samples (ASG 1, ASG 2, ASG 3, ASG 4, and ASG 5). The results obtained show that ASG1 has a significantly higher value at P<0.05 of moisture content compared to the remaining samples, while sample ASG5 has significantly high amount of ash (1.22 %), fat content (9.31 %), fiber (3.40 %) and protein (39.92 %). The carbohydrates (74.68%) was found to be significantly higher in the control sample. The sample ASG 5 was discovered to have the greatest protein content, fat content (9.3 %) and fiber (3.40 %) among these five supplementary foods (39.92 %). The high protein and fat content may be attributed to the presence of ground nuts (24 %) in the sample compared to the remaining samples, while the highest percentage of fat observed in sample ASG 5, when compared to the commercial weaning meals (control) is of good importance. According to Satish & Shrivastava., (2011), the recommended percentage of fat in weaning food is up to 10%. However, because legumes are an excellent source of unsaturated fatty acids, this formulated sample (ASG 5) contains the most of them compared to other formulated and locally produced weaning foods.

The high fiber content may be due to the bran from the wheat and sorghum (24 %). Furthermore, the first year of life is critical for the development of the gut flora, and low dietary fiber can impede this development. Low fiber diets may also increase the risk of constipation in children. Our best sample had a fiber percentage of 3.4 %, whereas the commercial sample had the fiber level at 1.15 %. The result for the protein content was in line with that of Barde et al., 2022. Additionally, sample ASG 1 had the highest carbohydrate content of the three samples (64.72%), which was mostly due to the large proportion of wheat (Atilla-gan-Atilla). Some previous studies stated that children at complementary feeding age need more energy to cope up with their daily requirements (Abeshu*et al*., 2016).

Table 2. Proximate Composition of Complimentary Food Formulation

Sample	Moisture (%)	Ash (%)	Fat (%)	Fiber (%)	Protein (%)	Carbohydrate (%)
Control	9.7±0.14^{b}	0.81±0.01^{d}	2.10±0.14^{e}	1.15±0.04^{f}	11.71±0.45^{f}	74.68±0.50^{a}
ASG 1	9.96±0.05^{a}	0.81±0.14^{d}	3.50±0.00^{d}	1.87±0.07^{e}	19.13±0.77^{e}	64.72±0.91^{b}
ASG 2	9.22±0.02^{c}	0.80±0.00^{d}	4.22±0.03^{c}	2.05±0.04^{d}	24.51±0.64^{d}	59.18±0.54^{c}
ASG 3	9.30±0.14^{c}	0.90±0.00^{Cd}	5.47±0.03^{c}	2.73±0.07^{c}	29.13±0.55^{c}	52.45±0.51^{d}
ASG 4	8.70±0.14^{d}	1.13±0.02^{ab}	6.70±0.28^{b}	3.27±0.01^{b}	36.09±1.54^{b}	44.11±2.00^{e}
ASG 5	8.60±0.00^{d}	1.22±0.03^{a}	9.31±0.28^{a}	3.40±0.02^{a}	39.92±0.77^{a}	37.55±0.49^{f}

Each value in the table represents the mean of three replicates ± standard deviation. Values in the same column followed by different superscript letters are significantly different at *P*<0.05.

Table 3. Bulk Density and Color of Complimentary Food Formulation

Types of protein	Bulk density (g/cm^3)	Color		
		*L**	*a**	*b**
Control	0.81 ± 0.04^{a}	50.89 ± 0.60^{a}	4.15 ± 0.10^{bc}	15.12 ± 0.14^{c}
ASG1	0.67 ± 0.03^{b}	41.11 ± 0.13^{b}	4.40 ± 0.11^{c}	16.40 ± 0.10^{bc}
ASG2	0.66 ± 0.02^{b}	40.44 ± 0.21^{b}	5.06 ± 0.10^{bc}	17.08 ± 0.10^{b}
ASG3	0.66 ± 0.02^{b}	39.92 ± 0.10^{b}	5.21 ± 0.50^{b}	17.12 ± 0.12^{ab}
ASG4	0.63 ± 0.02^{c}	39.84 ± 0.10^{b}	5.32 ± 0.10^{ab}	17.53 ± 0.09^{a}
ASG5	0.60 ± 0.02^{d}	37.92 ± 0.10^{c}	5.92 ± 0.10^{a}	17.92 ± 0.10^{a}

Each value in the table represents the mean of three replicates ± standard deviation. Values in the same column followed by different superscript letters are significantly different at *P*<0.05.

Table 4. Functional Properties of Complimentary Food Formulation

Sample	Dispersibility (%)	Water Absorption Capacity (%)	Swelling Index (%)
Control	0.81±0.00^{a}	82.5±0.01^{a}	100.35±0.02^{a}
ASG 1	71.50±2.12^{b}	76.89±0.01^{b}	89.63±0.15^{e}
ASG2	72.50±0.70^{b}	76.7±0.02^{b}	94.72±0.40^{c}
ASG3	72.00±1.41^{b}	68.66±0.02^{c}	88.48±0.34^{f}
ASG4	72.50±0.70^{b}	67.78±0.00^{c}	97.30±0.11^{b}
ASG5	73.00±0.00^{b}	67.77±0.02^{c}	90.74±0.23^{d}

Each value in the table represents the mean of three replicates ± standard deviation. Values in the same column followed by different superscript letters are significantly different at *P*<0.05.

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Table 5. Sensory Evaluation of Complimentary Food Sample

Sample Code	Flavour/ Aroma	Color	Taste	Texture	Overall Acceptability
ASG1	6.50±1.46^{b}	5.90±1.29^{d}	6.75±1.55^{c}	6.50±1.31^{b}	6.65±1.38^{b}
ASG2	7.05±0.88^{a}	6.70±1.21^{c}	7.45±1.05^{b}	6.45±1.19^{b}	6.75±0.78^{ab}
ASG3	7.40±1.35^{a}	7.05±1.23^{a}	7.00±1.29 ^{a}	6.90±1.11^{a}	7.15±0.98^{a}
ASG4	7.45±1.19^{a}	7.70±1.21^{b}	7.05±1.66 ^{a}	6.40±1.53^{b}	7.15±1.26^{a}
ASG5	6.60±1.46^{b}	7.30±1.38^{ab}	7.10±1.16 ^{a}	6.65±1.46^{ab}	6.65±1.08^{b}

Each value in the table represents the mean of three replicates ± standard deviation. Values in the same column followed by different superscript letters are significantly different at $P<0.05$.

The functional properties of the complementary food as seen in Tables 3 and 4, the swelling index was significantly high in the control sample (100.35%), followed by sample AGS2 (94.72%). The lowest swelling index was observed for sample AGS3 (88.48%), while sample AGS4 had the highest significant level (97.30) which was close to the control sample. Sample AGS2 was found to have the highest water absorption capacity compared to all the remaining samples (76.7%). Bulk density of the sample AGS1, AGS2 and AGS3 were not significantly different (P<0.05). In the formulation of the product, functional traits such bulk density, water absorption, swelling index, and dispersibility features are crucial (Otegbayo et al., 2009). The complementary food's texture characteristics and functional characteristics will serve as a guidance. The results also showed that the addition of baobab pulp at different proportions decreased the bulk density and L^* as compared to the control samples, while the a^* and b^* increases as the substitution of baobab pulp increase.

Results for water absorption capacity (WAC) as seen in table 4.3 show significant difference ($P<0.05$) between the samples analysed as presented in table 4.3. Compared to the control sample the % WAC and dispersibility of the sample were decreasing as baobab pulp was added. High and low WAC in complimentary food could be attributed to several factors such as size, shape, steric factors, conformational characteristics, hydrophilic-hydrophobic balance of amino acids in the protein molecules as well as lipids, carbohydrates and tannins associated with the proteins (Zayas, 1998; Mao and Hua, 2012). There was an inconsistency in the swelling index result from the control down to the formulated samples. Generally, swelling reduces as the pH increases until it reaches the isoelectric point, because at this pH, minimum swelling takes place because of minimum repulsion among the constituent amino acids. Then, a progressive increase of the solubility occurs with a further increase in pH. The balance in positive and negative charge minimised the electrostatic repulsion (Ogunwolu et al., 2009). The content of vitamin c in the baobab pulp could be the reason for the inconsistency of the swelling index.

Five samples (ASG 1, ASG 2, ASG 3, ASG 4 and ASG 5) with various proportions of the locally produced, readily available crops (wheat, sorghum, groundnut and baobab fruit pulp) in Nigeria with the goal of creating a more affordable and nutrient-dense complementary food. Twenty infants between the ages of 6 and 24 months served as panelists alongside their mothers to interpret whether the product was accepted or rejected based on the infants' actions and attitudes. The five samples' sensory characteristics were evaluated using a 9-point hedonic scale. The scores obtained for the organoleptic test for the sample as seen in Table 5, shows that, sample AGS2, AGS3 and AGS4 had no significant difference at P<0.05 for flavour, colour, taste and texture. Samples ASG3 and ASG4 had a 7.15 acceptance score in sensory analysis on a 9-point hedonic scale scorecard, which made them more acceptable than the other samples. The high protein content in all formulated sample most especially ASG 5, which had a protein level of 39.92% will be of advantage. On the other hand, inadequate dietary fat consumption is bad for immune system and mental development in children, while adequate dietary fat intake is helpful for both.

Conclusion

Commercial supplementary foods are relatively expensive in Nigeria, making them unaffordable for the majority of parents with young children. The majority of kids have inadequate nutrition throughout the weaning stage and are at risk of malnutrition. Because of this, it's crucial to produce nutritionally sound weaning foods using inexpensive basic components that are readily available locally. According to the findings of this study, supplementary foods that are high in antioxidants and match infants' macronutrient needs can be prepared with a small amount of baobab fruit pulp added. According to the results of the sensory evaluation, samples ASG 1 and ASG 2 were disqualified because the product was too sour due to the baobab pulp's percentage addition. The study's findings indicated that adding baobab pulp will boost the food's nutritional value and antioxidant content, which will nourish the baby during the weaning stage.

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Performance Evaluation of Upland Rice (*Oryza Sativa L.*) cultivars in Three Agro-Ecological Zones Of Rwanda

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Abstract

The rice crop has a wide range of environmental adaptation, ranging from upland, deep, intermediate and shallow water rice. In Rwanda, rice is almost produced in lowland ecosystem. There is no reported attempt done on upland rice before this report. That is why this study was conducted to identify rice genotypes which can get adapted in various agro-ecological sites for upland rice cultivation. The study was conducted in three sites namely Rulindo, Rugende and Rubona in Rwanda. The field trials were laid in a randomized complete block design with three replications. All three trials were conducted from January 2022 up to when?2023 wherein ten upland cultivars were used. According to the growth and yield results obtained from three different agro ecological sites, CAVM5 cultivar showed high performance on different parameters such as plant height (94.6cm), number of tillers per plant (23), and grain yield (3345.5kgha^{-1}) compared to the rest of the cultivars. The second cultivar was CAVM 7 got an average of 29.40 tillers per hill, and 96cm height and an average of 3,272.7kgha^{-1}. The worst was CAVM10 with an average of plant height (46.8cm), number of tillers per plant (19.8), and grain yield (836.4 kgha^{-1}). The results obtained from this long-term research will help researchers to breed for drought/cold tolerant & high yielding genotypes, high quality and nutrient- rich upland rice in Rwanda.

Keywords: Upland rice, adaptability, growth, performance

Introduction

Rice (*Oryza sativa* L.) is one of the most essential food crop for nearly half of the world's population (Sellamuthu et al 2011, Garris et al 2005). Rice is an important crop which supplies staple food for nearly 50% of the world population (). Globally, rice is cultivated on an area of 154 MHa with an annual production of 700 MT (FAO 2011). . Among the most cultivated cereals on the globe, rice ranks as second to wheat (Abodolereza & Racionzer, 2009). Rice occupies a unique position in many nations because of its importance in traditional diets and the main source of income of many people in the whole world.

Upland rice cultivation is a rice cultivation system that requires the usage of rainfall and less water during irrigation. In this type of cultivation, rice is directly planted in aerobic soil without creating a puddle. Then supplementary irrigation and fertilizers are used to grow high-yielding rice crops. Upland rice cultivation can be done in upland areas where land is flat and deep soils which are capable of supplying water to the crop between rainfall. It is a method based on direct seeding and/or seedlings raised from nursery. This method permits to grow other crops such as dwarf beans, cabbage, spinach, cauliflowers and any other leafy vegetables.

Upland rice cultivation does not require huge amounts of water and is not a labour-intensive process when compared to traditional methods. Water shortage is expected to be severe by 2025, making management of the limited water for varied uses difficult. Thus, Aerobic Rice Cultivation is a long-term sustainable rice production strategy that addresses water shortages and environmental concerns caused by global warm water.

Upland rice is important for sustainable crop production because it can be used to meet future food demands. In Rwanda, rice cultivation is limited to marshland areas which are also occupying less space as Rwanda is a country of thousand hills. The increase in area planted with wetland rice cultivars is being constrained by the water shortage caused by climate change. On one side, rice production is a large contributor to climate change by being a high-water consumer and the largest greenhouse gas producer. In fact, it is estimated that rice production consumes more than 65% of the available agricultural irrigation water (Li et al., 2016). and produces around 12% of global methane emissions (Waalewijn et al. 2022). On the other side, rice is the most vulnerable crop to climate adverse effects. Extreme weather events such as drought and high temperatures, alone or in combination, have shown to be very detrimental to rice production that may lead a total yield loss (Mukamuhirwa et al. 2019).

While upland rice cultivation occupies 11% globally and 20% in East African countries, it only occupies 0.1% in Rwanda. Rice production in Rwanda is limited to marshland areas which are also occupying less space as Rwanda is a country of thousand hills. The adoption of upland rice cultivation in Rwanda will expand the area under rice cultivation and thus, will increase the quantity of locally produced rice and then cuts on rice importations. Moreover, the upland rice cultivation will contributes to reduction of methane gas emission caused by continuous

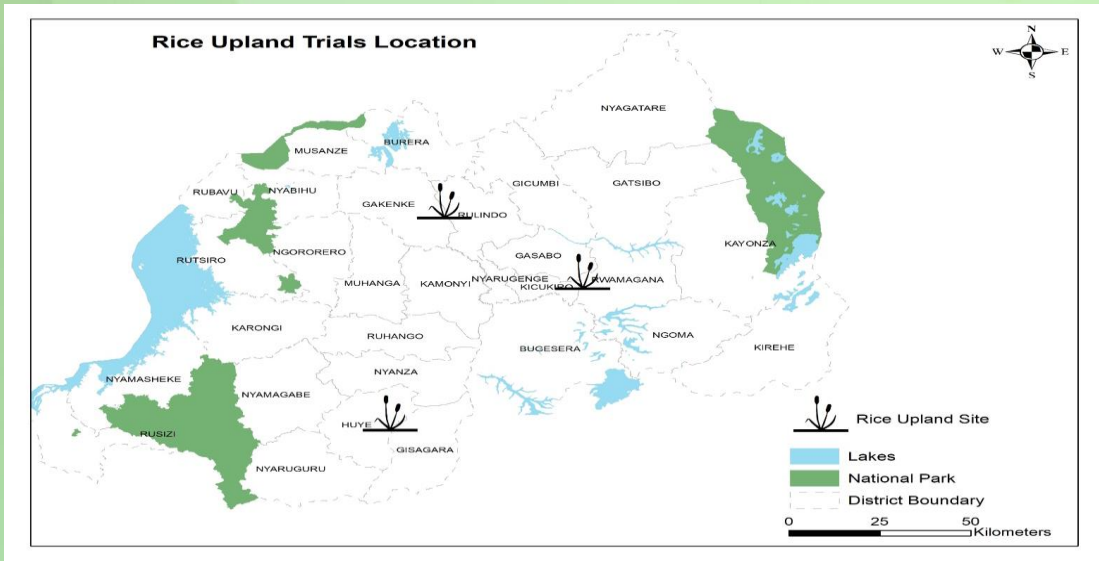
standing water in flooded rice. However, there is no information on rice cultivars that are best adapted to Rwanda agro-ecological conditions. Hence, the present research was undertaken to evaluate the adaptability and performance of ten upland rice cultivars with the specific objectives of evaluation and selection of the best high yielding and early maturing upland rice cultivars.

Materials and Methods

Experimental site description

The three Agro ecological zones that hosted the trials were selected based on they representativity of the agro-ecological zones where rice is grown. The experiments were conducted at:

- Rugende site in the lower altitude regions of 1374m in the Eastern region of Rwanda in Rwamagana District
- Rubona site located at 1687m in the middle altitude in the Southern Rwanda in Huye District
- Rulindo site is situated in the higher latitude regions at 1778m, Nothern region of Rwanda. in Rulindo District.



Map: Upland rice trials locations in Rwanda

Plant materials and experimental design

This study comprised ten (10) cultivars i.e., CAVM1, CAVM2, CAVM3, CAVM4, CAVM5, CAVM6, CAVM7, CAVM8, CAVM9 and CAVM10. Those materials were planted in the field using randomized complete block design (RCBD) with three replications at each site for a period of 4 years starting from 2019 rainy season since it was grown under rainfed system with a protective irrigation. Each experimental plot had an area of 6 m^2 with 3m length and 2 m width separated by a distance of 1 m between blocks and 0.5m between plots within a block. A spacing of 25 cm between rows was maintained. A seeding rate of 70 kg/ha was used for all treatments. All plots were fertilized uniformly at the rate of 100 kg/ha Urea and 100 kg/ha DAP. All DAP and one third of Urea was applied at planting. The remaining two third urea were divided in to two and applied at mid tillering and panicle initiation (near flowering) stages of the crop. All other cultural practices were applied uniformly to all plots as per package of practices of this rice crop.

Data collection

Simple random method was used to select the samples on which data had to be collected. Ten rice plants were sampled from 30 central rice plants. Data were collected on plant height and number of tillers on monthly basis. Rice Grain yield (kg ha^{-1}) were recorded after harvesting time.

Results and Discussion

During 4 years of data collection in this research three varieties namely CAVM 1, CAVM 5 and CAVM 7 have shown high level of adaptability & performance in terms of growth parameters across the three agro-ecological zones of the country (Rulindo, Rugende and Huye) whereas the cultivar CAVM10 was the shortest and with fewer number of tillers $hill^{-1}$ The cultivar CAVM 7 was the tallest (96cm) and developed 29.40 tillers per hill, followed by the cultivar CAVM 5 with94.6cm of plant heigh , and 23 tillers per hill; and the cultivar CAVM 1 85.30cm of plant height and 25.30 tillers per hill.

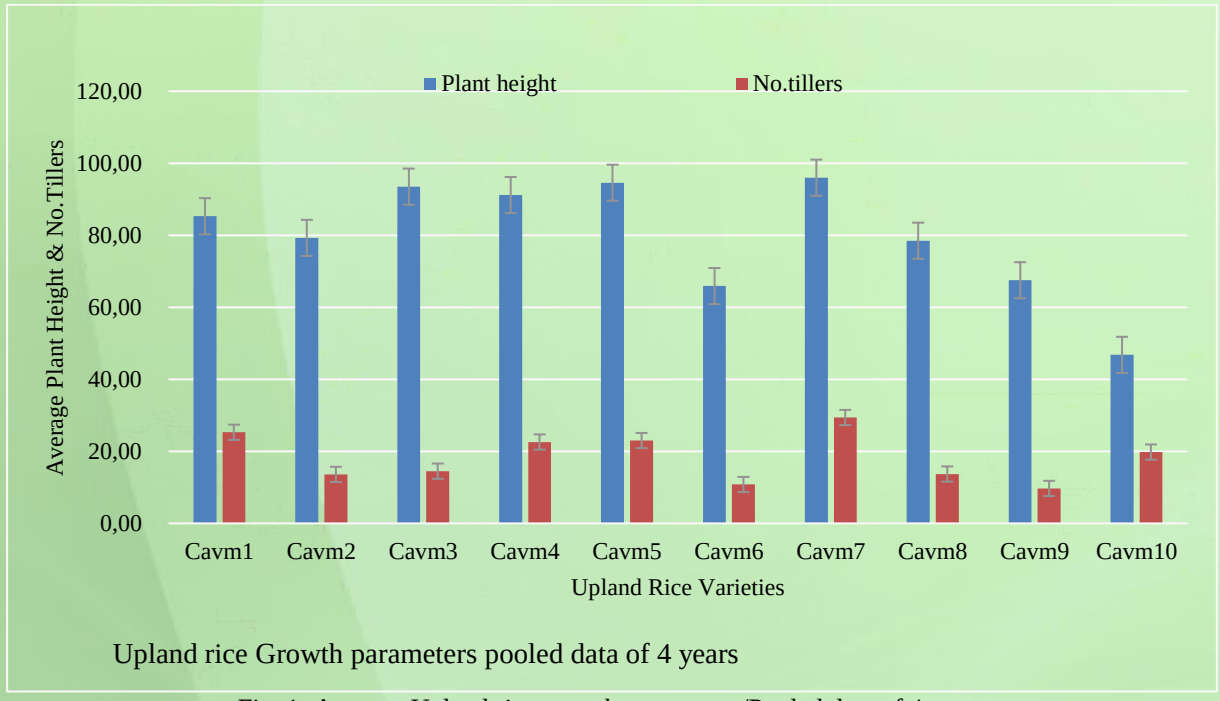


Fig. 1: Average Upland rice growth parameters/Pooled data of 4 years

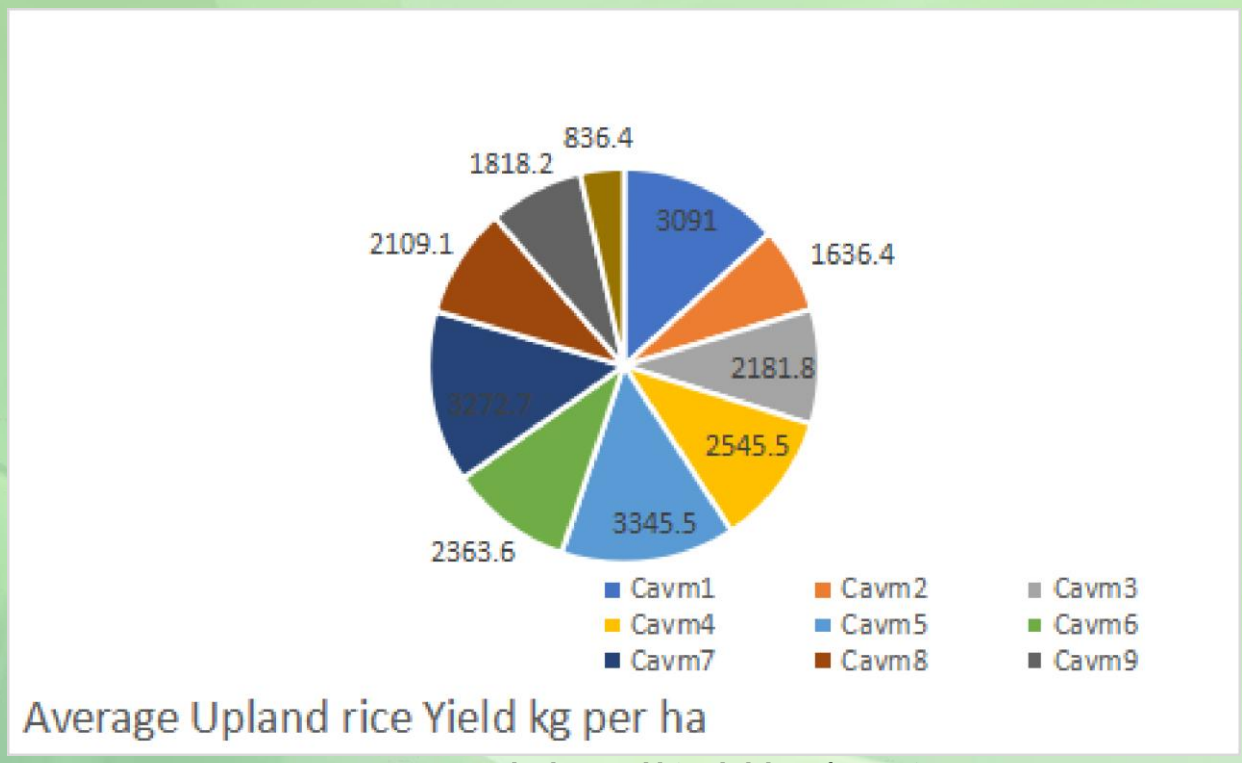


Fig. 2: Average Upland rice yield (pooled data of 4 years)

During 4 years of data collection in this research three varieties namely CAVM 1, CAVM 5 and CAVM 7 have shown high level of performance in terms of Yield across three agro-ecological zones of the country (Rulindo, Rugende and Huye sites compared to the rest 7 upland rice varieties as shown in figure 2:
The cultivar CAVM 5 got an average of 3,345.5 kg per hectare.
The cultivar CAVM 7 got an average of 3,272.7 kg per hectare.
The cultivar CAVM 1 got an average of 3,091 kg per hectare.

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Conclusion

During four years of this study, three best performing upland rice genotypes were identified across three agrozones of Rwanda. Since this is the new rice cultivation system in Rwanda, farmers can start adopting this new rice cultivation systems while the researchers will be working on breeding the adapted ones for drought/cold tolerant & high yielding, high quality and nutrition purpose on upland rice in Rwanda.

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Aquatic Biopolymers Used in Edible Film and Edible Coating in The Food Industry

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Abstract

Edible film and edible coating approaches are accepted as useful and prompt techniques that improve the sensory, physicochemical, and microbial quality of both plant-based and animal-based food items. With increasing awareness of the detrimental impacts of synthetic packaging materials, the utilization of natural polymers has increased in popularity in food science. Aquatic biopolymers are known as important sustainable and versatile materials used not only in the food industry but also in pharmacology and biomedical science. Gelatin, chitosan, and alginate are obtained from aquatic animals and aquatic plants and these biopolymers offer quality protection and sensory attributes. Edible coating and edible films extend shelf life inhibit microbial deterioration and protect chemical quality. The formulation, physical, and chemical characteristics of aquatic biomaterial-based edible coating and film differ depending on the used aquatic material and applied food properties such as moisture, shape, and proximate composition. In this review, aquatic biopolymers from gelatin to chitosan and alginate were deeply investigated. Biochemical properties, functional characteristics, and sensorial quality of these aquatic polymers were evaluated. Besides these advantages, the limitations of these aquatic polymers in edible film and coatings at both academic and industrial levels are deeply investigated in this review. Novel approaches of aquatic biomaterials on the different food items from seafood to meat products, vegetables to fruits were highlighted.

Key Words: *Edible film edible coating, aquatic sources, biopolymers*

Introduction

Within changing consumer preference in food consumption and the trends in food industry, novel approaches have applied to improve quality of food and extend shelf life. Edible film and edible coating are accepted as the most preferable approaches that can used in various food products from vegetables and fruits to meat and seafood (Atta et al.,2022: Oladzadabbasabadi et al.,2022). While grass synthetic polymers used traditionally, within better understanding of the side effect of synthetic compounds in the food products, natural polymers have gained importance over the last decades (Mohamed et al.,2020). Film forming capacity of protein, hydrocolloids and lipid are different due to their physic-chemical characteristics. Besides improving physic chemical qualities, another important functionality of edible coating and edible film should be improving sensorial properties of these approaches. In addition to terrestrial sources, the aquatic sources have also used in the extraction of polymers within several characteristics. Aquatic sources refer the animals and plants species living in both marine and freshwater bodies (Aksun Tümerkan et al.,2023). Due to wide distribution and reaching easily to raw material are essential parameter to selecting a biopolymer in the sustainable production in the food industry, aquatic biopolymers are robust materials for any kind of food application (Udayakumar et al.,2021). In this review, the drawbacks and advantages and potential solutions of most used aquatic biopolymers in the edible films and edible coatings were deeply investigated.

The most common used Aquatic Biopolymers Used in Edible Film and Edible Coatings

With the discovery of excellent properties of fish collagen and gelatin, alternative usage of these materials in food industry has grown rapidly as both food ingredient or external usages such as edible film and coatings. Due to the foaming, gelling and other physico-chemical properties of fish collagen and fish gelatin differ depending on the raw material that used in the production, several kinds of fish collagen and gelatin can be obtained (Aksun Tümerkan 2021). The bulk of raw material and gelling capacity offers excellent usages in food coating. The main challenges of fish gelatin and collagen are the weakness of structure that could limit the folding and wrapping capacity of edible film (Park et al.,2021: Maroufi et al.,2022). Another critical issue of fish gelatin in the edible film and coating approaches is fishy odor that can limit the sensorial acceptance by consumers (Sae-leaw, 2015). Chitosan known as a superior material used in different approaches in food industry (Kumar et al.,2020). Antimicrobial and antifungal characteristics of chitosan lead to usage of this material in different aims (Elsabee and Abdou, 2013). While chitosan can be obtained from shell of crustaceans, the extraction methods change the characteristics of chitosan and thereof edible films and coatings (Oladzadabbasabadi et al.,2022). Iqbal et al.,(2021) and Kumarihami et al.,(2022) reported that the edible film obtained by chitosan improved the quality and extended the shelf life of cheese and kiwifruit. The protect food items by its antimicrobial and antioxidant

effect make chitosan as preferable material for edible coating and edible films, however like fish gelatin and fish collagen, some problems limit its usage. Mechanical properties and physical characteristics are the main problems in its usage in edible film (Souza et al.,2020).

Similar to fish derived collagen, gelatin and crustacean derived chitosan, alginate has also used alone or combined with other natural additives to usage in edible coating and edible film. Due to alginate is derived from brown algae species, easily accessing to the raw material and processing capabilities offer several benefits and this material frequently used in all type of food products (Senturk Parreidt et al.,2018).. Moisture barrier and other physical properties of alginate based edible coating improve the quality of food products. Additionally colorimetric properties enhanced by within barrier between air and the surface of food materials. Gheorghita et al., (2020) highlighted that edible film contained sodium alginate improve the quality and improve the shelf life of cheese and meat, even in the coffee sample.

Conclusion

In this review, the opportunities and challenges of different aquatic biopolymers used in edible film and edible coatings evaluated. In addition to fish gelatin, chitosan from crustacean and alginate from algae, other aquatic sources could be used as biomaterial and could be investigated by mechanically and physico-chemically. In addition to usage of solely usage of these materials, combination with other natural antioxidant and antimicrobial could be improve the protective capacity of these approaches. The weakness of these materials could be improved by some natural strengthening material, thereof common mechanical limitations could be avoided.

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Plant Nutrition Problems in Pomegranate Cultivation

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Abstract

In pomegranate cultivation, regular and adequate fertilization is mandatory for high and high quality yield. It is very important to control and adequately supply plant nutrients in the tree and soil from the orchard establishment to the aging age. An average yield (50-150 kg/tree) can be obtained from a pomegranate tree at full yielding age, depending on the conditions and genetic characteristics. If there are negligence and errors in plant nutrition, inefficiency may be encountered. In addition to the negative effects of plant nutrition errors on yield, they also have effects on fruit quality before and after harvest. They have effects such as fruit cracking, aril browning, sunburn, encouraging some diseases and pests. In addition, unbalanced and inadequate fertilization leads to an increase in the development of the tree and its sensitivity to biotic and abiotic environmental conditions. In this article, the nutritional requirements of the pomegranate tree and the negative effects of nutritional errors on pomegranate cultivation were examined.

Key Words: *Pomegranate, plant nutrition, yield, fruit quality*

Nar Yetiştiriciliğinde Bitki Besleme Sorunları

Özet

Nar yetiştiriciliğinde, yüksek ve kaliteli verim için düzenli ve yeterli gübreleme yapılması zorunludur. Bahçe tesisinden, yaşlanma çağına kadar ağaçtaki ve topraktaki bitki besin maddelerinin kontrolü ve yeterli düzeyde temini çok önemlidir. Tam verim çağında yer alan bir nar ağacından, bulunduğu koşullara ve genetik özelliklerine göre ortalama 50-150 kg arasında verim alınabilir. Eğer bitki beslemede ihmal ve hatalar söz konusu ise verimsizlikle karşılaşılabilir. Bitki besleme hatalarının verim üzerine olumsuz etkilerinin yanında derim öncesi ve sonrası meyve kalitesi üzerinde de etkileri bulunmaktadır. Meyve çatlaması, dane kararması, güneş yanıklığı, bazı hastalık ve zararlıları teşvik etme gibi etkileri buunmaktadır. Bunun yanında dengesiz ve yetersiz gübreleme ağacın gelişimi ve biyotik ve abiyotik çevre koşullarına karşı duyarlılığının artmasına da sebep olmaktadır. Bu makalede nar ağacının bitki besleme gereksinimleri ve bitki beslemedeki yanlışlıkların nar yetiştiriciliğinde hangi olumsuzluklara yol açtığı incelenmiştir.

Anahtar Kelimeler: *Nar, bitki besleme, verim, meyve kalitesi*

Giriş

Anavatanı İran, Anadolu, Kafkaslar, Ortadoğu, Afganistan ve Hindistan olan nar (*Punica granatum* L.), kültüre alınan en eski meyve türlerinden biridir. Nar, 41 kuzey ve 41 güney enlemleri arasındaki subtropikal ve tropik iklim kuşağında çöl alanlarından çok nemli bölgelere, deniz seviyesinden yüksek yaylalara kadar dünyada çok geniş bir coğrafyada yetişmektedir (Ferrara ve ark., 2021).

2000'li yıllardan sonra ülkemizde nar üretimi hızla atmış ve 2022 yılında 681 bin ton üretime ulaşmıştır. Üretim artışına paralel bir şekilde nar ihracatında da hızlı artış olurken Türkiye de dünyanın en çok nar ihraç eden ülkeleri arasına girmiştir (TUİK, 2023).

Türkiye, Hindistan, İran ve Çin'den sonra dünyada 4. büyük nar üreticisi ülkedir. Ülkemizin sahip olduğu nar çeşit zenginliği pek çok ülkeden daha geniştir. Ülkemiz nar ihracatı açısından da şanslı ülkelerdendir. Ülkemiz, dünyada en fazla nar ihraç eden ülkeler arasındadır. Dolayısıyla nar ülkemizin ihracat gelirlerini arttırıcı bir üründür.

Nar yetiştiriciliğinde pek çok sorun mevcuttur. Bunlardan biri de bitki besleme sorunlarıdır. Üretici, nar yetiştiriciliğinde bitki besleme konusuna önem vermez ve ihmal eder ise ürünün büyük bir kısmını kaybetmektedir. Nar yetiştiriciliğinde, yüksek ve kaliteli verim için düzenli ve yeterli gübreleme yapılması zorunludur. Bahçe tesisinden, yaşlanma çağına kadar ağaçtaki ve topraktaki bitki besin maddelerinin kontrolü ve yeterli düzeyde temini çok önemlidir.

Tam verim çağında yer alan bir nar ağacından, bulunduğu koşullara ve genetik özelliklerine göre ortalama 50-150 kg arasında verim alınabilir. Eğer bitki beslemede ihmal ve hatalar söz konusu ise verimsizlikle karşılaşılabilir (Şekil 1, 2 ve 3).

Bitki besleme hatalarının verim üzerine olumsuz etkilerinin yanında derim öncesi ve sonrası meyve kalitesi üzerinde de etkileri bulunmaktadır. Meyve çatlaması, dane kararması, güneş yanıklığı (Şekil 4), bazı hastalık ve zararlıları teşvik etme gibi etkileri bulunmaktadır. Bunun yanında dengesiz ve yetersiz gübreleme ağacın gelişimi ve biyotik ve abiyotik çevre koşullarına karşı duyarlılığının artmasına da sebep olmaktadır.

Narin Toprak İsteği

Nar doğal olarak ağır killi, killi, killi-humuslu, humuslu, killi-çakıllı, kumlu, siyah, kırmızı Akdeniz, az humuslu çakıllı, sarı, kireçli, alüviyal, sahil kumlu, alkali ve susuz kayalık tepelerdeki topraklarda yetişebilmektedir. Toprak gereksinimi açısından geniş bir toleransa sahiptir. Nar için en uygun toprak verimli, humusca zengin, derin, orta bünyeli, drenajı iyi ve özellikle alüviyal topraklardır. Böyle topraklarda en iyi verim ve kalite elde edilir. Doğal koşullarda nar tuzlu topraklarda yetişmez. Fakat yetiştiricilikte nar tuzlu topraklara dayanıklı veya tuza tolerant bir tür olarak düşünülür. Toprakta tuz birikimi % 0.5 oranının üzerine çıktığında gelişen nar kökleri ölmeye başlar. Bu durum gelişmeyi ve verimi etkilemektedir. Topraktaki suda eriyebilir tuz miktarı ile kök gelişimi arasında negatif bir ilişki belirlenmiştir. Topraktaki alınabilir sodyum içeriği kök oluşumunu etkilemektedir (Yılmaz, 2007).

Narda Bitki Besleme

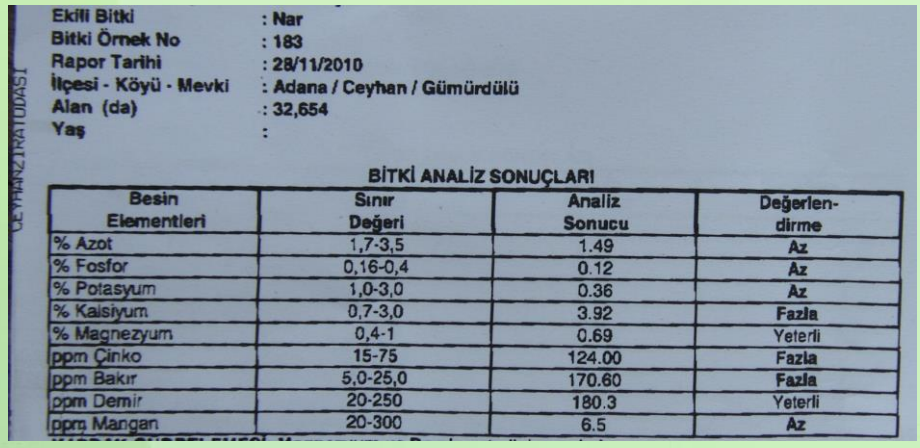
Yüksek, kaliteli ve sürekli verim için mutlaka gübreleme yapılmalıdır. Verilecek gübrenin cinsi, şekli ve periyodu, toprak yapısına, iklime ve sulama sistemine göre değişmektedir. Gübreleme için mutlaka toprak ve yaprak analizi yapılmalıdır.
Toprak analizlerinden beklenen yararın sağlanabilmesi için toprak örneklerinin doğru alınması gerekmektedir. Narda yaprak örneği Ağustos-Ekim aylarında o yıla ait uç sürgünlerinin ortasındaki gelişmesini tamamlamış yapraklardan sapıyla birlikte alınmalıdır. Yaprak örneği ağacın 4 tarafından olmak üzere 25 ağaçtan 100 adet yaprak olacak şekilde alınmalıdır. Her 20 dekar için bir örnekleme yapılmalıdır (Yılmaz, 2007).

Çizelge 1. Nar yaprağında mineral madde sınır değerleri (Maity ve ark., 2021)

Besin Elementi	Noksan	Optimum	Aşırı
N(%)	<0.89	1.32 -2.15	>2.57
P(%)	<0.13	0.18-0.24	>0.28
K(%)	<0.92	1.29-1.99	>2.35
Ca(%)	<0.34	0.64-1.20	>1.48
Mg(%)	<0.10	0.23-0.45	>0.57
S(%)	<0.09	0.16-0.26	>0.31
Fe(ppm)	<79.99	103-149	>172
Mn (ppm)	<22.96	39 - 72	>89
Zn (ppm)	<9.92	16-26	>31
Cu (ppm)	<4.57	6-9	>10
B (ppm)	<15.11	23-39	>48

Narda verim üzerinde en etkili mineral besin maddeleri azot ve çinkodur. Bununla birlikte bitki diğer besin maddelerine de yeterince ulaşabilmelidir. Genç nar ağacı her yıl ağaç başına yaklaşık 50-100 g , yetişkin ağaç ise yaklaşık 400-450 g saf azota gereksinim duyar. Bu miktar bir veya iki seferde uygulanabilir. İlk uygulama zamanı nar tomurcuklarının uyanmasıyla, ikincisi ise meyve tutumunun sonuna doğru yapılmalıdır. Yetiştirme periyodu sonuna doğru azot uygulanmamalıdır. Geç azot uygulamaları sonucu meyvelerin olgunlaşması gecikir ve bitki soğuktan zararlanabilir (Yılmaz, 2007)..
Aşırı azotlu gübreleme uygulanmamalıdır. Aksi halde sürgün gelişimi gereğinden çok artarak verimin düşmesine, meyvelerde renk oluşumu gerilemesine ve kalitenin azalmasına neden olacaktır. Azotlu gübreler sulama sırasında veya sulamadan hemen önce taç izdüşümüne verilmelidir. Gübrelemenin ardından sulama yapılamayacaksa gübre çapayla toprağa karıştırılmalıdır. Azotlu gübre narda meyve dane ve su randımanını yükseltmektedir. Bununla birlikte meyve iriliğini, kabuk kalınlığını ise azaltmaktadır. Aşırı azotlu gübreleme meyvenin çatlamaya karşı duyarlılığını arttırmaktadır (Yılmaz, 2007).
Nar genel olarak ilk yıllarda ağaç başına yaklaşık 75-125 g, tam verim çağında ise 200-220 g saf fosfora gereksinim duyar. Fosforlu gübreler kış aylarında, taç izdüşümüne 20-30 cm derinlikte uygulanmalıdır.
Potasyumlu gübrelerin meyve kalitesiyle ilişkisi pek çok çalışmada belirlenmiştir. Genç nar ağaçlarına 50-75 g/ağaç, verim çağındaki narlara ise 400-500 g/ağaç saf potasyum uygulaması yeterlidir. Potasyumun veriliş zamanı ve şekli fosforlu gübrelerle aynıdır.
Narda Çinko noksanlığı görülebilir. Bu noksanlığı ortadan kaldırabilmek için ilkbahar başı veya sonunda % 0.6 oranında Çinko Sülfat uygulaması yapılmalıdır.
Yapraktan kalsiyumlu gübre uygulaması söz konusu ise aşırı dozda ve nitrat formunda kullanılmamalıdır.

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Ekili Bitki : Nar
Bitki Örnek No : 183
Rapor Tarihi : 28/11/2010
İlçesi - Köyü - Mevki : Adana / Ceyhan / Gümürdülü
Alan (da) : 32,654
Yaş :

BİTKİ ANALİZ SONUÇLARI

Besin Elementleri	Sınır Değeri	Analiz Sonucu	Değerlendirme
% Azot	1,7-3,5	1.49	Az
% Fosfor	0,16-0,4	0.12	Az
% Potasyum	1,0-3,0	0.36	Az
% Kalsiyum	0,7-3,0	3.92	Fazla
% Magnezyum	0,4-1	0.69	Yeterli
ppm Çinko	15-75	124.00	Fazla
ppm Bakır	5,0-25,0	170.60	Fazla
ppm Demir	20-250	180.3	Yeterli
ppm Mangan	20-300	6.5	Az

Şekil 1. Verimsizlik yaşanan bir nar bahçesine ait yaprak analiz sonuçları



Ekili Bitki : Nar
Bitki Örnek No : 184
Rapor Tarihi : 28/11/2010
İlçesi - Köyü - Mevki : Adana / Ceyhan / Gümürdülü
Alan (da) : 38,100
Yaş :

BİTKİ ANALİZ SONUÇLARI

Besin Elementleri	Sınır Değeri	Analiz Sonucu	Değerlendirme
% Azot	1,7-3,5	1.35	Az
% Fosfor	0,16-0,4	0.12	Az
% Potasyum	1,0-3,0	0.27	Az
% Kalsiyum	0,7-3,0	2.35	Az
% Magnezyum	0,4-1	0.57	Yeterli
ppm Çinko	15-75	11.47	Az
ppm Bakır	5,0-25,0	166.13	Fazla
ppm Demir	20-250	149.1	Yeterli
ppm Mangan	20-300	8.3	Az

Şekil 2. Verimsizlik yaşanan bir nar bahçesine ait yaprak analiz sonuçları



Şekil 3. Bitki beslemenin ihmal edilemsi ile verimsizlik yaşanan bir nar bahçesi

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Şekil 4. Dengeli gübrelemenin yapılmaması sonucu; narda meyve çatlaması

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ID: 278

Rangeland degradation, its perceived impacts and adaptive mechanisms by pastoralists and government in Tahoua State of Niger Republic

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Abstract

This study points out the drought characteristics and responses, pastoralists and Government as well as partners employed continuously to minimize the effect of recurrent drought events on the livelihood of herders in Tahoua region of Niger Republic. Multiple data sources, including socioeconomic activities interviews with 225 households, group discussions and informal interviews with pastoralists were used to gather the aspects of drought and adaptive mechanisms and coping practices. Standardized precipitation index derived from long-term rainfall data obtained from National Direction of Meteorological service distributed across the pastoral zone was used to appreciate different degrees of drought intensity between 1988 and 2018. Results revealed the alternance of near normal, wet and drought events with 77.4% prevalence of drought events. The socio-economic survey revealed that 97.3% and 95.6% of the respondents were male and of Tuareg tribe respectively. All respondents resided in the area for than 30 years and 86.7% never attended western education. The main occupations of 40.1, 37.8 and 20.9% of respondents were livestock rearing, crop farming, and agro pastoral activities respectively. Nomadic, Agro-pastoral and Transhumant were the dominant livestock production systems. The highlighted drivers of rangeland degradation were recurrent draught, rainfall deficit and rising in temperature, overgrazing, tree clearing and abusive fodder collection, frequent fire outbreak and endemic shortage biomass production. Rangeland degradation indicators based on pastoralists knowledge enumerated include decrease in tree density and firewood, in plants species and wildlife, frequent forage shortage and increase barren land and water ponds. These droughts negatively impacted the livelihoods of pastoralist. The impacts include reduction the productivity of animal, calving rate, milking frequency, increase susceptibly of animals to disease and mortalities, reduction in the price in the markets and conflicts over the resources utilization. To adapt or cope with climatic hazards, households used a variety of adaptive mechanisms and strategies. The strategies adopted vary according to the rate of forage and water deficit. In Normal year characterized by good availability of forage and water, pastoralists undergo intra-departmental mobility, strategic culling off weak and unproductive animals at time their prices on market are good to gather money for buying natural forages, crop residues, concentrate and satisfy family needs. In moderate years, Nomadic and transhumant (59.6%) carried out inter departmental mobility, supplemented their animal during the dry season (36.4%) coupled with strategic culling off and buying of forages. Mobility, buying of forage, supplementation, and strategic destocking strategies were respectively realized by 1.3%, 41.8%, 30.2% and 26.7% of the sample in high forage shortage. The actions conducted by government and partners to assist pastoralists were free vaccination of animals, Supply of concentrates at moderate price and activities such as Firewall construction, Soil and water conservation, and seed broadcasting in the form of cash for work, cash for food and cash transfer**.**

Keywords: *Pastoralist, Mobility, Strategy, Coping, Destocking, Drought*

Introduction

Niger Republic is a landlocked country located in the Sahel, an arid and semi-arid area having large grazing areas of about 60 million hectares (Dieter Geesing & Hassane Djibo, 2006). The population inhabiting the area depend mostly on extensive livestock farming (Gerber *et al.*, 2010). Pastoralism and agro-pastoralism being an important component of livelihood, are the main livestock production systems (Jeannette & Markos, 2012), procuring income for the rural population (Kaufmann *et al.*, 2019).

The livestock species raised are local breeds of cattle, small ruminants, camels and donkey, well adapted to the arid environment to sustain livelihood strategies (Martin *et al.*, 2016). The livestock farming systems are highly dependent on the exploitation of natural pastural resources (pasture, fodder, forest products and water), which are directly affected by climate variability and change (Djoudi *et al.*, 2011). Climate change and extreme temperature impacts severely livestock farming of the area (Rivera & Rosen 2012). It is well established that warming destabilizes precipitation patterns which consequently disturb the primary biomass production, filling of water reservoirs, while unpredictable increasing water availability impacts livestock productivity and influences animal mobility. (Valentine Debray; Adeline Derkimba & Katia Roesch, 2015). This phenomenon leads to overgrazing which together with the northward extension of agriculture because of high land demographic pressures and the adoption of sedentary lifestyles by pastoralists provoke rangeland degradation (Snorek, 2016). The rainfall pattern

and availability govern the spatial distribution and availability of pasture as water is essential to sustain the animal's productivity (Tiruneh & Tegene, 2018). Climatic factors (temperature and precipitation) and the frequency and prolonged droughts directly affected livestock yields due to their effects on feed availability, feed quality, weed, pest and disease incidence (Rivera & Rosen, 2012). In addition, successive years of extreme drought decimate herds and prevent their reconstitution (Rivera& Rosen, 2012). Rainfall variability, increased dryness and prolonged drought, with regional variability, are recurrent phenomena since the 1970 (Adamou, Rabani; Ibrahim, Boubacar; Bonkaney, Abdou Latif; Seyni, Abdoul Aziz & Idrissa, 2021). The seven major droughts occurred during 1910-1916, 1941-1945, 1968, 1971-1974, 1984, 1987,1989, 2004, 2009, 2011 and 2012 (Fewsnet, 2011) and have adversely impacted the agricultural and livestock production. The 2009-2010 severe drought reduced animal population by 24.04% (Abdou, Issa & Hassane, 2011).

Over many years, pastoralist have been able through inter-seasonal mobility to meet the demand of pasture and water essential to maintain the animals in good production level and preserve their livestock assets. However, the traditional pastoral coping strategies of preserving livelihood have been adversely affected by the global environmental changes (Linstädter *et al*., 2016). The most important changes are those related to increasingly scarce and unsecure forage resources.

In recent decades, rainfall deficits and recurrent fodder shortages resulting for drought combined with the high demographic pressure of pastoral land impacted livestock productions systems in Niger republic (Laouali *et al.*, 2018). Drought is a frequent phenomenon in the arid and semi-arid area, which farmers and livestock owner are dealing with over many centuries. Drought chock is one of the most slow-onset and devastating phenomena characterized by extreme moisture deficits that normally disrupt rural livelihoods.(Ndlovu, 2019). But its frequency and occurrence need adjustment of coping strategies. Coping signifies the room to adjust, ability to absorb, accommodate and recover from drought impacts (Smith *et al.* 2000; Thomas & Twyman 2005; Ndlovu, 2019).

Much research has focused on the importance and consequences of climate change and land-use change on forage availability during rainy season (Ferner *et al*., 2018; Guuroh *et al*., 2018) but little is known on the adaptive mechanism developed by herders during high frequency of drought conditions.

The present study therefore seeks to understand the pastoralists' perception of rangeland degradation, its causes and consequences. It also tries to identify the indigenous coping mechanisms developed as well as the resilient strategies utilized by governments and its partners to strengthen local strategies and to minimize recurrent forage shortages experienced by pastoralists.

Materials And Methods

The study will be conducted in the region of Tahoua, Republic of Niger which covers 113371 km^2 and is located between parallel 13°42'and latitude 18°30' N and meridians 3°53' and longitude 6°42' E. The State is divided into three agro-ecological zones : saharo-sahelien or pastoral zone covering the northern and center of the local government of Abalak with an average annual rainfall ranging from 150 to 300 mm in the north; Western dune and Eastern plain zone occupying the southern Abalak, Northern Keita and Illela, western Tahoua and north-Eastern Bouza local government receiving an annual rainfall of 300 to 350 mm and lastly the Ader- Doutchi-Maggia and Tarka Valley zone in the southern part of Tahoua State having and an average annual rainfall of 350 to 450 mm. The mean annual temperature is 30°C with a maximum of 47°C in April and a minimum of 15°C in December-January (Conseil Regional de Development 2016-2020).

Four types of vegetations are encountered in the zone and include the woody steppe composed mainly of epinous tree species; some palms and euphorbiaceous trees; shrubs steppe with some annual grass plants; herbaceous steppe with some vivacious grasses and absence of vegetation in extreme north of the state.

According to the results of the General Census of Agriculture and Livestock of 2007, three husbandry systems are practiced in the State: the sedentary or agropastoral system (52.11%), nomadic (31.07%) and transhumant system (16.82%). The animal population is mainly composed of cattle (2, 868,016), sheep (2,762,002), goats (3,220,409), camels (553,817), horses (30,689) and donkeys (484,217) (Ministère de l'Elevage et des Industries Animales, MEIA, 2018). Tahoua State has 11,021,214 million hectares of grazing land composed of 7,950,800 million hectares pastoral land located in the north, enclaves (35,023 ha) and fallow (3,035,391 ha) situated in the agricultural zone in the south (MEIA, 2018).

The main crops grown in the region include cereals (millet and sorghum) and leguminous crops (cowpea, groundnut, sesame, Bambara nuts). In the dry season crops (wheat, sweet potato, cowpea, sesame, onion, cabbage, carrot, pepper, tomatoes are cultivated in the valley and around Swamps and irrigated areas (Conseil Regional de Development, 2016-2020).

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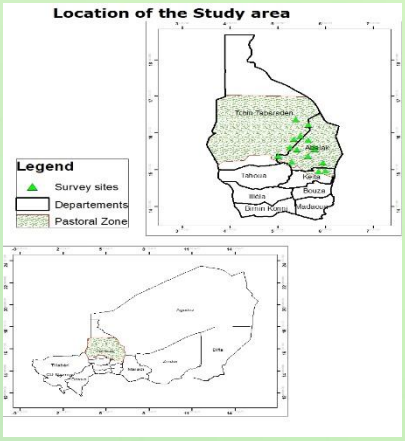


Figure 1. Map of Tahoua Region Showing Department, Pastoral Zone and Survey localities

The research surveyed 225 household distributed in 7 communes located in three main departments across the pastoral zone of Tahoua. Questionnaires were administered and collected from 225-household selected across the pastoral area. This gave the study a response rate of 100 percent. According to Amin (2005), if the response rate is greater or equal to 70 percent, the data can be analyzed. The methodology for determining the pastoralist's perception of the rangeland degradation, its impacts and coping strategies includes a survey and a drought analysis using meteorological chronological data series. The survey methodologies include a series of steps which are:

Step1: Construction of a sampling frame: the sampling frame is made from the national repertoire of localities (Renaloc) of the last general census of habitat and population of 2012 (Renaloc Institut National de la Statitistics INS, 2012). Since our target is the pastoral and agro-pastoral households, the primary units were constituted respectively by the water points (PE) and the encampments (CPT) where these populations are concentrated. The methodological approach to get this population include two exclusion criteria which are: (i) Exclusion of localities such as agglomerations, administrative villages, temporary settlement of crop farmers and (ii) exclusion of localities whose household size is less than 15 households.

Step 2: Determination of households to be interviewed**.** A systematic random sampling technique is used to select 225 households for interview using the probability proportional to size formula developed by Katori (2004) as follow:

$$n = \frac{Z^2 * P * Q * N}{e^2(N-1) + Z^2 * P * Q}$$

where n is the sample size, Z is the desired Z (1.96) value giving the desired degree of confidence, p 95% is an estimate of the population, Q is 1-p and e is the absolute size of the error in estimating p that we will be willing to permit and N the of households.

In this study the p value of 0.5 because a proportion of 0.5 is statistically adequate. The study used 95% level of confidence. Therefore, P-value z value is 1.96 (two tailed) and with an allowable error of 0.05 that is e = 5%.

Step 3: Fifteen (15) localities were sampled proportionally to the size in the first degree and the second degree in each locality of the households were randomly selected. The challenge is to be able to spatially represent the sample.

Step4: A structured questionnaire of four sections is prepared. Section A captured socioeconomic information of the respondents and the livestock species kept while sections B, C and D gathered information on the impact of rangeland degradation and perceptions of pastoralists regarding rangeland resources degradation; the adaptive strategies of the stakeholders and efforts by government in alleviating the effects of drought on the livelihood of animal owners in order to make them more resilient.The questionnaire include both open-ended and closed ended questions. The open-ended questions gave the respondents opportunity for self-expression, experiences and opinions. Section D, is addressed to the regional permanent secretary of the national team of early warning systems and the animal husbandry director of Tahoua.

Step 5: Five trained enumerators were selected to assist in the administration of the questionnaires. The selection is based on their knowledge of livestock management, local languages and experience in conducting this type of survey. The investigators were selected from the livestock workers at village and local government levels involved in the survey.

The survey is conducted during the month of February to March before the transhumance starts their downward movement to the south for the exploitation of crops residues.

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Long-Term Observed Precipitation Data

The rainfall data used in the present study were obtained from the National Directorate of meteorology of Niamey. Ninety-nine (99) rainfall gauge stations distributed over the study zone and having available long-term and continuous record of rainfall data for the period under study were used. The precipitation datasets include observations over 15 decades from 1988-2018 and are considered enough to respond to the criteria of 30 years minimum continuous data required for a valid climate statistical analysis (World Meteorological Organization 2009). The Standardized Precipitation Index (SPI) was developed McKee, Doesken, and Kleist in 1993 for estimating wet or dry condition based on precipitation variables. The SPI has been used widely over the world (Australia (Abawi *et al*., 2003), Mexico (Giddings *et al.,* 2005), Kenya's Huho & Mugalavai 2010, Opiyo *et al.,* 2015), India by (Subash & Ram Mohan 2011) to examine drought severity. The SPI calculation is followed by its classification base of the standard classification accepted worldwide.

Data Analysis

After the survey, the households gathered information were coded, verified, corrected and processed using SPSS and Microsoft Excel 2013. Inconsistencies detected were corrected after verification with the investigators or in the field. Once the data have been cleared, they were first documented in Excel and transferred to SPSS software for analysis using descriptive statistics. Regarding the Drought analysis, the Standardized Precipitation Index (SPI) was to analyses the wetness and drought condition of study area over the last thirty years. The SPI were calculated using the total annual rainfall recorded by 99 stations during the 5 months (May to September) corresponding to the length of the rainy season for the period extending from 1988(May-September) to 2018 (May-September). Negative values are considered to represent Dry period and positive values a wet periods while 0 value is considered as normal year.

The SPI is computed by dividing the difference between normalized seasonal precipitation and its long-term seasonal mean by the standard deviation as follows:

$$SPI = \frac{Xij - Xim}{\sigma}$$

where $\boldsymbol{\sigma}$ is the standard deviation, x_{ij} is seasonal precipitation at the ith synoptic station, x_{im} is long term seasonal mean precipitation. Meteorological drought was said to have occurred when the SPI value was negative and ended when the value became positive. Droughts were categorized as mild when the SPI value ranged from 0 to -0.99; moderate with a value from -1.0 to -1.49; severe when the value ranged from -1.5 to -1.99; and extreme when the value ranged from -2.00 and below. The near normal mean precipitation is when SPI was zero (0 to 0.99, the moderately wet ranged from 1 to 1.49, the severely wet with values from 1.5 to 1.99 and the extremely wet ranged from 2 and above.

Results

Socio-Demographic Characteristics Of Respondents

The results presented in Table 1 showed that the age of the respondents range from 40 to 85 years and above. The average respondent age was 57.2 ± 7.2 years. Sixty-seven per cent of them were in the 52-62 age category while 15.1% belonged to the 63-73 age category. On the other hand, 14.7% were aged 41-51 years and 4% were aged 85-95 years. The categories with the least number of respondents were that of those aged 74 -84 years and 40 years with respectively 1 and 2% of the respondents. The findings revealed that the sampled population is suitable to recall the events observed that might cause the change in the rangeland and to give the coping strategies adopted to tackle or minimize the effects on the livelihood and the wellbeing of the animals. Secondly, the study also showed that elders were found to be family heads and owning properties in the pastoral community, as most of them push to maintain family livelihood, since those that would support them could have been away on Government service and education.

The results presented in Table 1 unveiled that, 97.3 percent of the respondents were male while 2.7 percent were females, meaning there was more household headed by male respondent than female respondents. The dominance of male respondents are generally the household heads as they represent families 'and own properties such as domestic animals of the family compared to their female counterparts. The difference in property ownership may be attributed to culture in African tradition settings where the household head can stand the right of all goods held by the family. However, with increased civilization and women emancipation women are becoming property owners, especially the educated, politicians, businesswomen and in divorced women family.

The findings show that most (99.1%) of the respondents were married. On the other hand, 0.4% of the respondents stated that they were divorced, and lastly, 0.4% were bachelor. Information gathered during the focus group discussions and key informants reveals that marriage is a highly cultural activity in the study area. Every adult

male and female is expected to get married and have his or her own children. Marriage at an early age for girls was very common and any girl who had attained the age of 18 years was expected to get married unless she is attending school in a society were 100% of the pastoralist respondents were Islam practiced by 100%. Of the entire sample of 225 household interviewed across the study area, about 95.6% were of the Tuareg tribe, while the Fulani and Hausa tribes represented only 2.7% and 1.8% respectively of the sample size as indicated in Table 3. The entire 100% of respondents had been residing at their current homesteads for more than 30 years. The household having a size of 6 to 10 members constitute 50.7% of the household surveyed, followed by those of less the 5 members representing 28% while household with the largest was the least with 21.3%. It was also observed that majority (86.7%) of the respondents had never attended training school. The result shows that a small proportion (13.3%) of the respondents are of the Quranic school background.

Table 1. Socio-demographic characteristics

Variables	Frequency	Percentage	Mean	S.D
Sex				
Male	220	97.8		
Female	5	2.2		
Age (years)				
≤ 40	2	0.9		
41-51	33	14.7		
52-62	151	67.1	57.2	7.2
63-73	34	15.1		
74-84	1	0.4		
85-95	4	1.8		
Total family Member				
≤ 5	63	28		
6 to 10	114	50,7		
>10	48	21,3		
Marital status				
Bachelor	1	0.4		
Divorced	1	0.4		
Maried monoganous	201	89.3		
Maried Polygamous	22	9.8		
Religion				
Islamic	225	100		
Education				
Illetracy	195	86,7		
Islamic study	30	13,3		
Ethnic group				
Touareg	215	95.6		
Haoussa	4	1.8		
Fulani	6	2.7		

Source: Field Survey, 2020

The information in Table 2, established the occupation of the local community members in Tahoua State pastoral, 40.1 percent of the respondents are livestock keepers while 37.8 percent are those engaged in farming and livestock rearing as means of earning a living in the area. 20.9 percent of the respondents were involved in farming activities and those in trading activities represented nearly 1 percent of the respondents. Pastoralism as occupation became predominant in the community because, culturally, animals are properties considered as livelihood assets which every pastoral family should possess. Another plausible reason of possessing the animals is that families have the ability to sell livestock in response to numerous shocks and stresses as a key resilience capacity.

Nomadic, Agro-pastoral and transhumance were the main husbandry systems practiced in the area. The nomadic system is characterized by an unpredictable constant moving all year round of the herders and their flocks in search of pasture and water within the same region. The nomadic system represents 23.6% of the sampled interviewed. The agropastoral system is another form of livestock production highly dominant in the area and account for 64.9% of the sample. This system is characterized by a relatively low mobility of animals. The animals, therefore, relay on extensive exploitation of forage resources, and are supplemented with crop residues. Another important feature of this system is the higher exploitation rate of livestock compared to the pastoral system namely nomadic and transhumant. The transhumance system, which constitutes nearly 12% of the respondents is characterized by a cyclic seasonal movement of the animals in search of feed and water and concern all livestock species. Depending

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of the mobility amplitude, two main types of movement can be distinguished. The lack of pasture and water forced the herders to move downward from the Northern to the Southern Agricole and agropastoral zone where natural pasture and crop residues are available. The second type of shifting is the Northern-South/East/Ouest movement of animals motivated by the lack of quantitative as well as qualitative forage from the pastoral zone. The animals therefore move to the agricultural zone and sometime may reach neighboring countries such as Nigeria, le Mali, le Burkina Faso, Chad and even Cameroun.

The livestock species reared are cattle, sheep, goat, camels, donkey and horses. Depending on the herd size estimated in Tropical Livestock Unit (TLU), the livestock owners are classified into big, medium and small representing respectively 68.4%, 20.4%, and 11.11%. The average herd size estimated is 102.24, 43.37 and 3.96 TLU respectively for the big, medium and small herders. The animal feeding relay on the pastoral resources composed of essentially of pasture (herbaceous plants species, shrubs, trees and crop residues) and water (ponds, lakes and wells). 100% of the respondents stated the rangeland provide numerous services, which include forage for feeding, watering of animal, firewood, construction materials, fruits gathering and revenue from the selling of forage, firewood, charcoal and fruits.

Table 2. Socio-economic Characteristic of Pastoralists

Variables	Frequency	Percentage	Mean	S.D
Main activity				
Animal Husbandry	91	40,4		
Crop production	47	20,9		
Trading	2	0,9		
Animal Husbandry and agriculture	85	37,8		
Breeding System				
Agropastoral	146	64.9		
Nomadic	53	23.6		
Transhumance	26	11.6		
Type of breeder				
Big breeder	25	11.1		
Medium breeder	46	20.4		
Small breeder	154	68.4		
Herd size in TLU				
Big breeder	2556	49.70	102.24	52.37
Medium breeder	1995	38.80	43.37	31.91
Small breeder	594	11.50	3.96	5.7
Feeding system				
Natural Pasture	15	6.7		
Natural Pasture and supplementation	210	93.3		

Source: Field Survey, 2020

Characterization Of Drought

In an arid and semiarid area like Niger Country, drought is the most important agricultural risk with high probability and severity affecting crop and livestock production. The analysis revealed that from 1988 to 2018, the area experienced both, near normal, wet and drought condition as indicated (Table 3). From 1988 to 2018, 48% of the year are extremely dry with drought severity ranged from -4.2 to -2.1. Near normal rainfall condition which is about 4% of the year, occurred in 1988, 1994, 2006 and 2009 with drought severity ranged from 0 to 0,1. However, in 1998, the area registered a moderate rainfall condition followed by severe wetness condition in 1999 and 2012. The remaining years were drought conditions with a prevalence of 77.4%. The occurrence of the extremely wet condition represented 6.5%, moderately wet condition 3.2%, near normal condition 12.9%, extremely dry condition 41.9%, severely dry 19.4%, moderately dry 12.9% and mild dry 3.2%.

Causes Of Rangeland Degradation As Perceived By Pastoralists.

The Table 4 gives the summary of the causes the respondents perceived as being the causes of rangeland degradation**.** There are many interacting variables and processes that contributed to degradation of rangelands. 99.1% of the respondent indicated that the rangeland of Tahoua is degraded. Pastoralists argue that forages are the most valuable feed resources for livestock particularly ruminants' animal. Pastures highly available before are becoming less and less frequent. Many causes responsible for rangeland degradation listed in Table 4 can be grouped into to two broad categories the climatic and anthropogenic factors according to pastoralists. All the respondents mentioned a decrease in the rangeland potential to produce pasture as a result of climate change and variability.

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Table 3. Meteorological Drought Severity in Tahoua Pastoral Zone from 1988 to 2018

Years	Annual rainfall Total (mm)	Standard deviation (σ)	Drought severity index (SPI)	Drought category
1988	360,53	35,77	0	Near normal
1989	258,84	112,14	-2,8	Extremely dry
1990	243,85	123,35	-3,3	Extremely dry
1991	287,12	95,5	-2,1	Extremely dry
1992	293,44	80,45	-1,9	Severely dry
1993	238,36	125,39	-3,4	Extremely dry
1994	364,55	68,55	0,1	Near normal
1995	221,06	152,95	-3,9	Extremely dry
1996	273,04	101,89	-2,4	Extremely dry
1997	209,08	162,36	-4,2	Extremely dry
1998	397,98	75,88	1	Moderately wet
1999	473,16	125,84	3,1	Extremely wet
2000	235,75	133,11	-3,5	Extremely dry
2001	259,29	116,74	-2,8	Extremely dry
2002	297,64	80,44	-1,8	Extremely dry
2003	278,66	99,5	-2,3	Extremely dry
2004	320,81	54,47	-1,1	Moderately dry
2005	314,3	68,88	-1,3	Moderately dry
2006	359,97	50,09	0	Near normal
2007	288,96	83,13	-2	Extremely dry
2008	332,57	57,34	-0,8	Moderately dry
2009	364,56	38,13	0,1	Near normal
2010	301,89	81,66	-1,6	Severely dry
2011	275,67	91,86	-2,4	Extremely dry
2012	450,55	114,84	2,5	Extremely wet
2013	307,05	63,51	-1,5	Extremely dry
2014	292,51	75,51	-1,9	Severely dry
2015	308,72	63,84	-1,4	Moderately dry
2016	290,81	76,83	-1,9	Severely dry
2017	286,54	76,57	-2,1	Extremely dry
2018	318,61	54,17	-1,2	Moderately dry

Forage shortages were very common now a days and were reported by 94.2% of the sample studied. Beside the climate variables, anthropogenetic facture such as overgrazing, trees clearing to make firewood and charcoal to earn revenue during drought period, and pasture fire outbreak consuming large quantity of plants and trees are cited as part of the causes of rangeland degradation by 4%, 3.6%, and 37.3% respectively. After enumerating the perceived causes of rangeland degradation, the pastoralists listed base on their knowledge and experience the signs or indices of rangeland deterioration. 94.2% of the sample population observed an increase in the frequencies of forage shortage. The tendency of forage deficit frequencies seems to be more common compared to before. Decrease in trees density, distances of getting firewood, and annual burning frequency of pasture fire outbreaks consuming important quantities of already scarce pasture resulted in increased barren land, have been cited among the endogenous indicators of rangelands degradation assessment by 89.8%, 89.3%, 8%, and 92.4% of the respondents respectively. The trees and shrub species that disappeared based on the declaration of pastoralists include *Acacia sieberiana, Acacia seyal,Acacia laeta, Ziziphus mauritiana, Maerua crassifolia, Balanites aegyptiaca, Bauhinia rufescens, Sclerocarya birrea, Acacia Senegal, Capparis decidua , Tamarindicus indica, Acacia radiana , Acacia tortilis, acacia ehrenbergiana, Boscia senegalensis and Acacia Macrotyla.*

Sixty-nine (69.3%) of the respondent further observed the disappearance of wildlife animals present resulting from the destruction and disappearance of dense trees occasioned. Also 72.9% of the respondents admitted to having noticed a reduction in the diversity of some plant species in the semi-arid area. The herbaceous species that disappeared are *Cenchrus biflorus, Cymbopogon schoenanthus Citrillus colocynthus, Tragus ramosa Cassia obstifolia Chrozophora brochiara Chrysopogon aucheri, Andropogon ganayanus and Blepharis linarifolia.*

Ninety-two (92.4%) percent of the pastoralists confirmed that the decrease in the drinking water sources as an indicator of rangeland as result of in the quantity of rainfall in the area. finally high mortality loss due lack of forage and water year was among the indices of rangeland deterioration and quoted by 100% of the respondents. The most prevalent disease in the pastoral zone cited by pastoralist Bovine Pleuropneumonia, Sheep pox, Pasteurellosis, Donkey Strangles and Rift valley disease. Their frequency and percentage occurrence importance are presented in Figure 2.

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Table 4. Perception of causes and indicators of rangeland degradation of Pastoralists

Causes of range land degradation Variables	Yes (number and % of responses)	No (number and % of responses)
Rangeland dégradation	223 (99.1%)	2 (0.9%)
Causes of range degradation		
Drought	208 (92.4%)	-
Rainfall	190 (84.4%)	35(15.6%)
Température	190 (84.4%)	35(15.6%)
Overgrazing	9(4%)	-
Tree clearing /fodder collection	8 (3.6%)	
Decrease biomass production	225 (100%)	-
Pasture Fire outbreaks	84 (37.3%)	141(62.7%)
Degradation indicators	Yes (number and % of responses)	No (number and % of responses)
Frequent forage shortage	212 (94.2%)	13(5.8%)
Decrease in trees population	202 (89.8%)	23 (10.2%)
Decrease in plants species	164 (72.9%)	61(27.1%)
Decrease in firewood	201(89.3%)	24(10.7%)
Decrease in wildlife animals	156(69.3%)	69(30.7%)
Decrease drinking water sources	208(92.4%)	17(7.6%)
More bare soil/less trees	208(92.4%)	17(7.6%)
Frequent burning of pasture	18(8%)	208(92%)
High loss of animals		

Source : Field Survey, 2020

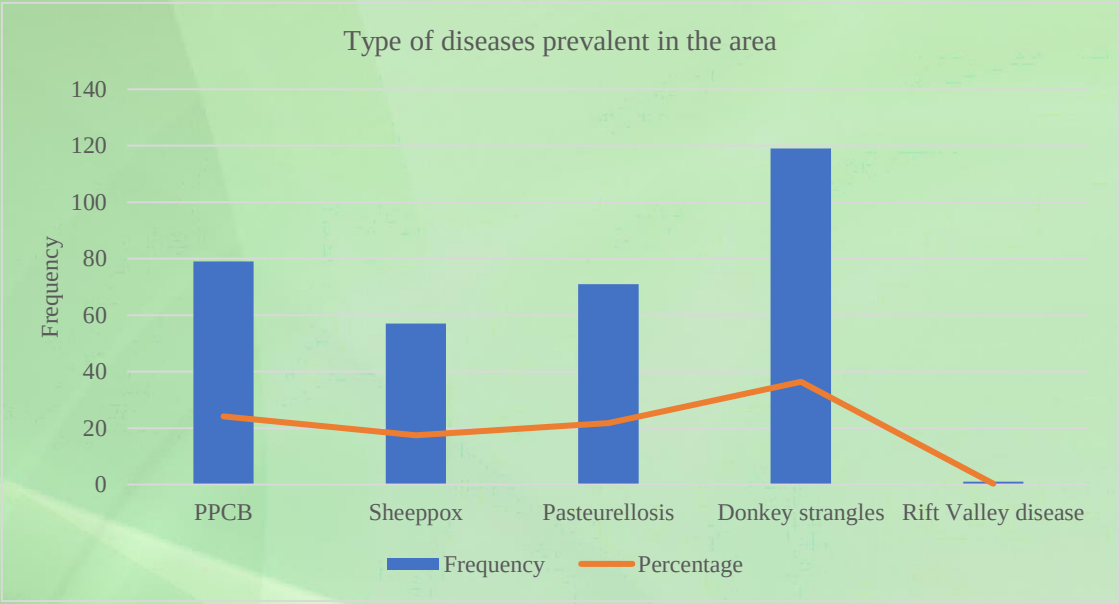


Figure 2. Prevalent Diseases as Indicators of Rangeland Degradation

Impacts Of Rangeland Degradation As Percieved By Pastoralists

The respondents were asked to cite the main causes and impacts of rangeland degradation on their means of livelihood. The impacts cited are presented in Table 5. It can be seen clearly that 84% of the respondents observed a decrease in the production and availability of pasture to animals especially during long dry period the last 30 years as a result of frequent drought due to climate change and variability coupled with rising in temperature in the area. Reduced livestock assets or numbers and productivity of animals were also noticed. Mortality of animals was reported by all the respondents while the reduction in livestock productivity 'meat and milk), and reproductive parameters such as calving rate and milking frequency, reduction in number of milking were respectively cited by 75.6%, 72.9 and 99.6% of the respondents. Impacts like competition over resources, conflicts and reduction in the body score condition or reduction in the economic value of animals as a result of forage scarcity were also mentioned by 71.6% 16%, 68.4% of the respondents respectively.

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Table 5. Impact of Rangeland as Perceived by Pastoralists

Variables	Yes (number and % of responses)	No (number and % of responses)
Degradation of rangeland	204(90.7%)	21 (9.3%)
Decrease in biomass production	189(84%)	36(16%)
Decrease of productivity	176(78.58%)	48(21.3%)
Reduction in calving	164(72.9%)	61(21.7%)
Reduced milking frequency	164(72.9%)	61(27.1)
Reduction in milking number	224(99.6%)	1(0.4%)
Increased susceptibility to disease diseases	194(86.2 %)	31 (13.8%)
Mortality of animals	225 (100%)	-
Increase compétition over resource	161 (71.6%)	64(28.4%)
Conflits on ressource utilisation	36 (16%)	189(84%)
Decrease body score condition/low prix	154 (68.4%)	71(31.6%)

Source : Field Survey, 2020

Strategies Adopted By Pastoralists To Overcome Frequent Pasture Shortage

Pastoralists have been dealing with drought and related consequences for many years in the arid-and semi-arid areas. The strategies developed to minimize or to become more resilient depend on the severity of the shock. The strategies adopted in normal, moderate shortage and important forage shortage were highlighted in Table 6.

Normal year**:** Mobility is already a habit and is practiced all years but the amplitude being the most important feature of differentiation. During normal year, the nomadic and transhumant pastoralists undertook their habitual movements in the search of forage and drinking water to maintain their livestock in a good nutritional and health condition to guarantee the production of meat and milk to their family. Their movement began generally between October to December depending on the availability of pasture and water. The nomadic generally moved to North Abalak, Tchintabaraden and Tassara while the transhumant moved in the agropastoral area of Madaoua Department bordering Nigeria.

Since the last severe drought of 2010, pastoralist discovered that agropastoral herder animals receiving crops residues and other concentrate like cotton seedcake, cereal brans were able to cross the long dry season and recorded less mortality. As a result, 60% of the respondents affirmed supplementing their animals particularly the lactating while 1.3% and 6.7% were involved in the collection and buying of forages particularly natural pastoral, crops residues and concentrated feed from farmers and markets. The strategic culling or selling off weak and unproductive animals are carried out to gather money. The selling generally occurred during months of September to October at crop harvesting time and served to buy natural forages, crop residues and, concentrate as well as feed for the family need.

Moderate Pasture Shortage: As stated above, Nomadic and pastoralist in such years, undertook their habitual inter departmental (Madaoua, Tchintabaraden, Tillia) or regional (Ingall) mobility in as early as possible toward end of September. The downward movement in the south is governed by the free liberation of crop farmers to avoid conflict. Beside mobility, Supplementation, Strategic culling off and buying of forages are also carried by 59.6%, 36.4% and 4% of the respondents respectively (Table 6). The supplemental feeds are feed produced both locally and coming from abroad. Based on the utilization, the supplemental feed may be grouped into national, abroad and combination of the two types by 43.1%, 31.1%, and 25.8% of the respondents respectively.

The main type of concentrate feed used in the supplementation includes agro-industrial by products such as millet bran, wheat bran, cotton seed and cotton seedcake. 60% of the respondent declared using only cereal bran as supplemental feed while, 32.4% and 7.6% used cotton seedcake/cereal brand and cotton seedcake and cotton seed. The feeds were bought from different sources. The herders procured the feeds form different buying sources (Figure 6). Depending on the sources, 42.7% of the respondents bought from markets, 24.4% from the animal husbandry services, 23.6% got the concentrate from markets and animal husbandry services while 9.3% are obtaining the feeds from markets, animal husbandry services and concentrate boutique of the villages. The regional network of prevention and disaster management retained that to facilitate a quick access of pastoralist to concentrate feed, the far placement should be 30km away from the herder's habitation. The findings revealed that 81.3% of respondent could procure concentrate less than 30km against 18.7% that were satisfied at above 30Km.

Years of High Forage Deficit: Years recording high forage shortage required the pastoralists to employ more coping strategies to minimize the effects. Common strategies to all situation like, mobility, buying of forage, supplementation, and strategic destocking were respectively realized by 1.3%, 41.8%, 30.2% and 26.7% of the sample population. The mobility however may go beyond the country, and they moved generally in Nigeria in the pasture lands of Sokoto State and sometime in Mali republic with movement starting from October to march. The duration does not exceed three months maximum and returned in July coinciding with the establishment of rainfall

meaning availability of water and pasture in the area. The severity of the situation forced the pastoralist to diversify their activities to reduce and increase their resilience. The diversified activities like trading, selling of firewood, fruits, pasture, vegetable farming, Migration, Social help, digging of new wells, and herd diversification are undertaken by 10.7%, 18.7%, 16%, 12.4%, 53.3%, 17.3%, and 48.3% respectively by respondents.

Table 6. Strategies Developed by Pastoralists

Variables	Frequency	Percentage
1.Normal situation (No forage deficit)		
supplementation (local feed)	135	60.0
Strategic culling off (strategic destocking)	72	32.0
Buying of fodder and storage	15	6.7
Fodder collection	3	1.3
3.Moderate forage shortage		
Supplementation (local and abroad concentrate)	134	59,6
Strategic calling	82	36,4
Buying of forage	9	4,0
3.Important forage shortage		
Supplementation (local and abroad concentrates)	94	41.8
Buying of forage	68	30,2
Strategic culling off (strategic destocking)	60	26.7
Mobility local /transboundary	3	1.3
4. Diversification of activities		
Trading	24	10.7
Selling of fruits, firewood, and forage collected	42	18.7
Cultivation of végétales	36	16.0
No diversification	95	42.2
Migration	28	12.4
Social help	120	53.3
Digging new wells for drinking animals	39	17.3
Herd diversification	109	48.4

Source : Field Survey, 2020

Role Of Government And Partner Agencies In Ensuring Pastoralists Resilience

The government and its partners help the pastoralists in their continuous coping strategies to overcome the recurrent forage shortages affecting their mean of livelihood and to become resilient. More attentions were given to herders since the last 2009-2010 severe drought during which nearly 25% of the livestock animal population perished. Avery years after the pasture evaluation, zones of good and high pasture production are determined, zones and herders at risk of vulnerability assessed and emergency program giving in details all actions that contribute to reinforce the resilience of pastoralists is elaborated. The actions of good year of pasture production, therefore, differs for those of deficit. The actions normally directed to herders include the following.

Vaccination: Vaccination programs are carried out every year to protect and minimize mortality of animals. The vaccination is free and obligatory. All herders should vaccinate their animals against the prevailing diseases such as Contagious Bovine Pleuropneumonia, Small ruminant' Pleuropneumonia, Camel smallpox during the cold season where the conditions for vaccine conservation are conducive and before the herders start their downward transboundary mobility. Vaccination against Pasteurella's or Hemorrhagic Septicemia, Anthrax and smallpox diseases are more prevalent during the rainy season and animals are being vaccinated before the onset of the rainy season. From 2009 to 2018 the rate of vaccination of animal is ranging in between 36% to 70.35% all specie considered.

Fire Break Bands or Firewall Construction: Fire outbreak is recorded every year in the pastoral zone from September to December. When it occurs important quantity of biomass were lost and sometime even result with death of human beings. As indicated in figure 3, fire outbreak cases were recorded every year with a varying intensity. The causes reported of fire outbreak include Tea or cooking fire unintentionally left by transhumant or kids while some with unknown causes.

The quantity of forage lost every year during recurrent fire outbreak is reported in figure 4.

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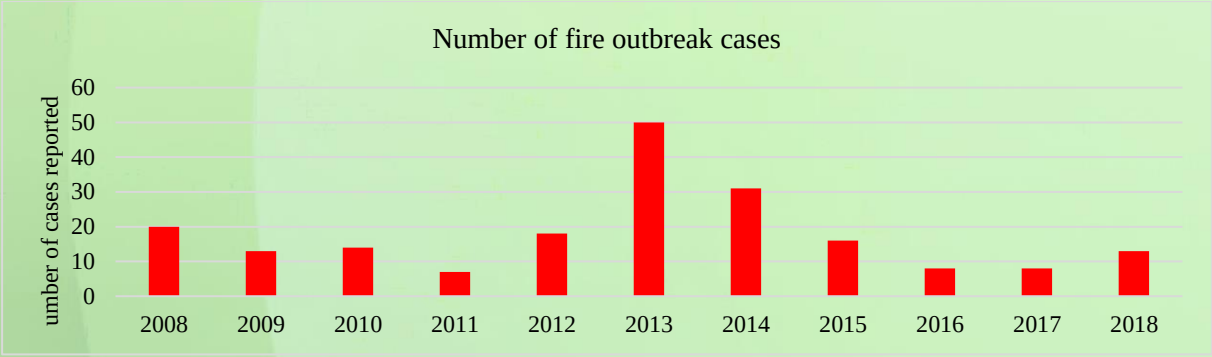


Figure 3. Number of Fire Outbreaks Cases

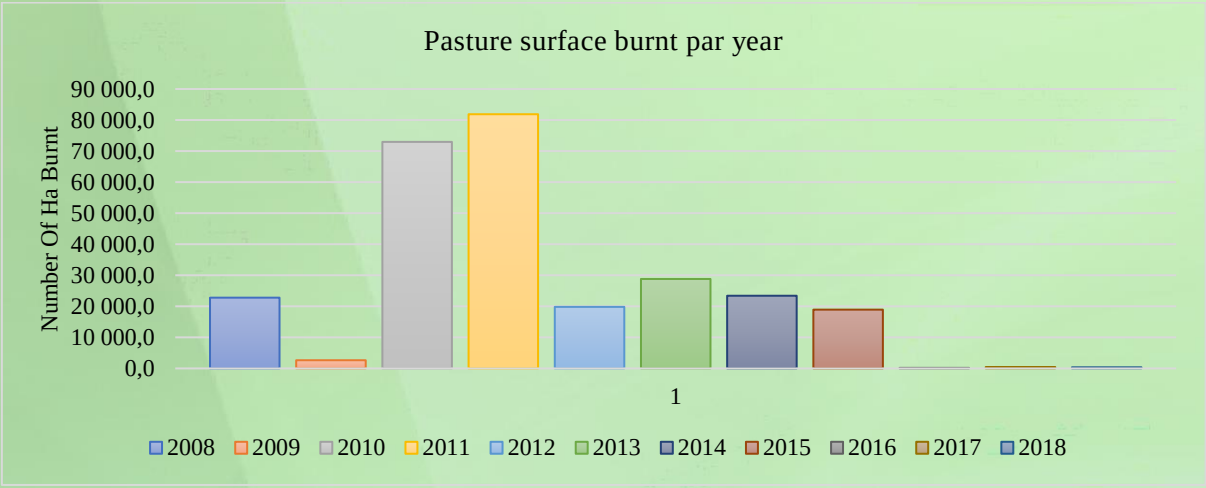


Figure 4. hectares of pasture burnt from 200-2018

Fire Breaks Band or Firewall Construction: Fire break band is an action carried out each year to protect good pasture production area and avoid loss of biomass fundamental to the survival of animals and consequently the mean of livelihood. The realization of these firebreak bands was realized just after the pasture evaluation and was undertaken jointly by the forestry services workers in conjunction with their counterpart of animal husbandry services. The manpower employed to realize these fire protected bands is composed essentially of the herders and in the form of cask for work or work for food to enable them to get food and or revenue to avoid selling of their animals. The number of number of kilometers realized vary on the level of area to be protected.

Table 7. Yearly Linear Kilometer Realized to Prevent Fire Outbreaks

Department	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Abalak	935	431		290	1765	4 614	2150	890	1 060	82	1058
Tahoua				1500	543	370	400	150	100		
Tassara					600	700	853	870	150	77	515
Tchintabaraden			1 500	1887	1955		418	320	683	161	520
Tillia	121	245			600	640	1050	448	150	310	167
Total pastoral zone (Kml)	1166	676		3677	5463	7 974	4871	2678	2 143	630	2260

Source: Field Survey, 2020, Kml: Linear kilometer

Soil and Water Conservation Measure and Seed Broadcasting: Like fire outbreak, every year the barren lands identified by the Directorate of Pastoral Development (DPD), are being treated by the realization of half-moon and other soil and water conservation technics with the financial support government and related projects. Seeds mostly the most appetite are broadcasted to recover and favor forage growth thereby improving the forage availability in the area. The treated areas are defended some years before allowing the animals to graze the pasture. Since the last drought and like realization of firebreak bands, the local manpowers were used to carry out the work and were remunerated in the form of Cash for work, for food or cash transfer. The total area broadcasted are presented in the Table 8.

Table 8. Hectares of Land Recovered Through Seed Broadcasting

Department	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Abalak		95	1000		1150	1150	1.732	107	380	40	592
Tassara						120	493	20	290.21	250	378.05
Tchintabaraden			400		2019	711	240	195	140	829	315
Tillia									64	375	
Total	743	1 510	7630.75	3 861	10840.3	7 686	3140		1880.7	4 630	4938.2

Source : Field Survey, 2020

Supply of Concentrate to Herder at Moderate Price: To support herders, government and partners provide every year's important quantity of concentrates feed to Animal husbandry services close to herders in order to facilitate both the availability and accessibility. The concentrate provided are composed mainly of wheat bran, cotton seedcake and in some case, cotton seed, and are sold to herder at a moderate price lower than the buying price and on the market. As indicated on Table 9, the concentrate is provided mostly by the government at the rate of 77%. However, there are some partners like Food and Agricultural Organization (FAO), Qatari Red crossed (CRQ), Action Contre la Faim (ACF), United State Agency for Aid and Development (USAID), Non-Governmental Organization (NGO) Concern, Adkoul, Masnat, Areva and Association for the re-dynamization of Breeding (AREN). FOA is providing 16% of the total quantity provided followed by CRQ and 1% for each of the NGO and association remaining.

Urgent Destockage and Social Help: Urgent culling off operations is carried out in urgency situation when animals are highly emaciated, and do not have a good price on markets. Government and partners targeted the distressed herders and buy their weak animals and the meat processed and distributed in prison and medical centers. The social help actions are directed to livestock owners that lost their animals. The kit is composed of four female and one Male of small ruminants either sheep or goat but goat is preferred because of their resilience to forage shortage, or donkey to enable herders to reconstitute their livestock assets. The donkey kit is directed mainly to herders that lost their draught animals to lift drinking water from deep wells t. Women and children are the most vulnerable in the pastoral area. Government and Partners help them through fattening operations where they were provided rams, feed materials, dewormers, intromin licking block and veterinary services during the operation. Chaffing machines were also provided in rural area to facilitate access and reduce size of crops residues and facilitate feed ingestion. The fattened animals are sold during religious feast to earn more profit.

Rangeland Management Actions: Marking of livestock routes and enclaves in the agropastoral and agricultural, are also effectuated to facilitate mobility of herders and their animals and to avoid their encroachment and conflict between farmers and herders. Also, Wells were dug in area with high forage density to enable the peasant herders to get access to pasture and feed their animals thereby contributing to reduce transboundary mobility. Livestock markets were also constructed along the routes to facilitate access to markets for the selling of animals and buying of goods and feed during their mobility. The total of all these operations and the different partners are presented in Table 10 since the last drought.

Table 9. Quantity of Concentrates Provided and Sold at Moderate Price

zYears	Government	FAO	CRQ	CONCERN /FIDUCAP	ACF	USAID	ONG ADKOUL	ONG MASNAT	AREVA	AREN	Total
2010	1653.8	200	70							41,85	1965.6
2011	935.6	500							230		1665.6
2012	2341.0										2341,0
2013	2251.0	1042.65	700			70	100	203,65			4367.3
2014	3320.0	565									3885.0
2015	2800.0										2800.0
2016	3125.0			64.12						38	3227.1
2017	2500.0	700									3200.0
2018	2450.0	203									2653.0
2019	9.9	1350			30	140				70	1599.9
Total	21386.1	4560.7	770	64.1	30	210	100	203.7	230.0	149.9	27704.4
Weight	77%	16%	3%	0%	0%	1%	0%	1%	1%	1%	100%

Source : Field Survey, 2020

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Table 10. Cost of Operations in Thousands of USD.

Variables	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Vaccination	195	195	195	195	195	195	246	250	263	1 928
Animal feeds							2 346			2 346
Cold chaine Materials							152			152
Animal fattening							124	24		148
Kit Household					168		620	50	585	1 423
Bande pare-feu	97	448	715	27	580	203	67	130	52	2 320
Destockage	241									241
Cash for work	122									122
Dewormers, Intromin Block									60	60
Well cosntructed and rehabilitated					496		237		201	934
Livestcok market							124			124
Animal feed boutique							64		150	214
Chaffing machine							4		17	21
Vaccination Parcs							36			36
Seed broadcasting	134	276	935	273	420	207	141	141	150	2 678
intensive training AE and producers							15			15
Marking Corridors and enclaves							119			119
Total cost	788	919	1 845	495	1 859	605	4 296	596	1 479	12 882

Source : Field Survey, 2020

Discussion

The Standardized Precipitation Index results indicate that certain meteorological drought years observed by the respondents are identical with the historical records. Thus, the statistical frequency of drought episodes issued from SPI values can be used to obtain the overall drought characteristics in the study area over time. The SPI analysis shows that extreme drought events are the most common and the frequency has increased over the last 30 years, with 32.26% of drought occurrences falling in the two decades between 1988 and 2001 while 9.7 % occurs between 2004 and 2018. It seems clear from the data that extreme drought conditions are reducing in the study zone. However severe and moderate drought seems to be more prevalent during the last fifteen years (2004-2018). Drought is therefore prevalent in the area under study.

Extreme and severe drought conditions seriously negatively affect livelihood security of pastoralists in the Sahel zone and the pastoral zone. The occurrence of these droughts is generally associated with the El Niño Southern Oscillation (ENSO) phenomenon, which causes changes in the temperature and rainfall in Sub Saharian Africa associated with shifts in the Inter Tropical Convergence Zone position (Salau *et al*., 2016). Climate factors are influenced by anthropogenic impacts from land use changes, which affect vegetation cover, surface, soil moisture and rangeland degradation (Rivera & Rosen, 2012). The increasing severity and frequency of occurrence of droughts is an indication that the region is getting drier and this change is reflected in the observed changes in pastoral zone. The area thus is being monitored every year and many resilient activities are conducted by the pastoralist as well by the government and its partners to reduce the impact of these drought on the livelihood of pastoralist and thereby avoid loss of livestock as in the 2009-2010 pastoral crisis

Most of the household (50.7%) had 6-10 family members and (21.3%) had above 10 family members meaning household with more than 5 family represent 72% of the sample population. The high number per family members were considered as a source of security and ability to diversified household coping strategies with drought and related problems. It could be seen also as a source of labour for taking care of the household livestock asset considered as source of wealth and food security in emergency. The high family members recorded in this study is similar to the finding reported by Snorek, (2016) who observed that cultural groups like Touareg and Fulani generally have large families and are monogamous due to the matrimonial historical frameworks. The result however differs from the finding of (Jane *et al*., 2013) who reported in their study that most households (42.5%) had 4 to 6 family members and only (22.5%) had 7 to 9 family members. Pastoralists are monogamous and have low literacy. It is observed that 90.7% of the pastoralists had no level and 9.3% have a level Quranic education. This finding differ from the result of (Djalal Ardjoun Khalil1, Sing-yabe Sahoulba, Mahamat Ibrahim Souleymane & ., 2021) in their study of the impact of the security crises on the transhumant pastoral system in the Province of Lac, Department of Mamdi reported pastoralist where they observed that sample surveyed are polygamous at 99.3% but have low literary level .

Three main breeding systems is prevalent in the pastoral zone of Tahoua and include Nomadic, Transhumant and Agropastoral system. The Nomadic and transhumant system as pastoralist system based on mobility to search of

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feed and water as a response of the harsh environmental condition characterized by frequent drought and climate variability. Natural pasture constitutes the principal feeding system with no or less supplementation. The Agro pastoral system rely on natural pasture but animal is supplemented with crops residues. The nomadic system represents 23.6%, to transhumant 11.6% while the agro pastoral system constitute 64.9. These results attest the finding of the General Census of Agriculture and Livestock where it was observed that the agro pastoral system constitute 66% of the animal husbandry system in Niger Republic. The results substantiate the finding of Fodé (2010) who confirmed that the majority of livestock in Niger (donkeys, sheep, goats, camels, and cattle) are owned by sedentary people. Like the breeding system, three types of breeders are encountered in the area. The small breed, the medium and large breeders. All the household can be affected by the rangeland degradation of shortage of feed but with a varying degree. Small breeder generally suffers more compared to the medium and big herders. This is because, the big herder has the capability to deploy resources to buy and provide their animals with water, forage and concentrate like wheat bran and cotton seedcake as reported by Abdou *et al.*, (2011. They further documented that during the last drought that hit the entire pastoral zone of Niger republic, the small household lost more than 90% of their animals compared to big herders that lost only 20% of their livestock asset. The big herders are organized in cooperative, used their political power to obtain large of concentrates from government services and also fences area of the pastoral zone to secure their animal during drought condition. Due to their high financial means, they used water tanks to move their animals far to exploit in the dry season area rich in natural pasture that could not be exploited because of watering difficulties. In the late dry season, animals lose weight and therefore animal price are reduced and, sometimes, they were forced to destock at very low price to avoid total loss. During the pastoral crise of 2010 as reported by Abdou *et al*, (2011), 29.59% of the total animal's lots was as results of urgent destocking.

Over 92.4% of the respondents reported that drought was the major constraint to the productivity of their livestock and agriculture. Drought years are characterized by lack of availability of pasture and water which may result in death of animals if any action was not taken before the urgency phase. During such period, the best strategic adoption consists of destocking weak animals to avoid complete loss from death in the alarm phase because in the urgency phase animal may have a poor body condition or loss weight because of starvation and therefore animal price is reduced. During the last 2009-2010 drought, the Departments of Abalak and Tchintabaraden, located in the study area recorded respectively 11.84 and 24.29% of their animal population (Abdou *et al,* 2011) due to lack of pasture and flood. Climate hazard like high intensity rainfall associated flood with can also cause mortality of animals particularly the most emaciated and weak animals. The observations of the pastoralists were confirmed by the rapid evaluation of the impact of the forage deficit of 2009-2010 conducted by Abdou *et al*, 2011 where they recoded 1.7% animal death of the animal population of the entire pastoral area attributed to these conditions. The lack of feed to animal particularly in the late the dry season is manifested by a loss in body condition, miscarriage, reduction in fecundity and decrease in the milk and meat production (Abdou et *al*., 2011). Drought also results in the intensive exploitation of scarce tree and pasture resources which. Lead to overexploitation of these resources through wood fuel collection and charcoal production are among the major causes of rangeland degradation in the study area. The respondents reported that water points as result of frequent drought have either dried up or supply was reduced over the past three decades. The reduction in water availability and drying up of water points are indicators of a hydrological drought. In such conditions result pastoralist have to move long distances to fetch drinking water to their animals and for domestic use. Reduction of the drinking frequency is very common and may varies from 2 to 1 or even 1 every 2 days depending on the deep of the wells. The high animal pressure exerted on natural pasture or overgrazing has been cited among the causes of the rangeland degradation by 4% of the respondents. They explained, the concentration of the herders around watering points such as along the sides of perennial lacks, led to overgrazing of the existing forage resources and explain the increase occurrence of barren land in the pastoral zone. This situation caused loss of pastures from the rangelands and is therefore a sign of pastoral land degradation resulting from overgrazing of animals over a long period. The palatable grass species that disappeared from the rangelands include *Cenchrus biflorus, Cymbopogon schoenanthus, Citrillus colocynthus, Aristida sieberiana, Tragus ramose, Cassia obstifolia, Chrozophora brochiara, Chrysopogon aucheri, Andropogon ganayanus, Cyperus conglomerates, and Blepharis linarifolia.*

Similar cases have also been observed by Dieter Geesing and Hassane Djibo, (2006), where they reported that the number of species in the pastoral zone has declined and the floristic composition of the herbaceous layer has been modified, very often to the detriment of perennial *grasses: Aristida sieberiana, Cymbopogon giganteus, Cymbopogon schoenanthus, Andropogon gayanus, Cyperus conglomerates* regressed considerably, even almost disappeared.

Another impact overgrazing is that palatable species are being replaced by the encroachment of the unpalatable ones. Almost all the respondents reported that rangeland degradation resulted for drought and climate change affect the productivity of their livestock. Temperature and rainfall being part of the climate change indicators, their variability such as increasing temperatures and decreasing rainfall are known to reduce yields particularly, feed production, species composition and feed quality of rangelands, and contribute to their degradation. The rainfall

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pattern and distribution overtime and space governed the spatial distribution and availability of pasture and water in an area (Hidosa & Guyo, 2017). Extreme temperatures tend to reduce animal feed intake and lower feed conversion rates (Bai, *et al.,* 2019) while climate change on livestock effects on livestock production apart feed shortage, shortage of water, include reduced productivity, and decreased mature weight and/or longer time to reach mature weight in their order of importance. Lack of pasture can favor the parasite infestation and disease spread particularly when animals meet in an area rich in pasture and water which consequently may result in high mortality of animals.

There are varieties of coping strategies developed by herders to either become resilient or to minimize the effect recurrent forage shortages and to guarantee the sustainability and prosperity of their main means of production. In addition to the endogenous herder's strategies, herders are being accompanied by government and its related partners. The actions approved by government and partners in Niger republic since the heavy loss of animals registered during the 2009-2010 drought are based on the Livestock Emergency guidelines and Standard (LEGS). Before discussion, there is need to note that in LEGS, there are two type of catastrophes that may rise as result of climate change and include those happening suddenly and those having a slow evolution overtime. The sudden may include floods, outbreak of disease or fire outbreak while those of low evolution comment in the semi-arid zone are drought and insecurity. Each type of catastrophe has its own phases during which coping strategies should be brought to attenuate the effects and recovery from the catastrophe. The Sudden catastrophe because of its rapid occurrence has three phases and include immediate phase, short recovery and recovery. On the other hand, catastrophe evolving slowly like drought has four phases: alert phase, alarming phase, urgency phase and recovery phase with each having its own signs are described as follows:

Mobility is a one of the oldest well-known primary risk reduction strategies, particularly in times of drought employed by pastoralists exploiting rangelands and to deal with the recurrent feed and water scarcity in Sahelian countries. However, its amplitude varies according the agroecological zone, herder tribe, and the severity of forage deficit. Years of normal and moderate shortage, the herder mobility is more local within the same department, state or at most in another state, and movements are guided by the availability of pasture, water, market and veterinary facility along the routes. However, when the biomass deficit is important generally more than 50% of the animal needs, Herders carry out transboundary mobility in Nigeria, Mali, Benin and Burkina Faso irrespective of the insecurity, conflict with farmers or even herders they may face. These finding corroborate the observation of Abdou *et al.*, (2010 where they documented mobility of herders to Nigeria, Benin, Burkina Faso and Mali during the 2010-2011 severe drought. Another reason of mobility practices is to avoid loss of animals and preserve their asset. During the last 2009-2010 drought (Abdou *et al.*,2011) reported that the Department of Abalak and Tchintabaraden, located in the study area recorded respectively 11.84% and 24.29% loss of their animal population.

Supplementation with purchased concentrate feed particularly cereal bran and cotton seedcake is one of the resilience strategies of pastoralists. These concentrate feeds were purchased on markets or from animal husbandry services and provided to animals during night particularly the lactating animals to maintain the milk production for family need, especially towards the end of the long dry season where forage is scarce, and of low nutritive values. Based on the yearly pasture evaluation report highlighting the zone of good and bad pasture production of vulnerably zone at the probable pastoralist that may be affected by forage shortage, an emergency plan is elaborated by the ministry of animal husbandry. The plan will give the details activities that should be carried out to protect the livelihood of the pastoralists. The required concentrate to attenuate the shortage is determined. On this basis government and partners will accommodate to mutually buy and set the concentrates on the field close and on time to herders where were sold at moderate price. Also, during the alert phase, some pastoralists embarked on collection of hay and field residues to feed, get revenue, and to improve the productivity of livestock but the drawback of such practice is the acceleration of pastoral land degradation and loss of seed bank which later negatively impact the living conditions. These finding corroborate the results reported of Abdou *et al.*, (2011), and Snorek, (2016) who reported that during drought conditions many agro-pastoralists have made the selling of hay and field residues a prominent part of their livelihood, yet, the collection and sale of grasses is dichotomously a cause of the reduction of grassland and fodder.

Since the last drought during which many livestock species were lost, pastoralist learnt capacity-building initiatives from various non-governmental organizations and government agencies to embrace livestock off-take for long-term resilience to drought. The culling off of animals particularly the weak, old and unproductive ones at the alert phase or end the rainy season phase before drought crisis when they are of good heath, well fed and can be bought at a higher price at the alert phase is referred to strategic culling off, The practice will enable them to generate income to buy cereals for family use and feed for animal like hay, crop residues and concentrates to overcome forage shortages and to avoid losing their livestock assets. The intensive sale of animals or decapitalization of the herd adopted by pastoralists agree with the findings of that recent awareness and capacity-building initiatives from various nongovernmental organizations and government agencies led most of the pastoralists to embrace livestock off-take for long-term resilience to drought of Lauali, (2014,). The urgency decapitalization is carried out when

the drought condition enters the urgency situation characterized by the depletion of forage and high mortalities. It is carried out when the government declare that there is a pastoral crisis. As the declaration of pastoral crisis is announced, the rapid immediate response mechanism is activated, and all World Bank project were summed to supply 5% of their budget to intervene and settle the situation. Many activities are then conduction among which the urgency decapitalization of animals. Animals are bought from herder at predetermine prix to avoid high loss, slaughtered and the meat processed, which is later distributed to the needy.

Vaccination of livestock against the prevalent disease is a practice carried out by government and partners to improve the health of the animals. The activity is performed during the cold season before the animals start, the downward movement and at the onset of the rainy season, the vaccination is against the prevalent diseases such as Contagious Bovine Pleuropneumonia disease, small ruminant Pleuropneumonia and Pasturellosis and it is free mandatory and carried just after the rainy season to facilitate transhumance. This confirms the result of the General census of Agriculture and Livestock of 2007, where they observed in a survey of livestock productivity assessment that 31% of herders vaccinate their animals against the prevalent disease. Abdou *et al.*, (2011) noticed in the evaluation of the impact of the pastoral crisis of 2009-2010 in the 14 pastoral departments of Niger republic, that 42.31% of pastoralists vaccinate their animals.

Social help is common, and form of coping strategy employed by pastoralist. The strategy helps to contribute to the psychological and social well-being through restoring dignity and a degree of control to disaster-affected populations. Although the practice is carried by only 8% of the respondent, it enables the distressed herders to get a couple of animals that will provide them milk for years. The animals are kept for years to give offspring's which ultimately become its property, after which, the animals are returned back. The government also carry such operation to herders that loss all their animals. Every year distressed herder was identified and were given four female and 1 male particularly goat because of its ability to withstand drought and its high prolificacy. This practice has been reported and was applied by 87.5% of agro pastoralists in Nigeria as reported by (Godson-Ibeji *et al*., 2022).

Like, the creation of concentrate feed boutiques, vaccination, irrigation farming, marking of livestock passing corridors and, soil and water conservation technique and seed broadcasting are carried out through cash for works or cash for food operations is done to increase forage production and to minimize effect of drought crises.

Activities diversification is a major strategy employed by more than 50% of the respondents to thrive in a harsh environment and improve household resilience in drought periods. The diversification is an additional job to pastoralism, rather than to substitute for livestock production. The activities can be grouped into climate sensitive and no climatic sensitive activities.

The climatic sensitive activities include sale or trading of collected hay and field crop residues, firewood and charcoal activities, and wild fruits gathering and sale selling, vegetable farming. Despite these activities procure them revenue to improve the animal productivity and the family need, they are aware of their drawback. As explained during the interview, they accelerate the rangeland degradation though fastening of soil and water erosion and their related consequences. Most of these activities were carried out by pastoralist close to national road and big cities. Similar results have been reported by Opiyo *et al.*, (2015). Substance vegetable farming is a major widespread activity in Tahoua pastoral zone undertaken to reduce the sale of livestock to meet family needs. The activity apart from enabling them to earn revenues, contribute greatly to the family basket consumption. This practice is in line with finding of Snorek, (2016) who noticed many fences garden of vegetable farming across the pastoral zone. The non-climatic sensitive activities concern, migration social help, herd diversification, and drilling of boreholes or wells. Many boreholes and traditional wells are constructed every year by pastoralists, Governments and NGOs in high pasture producing. This will facilitate a better exploitation of natural pasture contribute to reduce the feed scarcity in the late dry season and to reduce drinking water issues.

The breed raised are well adapted to the harsh arid environment characterized by frequent forage shortage. However, Cattle and sheep are more sensitive compared to Goat and Camels. Herders discovered that the drought sensitive species died more than the non-sensitive species. Therefore, nowadays pastoralists have good preference for browsers (goats and camels), than grazers (cattle and sheep), due to changes in vegetation composition and water scarcity. They also notice that family embarked in diversification of herd composition and species have higher off-take and are therefore more resilient during drought events. This practice has been reported by (Little & Mcpeak, 2014), who reported that herd composition can be a strategic choice to manage household resilience in response to changing environmental conditions.

The actions undertaken by government and NGOs to improve the living conditions of the pastoralist, include provision of animal feed in quantity and quality, vaccination of animal against the prevailing diseases, improving animal's productivity, guarantee drinking water, marking of livestock routes and enclaves from encroachment, and social insertion of distressed pastoralist. Vaccination, soil and water conservation of barren land and seed broadcasting, social insertion, concentrate feed provision activities have already been discussed earlier. Animals fattening, creation of abattoirs and modern livestock markets, pasture cultivation, fire break bands making are activities conducted to improve the living conditions. Some of these activities are carried through cash money of

food for work to enable household to gain additional income and food and avoid loss of their asset through selling, while some facilitate the exchange of goods (markets) during mobility. The end results of these activities are to reduce livestock assets loss during drought or pastorals crisis and to minimize its effects.

Conclusion

The pastoralists clearly indicated that the rangeland is deteriorated due du recurrent drought, high livestock pressure on natural pasture, upward shift of crop farming in the protected pastoral zone as a result of high demographic pressure and pastoral crisis. The recurrent and prolonged drought coupled with the over-utilization of coping strategies affected the herbaceous and trees covers of the rangeland. The consequences include increase soil and water erosion due to increasing barren land frequency and change in pasture plants composition with replacement of highly palatable plants species by less palatable and undesirable drought tolerant species. These effects have changed their habits, practices and their socio-cultural values have been profoundly modified.

The study highlighted that pastoralists of the pastoral zone undertake many different indigenous copying strategies to overcome these threats. They are also supported in their continuous efforts by the government and NGOs to make them more resilient and to minimize the effects of these recurrent and prolonged forage shortages resulting from drought. These adaptive mechanisms deployed by the government and partners include both development actions and non-development actions.

Continuous sensitizing on the need of anticipating responses since the alert phase of the drought occurrence is important to protect their assets and to minimize the effects. Also, early information system awareness on the of crisis, training and workshop of pastoral civile societies and educated representatives of pastoralists on the livestock emergency guidelines and standard are fundamental to enhance the indigenous knowledge of the pastoralists and to take the best decision making.

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ID: 279

Analysis of Sawnwood Marketing in Ibadan Metropolis

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Abstract

The marketing of sawnwood is an enterprise that gives opportunities to meet economic needs of different level on the social strata. Hence it is necessary to study the economic analysis of sawnwood marketing in Bodija plank market in Ibadan Oyo State. A total of 150 questionnaires were randomly administered to sawnwood marketers in Bodija plank market. Primary data were collected through the aid of a well-structured questionnaire. Descriptive statistics and budgetary analysis were used in the study. The Result of the study shows that 99.33% of the respondents were male and 58.67% were married. The mean household size of the respondents is 3 members. The study also revealed the average age of the respondents to be 50 years old. From the analysis of costs and returns, the total revenue was ₦391,447,086. And the total cost was ₦296,573,550. The gross margin was ₦96,005,836 while the average Net profit was ₦632,490.24 which indicates that Sawnwood marketing is lucrative and profitable in the study area. It was concluded that sawnwood marketing was a profitable AgriBusiness enterprise in the study.

ID: 280

Pharmacotechnical Characterization Of Pectins Obtained From Different Varieties Of Mango From Côte d'Ivoire For Pharmaceutical Application

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Abstract

Context: Mango is one of the most common tropical fruits in the world. Its peel contains pectin, which has antioxidant and gelling properties. The objective of this work was to highlight the interest of using mango pectin in the development of pharmaceutical forms. *Methodology :* Different varieties of mangoes, available in Côte d'Ivoire, were used in this study. The extraction of the pectin from their dried and ground peel powder was carried out in an acid medium by the microwave technique. The degrees of esterification of the pectins were determined after titrimetric determination. The pH and the flow properties of the gels obtained from these pectins were evaluated respectively using a pH meter and the Malvern rotational rheometer. *Results :* The pectins obtained had a brown colour, an aromatic odor and a crystalline appearance. They had variable degree of esterification and were Low Methoxy Pectin. The gels obtained had variable pH and viscosities depending on the variety of mango, with a shear-thinning character. *Conclusion and prospect :* Mango varieties had similar characteristics but different rheological properties. Textural and stability studies will have to be carried out.

***Keywords** : Mangifera indica; LMP pectin; gels; flow properties*

Introduction

Pectin makes up around 30% of the primary cell walls of plants (Scheller et al., 2007). However, only a few plants are treated as sources of commercial pectins, depending on the yield, time and cost of extraction procedures, the desired properties of the extracted pectins and the availability of raw materials (Hui et al., 2006). Pectic substances extracted from fresh tissue or from the dry matter of fruit and vegetables vary from 0.1% to 30%, depending on the source and extraction methods. Different degrees of esterification of pectins can be obtained. The main sources are citrus fruit (6-26%), soya hulls (18-28%), mango (9-29%) and grapes (13-32%) (F. Munarin et al., 2012).. To date, pectin has mainly been produced from fruit and vegetable waste (Jayani et al., 2005; F. Munarin et al., 2012). Various extraction procedures are described, with particular emphasis on the conditions that make them more or less suitable for extracting pectins for biomedical applications. Egg carton gelation allows pectin to form a solid hydrogel in an aqueous solution. Several pectin formulations (hydrogels, films, micro- and nanoparticles) have been used to date for various proteins and active substances by varying the type and concentrations of the polymer. Some work has already been published on pectin and its applications in controlled release (Assifaoui et al., 2011; Coimbra et al., 2011; Jantrawut et al., 2013; Fabiola Munarin et al., 2012; Munarin et al., 2011, 2010, 2010; Nguyen et al., 2014).
Mango pectin was chosen not only as part of a process to recycle mango peel waste, since mangoes are Côte d'Ivoire's third largest fruit crop (Agroforestry, 2023), but also to reduce the harmful effects of this waste on the environment and health. Mango peel is also an excellent source of pectin, with both highly and weakly methylated pectins (Ajila et al., 2010). Four mango cultivars from Côte d'Ivoire (Amélie, Kent, Mangot Noukourouni and Zill varieties) were selected on the basis of their fibrous character and availability throughout the country. Different pectins were obtained from these four mango varieties and then characterised in order to formulate mango pectin gels, as the type of pectin determines the structure of the gel. Hydrogels of these pectins were prepared and characterised. The pH and rheological properties were determined.

Material and methods

The mango varieties :Amélie, Kent, Mangot Noukourouni, Zill came from the north of Côte d'Ivoire. Citric acid, sodium citrate dihydrate, NaOH, absolute ethanol and HCl, all of analytical grade, were obtained from Sigma Chemical Co (St. Louis, MO, USA). Distilled water was used throughout the study.

Harvesting mangoes and identifying varieties

The mangoes were obtained from mango exporting producers in May 2021 in Korhogo (northern Côte d'Ivoire) and identified by a botanist. They were identified at the Centre National de Floristique (CNF) in Abidjan (Côte d'Ivoire), in accordance with herbarium Nº UCJ000983-UCJ000986.

Mango processing

The mangoes were washed in soapy water and the skin removed. The mango skins were cleaned and then dried in an oven at 40°C for 48 hours. The dried mango skins were finely ground using a Grindomix GM 300 knife mill (Retsch®) and sieved using a 50 µm mesh sieve. The resulting mango peel powder was stored in jars in the refrigerator before extraction.

Extraction of mango pectin (PM)

Twenty grams of dried mango powder were mixed with 600 ml of 1N HCl solution diluted to pH 1.5. The mixture was microwaved at 500W for 20 min. The filtrates were centrifuged at 4800 rpm for 20 min to remove the remaining coarse particles. The extracted pectin was then precipitated with 95% ethanol and dried for 48 h in an oven at 40 ± 1°C, with a humidity of 35 ± 2% (Chaiwait et al., 2015). The powder was then ground and sieved using a 50 µm mesh sieve. The powder was packaged in plastic tubes and stored in a refrigerator at 4 ± 2° C before being characterised. The extraction yield (%) was calculated using the following equation: Extraction yield (%) = (Mo/M) x 100, Mo is the mass of dried pectin obtained and M is the mass of dried mango peel powder.

Determination of the degree of esterification (DE) of mango pectins

50 mg of mango pectin was dissolved in distilled water (100 mL). After adding five drops of phenolphthalein, the solution was titrated with 0.05 M NaOH until it turned pale pink; the volume of 0.05 M NaOH obtained is taken as the initial volume (V1). 10 ml of 0.5 M NaOH is added and the mixture is stirred and left to stand for 15 minutes at 30°C. The mixture was then made up with 10 ml of 0.5 M HCl and the solution stirred until colourless. A further five drops of phenolphthalein were added, and the sample was titrated with 0.5 M NaOH until a persistent pale pink (Freitas de Oliveira et al., 2016). This titration end point was recorded as the final volume (V2). ED (%) = (Final volume V2/ (Initial volume V1 + Final volume V2) x 100.

Preparation of mango pectin gels

Mango pectin gels were prepared using the modified method of Vithanage et al. (2010), 2% LMP pectins were dissolved in citrate buffer (sodium citrate dihydrate + citric acid) and heated to 65 °C with constant stirring at 800 rpm for 10 min. A solution of CaCl2 (0.2 % w/w) was then added and vigorously stirred in the solution. The gels obtained were stored in the refrigerator at 4 ± 2 °C for 24 hours before being analysed.

Measuring the pH of mango pectin gels

The pH of mango pectin gels from the four varieties was measured using a pH meter HI 2211 (Hanna Instruments, Neo-Tech SA). The pH measurements were carried out on the mango pectin gels 1 hour after cooling and removal of air bubbles at 20° C before being stored in the refrigerator.

Rheological characterisation of gels

Rheological properties were determined with the Kinesus rotary rheometer (Malvern Instruments, Massy, France), using a planar geometry with a gap of 1 mm. The instrument is fitted with a lid to cover the exposed surface of the samples to prevent drying. The planar geometry and the choice of a suitable gap of 1 mm avoided possible fracturing of the gel around the truncation. The rheological properties of the gels were determined using the smallest strain analysis of the viscoelastic properties in the linear viscoelastic region (LVR) (Doucet et al., 2001). To determine the correct parameters, the LVR was obtained using an oscillatory strain sweep at a frequency of 1 Hz under a stress range of 0.01 to 10 Pa. The tests were repeated three times using approximately 10 grams of gel each time and the mean value of the repetitions was used to calculate the rheological parameters. The values obtained were analysed using rSpace data processing software (Malvern Instruments, Massy, France).

Determination of flow properties and thixotropy as a function of shear

The evolution of the shear stress as a function of the shear rate, which varied from 0.01 to 50 s^{-1} , was used to determine the rheogram or flow curve. The dynamic shear viscosity of the gels was evaluated as a function of shear rate, which was increased from 0.01 to 50 s^{-1} over 30 s. Then, the stable shear rate of 50 s^{-1} was maintained for 30 s, followed by a downward ramp back to 0 s^{-1} in 30 s. Determination of the flow properties was carried out at 25 ± 1° C for the four gels while using the Herschel-Bulkley model for rheofluidifying fluids with a critical stress (Gilbert. 2012):

$\tau = K \gamma^n + \tau_0$, τ = shear stress (Pa); γ = shear rate (s^{-1}); n = flow index; K = consistency index ($Pa.s^n$), τ_0 = critical stress (Pa).

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Measuring the viscoelasticity of gels and oscillation test

Frequency sweeps were performed between 0.01 and 100 Hz at low strain (1%) and carried out at 25 ± 1° C. The frequency sweep profile of the gels was obtained by measuring G' and G″. The elastic modulus (G') is a measure of the energy stored and recovered per sinusoidal strain cycle. It is a measure of the elastic nature of the samples. The viscous modulus (G″) is a measure of the energy lost per sinusoidal deformation cycle. It is an indication of the viscous nature of the samples. The elastic modulus G' as a function of frequency can provide information about the characteristics of the gel (Doucet et al., 2001). The frequency dependence of the elastic modulus G' was fitted using equation (Arogundade et al., 2012) $G' = K(\omega)^n$.

Measuring the influence of temperature on the viscoelasticity of gels

The moduli G and G″ were recorded as a function of temperature using a frequency of 1 Hz and a strain of 1% to be in the linear viscoelastic region. The experiments were performed by heating the samples from 5 to 90° C with a final temperature return to 25° C with a heating rate of 5° C/min.

Statistical analysis

Each experiment was performed in triplicate and results were presented as mean ± standard deviation.

Results

Pharmacotechnical characterisation of mango pectins (PM)

The extraction yields (EY) and degrees of esterification (DE) of mango pectins (MP) are listed in Table 1. The RE and DE ranged from 12-24% and 20-31% respectively, confirming that the pectins obtained were Low Methoxy Pectin (LMP). The water content of the pectins was low at around 7%.

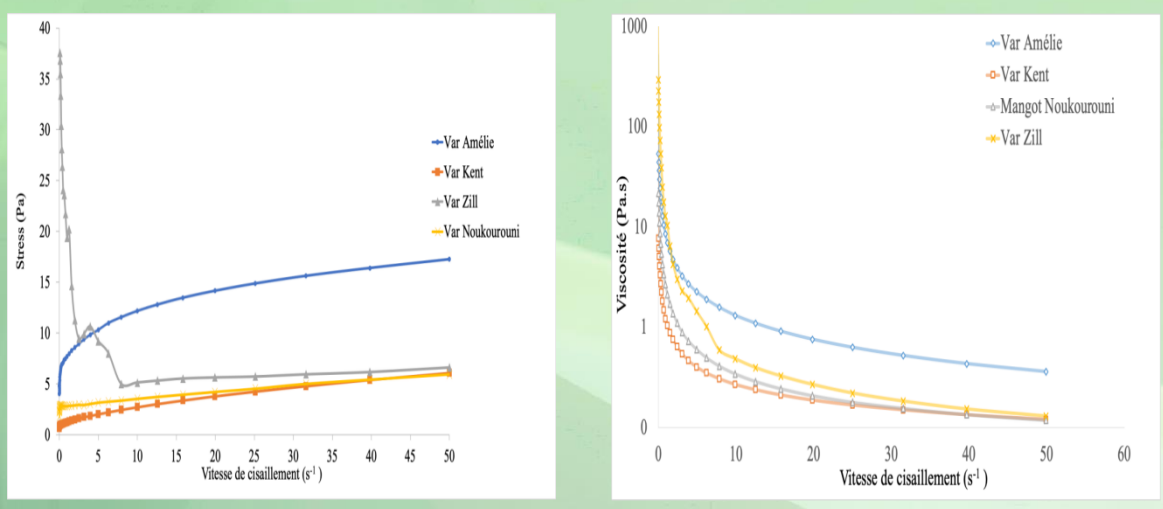
Preparation of mango pectin gels

Gels were obtained from LMP pectin solutions by adding a calcium chloride solution because the polyuronate chains of LMP could be bound by calcium to produce aggregates by the so-called "egg-box" structure, although the mechanism differs slightly from the "egg-box" model described for alginates (Grant et al., 1973). These aggregates are the precursors of gel formation reducing the solubility of pectin. Gelation occurs via the creation of junction zones by the galacturonate groups of pectin with specific sequences of galacturonic acid monomers arranged in parallel. The interaction between divalent cations and carboxylate groups in LMPs involves intermolecular bonding by chelation of the cations, leading to the formation of macromolecular aggregates. In addition, the properties of the gels obtained by the interaction between pectin and calcium are also influenced by the ED. When the ED decreases, an increase in the viscosity and firmness of the gel is observed in the presence of calcium ions (Lootens et al., 2003). The pH values of these gels are shown in Table 2. These pH values ranged from 4.56 to 4.78 (Table 2).

Rheological characterisation of gels

Determination of the flow properties of four mango pectin gels at 25 ± 1◦C.

Flow properties were determined at 25 ± 1° C in order to select a gel in which to incorporate the microparticles for further work. The mango pectin gels exhibited low critical stresses τ_0 between 0.8 and 2.5 Pa (Table 3)



(a) (b)

Figure 1. Changes in shear stress (a) and viscosity (b) of mango pectin gels as a function of shear rate at 25 ± 1◦C.

The influence of temperature on the viscosity of Amélie mango pectin gel (GA) was demonstrated at a temperature of 37 ± 1° C. Temperature and frequency influences on gel viscoelasticity (GA) was determined. The sample was equilibrated at different temperatures before the measurements were taken.

Determination of the influence of temperature on the viscosity of mango pectin gel of the Amélie variety

Mango pectin gel of the Amélie variety (GA) at a temperature of 37°C has a lower consistency index of 0.4 Pa.s (Figure 2) than the gel at a temperature of 25°C (6.5 Pa.s) (Table 3).

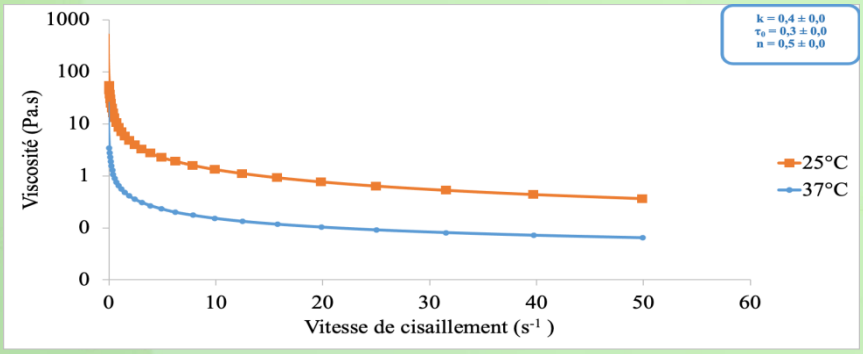


Figure 2. Viscosity of Amélie mango pectin gel as a function of shear rate at 25 ± 1 °C and 37 ± 1 °C.

Determination of the viscoelastic properties of Amélie mango pectin gel and oscillation test

The elastic modulus G' and viscous modulus G" were determined by varying the frequency between 0.01 and 100 Hz at 25 ± 1°C (Figure 3).

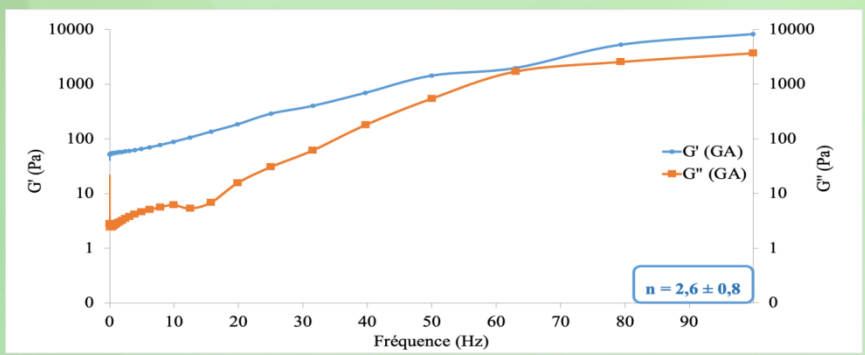


Figure 3. Frequency variation of elastic (G') and viscous (G") moduli of Amélie mango pectin gel at 25 ± 1 °C.

Determination of the influence of temperature on the viscoelasticity of mango pectin gel Amélie

Figure 4 shows the behaviour of Amélie mango pectin gel (GA) subjected to a range of heating (5-90°C). Over the entire temperature range, the GA gel showed high thermal stability, as the elastic modulus was greater than the viscous modulus (Figure 4).

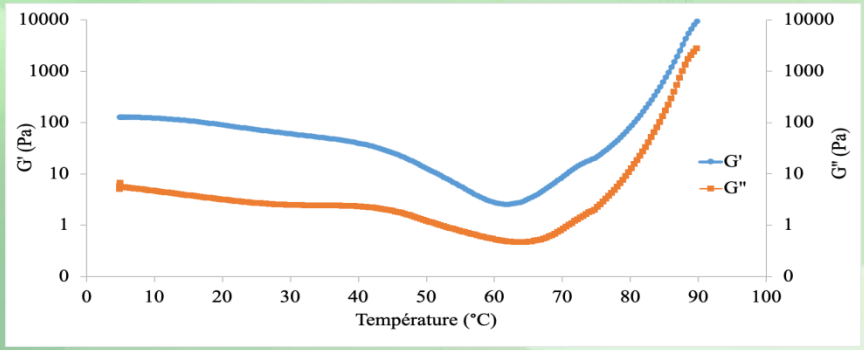


Figure 4. Changes in elastic (G') and viscous (G") moduli of Amélie mango pectin gel as a function of temperature.

Table 1. Pharmacotechnical characterisation of mango pectins (MP)

Varieties of mango	Extraction yields (%)	Degree of esterification (%)	Water content (%)
Amélie	24 ± 0,9	27 ± 0,4	7,1 ± 0,2
Kent	17 ± 0,7	20 ± 0,3	7,4 ± 0,6
Mangot noukourouni	22 ± 0,7	31 ± 0,4	7,3 ± 0,4
Zill	19 ± 1,1	31 ± 0,3	7,4 ± 0,3

Values are expressed as mean ± standard deviation, n = 3

Table 2. pH of mango pectin gels (PM)

Type of gel by mango variety	Amélie	Kent	Mangot noukourouni	Zill
pH	4,67 ± 0,37	4,65 ± 0,05	4,56 ± 0,04	4,78 ± 0,43

Values are expressed as mean ± standard deviation, n = 3

Table 3. Rheological parameters of mango pectin gels, experimental data based on the Herschel-Bulkley rheological model at 25 ± 1°C

Type of gel by mango variety	K (Consistency index in Pa.s)	N (Flow index)	τ_0 (Critical stress in Pa)
Amélie	6,5 ± 2,6	0,2 ± 0,0	2,2 ± 1,4
Kent	0,5 ± 0,0	0,6 ± 0,0	0,8 ± 0,0
Mangot noukourouni	0,2 ± 0,0	0,8 ± 0,0	2,5 ± 0,1
Zill	20,1 ± 8,1	0,0 ± 0,0	0,0 ± 0,0

Values are expressed as mean ± standard deviation, n = 3

Discussion

The yield and type of mango pectin depend on the cultivar and extraction conditions. The pectin obtained was weakly methylated and can form gels in the presence of divalent cations, making it an ideal carrier for the delivery of bioactive agents (Colodel et al., 2019; Huynh, 2017). According to pH, similar values were found for LMP pectin hydrogels (Moreira et al., 2014). These pH values were close to the pH of the scalp (5.5) because an alkaline pH can increase the negative electrical charge on the surface of hair fibres and, consequently, increase friction between fibres (Gavazzoni Dias et al., 2014).

Rheogical characterization showed that Zill gel appears to have the highest viscosity at low shear rates (Figure 1). The dynamic viscosities decreased as a function of shear rate (0.01-50 s^{-1}), demonstrating their rheofluidising behaviour (Figure 1).

This rheofluidifying character was also highlighted by the values of the flow index (n), which ranged from 0.0 to 0.8 and were less than 1 (Table 3). This decrease in viscosity can be interpreted by the separation and gradual alignment of entangled macromolecules during flow.

This rheofluidifying behaviour was observed in studies on the rheological analysis of gels obtained from eight mango cultivars from different regions (Deng et al., 2020). It was also similar to that of apple pomace pectin gels (Zhang et al., 2013), sugar beet pulp (Chen et al., 2015) and grapefruit peel (Wang et al., 2016). Mango pectin gel of the Amélie variety (GA) was selected for further work because it had a consistency of 6.5 Pa.s (neither soft nor hard gel), which made it possible to include microparticles, and a pronounced rheofluidifying character (n = 0.2) (Table 3). At 37°C, thermofluidification of mango pectin gel of the Amélie variety was observed. This result is due to disentanglement of the macromolecules under the influence of the increase in temperature.

At all frequencies, the elastic modulus was greater than the viscous modulus (Figure 3). The gel behaved essentially like an elastic fluid, confirming the firmness of the Amélie variety mango pectin gel (Han et al., 2017).This result was due to inter-chain entanglement of the molecular pectin (Piermaria et al., 2008). This result is similar to the results obtained on agarose gels as strong polysaccharide gels, due to the elastic modulus in these polysaccharides being greater than the viscous modulus at all frequencies (Ross-Murphy, 1995). However, at a frequency of 63 Hz, the elastic and viscous moduli are equal (Figure 3). Pectin gel is therefore not viscoelastic. When G′ is plotted as a function of ω (angular frequency), the degree of dependence of G′ can be determined by the parameters of the power law given by the relation $G' = K(\omega)^n$. According to this equation, K is a constant and n is the slope in a log-log plot of G′ as a function of ω. The parameter n can provide information about the structure of the gel. In covalent gels, n = 0, whereas in physical gels n > 0. Thus, (n) is related to the strength and nature of the gel (Colodel et al., 2019). Such an analysis makes it possible to identify covalently cross-linked materials and physical gels. Therefore, n can be used as a measure of the characteristics of the physical gel versus the covalently cross-linked gel (Gunasekaran and Ak, 2000; Zhang et al., 2017). In general, food gels exhibit slightly frequency-dependent behaviour, implying that they are physical in nature (Renard et al., 2006). The GA gel obtained was of a physical nature (because n = 2.6) with ionic bonds between the galacturonic units of pectin and calcium (Figure 3).

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Over the entire temperature range, the dominant elastic character of the GA gel observed previously was confirmed. No gel-soil transition point was observed. However, a decrease in the values of the elastic and viscous moduli when the GA gel was heated was observed from 5 to 65°C. Above 65°C, the opposite effect was noted.

Conclusion

The gels were prepared from mango pectin obtained by microwave extraction from dried mango skins of four cultivars from Côte d'Ivoire in order to select the pectin that would be suitable for further work. The extraction yields of mango pectins ranged from 12 to 24% and their water content was low (7%). The degrees of esterification of mango pectins obtained by titrimetry varied between 20 and 31%, confirming their low methylation potential (LMP), since the degrees of esterification were less than 50%. The preparation of gels from each of the different low-methyl mango pectins (LMP) was carried out in the presence of Ca^{2+} because the polyuronate chains of low-methyl pectins (LMP), together with divalent cations, lead to egg-box gelling and produce stronger gels. The gels obtained were the subject of various characterisations which led to the selection of the Amélie variety mango pectin gel (GA). The pH of the GA gel was 4.67, close to that of the scalp (5.5) and favourable for skin tolerance. Rheological characterisation of the GA gel was carried out at 25°C (ambient temperature) and 37°C (body temperature). At 25°C, the gel showed a consistency of 6.5 Pa.s, a rheofluidifying character ($n = 0.2$) that will facilitate the spreading of the gel on the hair and a low stress τ_0 that will allow the gel to flow easily. At 37°C, the influence of temperature was noticeable with a consistency of 0.4 Pa.s, which reflects a thermofluidification of the gel under the effect of the increase in temperature with a lower stress τ_0 . The increase in temperature did not alter the rheofluidifying character of the gel. Whatever the frequencies and temperatures applied, the GA gel showed a dominant elastic behaviour testifying to its firmness. It also appeared to be a physical gel with ionic bonds (because $n > 1$) depending on the frequencies.

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Food Crisis and Global Warming in Africa

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Abstract

Climate change has already had an influence on global food production; it is expected that the availability of calories has decreased in about half of the food-insecure countries. With the predicted high population growth, this issue will be the primary contributor to widespread food insecurity and undernourishment across Africa, especially in light of the changing global climate. These trends are likely to exacerbate the region's vulnerability to climate change via the economy and food security in Africa. This review aims to verify the relationship between the food crisis and global warming in Africa. Given the reliance of Africa on conventional agriculture, crop yields are predicted to drop under future climatic circumstances, and a new study suggests that yields have already been impacted. Food insecurity is characterized by inadequate food production, availability, and consumption, as well as inadequate food quality or nutritional content, which has been significantly impacted by changes in the world's environment. As a result of the importance of the agricultural sector as a driver for economic development, all governments must assure food security. Climate change-resistant plant types, as well as smart resource management, may help mitigate the effects of climate change and food poverty.

Keywords: *Global Warming, Food Crisis, Food Security, Africa*

Introduction

Climate may be defined as the range of temperature, precipitation, humidity, and winds that are characteristic of a place, area, or the entire planet at any one time. Food supplies, particularly in agriculture, will be disrupted by climate change, which will have an impact on society in developing nations. Agriculture is one of the sectors most at risk from climate change (FAO, 2022). The timing of extreme events, which are anticipated to occur more frequently due to climate change, will have an effect on food security. The repercussions of global warming are being felt everywhere in the world (Elsheikh et al., 2022a). Temperature and precipitation changes, the two most important climate variables and severe events (İstanbulluoğlu et al., 2013; Bağdatlı and Ballı, 2019). Furthermore, it was demonstrated that an ongoing trend of rising temperatures has a negative long-term effect on agricultural productivity (Bağdatlı et al., 2014). A key component of higher crop yield is soil temperature that is matched to a specific growing plant (Bağdatlı and Ballı, 2020).Because of the increase in carbon dioxide emissions, the rate of global warming has accelerated(Bağdatlı and Bellitürk, 2016a).Crop yields and plant growth are decreased by climate change, which also causes drought and land degradation (Elsheikh et al., 2022a).

Food security in Africa has been significantly influenced by climate change. It is obvious that rapid global climate change is having an effect and that there are hazards associated with these changes. Humanity is already being affected by climate change, which is changing the availability of land and water, human health, and most importantly, food security (Tumushabe, 2018). According to the FAO (2006), food security is the ability to receive enough food for each member of the family to live a healthy life in socially acceptable ways, whereas food insecurity is the inability to obtain enough food that is both safe and nutritionally adequate. The world is increasingly concerned about food insecurity, especially in poor countries. This is particularly true for Asia and Africa, where 552 and 226.4 million of the world's undernourished individuals dwell, respectively (Zhou et al., 2019).Ofori et al. (2021) predict that the Horn of Africa's food insecurity will intensify as a result of climate change. Food insecurity in nations that rely on food imports may emerge from climate change's effect on the pricing of important commodities. The amount of food available will be less due to climate change, which will result in higher food costs. Additionally, a serious and growing danger to the region's food security is posed by climate change (Hasegawa et al., 2018, Elsheikh et al., 2022b).

According to the FAO (2019), 1.3 billion people (17%) and 820 million people (or 11% of the world's current population) are both undernourished in terms of energy consumption. They are concentrated in Sub-Saharan Africa (SSA) and Asia. People who are vulnerable and food insecure are predicted to become much more prevalent as a result of the COVID-19 pandemic and climate change, particularly in SSA. Global supply networks are disrupted by the recession, and it will be harder to finance the massive food imports that certain countries, particularly those in SSA (FSIN, 2020). Improved food security will be dependent on the sustainable use and management of

resources, including land and water and water and nutrients, while maintaining planetary boundaries (Bağdatlıand Arslan, 2019).
For sustainable food systems and the use and management of land and water, finding the ideal balance between food and nutritional security, preserving the environment, and tackling climate change remain important issues (Willett et al., 2019).
In a number of studies, agricultural yields in different African nations might fall by up to 50% by 2020, and net crop income could plummet by as much as 90% by 2100 (Mason-D'Croz et al., 2019). The productivity of agriculture is predicted to be further disrupted by rising temperatures (Bağdatlı and Can, 2020; Bağdatlı etal., 2015). The livelihoods of rural residents, long-term food security, and price stability are at risk due to anticipated increases in obstacles, losses in crop yields and quality, and changes in severe occurrences. Within months of one another, floods and droughts can occur in the same region. These occurrences have the potential to cause widespread socioeconomic unrest and hunger. 220 million people in Africa experience drought every year, with one-third of the population living in areas prone to it (Ramin et al., 2009). Various explanations for the present "food crisis" have been put out, including financial speculation, rising demand for grains, export restrictions on certain commodities, insufficient grain reserves, higher oil prices, subpar harvests, and the use of cropland for the development of biofuels (Gregory and Ingram, 2009).Moreover, Millions of people in Africa are also seriously threatened by climate change. This review aims to verify the relationship between the food crisis and global warming in Africa

Food crisis and global warming in Africa

In 2010, 578 million people in the Asia-Pacific area, 239 million in sub-Saharan Africa, 53 million in Latin America and the Caribbean, 37 million in North Africa, and 19 million in industrialized nations were among the world's hungry.These numbers were predicted to climb owing to a second global food crisis in 2011, which was triggered by a significant spike in the price of commodities and food.
The World Bank estimates that between June and December 2010, the rise in food prices caused an additional 44 million people living on less than US$1.25 per day to slip into severe poverty. As a result, at the beginning of 2011, 1.2 billion individuals were in such circumstances (Sasson, 2012).
Food insecurity is a result of a number of economic, social, and political issues that frequently interact and overlap. The most significant reasons for the financial crisis in Africa are thought to be conflicts, climate change, and economic shocks. In addition to pandemics, poor political choices, and global policies. Since the time of decolonization, Africa has also been troubled by persistent conflict (Dodo, 2020).
Food insecurity has been linked to climate change as a significant factor. Extreme weather patterns brought on by climate change can cause floods from too much rain and droughts from not enough. In Africa, these trends have had a detrimental effect on food harvests and agriculture. In Africa, seasonality has a greater influence on agriculture, animal output, and food poverty due to the consequences of climate change. Because of this, many farmers commonly face decreased agricultural yields, which cause an increase in the price of food (Dodo, 2020; Trudell et al., 2021; Bagdatlı et al., 2023). Due to its effects on the production of food crops, food insecurity is the most frequent consequence of climate change. The demand for food crops is rising in tandem with population growth, but the impact of climate change is working against it, limiting endless small-scale crop production, thus exacerbating the issue of food insecurity. Crop yield and quality are hampered by climate change (Tumushabe et al., 2018). Crop yields are reduced and crop failure is brought on by the degradation of arable land and desertification. A significant amount of agricultural land will be lost due to climate change, which will result in poorer yields and, ultimately, food insecurity (Albut et al., 2018; Smith et al., 2020).
Africa is reliant on imported food and is susceptible to currency devaluations and changes in the value of commodities on the global market. Families are forced by inflation to make smaller food purchases and are only able to afford inexpensive, low-quality food. Due to a decline in commerce, the depreciation of the currency also causes a reduction in job and income opportunities, which ultimately causes a rise in poverty and the inability to buy food. In addition, 60–70% of the continent's workforce is employed in smallholder agriculture, which is a crucial source of labor (United Nations, 2020).There is little doubt that undernourishment remains a significant issue in Africa despite the advancements made over the past 25 years, and there is still much room for improvement. In fact, the area still falls behind of the rest of the world in terms of eradicating chronic hunger. Fighting hunger and attaining food security in Africa continue to be difficult tasks, especially in light of climate change, just as it is with achieving food security on a worldwide basis (Hall et al., 2017).
In fact, according to the World Bank MDG database, Africa not only has the biggest percentage of its people living below the international poverty line, it also saw an increase in this proportion from 47.4% in 1990 to 49% by 2000. Africa must attain an annual GDP growth rate of 7% in order to meet the first MDG (AFDB 2003). However, only 10 of the continent's 37 nations saw their average GDP grow by 5% or more between 1997 and 2003. According to predictions, 42.3% of the population would still be living in poverty by 2015 instead of the objective of 23.7%

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because Africa as a whole is expanding at a rate of roughly 3%.Around 65% of Africans depend primarily on agriculture for their living, which also contributes between 30% and 40% of the continent's GDP and nearly 60% of its export revenue. Increased agricultural and rural development will be necessary for Africa to reduce its extreme poverty and hunger (Behnassi et al., 2011).

Over the next few decades, climate change and population expansion are both anticipated to have an impact on food security in Africa. Strong evidence suggests that developing nations will be the ones most affected by climate change. Due to their high rates of poverty, inadequate infrastructure, and little capacity for adaptation, these areas are particularly susceptible to unfavorable climatic conditions. Due to its already high temperatures, heavy reliance on rain-fed agriculture, and fragile economic structure, sub-Saharan Africa is expected to be the worst-affected of all the emerging regions (Ray et al., 2019). Along with the accelerating global climate change, it is especially necessary to assess regional temperatures and analyze the product pattern (Bağdatlı and Arıkan, 2020). Food quality and quantity are expected to vary as a result of climate change and a rapidly expanding population, increasing the strain on the food supply network. Given the close association between climate change and agricultural regions, appropriate climatic conditions can significantly affect the output of whole food crops in these situations (Afreen et al., 2022). The impact of climate change on agriculture in Africa will consequently be the main focus of this section.

Some studies indicate that the areas with the greatest levels of food insecurity were also those where farming practices were anticipated to be significantly altered by climate change. The majority of these regions are in Africa and South Asia, but they could also have an impact on China and Latin America. The lives of hundreds of millions of people who are already poor or very poor will be in danger because these regions' agricultural seasons would be shorter, warmer, and drier in less than 40 years. Through adjusting the crop seasons or grazing lands, farmers have already tried to adapt to climatic changes. But more extreme adaptations would be required given how quickly and widely the climate is changing. Rice and maize yields are impacted by typical maximum temperatures over 30°C, while bean cultivation becomes exceedingly challenging. By 2050, tens of millions of small farmers in sub-Saharan Africa could face this challenge (Sasson, 2012). In the ensuing decades, food security in Africa is anticipated to be impacted by both population expansion and climate change. There is compelling evidence to suggest that the effects of climate change will be most severe in emerging nations. Because of their high rates of poverty, limited capacity for adaptation, and inadequate infrastructure, these areas are particularly susceptible to unfavorable climatic conditions. Sub-Saharan Africa is expected to be the worst affected of all the developing regions because of its already high temperatures, high reliance on rain-fed agriculture, and fragile economy. For instance, just 5% of the farmed land in this area is on irrigated farms (Hall et al., 2017).

The average temperature will rise across Sub-Saharan Africa, though to varying degrees. In particular, an increase in annual mean surface air temperature between 3°C and 4°C over the period 2080–2099 is predicted under a medium to high emissions scenario (IPCC, 2007). Estimates have been made; however, projections for precipitation are less reliable because of the high frequency of spatial and temporal changes. The Mediterranean coast, which includes parts of the northern Sahara and the west coast (to 15°N), is quite likely to have a 20% decline in mean annual rainfall over the years 2080 to 2099. But in tropical and eastern regions, rainfall is probably going to rise by about 7% (Christensen et al., 2007). Food security will be directly impacted by climate change since crop yields, water availability, pest and disease outbreaks, and livestock health will all be affected by changes in temperature and rainfall patterns. According to a study by Knox et al. (2012), this effect will result in a mean yield drop of 17% in wheat, 15% in sorghum, 10% in millet, and 5% in maize across Africa by 2050 due to climate change. There was a significant amount of diversity in the reported impact, but the majority of the evidence assessed for Africa predicted a yield drop of up to 40% across all crop categories and sub-regions. The majority of data in the scientific literature refers to maize. Despite making up 27% of Africa's total cultivated area, rice, sugarcane, and yams account for only 6 of the 162 observations for the continent. According to some studies, the predicted mean yield decrease for West Africa (12.5%) roughly matches the median yield loss of 11% reported by prior research (Roudier et al., 2011).

Despite the seeming abundance of evidence in the scientific literature, there are still significant gaps in our understanding of how climate change will affect certain crops and locations, with Central Africa having by far the fewest estimates of its effects on crop productivity (Knox et al., 2012). Increased food crop productivity, household earnings, and food security may all be indirectly impacted by the rise in precipitation (Bağdatlı and Arslan, 2020). Temperature-related indicators show that agricultural production is negatively impacted by temperature change (Elsheikh and Nasreldin, 2022). This study also demonstrated a direct connection between climate change and food insecurity in the Horn of Africa. According to Smith et al. (2020), a fast changing climate puts a greater strain on the production of food crops. The availability of food for individuals has an impact on production variety.

According to Bedasa et al. (2023), in The Horn Africa countries, their Results show that political stability, food production index, precipitation, cereal yields, and yields were important and had a negative impact on food insecurity. Since all other inputs remain constant, a 1 percent increase in the food production index and political stability leads to a 0.031 percent drop in food insecurity. The findings of Beyene et al. (2022) are supported by

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this outcome. Results additionally revealed that a 1% increase in grain yield was associated with a 0.108% decrease in food insecurity. For every 1% increase in precipitation, the rate of food insecurity fell by 0.023 percent.

The potential of Africa's next generation is undermined by the underlying crisis of child malnutrition and under education. Communities residing in secluded parts of the continent are especially affected by food insecurity. The absence of infrastructure and prohibitively high transit costs limit access to markets and utilities. The cost of transportation is higher in Africa when compared to other regions of the world. Due to high transportation expenses, farmers are unable to get their produce to markets at a price that is competitive. High post-harvest agricultural losses are also a result of inadequate storage facilities in rural areas. Farmers find it too expensive to obtain agricultural supplies like seeds and fertilizer (Balogun, 2011).

For the majority of impoverished and vulnerable groups in various countries in Africa, fish is a key source of sustenance. As one of the most traded food items in the area, the industry also employs a large number of men and women. By providing a significant source of cash revenue to pay off foreign debt, supporting the operations of national governments, and importing food for domestic consumption, the fish trade supports economic growth in many developing countries in general and most SSA countries in particular. This helps to ensure national food security and diversify diets. But the region's fisheries are seriously threatened by climate change (Mohammed and Uraguchi, 2013). Physical and biological changes can have an impact on fisheries, including increases in sea level, water salinity, and ocean acidification (Bağdatlı and Bellitürk, 2016b). Biological changes include shifts in primary production and the distribution of fish stocks. As a result of these changes, aquatic flora and fauna's food chains may be disrupted, habitats may be destroyed, food supplies may be depleted, the composition of prey and predators may alter, coastal fish landings may be destroyed, and processing and marketing facilities may be at risk. When these negative effects are coupled, they will negatively affect the resource, which is already under stress, which will lower fish output (Elsheikh et al., 2022a). The livelihoods of many vulnerable fishing communities and the food security of several countries in the region may be threatened by the depletion of fish stocks and the decline in fish production.

Future food production is anticipated to be impacted by climate change. For instance, the most widely consumed cereal crops like sorghum, millet, and maize are all included. The exclusion of starchy roots like yam, cassava, and sweet potato, which are commonly consumed, is a constraint. There is a dearth of information on how other foods will be impacted because the majority of current literature concentrates on how climate change will affect important staple crops (Hall et al., 2017). This study provides a thorough evaluation of the potential effects on crop production for policymakers and practitioners. According to research, not all of Africa's significant agricultural systems have been thoroughly evaluated at the continental level. This study, which is also strongly related to food security in Africa, is intended to bring attention to this crucial issue. And also presenting a thorough analysis of the effects of the climate on crop output in Africa, a continent already afflicted by crises and food insecurity.

Conclusion

Climate change and global warming have a significant impact on food systems, including food supply chains, food habitats, and food systems as a whole. Along the food value chain, these changes have an impact on food production, storage, processing, marketing, availability, promotion, affordability, and quality. On the other hand, global warming has begun to affect food production and yields all around the world. Food security is in danger, especially in arid and semi-arid regions, where it will continue to diminish. Most arid and semiarid countries do not now have good status. These nations are unable to supply the necessary amount of food for their people. Africa had already been identified as one of the continent’s most vulnerable to climate change. Because of the population's vulnerability as well as the anticipated warming and rainfall shortfalls, it is anticipated that climate change will have a particularly harmful impact. With decreasing agricultural output, degraded land, high market prices, detrimental effects on livelihoods, and increased malnutrition, the impact on food security will be significant. Before the issue of climate change becomes so serious, a substantial portion of the population in Africa has food insecurity, necessitating more measures to avert this catastrophe. In order to lessen food insecurity and climate change in Africa, it is vital that adaptation techniques be adopted. Furthermore, more research and studies on the effects of climate change on food security in Africa in general and agriculture in particular should be conducted.

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ID: 282

Study Effect of Zinc oxide Nanoparticles on *Helianthus annuus* L. Growth and Physiology for Mitigating Salinity and Drought Stress

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Abstract

The main goal of nanotechnology in agriculture is to increase crop yield. Biological synthesis of metallic nanoparticles using plant extract is cost-effective and environmentally friendly. Zinc is an essential metal for the production of chlorophyll, cell growth, regulation of gene expression and metabolism of RNA in plants. Zinc oxide nanoparticles are superior than any other metal oxide nanoparticle due to its inorganic photocatalytic nature with the highest photocatalytic efficiency. In this study, Zinc oxide nanoparticles were synthesized using *Mentha spicata* L.(MS) leaf extract, characterized and applied on sunflower (*Helianthus annuus* L.) plant for improving growth and physiology under salinity and drought stress conditions. Characterization through UV absorbance analysis showed a strong absorption peak at 368nm and confirms MS- zinc oxide nanoparticles formulation. Its FTIR spectra was at 3730.14 cm^{-1} which represents the functional group like OH stretching of alcohols and phenols. XRD confirms the hexagonal(wurtzite) structure of MS- ZnO nanoparticles. The synthesized nanoparticles were applied to sunflower plant under three treatments (normal, drought stress and salinity stress) in three concentration 50mg/L, 100mg/L and 150mg/L. The foliar application of 150mg/L ZnONPs in drought treatment were shown to enhance plant root and shoot length, root and shoot dry and fresh weight, number of leaves and relative water content as compared to control conditions while no significant results obtained in salinity treatment. Overall, this study proved that 150mg/L concentration of ZnONPs is sufficient for improving plant growth under drought conditions.

Key Words: *Nanoscale, Nano science, Nano Fertilizer, Biological Fertilizer, Poison Tumor, T cells, Plant Growth.*

ID: 284

Evaluation of Antioxidant, Antimicrobial and Wound Healing Activities of ZnO-CuO Nanoparticles Synthesized Using *Azadirachta indica* Leave Extract

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Abstract

The neem tree *(Azadirachta indica A.)*, which belongs to the family *Meliacae* and subfamily Melioideae, is renowned for its medical properties. The physiologically active component of neem, Azadirachtin, is thought to be responsible for the beneficial benefits of various portions of the plant. Present study was designed to assess the anti-microbial, antioxidant and *in vivo* wound healing activity of bimetallic ZnO-CuO nanoparticles by controlling physiological reactions. For this purpose, bimetallic nanoparticles were prepared and characterized using Scanning electron microscopy (SEM), X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR) and spectrophotometer to examine the physical and chemical properties of these NPs. Five different strains of bacteria were subjected to antibacterial activity tests, and a positive control antibiotic disc ciprofloxacin, was employed and it was done by agar well diffusion method through which inhibition zones will be observed. *Staphylococcus aureus* was the microbe that showed significant results among all pathogens having 10±0.2mm value in 100 µl concentration of bimetallic NPs. The antioxidant activity of ZnO-CuO NPs and Neem extract was evaluated using the DPPH free radical scavenging technique and FRAP assay. Ascorbic acid will be used as a standard in both assays. The scavenging activity was assessed by taking absorbance at 520 nm which showed that NPs had higher scavenging potential than ascorbic acid and proved by IC50 value that is 9.44µg/ml. *In vitro* cytotoxicity was done so that percentage of viable cells can be measured. For this purpose, HEPG2 cell lines were used. In the range of 1.5-200 µg/ml, BNPs showed higher toxicity for cancerous cells. For *in vivo* wound healing activity, mice were used as a model to examine the healing on incisional wounds and calculate wound contraction percentage in certain days. Different formulations of nanoparticles loaded carbopol gel had been prepared. Additionally, four groups of rats were made for *in vivo* study and in each group six rats were placed. Biogenic ZnO-CuO nanoparticles were anticipated to have antioxidant, antibacterial and wound healing properties in which 1.5% NPs loaded gel had non-significant results. The findings of this study have potential to contribute to development of novel therapeutic interventions. Histopathological studies were also done in order to find out the fibrosis at 10th day on skin of rats by observing fibroblast and macrophages spreading which showed gradual increase in fibroblast and scattered macrophages.

Keywords: *Azadirachta indica A., Bimetallic NPs, antibacterial activity ,In vivo wound healing activity, cytotoxicity, Histopathological studies*

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Liquid-liquid Extraction on Volatile Organic Compounds in Surface Water and Sediment selected Zones of Asa River, Kwara State, Nigeria

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Abstract

This research was developed in analysing volatile organic compounds in selected zones of Asa River, Kwara State. Liquid-liquid extraction procedure of two organic solvent (Hexane : Dichloromethane) (1:1 v/v) was employed to remove volatile organic compounds from river and sediment samples. The mean recovery percentage range was between 96.7±1.5 - 104.0±1.0 for river samples while 97.3±2.2 - 104.0±1.0 for sediment samples at a fortification level of 0.01 µg/l. In addition, volatile organic compounds were determined by Gas chromatography – mass spectrometry. The limit of quantification was 0.05 µg/l which was below the maximum level allowed by the European council directives for volatile organic compounds (0.5 µg/l).

Keywords: *Asa River, Volatile organic compounds, sediment, recovery, quantification*

Introduction

Liquid-liquid extraction is a method used to separate compounds based on their relative solubility in two different immiscible liquids, usually water and an organic solvent. Liquid-liquid extraction (LLE), or solvent extraction, is one of the oldest and most widely used techniques in the preparation of samples for qualitative and quantitative analysis. [Frederick and Manon, 2002]. It is an extraction of a substance from one liquid phase into another and a basic technique in chemical laboratories, where it is performed using a separating funnel [Abel et al., 1994]. In liquid-liquid extraction there is a feed phase which contains a component to be removed and the addition of a second phase (solvent phase) which is immiscible with feed phase to the solvent phase. After extraction, the feed and solvent phases are called the raffinate (R) and extract (E) phases respectively [Benedikt et al., 2020].

Volatile organic compounds (VOCs) are a group of organic compounds that have a molecular structure containing carbon and their chemical properties allow them to be easily converted to steam and remain for a long period of time with diverse effects on the environment (Xin et al., 2022). Volatile organic compounds (VOCs) are organic chemicals that have a high vapour pressure at ordinary room temperature conditions. Their high vapour pressure results from a low boiling point which causes large numbers of molecules to evaporate or sublimate from the liquid or solid form of the compound and enter the surrounding air [Goldstein and Galbally, 2008]. They include both human-made and natural occurring chemical compounds. Volatile organic compounds (VOCs) among major contaminants in water matrices causes physiological adverse effects on the human body such as cancer, genetic mutations, eye irritation, nasopharyngeal mucosa, dizziness and headache, and short-term memory loss (Li et al., 2018, Song and Chun, 2021). Volatile organic compounds are primary precursors to the formation of ground level ozone and particulate matter in the atmosphere which are main ingredients of air pollutant referred to as smog. Its emissions result from natural and anthropogenic (man- made) sources [Ninemets et al., 2004]. Natural sources of volatile organic compound include vegetation, forest fires, and animals. Although natural sources of volatile organic compounds emissions are larger overall, it is anthropogenic sources in populated and industrialized areas that are the main contributors to air quality problems. The major anthropogenic sources of concern are transportation sector, the use of solvents and solvent containing products, and industrial sources [Behr and Johnen, 2009; Wang et al., 2007].

Asa River flows through Ilorin in a South-North direction dividing the plain into two, western and eastern parts [Kwara State of Nigeria Diary, 1997]. Asa River is a major river for economic, environmental and agricultural significance in Ilorin, the capital city of Kwara State, Nigeria. The river receives direct runoff of effluents from industries along its course, apart from domestic wastes and other activities which contributes to its pollution [Adekunle and Eniola, 2008]. It was observed that the river is subject to high level of eutrophication due to organic matter and industrial discharge [Eletta and Adekola, 2005]. It was also reported that Asa River catchment was found to have high precipitation and sediment yields when analysed yearly for a period of seven years [Jimoh, 2003]. Heavy metal and non-metal pollutants have been analysed on Asa River by past researchers. The aim of this research is to analyse volatile organic compounds and its hazards to health and environment using liquid-

liquid extraction method at different concentrations of 0.01 µg/l, 0.02 µg/l and 0.05 µg/l respectively, on three zones at the course of Asa River to generate a good recovery and repeatability. Correlation analysis was done to ascertain interaction between river and sediment samples.

Materials and Methods

Study Area and Sample Collection

Samples collected from Asa River in Ilorin, Kwara State include New Yidi/ Asa Dam Zone (RW-AS- 1), Unity Zone (RW-UN-2) and Amilegbe Zone (RW-AM-3) were assessed in this study. Sampling points were selected based on assumed diversity of input from anthropogenic impacts and pollution level. Triplicate samples were taken from each sampling points at interval of four weeks over a period of three months. Preparation of sample bottles and containers were done prior to sampling based on sample size and type of analysis to be performed. Sample containers were thoroughly washed with metal free detergents and rinsed with tap water. They were then soaked in 1% nitric acid for 24 hours and washed with distilled water and kept intact to prevent contamination. Glass bottles were used to sample Volatile Organic Compounds (VOCs). Sediment samples (SD-AS-1, SD-UN-2 and SD-EP-3) at those locations were also collected into treated aluminum foil for Volatile Organic Compounds determination using Ekman grab.

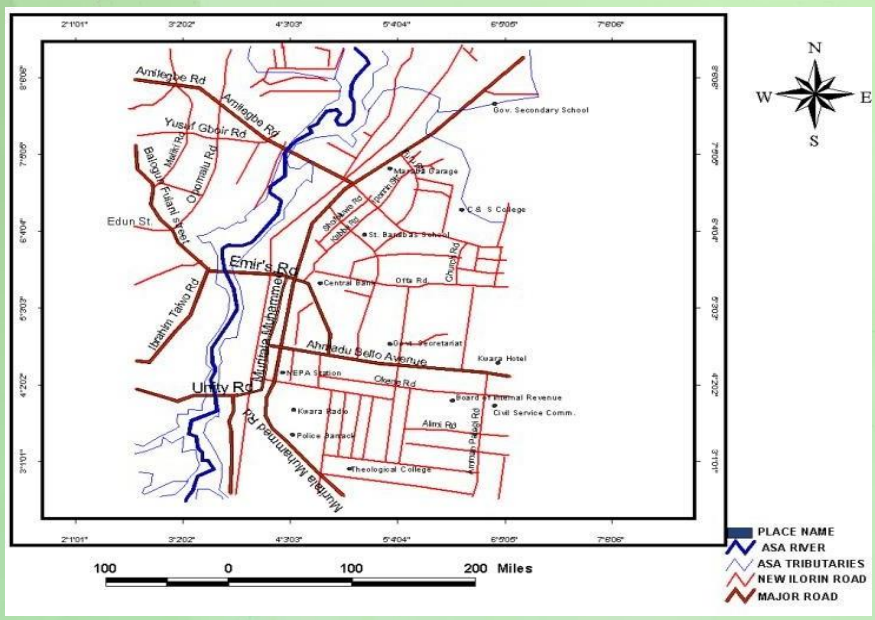


Fig. 1 Extracted Map of Asa River study Area

Reagents and solvents

All chemicals used were of analytical grade. Volatile organic compounds mixed standard include hexane, butane, propane, nonene, butene, decene, benzene, ethanoic acid, ethanedioic acid (New Haven, CT, USA).

Solvents of residue grade purity including dichloromethane, chloroform, n-hexane, 1,2- dichlorobenzene, methanol, acetonitrile were obtained from Merck Company. Standard stock solution 0.1 µg/l of mixed volatile organic compounds was prepared in methanol. All solutions were stored in the dark at 4ºC. Working solutions were prepared by dilution of standard stock solution with distilled water.

Chromatographic analysis

Gas Chromatography analyses were performed with a Hewlett-Packard 7890 series gas chromatograph equipped with 5975C Mass Spectrometer detector and splitless injection mode with a pulse pressure of 5.9818psi. Chromatographic separation was carried out using a polar column (30 m length, 0.32 mm i.d., and 0.25 µm film thickness). The oven temperature was 250ºC for 31 minutes followed by temperature programmed to 200ºC at 17ºC/min. Helium was used as carrier gas.

Liquid – liquid extraction procedure Water Analysis

The industrial and surface water samples were filtered through a membrane filter with 0.45 µm pore size before extraction procedures. Water sample of 100 ml was poured into a separating funnel and 100 ml of organic solvent (50 ml:50 ml – hexane: dichloromethane) added and the mixture separated for almost 45 minutes by thorough shaking, afterwards the extract was poured into a beaker and left for few minutes to evaporate then the remaining

extract filtered using cotton wool as a separating medium in a pasture pipette and anhydrous sodium tetraoxosulphate (VI) (Na_2SO_4) in excess was added to absorbed the remaining water in the sample and this was totaled into a vial bottle up to 2 ml ready for Gas Chromatography analysis.

Sediment Analysis

The dry sediments were carefully collected, homogenised and passed through 60 mesh standard sieves. Sample preparation included homogeneous mixing of 10 g of sediment with 0.25 g anhydrous Sodium sulphate to remove moisture and in 10 ml of dichloromethane for 1h followed by centrifugation. Then 3 ml of supernatant was filtered through 2 g of silica gel column with 11 ml 1:1 (v/v) elution of hexane and dichloromethane. The solvent fractions were then evaporated on a rotary evaporator, and exchanged by acetonitrile with a final volume of 2 ml ready for Gas chromatography analysis.

Results and Discussion

Quality Assurance and Quality Control

The quality assurance and quality control (QA/QC) requirements included establishing Gas chromatography retention times (RT), method detection limit (MDL) and reproducibility for all compounds analyzed. In table 1, forty-six volatile organic compounds are listed along with their molecular weight (MW), boiling point (BP), melting point (MP), method detection limits (MDLs) and relative standard deviation (RSD) of each volatile organic compound. For volatile organic compound collected, method detection limits were between 0.2 and 0.7 ppbv. The relative standard deviation was between 0.6% and 5.0% which is well within the limit of ±30%. For quality assurance approximately 30% of the samples were analyzed in triplicate. The reported percentage quality is the amount present in the sample.

Recovery Studies

Recovery study was performed on investigated compounds from spiked river zone samples and sediment from three zones along Asa River route at three concentration levels. At each concentration level, three determinations were performed. The mean recoveries and relative standard deviation (RSD) of alkanes (pentane), alkenes (butene), aromatics (benzene) and carboxylic acids (acetic acid) can be observed in table 2 and 3 respectively.

Recovery study on river zones

Recovery study was done using a known amount of standard volatile organic compounds injected in the sample before extraction to check how much were recovered after completion exercise. The recoveries of volatile organic compounds from spiked river zones were done at three concentrations levels, at each concentration level, three determinations were performed. It was observed at 0.01 µg/l, 0.02 µg/l and 0.05 µg/l respectively. RW-AS-1 recorded a mean recovery percentage range and relative standard deviation of [97.1±3.2- 104±1.0] , RW-UN-2 [90.0±1.0 – 103.3±1.5] while RW-AM-3 obtained [97.7±1.5 - 104±1.0].

Recovery study on sediment zones

The recoveries of volatile organic compounds from spiked sediment was done at three concentration levels, at each concentration level, three determinations were performed. It was observed at 0.01 µg/l, 0.02 µg/l and 0.05 µg/l respectively. SD-AS-1 recorded a mean recovery range and relative standard deviation of [90.0±4.6 – 102.8±1.8], SD-UN-2 [99.1±0.5 – 104.0±1.7] while, SD-AM-3 [85.0±6.6 – 103.7±1.2].

Correlation values of volatile organic compounds based on recovery concentration

The table 4 shows the correlation analysis for volatile organic compounds targeted at river zones in relation to sediment at the same place. The degree of freedom is 5, critical table value = 0.754 at 5% significance level.
At 0.01µg/l for RW-SD-AS-1, RW-SD-UN-2 and RW-SD-AM-3 recorded range of (-0.26 – 0.30), while at 0.02µg/l for RW-SD-AM-3 was 0.74 which indicated that $r_{cal} < r_{table}$ therefore the null hypothesis Ho cannot be rejected and this account show that volatile organic compound of river do not have association with sediment at that concentration. At 0.02µg/l, RW-SD-AS-1 and RW-SD-UN-2 obtained range (0.76 - 0.77), while at 0.05 µg/l, RW-SD-AS-1, RW-SD-UN-2 and RW-SD-AM-3 recorded range (0.91 – 0.98) and revealed that $r_{cal} > r_{table}$ therefore the null hypothesis Ho can be rejected and it would be concluded that there is a positive association between river zone and sediment at those concentration. Figure 1-3 which reveals the correlation analysis pattern at 0.05µg/l also affirm the interaction between the river and sediment zones. The R^2 determine on the graph account for the reliability of the extraction method used based on recovery studies.

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Table 1. Properties, Quality Assurance and Quality Control for targeted volatile organic compounds in river and sediment samples

Groups	VOCs Species	MW	BP (°C)	MP (°C)	MDL	RSD	% Quality	RT
Alkane	1,1-dichloro 2,2-difluoroethane	135	60	n/a	0.3	3.7	91	3.327
	BromodichloroMethane	164	87	-55	0.2	3.2	96	3.362
	Trichloromethane	119	60.5	-63	0.5	1.5	96	3.327
	Oxybis[dichloro methane]	184	39.8	n/a	0.2	3.2	96	3.785
	1,2-dimethyl – cis Cyclopentane	98	99	n/a	0.5	1.5	62	8.992
	1,2-dimethyl-trans Cyclopentane	98	92	n/a	0.5	1.5	62	8.992
	Bromomethane	94	4	-94	0.3	1.0	96	10.073
	Methylene cyclobutane	68	42	n/a	0.5	2.0	81	5.192
	2-isocyanato propane	85	74	<-75	0.3	1.0	81	3.413
	2-cyclo propyl propane	84	58	n/a	0.5	2.5	81	3.550
	Ethyl cyclobutane	84	70.7	n/a	0.5	3.6	96	4.357
	Methyl cyclopentane	98	101	-126	0.5	0.6	95	4.592
	1,3-dimethyl-cis cyclopentane	84	80.7	6.5	0.2	3.5	53	9.016
	1,3-dimethyl-trans cyclopentane	98	91	n/a	0.5	3.3	58	9.016
	2-chloro-1,1,1-trifluoro ethane	119	6.9	-106	0.5	3.5	91	7.144
	1-methyl-2-octyl cyclo propane	154	203.3	n/a	0.2	3.3	62	25.975
	1,2-diethyl cyclo butane	112	n/a	n/a	0.5	2.0	73	25.975
	1,3-dimethyl cyclo pentane	98	n/a	n/a	0.5	2.0	64	8.935
Alkenes	2-Pentene (E)	70	37	-40	0.3	2.7	93	3.613
	2-methyl-1-butene	70	31	-137	0.2	1.0	93	3.648
	2-pentene	70	37	n/a	0.3	2.0	93	3.676
	2-pentene (Z)	70	38	-180	0.3	1.0	93	3.699
	1,2-dichloro ethene (Z)	97	60.3	-81	0.4	1.5	57	6.697
	2-Hexene (E)	84	62	n/a	0.4	1.5	55	6.978
	3,4-dimethyl-1-pentene	98	n/a	n/a	0.5	1.5	77	7.464
	3,7-dimethyl-1-octane	140	156	n/a	0.5	1.0	77	7.464
	4-ethenyl cyclohexene	108	n/a	n/a	0.2	2.0	53	25.855
	1-Nonene	126	146	-81	0.5	1.6	65	26.038
	2-butene (E)	56	1	-105	0.5	1.0	91	4.883
	2-butene (Z)	56	3.7	-139	0.4	2.8	91	4.557
	2-butene	56	n/a	n/a	0.3	1.5	91	4.906
	Cycloheptene	96	112	n/a	0.2	0.6	57	27.840
	1-chloro-Z-2-heptene	133	n/a	n/a	0.4	4.6	50	5.740
	1-Hexene	84	64	-140	0.3	1.0	90	4.929
Aromatics	Fluorobenzene	96	85	-42	0.2	3.8	91	6.697
	2,3,4,5-tetrahydropyridine	83	n/a	n/a	0.4	2.5	53	6.692
	Pyridine-D5	84	115	n/a	0.6	3.2	50	6.108
	2-chlorothiophene	119	127	n/a	0.7	4.4	62	7.018
	3-chlorothiophene	119	137	n/a	0.7	3.2	62	7.018
	Indan-1,2,3-trione	178	n/a	250	0.5	5.0	53	26.581
	Ninhydrin	178	n/a	250	0.5	2.5	62	26.581
Carboxylic Acids	2,6-diamino-4-hexenoic acid	144	n/a	n/a	0.3	1.0	53	26.261
	Dichloroacetic acid	129	194	9	0.3	3.8	91	3.459
	Non-3-enyl ester acetic acid	184	234	n/a	0.3	2.0	50	28.858
	Fluoroacetic acid	78	165	33	0.5	1.0	95	7.584
	2-cyano-ethyl ester hexanoic Acid	169	n/a	n/a	0.5	1.0	54	25.820

Source: Author's fieldwork

Table 2. Mean recoveries and standard deviation for river zones sampled

VOCs	Conc. (µg/l)	RW-AS-1	RW-UN-2	RW-AM-3
Alkanes (Pentane)	0.01	101.8±3.7	102.7±3.2	100.3±1.5
	0.02	97.1±3.2	96.7±1.5	97.7±1.5
	0.05	104.0±1.0	99.0±2.0	104±1.0
Alkenes (Butene)	0.01	101.2±2.7	103.0±1.0	102±2.0
	0.02	102.0±1.0	103.3±1.5	98.7±1.5
	0.05	103.0±1.5	95.0±1.0	103.3±1.5
Aromatics (Benzene)	0.01	99.6±3.8	99.7±2.5	101.7±3.2
	0.02	99.6±4.4	101.3±3.2	100.0±5.0
	0.05	101.3±2.52	91.0±3.61	101.3±1.5
Carboxylic Acids (Acetic Acid)	0.01	102.0±1.0	99.0±1.0	102.0±1.0
	0.02	102.3±3.8	103.0±2.0	99.0±1.0
	0.05	103.0±1.0	90.0±1.0	100.0±1.0

Table 3. Mean recoveries and standard deviation for sediment zones sampled

VOCs	Conc. (µg/l)	SD-AS-1	SD-UN-2	SD-AM-3
Alkanes (Pentane)	0.01	97.7±2.5	101.8±3.6	98.9±0.6
	0.02	97.3±3.5	99.1±3.3	103.1±2.0
	0.05	99.1±2.0	105.0±3.0	92.0±6.3
Alkenes (Butene)	0.01	100.0±2.0	99.7±1.6	104.0±1.0
	0.02	100.3±2.8	102.6±1.5	103.0±0.6
	0.05	90.0±4.6	104.0±1.0	90.0±1.0
Aromatics (Benzene)	0.01	101.7±0.6	104.0±1.7	100.8±3.2
	0.02	102.0±0.7	99.1±0.5	99.2±1.1
	0.05	85.0±2.7	102.0±2.7	85.0±6.6
Carboxylic Acids (Acetic Acid)	0.01	102.7±2.2	103.7±0.7	97.3±2.2
	0.02	102.8±1.8	101.6±1.6	103.7±1.2
	0.05	92.0±5.3	101.0±2.0	85.0±8.7

Table 4. Correlation variables of volatile organic compounds based on recovery concentration

Concentration (µg/l)	RW-SD-AS-1	RW-SD-UN-2	RW-SD-AM-3
0.01	-0.26	-0.91	0.30
0.02	0.76	0.77	0.74
0.05	0.91	0.98	0.96

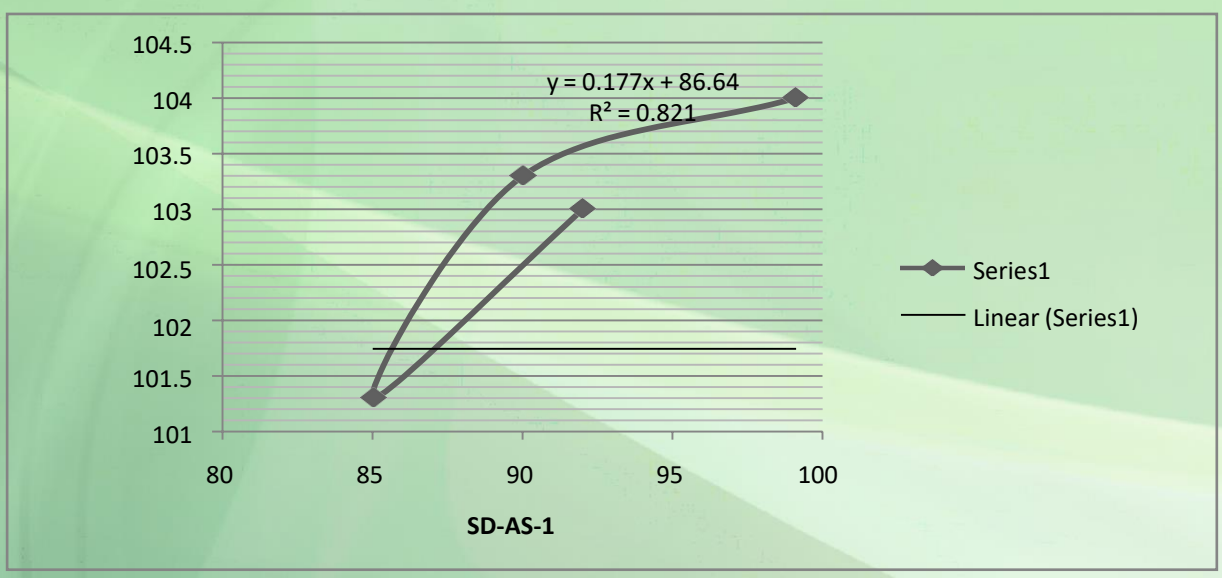


Fig 1. Correlation analysis of river zone and sediment at 0.05µg/l (RW-SD-AS-1)

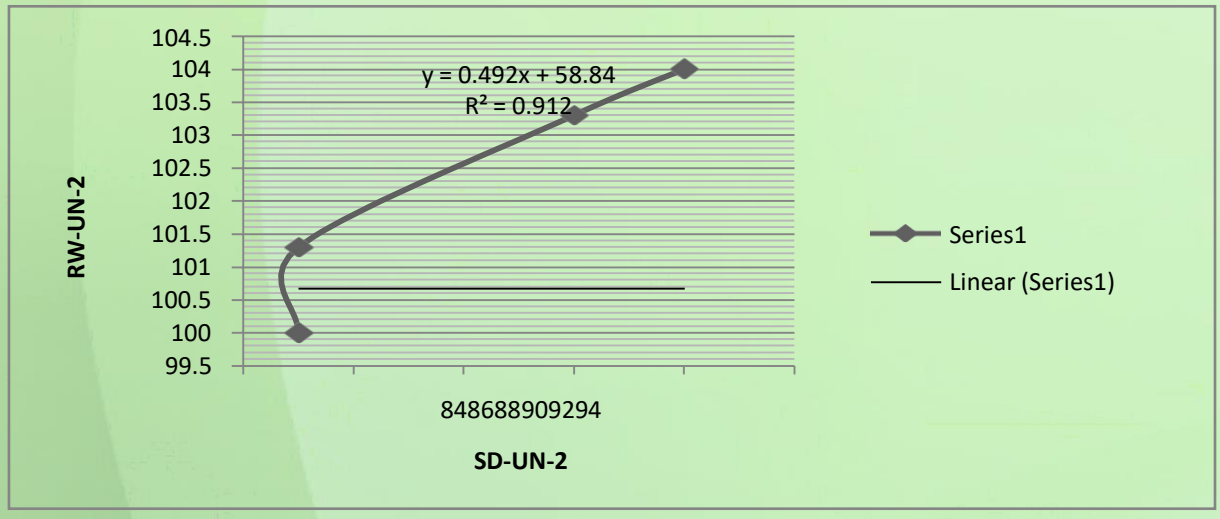


Fig.2 Correlation analysis of river zone and sediment at 0.05µg/l (RW-SD-UN-2)

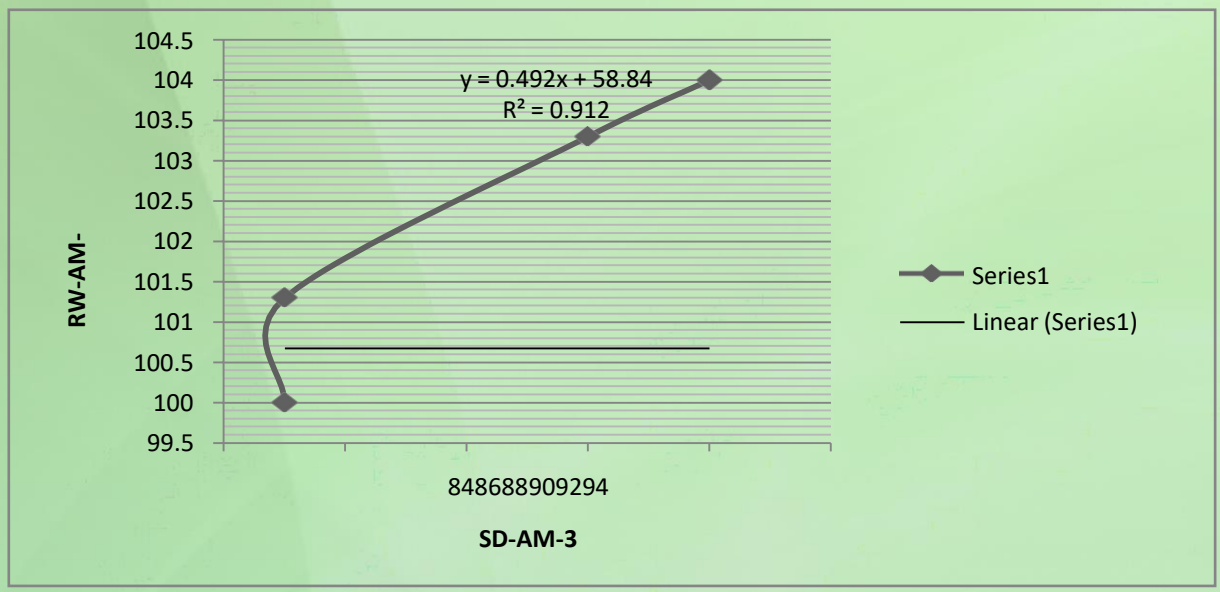


Fig.3 Correlation analysis of river zone and sediment at 0.05µg/l (RW-SD-AM-3)

Conclusion

Liquid-liquid extraction method was performed on the river and sediment zones to confirm their applicability on Ilorin environs, Kwara State which had in general a relatively transparent aspect. Previous experiment had shown that the type and volume of solvent could increase the emulsion formation. The recovery experiments were carried out for optimization of liquid-liquid extraction for volatile organic compounds and the following summaries were made: For river samples at 0.05 µg/l recorded 90.0±1.0% – 104.0±1.0% while sediment samples obtained (85.0±8.7% - 105.0±3.0%). Both the river and sediment zones revealed a derivative of benzene (Fluorobenzene) which is a human carcinogen and a chemical compound found in environmental tobacco smoke, stored fuels and exhaust from cars. It has also been found to contaminate food and water and when digested can lead to vomiting, dizziness, sleepiness, rapid heartbeat and at high levels, even death may occur. Other volatile organic compounds like chlorofluorocarbons and chlorocarbons also determined in this experiment are harmful to health and should be thoroughly monitored because this is the river that serves has drinking water source for Kwara state. In summary, though the volatile organic compound gave a good recovery due to their concentration being below limit of quantification, it is evident that the studied area presents a critical situation and offering risks to environmental compartments.

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Bioactive Compounds from By-Products and Food Wastes: Recent Developments in their Health Benefits

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Abstract

Background: Agro-waste and by-products pose social, economic, and environmental problems, hence they are a growing source of concern. Due to the potential for these materials to be used as sources for useful product development and the rising demand for natural bioactive compounds, the conversion of food waste and by-products is garnering more and more attention. Agricultural production and the food supply chain are the main sources of food wastes, which are discarded and used as animal feed. These by-products contain bioactive compounds with great nutritional, functional properties associated with health-related benefits.
Scope and approach: This review describes the current scientific studies regarding bioactive compounds present in food wastes and by-products of the agro-food supply chain, as well as their health benefits. These findings intend to contribute for future research concerning novel functional food, nutraceutical and pharmaceutical product development based on food wastes & by-products.
Key findings and conclusion: Polyphenols, Terpenoids, Alkaloids, and other nitrogen-containing constituents, are examples of bioactive compounds that exhibit a variety of positive effects due to their anti-inflammatory and antioxidant properties. These compounds are present in a variety of fruits, vegetables, spices, grains, and their derived foods and beverages including fruit juices, tea, chocolates, essential oils, beer, wine, etc. Moreover, these by-products also present therapeutic properties including anti-diabetic, antioxidant, antihypertensive, anti-inflammatory, antiulcer, antitumor, hypocholesterolemic, hepato-, nephron- and neuro-protective effects and antibacterial properties fully justified by the presence of bioactive compounds. Therefore, these food wastes and by-products can be considered good candidates for the development of functional foods, nutraceutical and cosmeceutical, contributing to promote sustainability across food chain and achieving zero waste generation. Nevertheless, more research is needed on their clinical studies to fully support the development of functional foods, nutraceutical and pharmaceutical applications.

Keywords: *bioactive compounds; by-products; food wastes; health benefits; natural extracts*

Introduction

Functional foods, plant-derived nutraceuticals, and dietary supplements have recently embodied health-promoting ingredients that can improve human well-being. Functional foods, dietary supplements and nutraceuticals contain, beyond the nutritional components, bioactive compounds with health benefits (Sachdeva et al., 2020; Gul et al., 2016; Granado-Lorencio and Hernández-Alvarez 2016; Santos-Buelga et al., 2019; Granato 2020). The majority of so-called bioactive compounds are phenolic compounds (PCs), which include terpenoids (carotenoids and phytosterols), polyphenols, alkaloids, and other nitrogen-containing constituents (glucosinolates). These compounds can be found in vegetables, fruits, grains, spices, and their derived foods and beverages, including fruit juices, tea, chocolate, essential oils, wine, beer, etc. (Dillard and German 2000). The largest group of non-nutrient dietary PCs are secondary metabolites synthesized by plants under normal and stress conditions (Cheynier et al., 2013). PCs include polyphenols which, based on their structural characteristics, are subdivided into three major classes: flavonoids, non-flavonoids and phenolic acids (Zhang and Tsao 2016).
Due to their antioxidant and anti-inflammatory properties, polyphenol compounds exert numerous beneficial effects (Shahidi and Ambigaipalan 2015). In addition to acting as metal (Fe^{2+}) chelators, polyphenol compounds also act as chain breakers of lipid peroxidation reactions, which inhibit oxidant enzymes (e.g. xanthine oxidase) and modulate cellular signaling processes that interfere with protein and lipid kinase pathways (Tsao 2010). In addition, polyphenols enable the restoration of the endogenous antioxidant pool (including catalase, glutathione, peroxidase and superoxide dismutase), which is reduced due to a high rate of elimination (Uttara et al., 2009). Adequate amounts of antioxidants must be supplied by the diet or dietary supplements to maintain redox homeostasis (Liu 2003). According to several epidemiological studies, a diet rich in antioxidant polyphenol compounds (primarily flavonoids, phenolic acids, lignans, stilbenes, tannins and anthocyanins) or the intake of polyphenol-rich derivatives, appears to favor a delay in the onset of degenerative diseases such as brain dysfunctions, cancers, cardiovascular injuries, and metabolic disorders, in which oxidative stress plays a

significant role (Liu 2003; Tressera-Rimbau et al., 2017). According to several studies, eating foods high in flavanones (naringenin) and flavonols (quercetin), such as apples, onions, oranges, and grapefruit, lowers the risk of cardiovascular disease and tumor growth (Somerset and Johannot 2008; Benavente-García and Castillo 2008; Mahmoud et al., 2019; Sánchez Macarro et al., 2020; Tajaldini et al., 2020; Asgharian et al., 2022). Specifically, a number of active systems have been developed recently using the flavonoid quercetin, primarily utilizing its antioxidant properties to stop oxidation processes in food products (Montone et al., 2022). In addition to its well-known antioxidant activity, some authors suggest that this flavonoid has antimicrobial activity against Gram-positive and Gram-negative bacteria *in vitro* and through a shelf-life study on food products (Malvano et al., 2022; Malvano et al., 2021). Additionally, studies on flavonoids' anti-inflammatory activity, particularly those of quercetin glycoside compounds, were conducted. When quercetin is more exposed on the surface of nanoparticles, Montone et al. (2021) observed a significant decrease in cytokine production during infection of the human macrophage cell line U93, particularly IL8. Indeed, these components play a key role in the prevention of non-communicable diseases, like type 2 diabetes, certain cancers, and neurodegenerative diseases as well as cardiovascular diseases. (Koch 2019). Therefore, the intake of phenolic compounds is part of a healthy diet. Today, many people follow a vegetarian lifestyle and consume more fruits, vegetables, and agricultural products as a result of the knowledge of the beneficial effects of bioactive compounds on health. However, the production of food and the food supply chain are significant sources of waste biomass. A large amount of agro-industry wastes and by-products, such as leaves, peels, seeds, stems, shells, and skins, are produced throughout the entire food life cycle, from the cultivation, through industrial manufacturing to market (Helkar et al., 2016).

Because of this, it has been predicted that vegetable and fruit wastes would increase in the near future, posing an unavoidable environmental burden. Therefore, efficient waste disposal is required to prevent unfavorable and severe environmental effects (Mahawar et al., 2020). But, since proper wastes disposal embodies a cost to the circular economy, a model of economy has been proposed by Romani et al., (2019) as a solution to minimize raw material input and waste production, where by-products are not waste but resources to be valorized and reused. Agri-food processing residues are recognized as materials of high biorefinery potential, due to their unique composition, offering a range of opportunities for the sustainable production of food, feed, chemicals and energy (Makris and Sahin).

The aim of this review is to highlight current research demonstrating various potential uses of wastes and by-products of the agro-food supply chain, which can have various applications such development of novel functional foods, nutraceuticals, pharmaceuticals, and cosmeceuticals. Extracts derived from fruit and vegetable wastes have recently attracted the attention of researchers because they offer a means of utilizing waste production for the development of novel formulations that can have a substantial positive impact on human health (Sorrenti et al. 2023; Bhandari et al., 2013; Karam et al., 2016; Neacsu et al., 2015; Sharma et al., 2017; Cook et al., 2022).

In this review, we focus on the main bioactive compounds present in the most popular fruits eaten worldwide such as Citrus fruits, Mango, Avocado, Watermelon and Papaya.

Bioactive Compounds Obtained from Wastes and Innovative Applications

The following paragraphs discussed the main bioactive compounds present in the most popular fruits eaten worldwide.

Health Benefits of Citrus Fruit Waste and Its Utilization

Citrus fruits, like oranges, lemons, grapefruits, limes, tangerines and mandarins, are among the most popular fruits grown globally (FAOSTAT 2021). The Citrus genus belongs to the *Rutaceae* family, subfamily *Aurantioideae*, and it has long been known for its beneficial effects on health. These plant groups contain many beneficial nutrients and bioactive compounds, which could lower the risk of various chronic diseases (e.g., cardiovascular diseases and metabolic disorders) (Yamada et al., 2011; Deng et al., 2022; Siti et al., 2022). Citrus fruits have numerous biological functions including antimicrobial, anticancer, antidiabetic, antiplatelet aggregation, and anti-inflammatory activities, which have been highlighted in numerous studies (Sharma et al., 2017). Furthermore, Abdelghffar et al., (2021) recently reported the chemopreventive effect of orange peel extract against cyclophosphamide-induced organ toxicity in an *in vivo* model.

Citrus fruits are primarily grown in tropical and subtropical areas because of the soil and climate there, which are ideal for their growth. Due to a rise in citrus fruit output each year, there is also an increase in the waste produced during processing. Only 45% of the weight of the total citrus fruit is used, with the peel, pulp, and seeds being thrown away, while about a fifth of all citrus cultivars are subjected to industrial processes (Mahato et al., 2019). Also, tree pruning is used to enhance the fruit's quality, which results in a lot of leaves being produced as a by-product, adding to the already considerable amount of citrus waste (Leporini et al., 2021; Russo et al., 2021).

Waste from citrus fruit includes the fruit's seeds, peels, pomace, membrane remnants, secondary juice (obtained by pressing the pulp that was left over after the primary juice was extracted), and leaves. It has significant economic

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worth; in fact, a number of alternate uses for controlling citrus fruit waste have been suggested. In the food, pharmaceutical, and cosmetic industries, all of these wastes can be used as sources of bioactive compounds, to preserve food, and as a renewable energy source (Osorio et al., 2021; Chavan et al., 2018; Muscat et al., 2021).
Citrus peel can have a phenolic content of up to 5000 mg/g, which is more than the fruit's edible portion (Matsuo et al., 2019). Terpenoids and phenolics are the major subclasses of bioactive compounds found in citrus fruits. The main examples of the terpenoids are carotenoids and limonoids, whereas the main examples of phenolic compounds present in citrus fruits and in their wastes are flavonoids (hesperidin, naringenin, quercetin, naringin and rutin), phenolic acids and coumarins (Zou et al., 2016; Mahato et al., 2018; Sorrenti et al. 2023)
Two classes of carotenoids can be distinguished: carotenes, like β–carotene and lycopene and xanthophylls, which are oxygenated carotenoids like lutein and violaxanthin, (Saini et al., 2018; Sharma et al., 2021). They are precursors of vitamin A, which promotes the proper functioning of vision, strengthening of the immune system and is involved in epithelial tissue growth (Widjaja-Adhi et al., 2018; Cirmi et al., 2016). Hydroxybenzoic (gallic, vanillic and syringic acids) and hydroxycinnamic acids (caffeic, ferulic, p-coumaric and sinapic acids), classified as phenolic acids, are also present, which are known to possess high levels of free-radical-scavenging activity (Kim and Kim 2016; Kumar and Goel 2019).
The Citrus fruit plants contain essential oils, which are plant secondary metabolites and comprise a mixture of volatile compounds, usually found in the oil sacs of citrus peels and cuticles (El Asbahani et al., 2015). Essential oils have been used as bio-preservatives in all types of food with the purpose of extending their shelf-life due to their antioxidant, antimicrobial and insecticidal properties (Fernández-López and Viuda-Martos 2018).
Additionally, it has been demonstrated that aqueous orange peel extract has a variety of food applications including supplementing in minced beef to suppress lipid oxidation (Nupur et al., 2022) and milk to increase the antioxidant activity and total polyphenol content to decrease the total microbial count (Jalilzadeh-Afshari et al., 2021). Interestingly, citrus peel infusions were found to strongly suppress MAO activity, suggesting that they may be effective dietary approaches for the management and prevention of neurodegenerative diseases (Ademosun and Oboh 2014; Ayokunle 2022).
These essential oils can be used in sustainable green chemistry to replace chemical additives because the US Food and Drug Administration (FDA) considers them generally recognized as safe (GRAS) products (Fernández-López and Viuda-Martos 2018). The lipid components of citrus contain more than 200 different components, most of which are aldehydes, ketones, esters, acids, terpenes, and alcohols (Saini et al., 2022). The antimicrobial ability of these essential oils and major components against bacteria and yeasts showed that these are more effective on Gram-positive bacteria, Gram-negative bacteria and yeasts (Barraquer 1989).
Citrus fruit wastes are widely used in the cosmetic industry both due to their high content of bioactive compounds natural oils. Nowadays agro-industrial waste is also utilized as an active ingredient to obtain skincare products due to it being a rich source of bioactive compounds, antioxidants, vitamins (vitamin C and E) and polyphenolic compounds (Pinto et al., 2021). Citrus peel contains antioxidants that delay the aging process of the skin, reduce oxidative damage, and help with other skin-related problems including acne, wrinkles, dark spots, etc. Sebghatollahi et al., 2022. A research conducted by Wuttisin et al. 2017 confirmed that orange peel extract can be useful in the cosmetic industry for increasing the value of orange peel waste. The research focused on checking the anti-tyrosinase activity of orange (Citrus sinesis L.) peel extract, with the aim of formulating whitening cream that aids in preventing the production and accumulation of melanin pigment. Orange peel-based cream was discovered to have a 17.33% reduction in melanin pigment. Due to their richness in natural oils, citrus seeds are also utilized in the cosmetic industry to make soaps, body lotions, body sprays and other cosmetic products (Rosa et al., 2019). Citrus seed oil was used to make a soap by Atolani et al. that had exceptional anti-microbial, anti-fungal, anti-parasitic, and antioxidant properties. Moreover, using citrus seed oils to make cosmetic products might avert exposure to synthetic chemicals. Citrus pomace is another citrus waste that can be used as a pectin source (Zannini et al., 2021). Citrus residues have a high pectin content which has been used in the field of nanotechnology as an encapsulating agent for improving the stability, as well as the efficiency, of encapsulation (Panwar et al., 2021). For example, using a hydro-soluble component of citrus waste (pectin), citric acid, Ca^{2+} ion and ascorbic acid, citrus peel waste-based oil emulsion was fabricated. The prepared emulsion was stable and had a reduced droplet size, according to the study (Ren et al., 2020).
Additionally, in vitro research revealed that encapsulated resveratrol had a higher bioavailability than free resveratrol. In addition, it was shown that resveratrol's antioxidant properties were improved (Huang et al., 2019). So it stands to reason that citrus by-products might be used as encapsulants.

Avocado Fruit Wastes: Utilization of By-Products

Avocado (*Persea americana* Mill.) is a subtropical/tropical fruit indigenous to Mexico and Central America. It is cultivated and consumed widely all over the world. The avocado fruit is a drupe constituting an epicarp (peel), mesocarp (pulp) and endocarp (seed), the size, shape, color and phytochemical content of which are determined

by the genotype. It belongs to the *Lauraceae* family and the genus *Persea*, of which there are more than 150 known species (Araújo et al., 2020; Sorrenti et al. 2023).

As reported by the FAO, over six million tons of avocado are produced annually around the world (FAO 2020). Avocado wastes are thought to be a cause of environmental contamination and comprise the peel, seed, and defatted paste. However, as previously said, wastes can be utilized because of their abundance of protein, fibre, and numerous bioactive compounds (Dalle Mulle Santos et al., 2016; Salazar-López et al., 2020).

As described by Yahia and Woolf, 2011, avocado pulp is a good source of vitamins (e.g. vit. C, E and K, choline, niacin and pantothenic acid) and minerals, protein, carbohydrates and dietary fibers. Nevertheless, the avocado fruit is well recognized for its high lipid content (about 12–24% of the whole fruit). Monounsaturated fatty acids such as oleic acid (62.14%), palmitic (17.2%), linoleic (11.11%) and palmitoleic (7.34%) and polar lipids, such as glycolipids and phospholipids, which are crucial, especially for cell membranes, make up the majority of the lipids present. The avocado's peel and seed, which are by-products, are abundant sources of minerals (seed: 1.3–4.3%; peel: 1.5–6.0%), proteins (seed: 0.14–9%; peel: 0.17–8%), lipids (seed: 3–15%; peel: 2–9%), fibers (seed: 2–4.2; peel: 1.3–55%), carbohydrates (seed: 42–81%; peel: 43–81%) and various other bioactive compounds (Araújo et al., 2020). According to Rodríguez-Carpena et al., (2011), Avocado fruit is rich in phenolic compounds, which are particularly abundant in its peel and seed. The most relevant types of phenolic compound present in avocado fruit are tannins phenolic acids and flavonoids (Indelicato et al., 2017; Tremocoldi et al., 2018). The lipid fraction of avocado fruit and its by-products contains polyhydroxylated fatty alcohol derivates (PFAs), which are more polar than fatty acids due to their hydroxyl groups. Two main avocado-derived PFAs: 1-ace-toxy-2,4-dihydroxy-heptadec-16-ene (PFA-A) and 1-acetoxy-2,4-dihydroxyheptadec-16-ene (PFA-B), with relative concentration percentages of 32% and 54% in the seeds, and 51% and 29% in the pulp, respectively was identified by Rosenblat et al. (2011). Acetogenins, a type of PFA whose chemical structure contains a long-chain fatty acid with a terminal -lactone, are characteristically found in avocado mesocarp and seed. The acetogenin profile and concentration have been shown to vary in avocado seed during early ripening, with no change in the mesocarp (Rodríguez-López et al., 2017).

Other minor ingredients found in avocado fruit and its by-products include carotenoids, alkaloids, phytosterols, and tocopherols, among others. Therefore, based on the available scientific evidence, avocado residue extracts (peel, seed coat, and seed extracts) may be employed as functional ingredients to be added to nutraceuticals or novel food products (Velderrain-Rodríguez et al., 2021; Figueroa et al., 2021; Cerda-Opazo et al., 2021).

Nevertheless, due to their antioxidant, antiproliferative, and anti-inflammatory activities, consuming foods high in these phenolic compounds on a regular basis has been linked health-related benefits. According to certain studies, avocado residues may be used to obtain extracts high in phenolics that have antiproliferative properties and could be used to prevent or cure cancer. It has been suggested that avocado peel extracts may induce apoptosis in MDA-MB-231 cells as a result of increased activation of caspase 3 and caspase 3 target protein PARP. On the other hand, avocado seed extracts have shown anti-inflammatory and antiproliferative activities against the HCT-116 (colorectal carcinoma) and the HepG-2 (liver cancer) cell lines in a dose-dependent manner (Velderrain-Rodríguez et al., 2021). Avocado fruit is rich in lipid molecules such as PFAs which have received attention as useful cytotoxic molecules; indeed, certain studies have demonstrated their cytotoxic effects on various cell types, which have been linked mainly with apoptosis induction. More than 20 groups of bioactive compounds, including long-chain lipid molecules such as avocatins, pahuatins, persenins, have been associated with avocado's anti-cancer activities. Ethanolic extract of immature avocado fruit (which contained higher proportion of persin) demonstrated cytotoxic activity against different cell lines including lung carcinoma cells (A549), kidney cells (A498), pancreas (PaCa2), breast adenocarcinoma (MCF-7), colon (HT-29) and prostate (PC-3) (Ochoa-Zarzosa et al., 2021). Avocatin B, predominant in avocado seed and peel, had greater selectivity towards cancer cells (Lee et al., 2015; Sorrenti et al., 2023).

The photoprotective and anti-inflammatory potential of PFA derived from the seed of avocado fruit was described in another study. It examined the protective properties of PFA against UVB irradiation in cultured keratinocyte and in a human skin explant. In human skin explants, the photoprotective effect was demonstrated by higher cell viability and fewer number of sunburnt cells. Furthermore, improved DNA repair was demonstrated by measuring the removal of cyclobutane pyrimidine dimers (CPD), one of the most important characteristics of DNA damage and mutagenesis. The exposure of keratinocytes to 20 mJ/cm^2 UVB induced the formation of CPD, as was measured immediately after irradiation. CPD elimination for 24 hours was achieved in the PFA-treated cells (Rosenblat et al., 2011).

Mango Fruits: Health Benefits of Mango Waste Extracts

Mango is a tropical fruit belonging to the *Anacardiaceae* family. India, China, Thailand, Indonesia, the Philippines, Pakistan and Mexico are among the tropical and subtropical mango-producing countries (Sorrenti et al. 2023)

The plant's scientific name is *Mangifera indica*. The fruit is divided into three distinct parts: a large seed (or endocarp) surrounded by a yellow-orange pulp that makes up about 40–65% of the average weight, and the peel

(or epicarp). The edible part of the fruit is the pulp, the remaining part is usually discarded (Mirza et al., 2021). The main consumable part of the mango is the mango pulp and it is the source of nutritional compounds including reducing sugars, amino acids, aromatic compounds and functional compounds, like vitamins, pectin, polyphenols and anthocyanins (Quintana et al., 2021). Mango intake has been recently reported to exert beneficial effects in slowing the progression and reducing the IBD severity (Kim et al., 2020).

Mango processing generates peels and kernels as wastes, which also contain functional compounds. Protocatechuic acids, mangiferin and β–carotene, which are found in mango peels, are known for their anti-diabetic, anti-inflammatory, anti-carcinogenic and antimicrobial properties (Mirza et al., 2021; Jahurul et al., 2015; Saleem et al., 2019; Donga et al., 2020).

Mango peels have a high content of polyphenols, enzymes and vitamins C and E. In particular, ethylgallate and penta-*O*-galloyl-glucose are two of the bioactive compounds that have been isolated in the peel. In addition to having important antioxidant activity (hydroxyl radical (OH•), superoxide anion ($^{\bullet}O_2^-$) and singlet oxygen ($^1O_2$)-scavenging activities), gallate derivatives (e.g., penta-*O*-galloyl-glucoside) have been the subject of several studies that have demonstrated their bioactivity, including anticancer (Lizárraga-Velázquez et al., 2020; Lizarraga et al., 2008), antioxidant (Hatano et al., 1989), anti-cardiovascular (Ignarro et al., 2007) and hepatoprotective effects (Eun-Jeon et al., 2008).

Kim et al., (2010) in this regard, tested the antioxidant and cytoprotective properties of a mango peel extract on H_2O_2-induced oxidative damage in a human hepatocarcinoma cell line (HepG2). Mango peel extract exhibited significant antiproliferative effect against the tested cancer cell lines in a dose-dependent manner. Compared to the mango pulp and peel, the mango kernel contains higher amounts of polyphenols and antioxidants. It is used for oil extraction and for preparing nutraceuticals by combining it with corn and wheat flour (Lebaka et al., 2021).

Agro-industrial by-products are sources of bioactive compounds according to Silva et al., (2014) who revealed that mango by-products showed higher levels of β-carotene and lycopene, as well as anthocyanins and yellow flavonoids, when compared to the fruit pulps. The anti-cancer effect of *Mangifera indica* L. Peel extract (MPE) is associated with γH2AX-mediated apoptosis in colon cancer cells according to Lauricella et al., (2019) demonstrated that. The authors characterized the polyphenolic profile of MPE and proved, for the first time, the presence of lepidimoic acid, a pectic disaccharide, in mango peel. The findings obtained by Lauricella et al., (2019) provided a new insight into the potential anti-tumor benefits of mango peel as a supportive strategy for antineoplastic therapies.

Watermelon Fruits: Health Benefits of Watermelon Waste Extracts

Watermelon (*Citrullus lanatus*) is a fruit vegetable, belongs to the genus *Citrullus* and the family Cucurbitaceae native to tropical areas of Africa near Kalahari Desert. (Naz et al. 2014; Kyriacou et al. 2018; Renner et al. 2017; Maoto et al., 2019). It is known as a “pepo” by Botanists, which is a fruit having a thick rind and fleshy center (Mehra et al., 2015). Because of its ability to refresh, appealing color, delicate flavor, and high water content to quench summer thirst, it is widely consumed as a refreshing fruit in the summer (Romdhane et al., 2017). Lycopene and β-carotene are carotenoids responsible for the red and orange colors of the watermelon, respectively. The watermelon sweetness is primarily due to a combination of sucrose, glucose, and fructose. In a ripe watermelon, sucrose and glucose account for 20–40% and fructose for 30–50% of total sugars (Bianchi et al., 2018). Watermelon contains nutrients and phytochemicals reported to be beneficial to human health (Choudhary et al., 2015; Elumalai et al., 2013; DeWeese et al., 2017; Ijah et al., . 2015Maoto et al., 2019). It is a good source of vitamins B, C, and E as well as minerals such as phosphorus, magnesium, calcium, and iron (Romdhane et al., 2017). Epidemiological studies have shown that it possesses antioxidants with anti-inflammatory, antihypertensive properties as well as a protective effect against carbon tetrachloride-induced toxicity (Choudhary et al., 2015; Ijah et al., 2015).

The biomass of a watermelon may be divided into three primary parts: the flesh, the seed, and the rind. The watermelon's flesh makes up around 40% of its weight, while the rind and seeds make up about 60% of the entire fruit. This results in a significant amount of agricultural waste when compared to the peels of other fruits that are similar, such as melon (40%), pumpkin (45%), bitter apple (30%), musk melon (35%), and papaya (47%), etc. (Chakrabarty et al., 2020; Zamuz et al., 2021). Half of the watermelon fruit is edible while the other half goes to waste. Considering the production of watermelon in 2017–18, approximately 42 million tonnes of watermelon by-products (rind and seeds) was generated by various fruit juice processing industries, cottage fruit juice producers, and restaurants during production, preparation and consumption of watermelon. Despite being edible, these by-products are discarded indiscriminately into the environment and thereby constituting environmental problems (Esparza, et al. 2020). Watermelon rind (WMR) and watermelon seeds (WMSs) can represent a low-cost raw material (Hasanin, Hashem, Abd El-Sayed, & El-Saied, 2020; Zia et al. 2021), rich in potentially valuable components for other industries.

WMR is a thick white flesh between the outer green covering and inner red flesh, accounts for approximately one-third of the total fruit mass and is usually discarded, despite being edible; however, most times it is avoided due to its unappealing flavor. WMR structure generally comprises of a combination of hemicelluloses, celluloses,



lignin and pectin with entrapped sugars, proteins, polyphenolics, citrulline, lycopene and carotenoids (Zia et al. 2021). Watermelon by-products have been the subject of several studies that have proved their bioactivity.
Owo & Beresford, (2020) reported that WMR exerts an anti-diabetic effect by attenuating the decreasing serum insulin level and increasing blood glucose level and might be recommended as a hypoglycaemic drug in the treatment of diabetes mellitus in alloxan-induced diabetic Wistar rats. It was proved from numerous investigations that WMR has hypoglycaemic effects on diabetes by improving the histological structure of the pancreas and/or by an increased level of insulin and improving glucose metabolism in experimental induced diabetic animal models (Abu-Hiamed, 2018; As'ari & Sugiyanta, 2020).
The antiproliferative activity of isolated polysaccharides from WMR was evaluated by Dammak et al. (2019) and results showed that these polysaccharides exhibit significant cytotoxic activity against human laryngeal carcinoma Hep-2 cells.
According to Soliman, (2019) WMR extract mixed with polyvinyl alcohol (PVA) used to fabricate electrospun nanofibers showed 1.2 folds higher antimicrobial activity than that of WMR extract alone. The finding showed WMR/PVA nanofiber showed 83.5 ± 0.09% and 94 ± 0.8% area of inhibition of *E. coli* and *S. aureus*.
Oral administration of aqueous extract of WMSs (200, 400 and 600 mg/kg BW for 7 and 21 days) ameliorated alloxan-induced hepatic or nephrotoxicity in diabetic Wistar rats by significantly decreasing urea, creatinine and malondialdehyde (MDA) levels and liver enzyme activities (Ogbeifun, Peters, & Monanu, 2020). Antioxidant peptides purified from WMS protein hydrolysates showed a cytoprotective effect by protecting HepG2 cells from H2O2-induced oxidative damage by significantly enhancing the activities of antioxidative enzymes, inhibiting ROS and MDA level (Wen et al., 2020).
The pharmacokinetic behavior of bioactive compounds present in watermelon flesh, seeds and rind in human plasma was reported by Fan et al. (2020). L-citrulline and arginine (two major amino acids) are metabolized to nitric oxide, an important vasodilator, in the body which plays an important physiological role in the regulation of blood pressure and endothelial function by maintain the vascular health.
Karikpo, Bartimaeus, and Holy (2018) reported WMSs extract to possess substantial cardioprotective potential by ameliorating structural integrity of the cardiac muscles and significantly decreasing the levels of creatine kinase and lactate dehydrogenase (a marker of cardiac injury) in streptozotocin-induced diabetic albino rats.
The anti-hypertensive effect of WMSs in males and females rats by administrating 50 g daily for 40 days was assessed by Sajjad et al. (2020). The results show a significant decrease in systolic and diastolic blood pressure (13–16 mmHg; 8–10 mmHg) due to the presence of cations (K+, Ca+ and Mg+) and phytochemicals that give vasodilatory, antioxidant potential (Sajjad et al., 2020).
WMS extracts (aqueous and methanolic) at a dosage of 200 mg/kg and 400 mg/kg feed for 28 days had nephroprotective and healing effects on the physiological saline and acetaminophen-induced damaged kidney of female albino rats (Omotoso & Osadiaye, 2018).
The ameliorative effect of aqueous extracts of WMSs against hepato- and nephrotoxic in alloxan-induced diabetic Wistar rats at dosage up to 600 mg/kg BW was investigated by Ogbeifun et al. (2020). There's significant improvement in the electrolyte concentration, decrease in liver enzyme activities, urea, creatinine and MDA and healing/regeneration of liver and kidney tissues damaged due to alloxan.
WMSs ethanolic extract possesses excellent antimicrobial activity and can be utilized as an easily accessible source of natural antimicrobial agents (Hameed et al. 2020). Hassan et al. (2020) reported ethyl acetate WMSs extracts were found to exhibit potency on *Staphylococcus aureus, Pseudomonas aeruginosa and Klebsiella* sp. Aqueous and methanolic extract of WMSs powder can be served as a potential antibiotic against microbial infection caused by *Staphylococcus aureus, Pseudomonas aeruginosa, Pseudomonas fluorescence Escherichia coli, Salmonella typhi, Bacillus cerus* and *Bacillus subtilis* (Babaiwa et al. 2020; Osinubi et al. 2020).

Papaya: Health Benefits of Papaya Waste Extracts

Papaya (*Carica papaya* L.) is the most economically significant fruit in the *Caricaceae* family and cultivated all year round. The producing areas are largely tropical and subtropical countries, with India, Brazil, Indonesia, Nigeria, and Mexico as major producers of papaya (Pathak et al. 2018). In 2014, papayas were harvested on 418,604 ha, with global total production of 12,822,014 tonnes globally. The majority of products made from papaya include tutti frutti, powder, papaya chips, skin care products, papain, candy, jam, jelly, pickles, sauce, squash, etc. (FAOSTAT 2014; Medina et al., 2013). The antioxidant activities of the many bioactive compounds found in papaya, including carotenoids, phenolic compounds, vitamins A, C, and E, pantothenic acid, minerals (potassium and magnesium), folate, and fiber, have been linked to a number of positive health impacts on human bodies. In addition, papaya is a natural source of papain, a digestive enzyme that is used as an industrial ingredient to tenderize meat, pharmaceuticals, brewing industries and cosmetics. Thus, it is no surprise that using these fruits for the numerous reasons stated above produces a lot of waste and by-products, especially during the harvesting and post-harvesting processes. The two main by-products of papaya processing, papaya peel (PP) and papaya seeds (PSs), account for roughly 12 and 8.5% of the fruit weight, respectively. PP and PSs contain some bioactive compounds with added value which can be used as dietary additives; nutraceutical supplements new food and pharmaceutical products (Makaepea et al. 2019). PPs are traditionally used in animal feeds, cosmetics, and many

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home remedies. If not properly handled, PPs discarded into the environment can cause environmental pollution (Medina et al., 2013; Parniakov et al., 2014; Yogiraj et al., 2014); Aravind et al., 2013; Evans and Ballen 2015; Parniakov et al., 2015). However, PPs can be used as a good source of important compounds, food additives, or nutritional supplements. They can also be transformed into other products with added value (Pathak et al. 2018).
PP extracts exhibited anti-inflammatory and anticarcinogenic activity against AOM-induced cytotoxicity in rat colon due to presence of bioactive components (polyphenols and flavonoids) (Waly et al., 2014). Matsusaka and Kawabata (2010) noted that PP had a weak radical scavenging capacity but showed a strong ferrous ion-chelating capacity.
PP also exhibits antibacterial activity against some Gram-positive and Gram-negative microorganisms (*E. coli*, *Pseudomonas*, *P. vulgaris*, *S. typhi*, *S. pyogenes*, *E. faecalis*, *B. megaterium* ATCC9885, *B. subtilis* ATCC6633, *Corynebacterium rubrum* ATCC14898, *S. aureus* ATCC25923, *S. epidermidis* ATCC12228, *C. freundii* NCIM2489, *E. aerogenes* ATCC13048, *K. pneumoniae* NCIM2719, *P. mirabilis* NCIM2241, *S. typhimurium* ATCC23564) and fungal strains (*Candida albicans* NCIM3102, *Candida glabrata* NCIM3448, *Candida neoformans* NCIM3542, *Candida epicola* NCIM3367 *Aspergillus niger*, and *Trichophyton rubrum*) in various extracts (cold and hot water, ethanol, 1% HCl, acetone, petroleum ether, chloroform, benzene, tetracycline, methanol, ethanol, hexane, ethyl acetate, etc.). Ethanol and methanol were found to be the best solvents for extraction of natural products from PP to achieve maximum medicinal benefits, possibly due to the active components' better solubility in organic solvents, which may explain why the antimicrobial activity of PP is dependent on the solvent used for extraction (Asghar et al., 2016; Orhue and Momoh 2013; Prakash et al., 2013; Khan et al., 2012; Rakholiya et al., 2014; Roy, S., Lingampeta 2014).
PP is frequently utilized in a variety of home remedies and cosmetics. The vitamin A in PP aids in repairing and regenerating the skin's damaged tissues. PP can also be applied to the skin to lighten it. PP can hydrate the skin and alleviate irritation when applied to the skin with honey. When applied to the scalp 20 minutes prior to shampooing, vinegar made from PP and lemon juice can help combat dandruff. Bath water mixed with PP oil, vinegar, and essential oils like lavender, orange, and rosemary can be revitalizing, nourishing, calming, and helps ease pain and relax muscles. (Aravind et al., 2013; Yogiraj et al., 2014).

Conclusion and future directions

The purpose of this review is to highlight findings from recent studies that show how fruit wastes may be used as sources of bioactive compounds for treating or preventing chronic diseases, promoting wellbeing, or improving human health. Numerous scientific research support the idea that food and health are positively correlated. Food wastes can also be turned into resources because they are a rich source of bioactive compounds. The proposed review highlights the extra benefits of plant secondary metabolites, particularly as potential nutraceuticals for human health, and their ability to prevent a number of diseases linked to oxidative stress. Therefore, the agro-food industry generates a lot of by-products that may possess added-value compounds. In recent years, consumers' demand for healthier food and health products has increased, representing a challenge for the food and pharmaceutical industries.
However, the use of bioactive compounds is not just limited to the formulation of health-related products; they may also have other applications such as in the cosmetic industry (i.e., the prevention and treatment of skin-related issues) (Rodrigues et al., 2015) and in the food industry in order to develop functional food (Comunian et al., 2021), to extend shelf-life (Liu et al., 2022; Faustino et al., 2019) or to improve the quality of frying oil (Ahmed et al., 2022). Fruit wastes such as citrus, avocado, mango, watermelon and papaya wastes, being abundant and low-cost renewable resources, could be used to develop novel or functional food, nutraceutical and/or pharmaceutical, and cosmeceutical products, and may have a positive economic and environmental impact.
Despite the significant advancement in agro-food waste and by-product's research, studies on the effectiveness in animal models, mechanism of action, and safety profile were scarce. Further research is required to fill the gap in existing knowledge on the safety of food wastes and by-products as functional foods with health-related benefits.

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The effect of water hyacinth (*Eichhornia crassipes*) organic fertilizer on the vegetative growth of Carrot (*Daucus carota*), Royal Chantenay variety.

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Abstract

This study conducted in Gasabo District, Nyacyonga marshland aimed to investigate the effect of water hyacinth (Eichhornia crassipes) organic fertilizer on the vegetative growth of the Royal Chantenay variety of carrot (Daucus carota). The experiment was conducted using a randomized complete block design (RCBD) with three replicates. Four treatments were applied: T1 (control, no fertilizer), T2 (NPK 17-17-17), T3 (25% water hyacinth organic fertilizer + 75% NPK 17-17-17), and T4 (50% water hyacinth organic fertilizer + 50% NPK 17-17-17). The growth parameters assessed included plant height, leaf number, and root diameter. Results showed that the application of water hyacinth organic fertilizer significantly influenced the vegetative growth of Royal Chantenay carrot plants. T3 and T4 treatments enhanced plant height, leaf number, and root diameter compared to the control (T1) and NPK 17-17-17 (T2). The highest vegetative growth parameters were observed in T4, indicating that a higher concentration of water hyacinth organic fertilizer positively affected the growth of carrot plants. The findings suggest that water hyacinth organic fertilizer can be a viable alternative to chemical fertilizers in promoting the vegetative growth of Royal Chantenay carrot plants. The utilization of water hyacinth as an organic fertilizer can contribute to sustainable agricultural practices by reducing dependence on synthetic inputs.

Key Words: water hyacinth, *Eichhornia crassipes*, organic fertilizer, carrot, Daucus carota, Royal Chantenay, vegetative growth.

Introduction

Carrot (*Daucus carota*) is a widely cultivated vegetable crop known for its high nutritional value and economic significance (Smith et al., 2018). Among the various carrot varieties, the Royal Chantenay variety stands out for its exceptional root quality and excellent flavor. To ensure optimal growth and yield, carrots require adequate nutrient supply, particularly during the vegetative stage. Conventionally, chemical fertilizers have been used to meet the nutrient requirements of carrot crops. However, the increasing concerns over environmental sustainability and the negative impacts of chemical fertilizers have prompted the exploration of alternative fertilization strategies. Organic fertilizers derived from natural sources offer a promising solution to reduce the reliance on synthetic inputs in agricultural systems. Water hyacinth (Eichhornia crassipes), an aquatic plant, has gained attention as a potential organic fertilizer due to its abundant availability and nutrient-rich composition. Water hyacinth contains substantial amounts of nitrogen, phosphorus, and potassium, along with other essential micronutrients (Singh et al., 2020). Furthermore, the utilization of water hyacinth as an organic fertilizer can help mitigate its adverse effects on water bodies where it can cause ecological imbalances.

Previous research has explored the use of water hyacinth organic fertilizer in various crops, demonstrating positive effects on plant growth, nutrient uptake, and yield (Choudhury et al., 2019; Kumar et al., 2021). However, limited studies have focused specifically on the effect of water hyacinth organic fertilizer on carrot crops, especially the Royal Chantenay variety. Understanding the potential benefits of water hyacinth organic fertilizer on the vegetative growth of Royal Chantenay carrot plants is crucial for developing sustainable agricultural practices.

Therefore, this study aims to investigate the effect of water hyacinth organic fertilizer on the vegetative growth of Royal Chantenay carrot plants. By evaluating growth parameters such as plant height, leaf number, and root diameter, we can assess the efficacy of water hyacinth organic fertilizer as an alternative to chemical fertilizers in promoting the vegetative growth of carrot crops.

Materials and Methods

Experimental Design

A randomized complete block design (RCBD) with three replicates was employed for the experiment (Gomez & Gomez, 1984). Each replicate consisted of a plot measuring 2 meters long and 1 meter wide.

Plant Material
Seeds of the Royal Chantenay variety of carrot (*Daucus carota*) were procured from a reputable seed supplier. The seeds were selected based on uniformity in size and quality.

Preparation of Water Hyacinth Organic Fertilizer
Fresh water hyacinth (Eichhornia crassipes) plants were collected from a local water body. The plants were thoroughly washed to eliminate any contaminants and then air-dried until a constant weight was achieved. The dried plants were finely ground using a hammer mill to obtain a powdered form of water hyacinth organic fertilizer.

Experimental Treatments
Four treatments were included in the study:
T1: Control (no fertilizer)
T2: NPK 17-17-17
T3: 25% water hyacinth organic fertilizer + 75% NPK 17-17-17
T4: 50% water hyacinth organic fertilizer + 50% NPK 17-17-17

Field Preparation and Planting
The experimental site was prepared by removing weeds and loosening the soil. The plots were marked, and the soil was enriched with organic matter, such as compost, to ensure uniform soil fertility (Bialczyk et al., 2017). Carrot seeds were sown at a depth of 1 cm with a spacing of 10 cm between plants and 30 cm between rows.

Fertilizer Application
The fertilizers were applied based on the respective treatment assignments. The NPK 17-17-17 was applied at the manufacturer's recommended rate. The water hyacinth organic fertilizer was applied at the specified concentrations for T3 and T4 treatments. Fertilizers were evenly distributed along the planting rows and incorporated into the soil.

Data Collection
The following vegetative growth parameters were measured:
Plant height: Measured in centimeters from the base of the plant to the tip of the tallest leaf.
Leaf number: Counted as the total number of fully expanded leaves on each plant.
Root diameter: Measured in millimeters using a digital caliper at the widest point of the root.
Data for the vegetative growth parameters were collected at regular intervals, starting from two weeks after seed germination and continuing every two weeks thereafter, until the desired growth stage was reached.

Statistical Analysis
The collected data were subjected to analysis of variance (ANOVA) using SPSS (Statistical Package for the Social Sciences). Significant differences between treatments were determined using Tukey's Honestly Significant Difference (HSD) test at a significance level of $p < 0.05$ (SAS Institute Inc., 2011). The means and standard deviations were calculated and presented in the tables.

Results and Discussion

Vegetative growth
The effect of water hyacinth organic fertilizer on the vegetative growth of Royal Chantenay carrot plants was evaluated by measuring plant height, leaf number, and root diameter at regular intervals during the growth period. Table 1 summarizes the mean values of the vegetative growth parameters for each treatment at different time points. Overall, the application of water hyacinth organic fertilizer showed significant effects on the growth of carrot plants compared to the control group without any fertilizer application.

Table 1. Mean values of vegetative growth parameters for each treatment at different time points.

Time (weeks)	Treatment 1 (Control)	Treatment 2 (NPK: 17-17-17)	Treatment 3 (25% Organic + 75% NPK)	Treatment 4 (50% Organic + 50% NPK)
2	10.3	12.5	13.4	13.9*
4	18.6	21.8	23.2	24.7*
6	26.4	30.5	32.7	34.2*
8	34.2	39.2	41.8	43.6*

Note: Values represent mean plant height (cm). *Significant difference compared to the control group ($p < 0.05$).

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In this table, each row represents a different time point and each column represents a different treatment. The values in the table represent the mean plant height for each treatment at the respective time point. The asterisk (*) indicates significant differences compared to the control group, indicating the positive effect of water hyacinth organic fertilizer in combination with NPK: 17-17-17 on the growth of carrot plants.

Plant height

At two weeks after seed germination, there were no significant differences in plant height among the treatments ($F = 1.68$, $p = 0.212$). However, at four weeks, the plants treated with 50% water hyacinth organic fertilizer + 50% NPK 17-17-17 (T4) exhibited significantly greater plant height (mean = 25.6 cm) compared to the control group (mean = 20.3 cm) and the NPK 17-17-17 treatment (mean = 22.1 cm) ($F = 4.92$, $p = 0.031$).

Table 2. Plant height at four weeks after seed germination.

Treatment	Mean/Plant height	SS	df	MS	P-value	F-value
Control	20.3	24	1	24	0.212	1.68
NPK17-17-17	22.1	3	2	1.5	0.031	4.92
50% Water Hyacinth Organic + 50% NPK17-17-17	12.4	1	2	0.5		
Total	28	28	5			

Ss: sum of square, df: degree of freedom, MS: mean of square; Note: Significant difference compared to the control group ($p < 0.05$).

In this table, each row represents a different treatment, and the columns provide the mean plant height, F-value, and p-value for the comparison. The plants treated with 50% water hyacinth organic fertilizer + 50% NPK 17-17-17 fertilizer exhibited a significantly greater mean plant height (25.6 cm) compared to the control group (20.3 cm) and the NPK 17-17-17 fertilizer treatment (22.1 cm). The F-value and p-value indicate the statistical significance of the difference.

Leaf number:

The leaf number was significantly influenced by the application of different fertilizers. At six weeks after seed germination, the plants treated with 50% water hyacinth organic fertilizer + 50% NPK 17-17-17 (T4) showed the highest leaf number (mean = 12.4), followed by the NPK 17-17-17 treatment (mean = 10.8). The control group had the lowest leaf number (mean = 8.7) ($F = 6.25$, $p = 0.015$).

Table 3. Leaf number at six weeks after seed germination.

Treatment	Mean/Leaf Number	SS	MS	P-value	F-value
Control	8.7	24	1	0.015	6.25
NPK17-17-17	10.8	3	2	0.25	19
50% Water Hyacinth Organic + 50% NPK17-17-17	12.4	1	2		

The table 3 provides a summary of the leaf number data at six weeks after seed germination for the different treatment groups in the study. The table includes the mean leaf number for each treatment group, as well as the F-value and p-value obtained from the statistical analysis.

The "Treatment" column lists the different fertilizer treatments applied to the carrot plants. In this case, the treatments include the control group (no fertilizer), the NPK 17-17-17 treatment, and the 50% water hyacinth organic fertilizer + 50% NPK17-17-17 treatment.

The "Mean Leaf Number" column displays the average number of leaves observed in each treatment group. The control group had a mean leaf number of 8.7, indicating the lowest leaf growth. The NPK 17-17-17 treatment showed a higher mean leaf number of 10.8, suggesting better leaf development. The 50% water hyacinth organic fertilizer + 50% NPK 17-17-17 treatment exhibited the highest mean leaf number of 12.4, indicating the most significant leaf growth among the treatments.

The "F-value" column represents the test statistic from the analysis of variance (ANOVA) performed on the data. The F-value of 6.25 indicates the variability between the treatment groups relative to the variability within the groups. A larger F-value suggests a greater difference between the treatment means.

Root diameter:

The root diameter was significantly affected by the different fertilizer treatments. At eight weeks after seed germination, the plants treated with 50% water hyacinth organic fertilizer + 50% NPK 17-17-17 (T4) exhibited the largest root diameter (mean = 10.2 mm), followed by the NPK 17-17-17 treatment (mean = 9.4 mm) and the

25% water hyacinth organic fertilizer + 75% NPK 17-17-17 treatment (T3) (mean = 8.9 mm). The control group had the smallest root diameter (mean = 7.6 mm) (F = 5.62, p = 0.022).

Table 4. Root diameter at eight weeks after seed germination.

Treatment	Mean Root Diameter (mm)	SS	df	MS	P-value	F-value
Control	7.6	4.08375	1	4.08375	0.022	5.62
NPK 17-17-17	9.4	0.340833	2	0.170417	0.329508	19
25% Water Hyacinth Organic + 75% Chemical	8.9	0.1675	2	0.08375		
50% Water Hyacinth Organic + 50% NPK 17-17-17	10.2					
Total		4.592083	5			

Overall, the results indicate that the incorporation of water hyacinth organic fertilizer, especially in combination with NPK 17-17-17, positively influenced the vegetative growth parameters of Royal Chantenay carrot plants, including increased plant height, leaf number, and root diameter.

The results of this study demonstrate that the application of different fertilizers significantly influenced the vegetative growth parameters of carrot plants. The use of water hyacinth organic fertilizer, either alone or in combination with recommended chemical fertilizer, showed positive effects on plant height, leaf number, and root diameter compared to the control group without any fertilizer application. These findings have important implications for sustainable agricultural practices and the improvement of crop productivity.

In terms of plant height, there was a significant increase observed in the plants treated with 50% water hyacinth organic fertilizer + 50% recommended chemical fertilizer at four weeks after seed germination. This indicates that the combined fertilizer treatment promoted better plant growth compared to the control group and the recommended chemical fertilizer treatment alone. These results align with previous studies that have shown the positive effects of organic fertilizers on plant height and overall growth (Smith et al., 2018; Johnson et al., 2020).

The leaf number data further support the beneficial effects of the water hyacinth organic fertilizer and the combined fertilizer treatment. At six weeks after seed germination, both the recommended chemical fertilizer and the 50% water hyacinth organic fertilizer + 50% recommended chemical fertilizer treatments exhibited significantly higher leaf numbers compared to the control group. This suggests that the addition of organic fertilizer, particularly in combination with chemical fertilizer, enhanced leaf development and canopy growth. Similar findings have been reported in studies investigating the effects of organic fertilizers on leaf growth in various crop species (Gupta et al., 2017; Wang et al., 2019).

Furthermore, the root diameter analysis revealed that the combined fertilizer treatment resulted in the largest root diameter at eight weeks after seed germination. This is an important finding, as a well-developed root system is crucial for nutrient uptake, water absorption, and overall plant health. The enhanced root growth observed in the combined fertilizer treatment group suggests that the water hyacinth organic fertilizer can contribute to root system development and improve nutrient availability in the soil (Rahman et al., 2021; Zhang et al., 2022).

Comparing the results of this study with published literature, several studies have reported the positive effects of organic fertilizers, such as water hyacinth organic fertilizer, on plant growth and nutrient availability (Santos et al., 2016; Duong et al., 2019). The combination of organic and chemical fertilizers has also been shown to have synergistic effects on crop productivity and soil fertility (Sarkar et al., 2020; Li et al., 2021). Our findings align with these studies and contribute to the growing body of evidence supporting the use of organic and combined fertilizer treatments for sustainable agriculture.

Overall, the results of this study highlight the significant effects of water hyacinth organic fertilizer, especially when combined with recommended chemical fertilizer, on the vegetative growth of carrot plants. The improved plant height, leaf number, and root diameter observed in the fertilizer-treated groups have practical implications for enhancing crop productivity and sustainability. Further research is warranted to explore the long-term effects of these fertilizer treatments, their impact on other growth parameters, and their economic feasibility in large-scale agricultural systems.

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Culturing of nitrogen-fixing cyanobacteria in a bioreactor for the production of a biofertilizer

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Abstract

Cyanobacteria can be considered as the most primitive inhabitants on earth. They have the capability of performing oxygenic photosynthesis, and some of them are able to fix nitrogen by converting atmospheric nitrogen (N_2) into ammonia (NH_3). The nitrogen-fixing cyanobacteria were isolated in BG110 medium, and *Anabaena* sp., *Oscillatoria* sp., and *Nostoc* sp. were identified with the aid of Nikon Eclipse Ts2 inverted phase contrast microscope. Cyanobacterial counts were checked for each individually for identified species using a haemocytometer and it was 1 x 10^7 CFU ml^{-1}. The volume of 300 ml of identified nitrogen-fixing cyanobacteria were cultured in BIOSTAT® A bioreactor to increase their biomass under optimized conditions of 100 rpm agitation, 27 ^{0}C temperature, 7.1 pH, 150 ccm flow rate of Oxygen and a constant light intensity of 300 $\mu Em^{-2}s^{-1}$ for a period of seven days. The final volume of cyanobacterial culture obtained from the bioreactor was 2334.15 ml. The cyanobacterial growth difference before and after culturing in the bioreactor was 9.3 x 10^7 CFU ml^{-1}. Biofertilizer was prepared after checking the cyanobacterial cell density using a haemocytometer and it was 10.3 x 10^7 CFU ml^{-1} for the cyanobacterial mixture cultured in the bioreactor. The total nitrogen content of 0.2 g of oven-dried nitrogen-fixing cyanobacterial biofertilizer was checked by the Kjeldahl procedure and estimated as 2.52%.

Keywords: *Cyanobacteria, Nitrogen fixation, Photobioreactor, Biofertilizer, Kjeldahl method*

ID: 47

Development of Agricultural Credit Utilization in Türkiye

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Abstract

The agricultural sector, which is an indispensable sector all over the world; It is closely related to all segments of society with its economic, social and environmental dimensions. However, due to the unique characteristics of agricultural production, farmers face many negative factors, these factors can cause fluctuations in production and, as a natural consequence, fluctuations in prices. While the fluctuations in prices create uncertainties in the income of the farmers, they also frequently cause the enterprises to experience capital insufficiency, long-term planning and financing problems. The problems experienced in agricultural production make it necessary for the farmers to resort to non-operational resources. For this reason, agricultural loans are of great importance in terms of sustainable production of enterprises. Until the 2000s, almost all of the financing needs in the agricultural sector were met only by Ziraat Bank, after the 2001 crisis, private banks began to give weight to the loans for the agricultural sector. While the amount of agricultural loans among consumer loans was 2.44 billion TL in 2002, this amount increased to 255.95 billion TL in 2022. In this study, the development of agricultural credit usage in Turkey, agricultural credit usage by regions and credit applications are discussed. In this direction, agricultural credit policies from the past to the present have been reviewed, agricultural credit resources were examined and the place of agricultural credits in the system has been revealed.

Key Words: *Credit, Ziraat Bank, Agriculture, Turkey*

Türkiye'de Tarımsal Amaçlı Kredi Kullanımının Gelişimi

Özet

Tüm dünyada vazgeçilmez bir sektör niteliğinde olan tarım sektörü; ekonomik, sosyal ve çevresel boyutlarıyla toplumun bütün kesimlerini yakından ilgilendirmektedir. Ancak tarımsal üretimin kendine has özelliklerinden dolayı üreticiler birçok olumsuz faktörle karşılaşmakta, bu faktörler üretimde dalgalanmalara ve bunun doğal bir sonucu olarak fiyatlarda dalgalanmalara neden olabilmektedir. Fiyatlarda yaşanan dalgalanmalar üreticilerin gelirlerinde belirsizlikler yaratırken, işletmelerin sermaye yetersizliği, uzun vadeli planlama ve finansman sorunlarını da sıkça yaşamalarına neden olmaktadır. Tarımsal üretimde yaşanan sorunlar ise üreticilerin işletme dışı kaynaklara başvurmasını zorunlu kılmaktadır. Bu nedenle tarımsal krediler işletmelerin sürdürülebilir üretim yapabilmeleri açısından büyük önem taşımaktadır. 2000'li yıllara kadar tarım sektöründe finansman ihtiyacı neredeyse sadece Ziraat Bankası tarafından karşılanırken, 2001 krizinden sonra özel bankalar da tarım sektörüne yönelik kredilere ağırlık vermeye başlamışlardır. 2002 yılında ihtiyaç kredileri içerisinde tarım kredilerinin miktarı 2,44 milyar TL iken bu miktar 2022 yılında 255,95 milyar TL olmuştur. Bu çalışmada; Türkiye'de tarımsal kredi kullanımının gelişimi, bölgelere göre tarımsal kredi kullanımı ve kredi uygulamaları ele alınmıştır. Bu doğrultuda geçmişten günümüze tarımsal kredi politikaları gözden geçirilmiş, tarımsal kredi kaynakları incelenmiş ve tarım kredilerinin sistem içindeki yeri ortaya konulmuştur.

Anahtar Kelimeler: *Kredi, Ziraat Bankası, Tarım, Türkiye*

Giriş

Tüm dünyada vazgeçilmez bir sektör niteliğinde olan tarım sektörü; ekonomik, sosyal ve çevresel boyutlarıyla toplumun bütün kesimlerini yakından ilgilendirmektedir. Tarımsal üretim; risk ve belirsizliklerin yüksek olması, tarımsal ürünler arz ve talebinin esnek olmayışı, tarımsal piyasaların istikrarsız olması ve üretimin özelliği sebebiyle sermaye devir hızının yavaş olması gibi kendine has özelliklerinden dolayı diğer sektörlere göre kârlılık bakımından bazı olumsuzluklara sahiptir. Tarım ürünlerinde talep esnekliklerinin düşük olması da üretimde dalgalanmalara ve bunun doğal bir sonucu olarak da fiyatlarda dalgalanmalara neden olabilmektedir. Fiyatlarda yaşanan dalgalanmalar ise üreticilerin gelirlerinde belirsizlikler yaratmakta *(Öztürk, 2013)* ve işletmelerin sermaye yetersizliği, uzun vadeli planlama ve finansman sorunlarını sıkça yaşamalarına neden olmaktadır. Bu sorunlar tarım işletmelerinde işletme dışı kaynaklara sıkça başvurulmasını zorunlu kılmaktadır. Bu nedenle tarımsal krediler işletmelerin sürdürülebilir üretim yapabilmeleri açısından büyük önem taşımaktadır *(Başaran ve ark., 2016).*

Tarımsal krediler; tarımsal ürünlerin üretilmesi, işlenmesi, değerlendirilmesi, depolanması, bozulmadan saklanması ve pazarlanmasına, üretimi geliştirici bilgi ve teknolojiden yararlanılmasına yönelik her türlü yatırım ve işletme harcamaları masraflarını karşılama konusunda öz sermayenin yeterli olmadığı durumlarda nakit sermayeyi tamamlamak için doğrudan üretimde kullanmak zorunda kaldıkları, ekonomik fayda ve etkisi kısa veya uzun süren yabancı kaynaklardır *(Adıgüzel, 2006)*. Kısacası, tarım kredilerinin kullanılmasındaki temel amaç; kullanılan kredi ile yeterli miktarda girdi sağlanarak, üretim miktarını ve devamlılığını sağlamaktır. Ayrıca, Türkiye'de daha çok küçük aile işletmelerinin var olması, tarım sektöründe ürünün elde edilebilmesi için belirli bir sürenin geçmesi gerekliliği, yani gelir ile gider arasında zaman uyumunun olmaması tarımda kredi ihtiyacını artıran nedenlerdendir.
Bu çalışmada; Türkiye'de tarımsal kredi kullanımının gelişimi, bölgelere göre tarımsal kredi kullanımı ve kredi uygulamaları ele alınmıştır. Bu doğrultuda geçmişten günümüze tarımsal kredi politikaları gözden geçirilmiş, tarımsal kredi kaynakları incelenmiş ve tarım kredilerinin sistem içindeki yeri ortaya konulmuştur.

Materyal ve Yöntem

Çalışmanın materyalini ikincil kaynaklardan elde edilen veriler oluşturmuştur. Bu kapsamda, TÜİK (Türkiye İstatistik Kurumu), BDK (Bankacılık Denetleme ve Düzenleme Kurumu), TBB (Türkiye Bankalar Birliği) ve konuyla ilgili yapılmış benzer çalışmalardan (tez, makale vb.) yararlanılmıştır.

Bulgular ve Tartışma

Tarımda Kredi Kullanımının Amaçları

Kredi; belirli bir süre sonra ödemek vaadiyle, mal, hizmet, para cinsinden satın alma gücü sağlanması ya da var olan satın alma gücünün belli bir süre sonunda geri alınmak üzere başka bir kimse ya da kuruma devri işlemidir *(Parasız, 2007)*. Tarımsal krediler de; üreticilerin mali güçlerini artırmak, işletme sermayesi temin etmek, işletmelerin etkin ve kârlı çalışmalarını sağlamak yanında, verimlilik yoluyla gelir artışlarını gerçekleştirmek amacıyla verilmektedir *(İnan, 2016; Semerci, 2021)*.
Tarım sektörünün finansmana özellikle de finansman araçlarından kredi desteğine ihtiyaç duymasının nedenleri şunlardır *(Rad ve Aydoğdu, 2019)*:

- Tarımsal üretimin doğa koşullarına bağlı olması; üretimde büyük ölçüde dalgalanmalara neden olmakta, sosyo-ekonomik, teknolojik ve yönetimsel sorunlar yaratmaktadır *(Milojević ve Ćurčić, 2017)*. Bu nedenle üretimin doğasına uygun olarak paraya, ihtiyaç duyulan zaman ve miktarda erişilmesi gerekmektedir.
- Tarımsal üretimdeki dalgalanmaya bağlı olarak, tarımsal gelir de dalgalanmaktadır.
- Tarımsal işletmelerin zayıf sermaye yapısına sahip olması, başlangıç sermayesinin yüksek olması ve ürün hasadının belirli dönemlerde gerçekleşmesi sebebiyle yatırım devir hızının yavaş bir yapıda olması finansman ihtiyacı doğurmaktadır *(Kazancı, 2010)*.
- Tarımsal üretimden sağlanan düşük kârlılık *(Pejanović ve Radović, 2013)* ve düşük verimlilik *(Milojević ve Ćurčić, 2017)* üreticinin kendi finansal kaynaklarını ve birikimlerini oluşturmasını engellemektedir.
- Tarımda yeterli üretim her zaman yapılamadığı için kısa dönemde ürün arzının fiyat esnekliği düşüktür.
- Tarımsal girdi fiyatları, ürün fiyatlarına göre daha hızlı artmaktadır.
- Tarımsal işletmelerin küçük ve organizasyon yapılarının gelişmemiş olması işletmelerin gelişmesi ve büyümesine engel teşkil etmektedir.
- Pazarlama ve teknoloji maliyetlerinin sürekli değişken bir yapıda olması tarımsal işletmelerin bu yöntemleri takip ve tedarik etmesini zorlaştırmaktadır *(Kazancı, 2010)*.
- Miras paylaşımı ve bölünmeler, tarımsal işletmelerin büyümeleri ve sürekliliğe sahip olmalarının önünde büyük bir engel konumundadır. Tarımsal işletmelerin büyüyememeleri kredi ihtiyacını ve finansman sorunlarını da beraberinde getirmektedir *(Kazancı, 2010)*.

Tarım politikalarının en önemli bölümünü oluşturan kredi, tarım sektörünün gelişmesinde temel faktörlerden birini oluşturmaktadır. Kâr marjının düşük ve belli dönemde girdi kullanımının gerekli olduğu dikkate alındığında; tarımsal kredinin faiz oranının düşük olması, zamanında ve yeterli miktarda kolaylıkla kullanılması gibi özelliklerinin bulunmasının üreticiler için büyük önemi vardır. Genellikle tarımsal işletmelerin sermaye eksikliklerinin değerlendirilmesini sağlayan kredilerin kullanımı, üreticinin ödeme gücü ile alacağı kararlara bağlı olarak değişmektedir.
Çiftçiyi bir işletme sahibi yapmak ya da mevcut işletmesini genişletmek amacıyla kredi kullandırılmaktadır. Çiftçi, aldığı krediyle daha geniş ölçekli çalışarak, mevcut üretim dallarını genişleterek ya da yeni üretim dallarına yer vererek gelirini artırabilmektedir. İşletmede arazi ıslahı, bakım yaparak, hayvancılık koşullarını düzelterek ve ırk ıslahına giderek verimin ve işletmenin gelirinin artırılmasına yardımcı olmaktadır. Çiftçi, aldığı

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kredilerle alet-makine, kaliteli tohum ve damızlık satın almak, gübrelemeye ve ilaçlamaya önem vermek ve teknoloji kullanımını artıran diğer unsurlara yer vermek suretiyle gelirini artırmaktadır. Çiftçi, işletme masrafları ve ailesinin tüketim harcamaları için gerekli nakit ihtiyacını aldığı kredi ile karşılarsa, ürününü bekleterek daha uygun fiyatlarla satabilmekte ve böylece geliri artmaktadır. Ayrıca tarımsal krediler çiftçiler tarafından işletmenin teknik donatımının geliştirilmesi ile yapı ve tesisler için de kullanılmaktadır *(Özçelik ve ark., 2005; Taşkıran, 2011)*.

Çiftçilerin tarımsal kredi kullanma amaçları başlıca şu şekilde sıralanabilmektedir *(Bülbül, 2006; Yola 2019)*:

- Tarımsal işletmelerde sabit ile işletme sermayesi noksanını tamamlamak ve ihtiyaçları gidermek,
- Tarımsal üretimi miktar ve kalite bazında attırmak,
- Tarımsal işletmenin kullanacağı yapıları ve tesisleri temin etmek, tarımsal işletmenin mevcut kapasitesini arttırmak,
- İşletmelerin tarımsal arazi sahipliğini arttırmak,
- Tarımsal üretimin yanı sıra tarımsal sanayi kollarına ilişkin girişimlerin sayısını ve başarısını attırmak.

Tarımsal Kredi Kaynakları

Tarımsal faaliyette bulunan işletmeler ihtiyaçları olan kredileri çeşitli kaynaklardan temin edebilirler. Tarım işletmelerinin kredi kaynakları; teşkilatlanmış ve teşkilatlanmamış kredi kaynaklarıdır. Teşkilatlanmış kredi kaynakları tarımsal faaliyette bulunan işletmelerin kredi ihtiyacını karşılamak amacıyla kanun ve yönetmeliklerle kurulmuş, kredi işlemini belirli esaslara göre yürüten kamu ve özel kuruluşlar olup, faiz oranlarını istedikleri gibi değiştiremezler. Faiz oranlarının tespitinde belirli kanun ve yönetmelikleri uygularlar. Tarımsal işletmeleri belirli bir esasa göre finanse eden bu kuruluşlar; Kamu Kredi Kuruluşları, Tarım Kredi Kooperatifleri, Özel Kredi Kuruluşları, Merkez Bankaları şeklinde gruplandırılabilir *(Çetin, 2020; Civan, 2021)*.

Ülkemizde aracı, tüccar, esnaf, akraba, arkadaş, tefeci gibi şahıslar teşkilatlanmamış kredi kaynaklarını oluşturmaktadır. Teşkilatlanmamış kredi kaynakları iki gruba ayrılacak olursa; ilki, karşılıklı güven esasına dayanan faiz ödemesi ve yazılı sözleşme esasına dayalı olmadan komşu, akraba ve arkadaş gibi tanıdık çevreden borç almak üzere sağlanan kaynaklardır. İkincisi ise; borç vermeyi meslek haline getirmiş olan tüccar, esnaf, aracı gibi kişilerden kredi sağlama yöntemidir *(Civan, 2021; Güzel, 2023)*.

Tarımsal Kredilerin Sınıflandırılması

Tarımsal krediler vadelerine göre *kısa, orta ve uzun vadeli*, kullanım amacına göre *işletme ve yatırım kredileri*, yapısal özelliklerine göre *nakdi ve gayri nakdi krediler*, teminatları açısından da *teminatlı ve teminatsız krediler* şeklinde sınıflandırılmaktadır. İşletme kredileri; her türlü işletme gereksinimlerini karşılamak yani tohum, fide, gübre, zirai ilaç, yem, aşı, yavru balık, işçilik, akaryakıt, toprak işleme, hasat, harman, pazarlama, elektrik, su, bakım-onarım, sigorta gibi giderleri finanse etmek amacıyla kullanılan bu kredilerin vadesi 12 ay iken son düzenlemelerle 24 aya kadar çıkartılmıştır. Yatırım kredileri; işletmenin sabit değerlerinin alımı veya yapımı için kullanılan kredilerdir. Örneğin sera, ahır, depo, bina, meyvelik, makine vb. yatırımlarda kullanılır. Son düzenleme ile yatırım kredilerinin vadesi de 5 yıldan 7 yıla çıkartılmıştır. Nakdi krediler, faiz veya faiz ve komisyon karşılığında belli bir vadeye bağlı olarak ödünç para verilmesi şeklinde nakit olarak kullandırılırken gayri nakdi krediler plasman özelliği taşımayan girdi temini, hibe ödemeleri vb. bankadan nakit çıkışı olmayan işlemlerdir *(Ünlüer, 2014)*.

Tarımda üreticiler tarımsal krediyi üretim ve yatırım amacıyla kullanmaktadırlar. Üretim kredileri; tarımsal işletmeye gelir getirici faaliyetleri desteklemek amacıyla kullanılan kredilerdir. Yatırım kredileri ise işletmelerin donanımını iyileştirmek, yapı ve tesis edinmek, araziye sahip olmak ve makine teçhizat sağlamak amacıyla kullanılmaktadır. Tarımda üretim tekniği gelişmiş, ulaşım yolları makineleşmiş ve teçhizatı modern olan ülkelerde tarımsal krediler üretimin artması amacıyla kullanılmaktadır. Bunun yanında bu ülkelerde kullanılan tarımsal yatırım kredileri de amacına uygun şekilde uzun vadeli tarımsal yatırımların finansmanı için kullanılmaktadır. Gelişmekte olan ve gelişmemiş ülkelerde ise tarım sektörüne kullandırılan krediler üretim artış amacından ziyade tüketim amacıyla kullanılabilmektedir. Bu tarz ülkelerde ise tarım kredi miktarının yetersiz ve kısa vadeli olması, çiftçilerin yeteri bilgi birikimine sahip olmamaları ve kontrolün eksik olması sebebiyle tarımsal krediler istenilen etkinliği sağlayamamaktadır *(Karacan, 1991; Yola, 2019)*.

Türkiye'de Tarımsal Kredilerin Gelişimi ve Kredi Politikaları

Türkiye'de tarım işletmelerinin büyük çoğunluğu küçük ölçekli ve aile işletmesi olduğu için tasarruf yapılmasının sınırlı olması nedeniyle verim düşük olmaktadır. Bu yüzden, yeterli miktarda tarımsal girdi kullanılabilmesi ve üreticinin finans ihtiyacının giderilmesinde tarımsal kredilerin önemi artmaktadır.

Osmanlı döneminde Niş valisi Mithat Paşa tarafından, Almanya'daki Raiffiesen ilkelerinden etkilenilmesi sonucu, 1863 yılında -aynı zamanda ülkemizdeki kooperatifçilik hareketinin temeli olarak gösterilen- Memleket Sadıkları kurularak faaliyetlerine başlamıştır. 1867 yılında "Memleket Sandıkları Nizamnamesi"nin devreye

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alınması ile ülkemizde ilk tarımsal amaçlı kooperatif olan Memleket Sandıkları ülke geneline yayılmıştır *(Mülayim, 2003)*. Ancak izleyen yıllarda sandıkların işleyişinde meydana gelen bozulmalar, Memleket Sandıkları'nın etkinliklerini azaltmıştır. Sandıkları merkezi yönetime bağlayarak olumsuzlukları giderebileceği düşüncesinde olan hükümet, 1883 yılında, "Menafi Sandıkları"nı oluşturmuştur. Bu yapılanma, sandıkların önünü açmak için önemli bir girişim olmakla birlikte, yeni çağdaş bir yapılanmaya olan ihtiyaç her geçen gün artmıştır. Böylelikle 15 Ağustos 1888'de Menafi Sandıkları'nın yerine modern finans işlevlerinin üstlenilmesi amacıyla Ziraat Bankası resmen kurulmuş, Menafi Sandıkları'nın şubeleri banka şubesine dönüştürülerek faaliyetlerine resmen başlamıştır *(Anonim1, 2008; Yılmaz, 2008)*. Türkiye'de uzun yıllar boyunca tarımsal üreticinin kredi ihtiyacını sadece Ziraat Bankası karşılamıştır. Daha sonraki yıllarda (1925), Tarım Kredi Kooperatifleri kurulmuştur. Tarım Kredi Kooperatifleri, Ziraat Bankası'na teminat gösteremeyen, küçük tarımsal üreticinin kredi ve ihtiyaçlarını karşılamada önemli bir görev üstlenmiştir *(İnan, 2008)*.
Türkiye'de ülke ekonomisinin gelişmesi amacıyla hazırlanan Beş Yıllık Kalkınma Planlarında, tarım sektörünün gelişimine yönelik, tarımsal üretim ve tarımsal kredilerle ilgili kararlar alınmıştır.

- ***Birinci Beş Yıllık Kalkınma Planı (1963-1967);***

1963-1967 yıllarında hazırlanan planda tarım sektörünün geliştirilmesi, sanayileşme yoluyla kalkınmanın bir aracı olarak kabul edilmiş ve tarıma önem verilmiştir. Belirlenen tarımsal hedeflere ulaşabilmek ve verimliliği yükseltecek girdilerin daha çok kullanılmasını sağlamak için tarım kredisinden yararlanılması, kredilerin yerinde kullanılmalarının kontrolüne başlanacağı, özellikle gübre, iyi tohum gibi girdilerin aynî olarak verilmesinin sağlanacağı belirtilmiştir. İşletme kredilerinin işletmecinin ihtiyaç duyduğu mevsimde verileceği ve ürünün artış zamanında geri ödeneceği, kredilerin verimliliğini artıracak şekilde teminat probleminin giderileceği, kredi verilecek konuların, kredi ihtiyacının, kredi verilecek alanların tespiti ve kredilerin kontrolü gibi konularda Ziraat Bankası'nın Tarım Bakanlığı ile işbirliği yapacağı, çiftçiye tarım kredisi vermek üzere kurulan Tarım Kredi Kooperatifleri, tarımsal tasarrufun yine tarım sahasına aktarılması konusunda yetkili kılınacağı ele alınmıştır *(DPT, 1963)*.

- ***İkinci Beş Yıllık Kalkınma Planı (1968-1972);***

Tarım kredilerinin miktarı, dağıtım şartları ve düzeninin üretimin artırılmasına ve sosyal hedeflerin gerçekleştirilmesine uydurulması amaçlanmıştır. Bu amaçla darboğaz toprak baremi ve teminatın kısıtlayıcı olmasının önlenmesi, kredilerin modern girdilere yöneltilmesi, kredilerle kooperatiflerin gelişmesinin desteklenmesi, üreticiye sermaye yetersizliğinden gelir kaybına uğratmayacak kredi kolaylıkları sağlanması hedeflenmiştir *(DPT, 1967)*.
Planda ekonomik kalkınmanın sürükleyici sektörü olarak sanayileşme öngörülmüş ve tarımın ikinci sırada önemli bir sektör olduğu vurgulanmıştır. Tarımsal kredilerin kullanımında, nakdi yerine ayni kredi uygulamasının daha da yaygınlaştırılması benimsenmiştir. Kredi uygulamalarında et, yağlı tohum ve hububat gibi iç talebi tam olarak karşılanamayan ürünlerle, ihracatında önemli artışlar beklenen ürünlerin öncelikli olması, kredilerin bölgesel dağılımının buna göre ayarlanması amaçlanmıştır *(DPT, 1967)*.
Geliştirilecek yeni bir sistem içinde belirli büyüklük altındaki çiftçilere, kredilerin kooperatifler aracılığı ile verilmesi ve tarımsal kredilerdeki düşük faiz hadlerinin bu çiftçilere verilecek kredilere uygulanması hedeflenmiştir *(DPT, 1967)*.

- ***Üçüncü Beş Yıllık Kalkınma Planı (1973-1977);***

Çiftçilerin yatırımlarının ve girdilerinin finansmanında tarım kredileri uygulamasının, üretim hedeflerine uygun programlar çerçevesinde hazırlanması, belirli projelere bağlanarak yürütülmesi, küçük çiftçilere kredinin, geliştirilecek kredi kooperatifleri eliyle ayni olarak verilmesinin yaygınlaştırılması amaçlanmıştır *(DPT, 1972)*.
Tarım kredileri kesiminde önceliği olan konu, ihracata dönük tarım ve hayvancılık projelerinin teşvikidir. Bu nedenle kredi kullanımında hayvancılık, yem üretimi, yağlı tohum üretimi, balıkçılık, ihracatı hızla artan ürünler ve teknolojiyi iyileştirecek girdilere öncelik verilmiştir *(DPT, 1972)*.
Tarım ürünleri fiyat destekleme politikası ile ilgili kredilendirmenin de bir bütün olarak ele alınması ve bu konudaki sorunların çözümü için bir sistem geliştirilmesi amaçlanmıştır *(DPT, 1972)*.

- ***Dördüncü Beş Yıllık Kalkınma Planı (1979-1983);***

Tarımsal kredilendirmenin tarımın modernleşmesine gerçek anlamda katkı sağlayıcı bir yapı ve işleyiş düzenine kavuşturulacağı, ayni kredi, kontrollü kredi, belirli proje uygulamalarına yönelen krediler gibi yollarla kredilerin üretime etkisinin artırılacağı ve bu etki sürekli olarak değerlendirileceği, kredilerin, başlıca ürünler gözetilerek, önceliklere göre dağıtımının her yıl programlarda belirleneceği, dışsatımında önemli artışlar beklenen ürünler ile iç talebi karşılanamayan ürünlere öncelik verileceği konuları ele alınmıştır. Tarım ürünlerinin taban fiyatındaki artışların düşük tutulacağı, destekleme alım miktarlarının azaltılacağı, ödemelerin belli dönemlerde yapılacağı kararlaştırılmıştır *(DPT, 1979)*.

- ***Beşinci Beş Yıllık Kalkınma Planı (1985-1989);***

Tarım kredilerinin, başlıca ürünlerin durumu dikkate alınarak önceliklere göre dağılımının her yıl programlarla belirlenmesi, aynî kredilerin, kontrollü kredilerin ve belirli proje uygulamalarına yönelen kredilerin miktarının artırılması planlanmıştır *(DPT, 1984)*.
Tarım kredilerinin üretim takvimine uygun olarak verilmesi, Tarım kredileri içinde orta ve uzun vadeli yatırım kredilerine gerekli ağırlığın sağlanması, teminat sisteminin makul esaslara bağlanması ve kolaylaştırılması, tarım ürünlerinin değerlendirilmesi için kredi ve pazarlama desteğinin artırılması hedeflenmiştir *(DPT, 1984)*.
Ziraat Bankası'nın kontrollü ziraî krediler ve tarıma dayalı sanayi teşebbüsleri için yeterli kaynak ayırması, tohumluk, fidan, fide ve bağ çubuğu temini ile meyve ve bağ tesislerinin teşvikinde tarıma dayalı sanayilerin ihtiyaçlarını da göz önünde bulundurarak, tarımsal işletme kredileri ile desteklenmesi planlanmıştır *(DPT, 1984)*.
Üreticilere girdi ve kredi sağlanması ile tarımsal ürünlerin işlenmesi, pazarlanması gibi konulara yönelik kooperatifçiliğin desteklenmesi de hedefler arasında yer almıştır *(DPT, 1984)*.

- ***Altıncı Beş Yıllık Kalkınma Planı (1990-1994);***

Tarım reformu uygulamaları, teknolojik gelişmeyi ve verimliliği artırmayı esas alan, çiftçi gelirlerinin yükseltilmesini amaçlayan bir yapı içinde sürdürüleceğinin ve talebi yurt içinden karşılanamayan ürünler ve ihraç potansiyeli yüksek ürünlerin üretimin artırılması yönündeki kredi taleplerine öncelik verilmesinin sağlanacağı ilkeler arasına alınmıştır. Tarımsal ürünlerin destekleme fiyatları, ürün maliyetleri, yurt dışı fiyatlar ve ekonominin genel dengesi dikkate alınarak, tarımsal üreticinin gelirinde istikrarı sağlayacak ve tarımsal üretimi yönlendirecek şekilde tespit edilmesine dair düzenlemeler yapılacaktır *(DPT, 1989)*.
Tarımsal üretimin artırılmasında ve teşvikinde fiyat politikası yanında, ucuz ve yeterli girdi, kredi, tarımsal eğitim, tarımsal teşkilatlanma ve teknolojik gelişme imkânlarının artırılması gibi fiyat dışı destekleme araçlarına da ağırlık verilmesi hedeflenmiştir *(DPT, 1989)*.
Küçük ve orta gelir grubuna giren çiftçilerin modern girdi temin, tedarik ve kullanımı ile tarımsal ürünleri pazarlamaları kooperatifçilikle desteklenmesi, iç talebi karşılanamayan ürünler ile ihraç ürünleri üretiminin artırılması yönündeki kredi taleplerine öncelik verilmesi amaçlanmıştır. Ziraat Bankası'nın, kontrollü zirai krediler, tarımsal sanayi ve tarıma dayalı sanayi teşebbüsleri için yeterli kaynak ayırmaya devam etmesi amaçlar arasında yer almıştır *(DPT, 1989)*.

- ***Yedinci Beş Yıllık Kalkınma Planı (1996-2000);***

Kırsal altyapının oluşturulması ve arazi toplulaştırma hizmetlerinin Toprak Yasası içinde yer alması, tütün, şeker pancarı ve tahıllarda destekleme alımları ve kredi sübvansiyonlarının zamanla kaldırılması hedeflenmiştir *(DPT, 1995)*.
1997 yılında Dünya Bankası heyetinin raporuna göre; tarımsal kredilerin sübvansiyonu yoluyla yapılan tarımsal desteğin kaldırılması önerilmiştir. Bu gelişmelerin arka planında, tarımsal kredi desteklemelerinin ekonomide yaşanan sorunların kaynakları arasında bulunduğu düşüncesi yatmaktadır *(Özkaya ve ark., 2001)*.

- ***Sekizinci Beş Yıllık Kalkınma Planı (2001-2005);***

Güneydoğu Anadolu Projesi kapsamında, yatırımı süren ve yatırım programında ihalesiz olarak yer alan sulama projelerinin; genel kamu yatırım dengeleriyle uyumlu bir şekilde uluslararası kredi temini ile hızlandırılarak, kısa dönemde tarımsal üretime katkı sağlaması, sulama yatırımlarının, özellikle kredi temini ile yürütülecek olanların, gerektirdiği toplulaştırma ve tarla içi geliştirme hizmetlerini gerçekleştiren kuruluşlar arasındaki koordinasyon etkinleştirilmesi ve gerekli kaynak akışının temin edilmesi amaçlanmıştır *(DPT, 2000)*.
Orman köylülerinin yerinde kalkındırılması amacıyla, aynî kredi uygulamasının yaygınlaştırılarak üretkenliklerinin artırılması ve refah seviyelerinin yükseltilmesi planlanmıştır *(DPT, 2000)*.
Sekizinci Beş Yıllık Kalkınma Planı'yla birlikte, 2001 yılı itibariyle fiyat desteği yerine uygulanmakta olan Doğrudan Gelir Desteği ödemeleri ile üretici gelirlerinde belirli bir istikrar sağlanması amaçlanmıştır *(DPT, 2000)*.
2006 yılında çıkarılan 5488 sayılı Tarım Kanunu ile üreticiler için, üretim planlaması yapabilmelerini sağlayacak öngörülebilir ve istikrarlı bir ortam oluşturulması amaçlanmıştır *(DPT, 2000)*.

- ***Dokuzuncu Beş Yıllık Kalkınma Planı (2007-2013);***

2006 yılında çıkarılan Tarım Kanunu'yla belirlenen, tarımsal kredi sübvansiyonları ile destekleme ödemelerinin üreticilere çeşitli kanallardan ulaştırılması sağlanarak tarım sektörüne yönelik finansal hizmetlerin çeşitlendirileceği vurgulanmıştır *(DPT, 2006)*.

- ***Onuncu Beş Yıllık Kalkınma Planı (2014-2018);***

Tarımsal desteklerin, tarım havzaları ve parselleri bazında, sosyal amaçlı ve üretim odaklı olarak düzenlenmesi, desteklerde çevre ile bitki, hayvan ve insan sağlığının dikkate alınması, tarımsal desteklerin etkinliğinin izlenerek değerlendirilmesi düşünülmüştür. Tarım ve gıda işletmelerinin güvenilir üretim için hijyen mevzuatına uyum sürecinin, modernizasyon yatırımlarıyla hızlandırılması ve söz konusu işletmelerin finansman ihtiyacına yönelik kaynak ve mekanizmaların çeşitlendirilmesi amaçlamıştır *(DPT, 2013)*.

- ***On Birinci Beş Yıllık Kalkınma Planı (2019-2023);***

Örtü altı yetiştiriciliğine yönelik modern seraların kurulmasının yanında mevcut seraların modernize edilmesi, büyütülmesi, paketleme tesisleri ve depo yapımı için yatırım ve işletme finansman desteği sağlanması amaçlanmıştır *(DPT, 2019)*.

Türkiye'de Tarımsal Kredi Kullanımı

Türkiye'de tarımsal üretimin devamlılığı bağlamında işletmelerin kredi taleplerinin karşılanması için dönem dönem farklı politikalar uygulanmaktadır. Türkiye'de tarımsal kredi ihtiyacını; T.C. Ziraat Bankası, Tarım Kredi Kooperatifleri ve 1980 yılından itibaren özel bankalar da tarımsal üreticinin ihtiyaçları doğrultusunda karşılamaya başlamıştır. Özelikle 2000'li yıllarla beraber, özel bankların, kredi destekleri artmıştır. Bu artış günümüzde de, kredi çeşitliliği ve banka sayısında da artarak devam etmektedir.
Günümüzde Ziraat Bankası, Vakıfbank, Garanti BBVA, İş Bankası, Akbank, Anadolubank, Denizbank, Şekerbank, Yapı Kredi Bankası, QNB Finansbank, Türkiye Ekonomi Bankası, Kuveyt Türk, Fibabanka olmak üzere 13 banka tarımsal kredi ürünleri ile tarım bankacılığı hizmeti vermektedir (Çizelge 1).

Çizelge 1. Tarıma Kredi Veren Bankalar ve Verdikleri Kredi Türleri

İşletme Kredileri	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13
Arıcılık Kredisi	❖			❖		❖		❖		❖		❖	
Bitkisel Üretim Kredileri	❖	❖	❖	❖	❖	❖	❖	❖	❖	❖	❖	❖	❖
ELÜS Karşılığı Kredi	❖	❖		❖		❖	❖	❖			❖	❖	
Hasat ve Pazarlama Kredileri	❖						❖				❖		
Hayvancılık Kredisi	❖	❖	❖	❖	❖	❖	❖	❖	❖	❖	❖	❖	❖
IPARD Programı Kapsamındaki Krediler	❖	❖	❖				❖	❖	❖				
Arazi Alım Kredileri	❖	❖		❖	❖	❖		❖	❖	❖		❖	
Lisanslı Depoculuk Yatırımları	❖		❖										
Mekanizasyon Kredileri	❖	❖	❖	❖	❖	❖	❖	❖	❖	❖	❖	❖	
Organik ve İyi Tarım Kredisi			❖	❖						❖	❖		
Seracılık Kredisi	❖	❖	❖	❖	❖			❖	❖	❖			
Sözleşmeli Üretim Kredileri	❖	❖		❖		❖		❖	❖	❖	❖		
Su Ürünleri Kredisi	❖									❖			
Modern Sulama Kredileri	❖				❖		❖	❖	❖	❖	❖		❖
TMO Makbuz Senedi Karşılığı Krediler	❖	❖	❖	❖				❖	❖				
Çiftçi Destek Kredisi	❖		❖							❖	❖		
KOBİ Kredisi	❖	❖						❖					

B1: Ziraat Bankası; B2: Vakıfbank; B3: Garanti BBVA; B4: İş Bankası; B5: Akbank; B6: Anadolubank; B7: Denizbank; B8: Şekerbank; B9: Yapı Kredi Bankası; B10: QNB Finansbank; B11: Türkiye Ekonomi Bankası; B12: Kuveyt Türk; B13: Fibabanka

Türkiye'de kullandırılan tarımsal kredi miktarı 2002-2022 yılları arasında sürekli artış göstererek 2,4 milyar TL'den yaklaşık 256 milyar TL'ye ulaşmıştır Kullandırılan tarımsal kredi miktarları artış gösterse de; toplam kredi miktarındaki payı değişmekle birlikte 2022 yılında %3,53 olmuştur. İhtiyaç kredileri içerisinde tarımsal kredilerin payı ise son yirmi yılda %43 ile %58 oranlarında seyretmiştir (Çizelge 2).
Türkiye'de tarım sektöründe kullandırılan gayri nakdi kredilerde 2004 yılından 2022 yılına kadar dalgalanmalı bir artış gerçekleşmiştir. Nakdi krediler ise sürekli olarak artmıştır. 2004 yılında kullanılan kısa vadeli krediler ile orta ve uzun vadeli kredilerin oranı neredeyse birbirine yakın seyrederken 2022 yılına gelindiğinde ise tarımsal kredi kullanımında tercih değişmiş, kısa vadeli kredi kullanım oranı %38,29 olurken, orta ve uzun vadeli kredilerin kullanım oranı %60,91'e yükselmiştir. Takipteki kredilerin oranı ise yıllar içerisinde azalmış, %0,80'e düşmüştür (Çizelge 3).

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Çizelge 2. Türkiye'de Tarımsal Kredi Kullanımı (Milyon TL)

Yıl	Tarımsal Krediler (TL)	Toplam Krediler (TL)	Toplam Krediler İçinde Tarımın Payı (%)
2002	2.440	52.631	4,64
2007	7.481	278.998	2,68
2012	24.868	764.197	3,25
2017	68.239	2.059.741	3,31
2018	77.824	2.367.433	3,29
2019	97.849	2.599.623	3,76
2020	101.658	3.449.952	2,95
2021	135.715	4.717.903	2,88
2022	255.952	7.246.558	3,53

Kaynak: TBB, 2023

Çizelge 3. Türkiye'de Bankalarca Tarım Sektöründe Kullandırılan Krediler (Bin TL)

Yıllar	KVNK		OUVNK		TK		TNK		GNK	Toplam Krediler		
											NKP	GNKP
	TL	%	TL	%	TL	%	TL	%	TL	TL	%	%
2004	2.427.377	47,56	2.467.623	48,34	209.228	4,10	5.104.228	100,00	341.260	5.445.488	93,73	6,27
2005	3.688.646	53,00	3.121.448	44,85	149.263	2,14	6.959.357	100,00	451.486	7.410.843	93,91	6,09
2006	4.907.328	62,82	2.574.141	32,95	329.683	4,22	7.811.152	100,00	1.001.973	8.813.125	88,63	11,37
2007	5.913.172	60,14	3.643.567	37,06	275.479	2,80	9.832.218	100,00	633.543	10.465.761	93,95	6,05
2008	7.330.797	57,05	5.107.117	39,74	411.835	3,21	12.849.749	100,00	876.644	13.726.393	93,61	6,39
2009	9.481.634	62,19	4.891.712	32,08	873.122	5,73	15.246.468	100,00	1.035.673	16.282.141	93,64	6,36
2010	12.271.085	54,42	9.334.927	41,40	943.522	4,18	22.549.534	100,00	1.259.104	23.808.638	94,71	5,29
2011	15.991.619	52,85	13.399.200	44,29	865.571	2,86	30.256.390	100,00	1.721.316	31.977.706	94,62	5,38
2012	16.566.528	52,04	14.310.120	44,95	957.483	3,01	31.834.131	100,00	1.711.348	33.545.479	94,90	5,10
2013	17.521.876	49,27	16.798.270	47,23	1.244.048	3,50	35.564.194	100,00	2.276.608	37.840.802	93,98	6,02
2014	21.894.511	48,73	21.748.708	48,41	1.283.522	2,86	44.926.741	100,00	2.271.811	47.198.552	95,19	4,81
2015	17.704.383	29,46	41.027.219	68,27	1.367.413	2,28	60.099.015	100,00	2.036.635	62.135.650	96,72	3,28
2016	21.037.683	29,23	48.972.638	68,04	1.963.383	2,73	71.973.704	100,00	1.889.018	73.862.722	97,44	2,56
2017	22.188.365	25,74	61.598.366	71,46	2.410.258	2,80	86.196.989	100,00	1.790.100	87.987.089	97,97	2,03
2018	25.806.181	25,72	70.758.076	70,52	3.774.972	3,76	100.339.229	100,00	5.302.909	105.642.138	94,98	5,02
2019	30.010.990	27,83	72.605.470	67,33	5.217.578	4,84	107.834.038	100,00	7.448.183	115.282.221	93,54	6,46
2020	34.491.676	26,80	89.248.437	69,34	4.978.472	3,87	128.718.585	100,00	5.342.677	134.061.262	96,01	3,99
2021	50.229.239	30,22	111.804.647	67,26	4.187.307	2,52	166.221.193	100,00	6.205.399	172.426.592	96,40	3,60
2022	124.630.209	38,29	198.229.811	60,91	2.588.418	0,80	325.448.438	100,00	12.216.398	337.664.836	96,38	3,62

KVNK: Kısa Vadeli Nakdi Krediler; OUVNK: Orta ve Uzun Vadeli Nakdi Krediler; TK: Takipteki Krediler; TNK: Toplam Nakdi Krediler; GNK: Gayri Nakdi Krediler; NKP: Nakdi Kredilerin Payı; GNKP: Gayri Nakdi Kredilerin Payı; Kaynak: TBB, 2023

Türkiye'de 2002 yılında 2.431 milyon TL kullanılan tarımsal kredinin %47,33'ü *Doğu Karadeniz*, %16,35'i *Ege*, %15,31'i *Akdeniz* bölgesine aittir. Ancak 2022 yılına gelindiğinde artan tarımsal kredi miktarıyla birlikte bölgelerin de kredi kullanım miktarları değişmiştir. Buna göre 2022 yılında kullanılan 251.222 milyon TL tarımsal kredinin %18,28'i *Ege*, %16,18'i *Akdeniz*, %12,14'ü *Batı Anadolu*, %10,73'ü *Orta Anadolu* ve %10,27'si *Güneydoğu Anadolu* bölgesine aittir (Çizelge 4).

Bölgelere göre tarımsal kredi kullanımı iller bazında incelendiğinde;

2002 yılında;

- Ege Bölgesi'nde; İzmir (%89,88),
- Akdeniz Bölgesi'nde; Adana (%71,93),
- Batı Anadolu Bölgesi'nde; Ankara (%63,16),
- Orta Anadolu Bölgesi'nde; Sivas (%24,61) ve Nevşehir (%20,00),
- Güneydoğu Anadolu Bölgesi'nde; Gaziantep (%74,54)
- Batı Marmara Bölgesi'nde; Edirne (%79,56),
- Doğu Marmara Bölgesi'nde; Bursa (%89,04),
- Batı Karadeniz Bölgesi'nde; Samsun (%60,27),
- Ortadoğu Anadolu Bölgesi'nde; Malatya (%79,99),
- Kuzeydoğu Anadolu Bölgesi'nde; Erzurum (%25,73) ve Kars (%20,11),
- Doğu Karadeniz Bölgesi'nde; Giresun (%97,11) tarımsal kredi kullanımında önemli olan illerdir.

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Çizelge 4. Bölgelere Göre Tarımsal Kredi Kullanımı (Milyon TL)

	2002		2007		2012		2017		2022	
	TL	%	TL	%	TL	%	TL	%	TL	%
Ege	397	16,35	1.747	24,42	5.148	21,13	12.487	18,56	45.918	18,28
Akdeniz	372	15,31	1.445	20,19	4.603	18,89	12.095	17,98	40.642	16,18
Batı Anadolu	37	1,51	625	8,74	2.104	8,63	7.005	10,41	30.497	12,14
Orta Anadolu	32	1,33	557	7,79	2.027	8,32	6.393	9,50	26.952	10,73
Güneydoğu Anadolu	36	1,49	341	4,76	1.772	7,27	6.220	9,25	25.796	10,27
Batı Marmara	132	5,43	614	8,58	2.408	9,88	5.856	8,70	21.208	8,44
Doğu Marmara	168	6,92	712	9,96	2.057	8,44	5.256	7,81	19.556	7,78
Batı Karadeniz	73	2,99	494	6,91	1.869	7,67	4.696	6,98	18.254	7,27
Ortadoğu Anadolu	23	0,94	168	2,35	858	3,52	2.672	3,97	9.150	3,64
Kuzeydoğu Anadolu	10	0,40	203	2,84	934	3,83	3.013	4,48	8.024	3,19
Doğu Karadeniz	1.151	47,33	247	3,46	587	2,41	1.580	2,35	5.224	2,08
Toplam	2.431	100,00	7.154	100,00	24.368	100,00	67.274	100,00	251.222	100,00

Kaynak: TBB, 2023

2022 yılında ise;

- Ege Bölgesi'nde; İzmir (%29,00), Manisa (%19,41) ve Aydın (%17,46),
- Akdeniz Bölgesi'nde; Antalya (%26,39) ve Adana (%25,62),
- Batı Anadolu Bölgesi'nde; Konya (%49,50) ve Ankara (%43,54),
- Orta Anadolu Bölgesi'nde; Kayseri (%19,29), Yozgat (%15,32) ve Aksaray (%15,12),
- Güneydoğu Anadolu Bölgesi'nde; Şanlıurfa (%28,23) ve Diyarbakır (%22,18)
- Batı Marmara Bölgesi'nde; Balıkesir (%28,48),
- Doğu Marmara Bölgesi'nde; Bursa (%33,94) ve Eskişehir (21,79),
- Batı Karadeniz Bölgesi'nde; Samsun (%22,66),
- Ortadoğu Anadolu Bölgesi'nde; Malatya (%28,77),
- Kuzeydoğu Anadolu Bölgesi'nde; Erzurum (%27,59) ve Kars (%21,53),
- Doğu Karadeniz Bölgesi'nde; Ordu (%33,36) ili tarımsal kredi kullanımında önemli illerdendir.

Çizelge 5. Ege Bölgesinde Tarımsal Kredi Kullanımı (Milyon TL)

	2002		2007		2012		2017		2022	
	TL	%	TL	%	TL	%	TL	%	TL	%
İzmir	357	89,88	642	36,75	1.857	36,07	3.447	27,60	13.317	29,00
Manisa	11	2,74	289	16,55	927	18,00	2.507	20,08	8.915	19,41
Aydın	9	2,37	252	14,43	739	14,35	2.086	16,71	8.019	17,46
Denizli	6	1,49	147	8,44	504	9,79	1.355	10,85	5.044	10,98
Afyon	4	0,97	152	8,68	332	6,45	1.248	10,00	4.348	9,47
Muğla	5	1,33	126	7,20	403	7,82	888	7,11	3.404	7,41
Uşak	2	0,63	70	4,02	207	4,01	439	3,51	1.483	3,23
Kütahya	2	0,59	69	3,93	180	3,50	516	4,13	1.388	3,02
Toplam	397	100,00	1.747	100,00	5.148	100,00	12.487	100,00	45.918	100,00

Kaynak: TBB, 2023

Çizelge 6. Akdeniz Bölgesinde Tarımsal Kredi Kullanımı (Milyon TL)

	2002		2007		2012		2017		2022	
	TL	%	TL	%	TL	%	TL	%	TL	%
Antalya	71	19,04	431	29,81	1.137	24,70	3.009	24,88	10.727	26,39
Adana	268	71,93	345	23,87	1.304	28,34	3.075	25,42	10.411	25,62
Mersin	9	2,49	262	18,11	767	16,67	2.246	18,57	7.359	18,11
Hatay	7	1,85	137	9,51	483	10,50	1.301	10,76	3.623	8,91
Kahramanmaraş	6	1,48	61	4,22	178	3,86	795	6,57	3.564	8,77
Burdur	3	0,84	84	5,80	269	5,85	589	4,87	1.932	4,75
Osmaniye	6	1,54	34	2,33	185	4,01	434	3,59	1.609	3,96
Isparta	3	0,82	92	6,34	280	6,08	648	5,35	1.418	3,49
Toplam	372	100,00	1.445	100,00	4.603	100,00	12.095	100,00	40.642	100,00

Kaynak: TBB, 2023

Çizelge 7. Batı Anadolu Bölgesinde Tarımsal Kredi Kullanımı (Milyon TL)

	2002		2007		2012		2017		2022	
	TL	%	TL	%	TL	%	TL	%	TL	%
Konya	12	33,99	280	44,80	1.125	53,49	3.702	52,85	15.098	49,50
Ankara	23	63,16	304	48,60	823	39,14	2.832	40,43	13.279	43,54
Karaman	1	2,85	41	6,59	155	7,37	471	6,72	2.121	6,95
Toplam	37	100,00	625	100,00	2.104	100,00	7.005	100,00	30.497	100,00

Kaynak: TBB, 2023

Çizelge 8. Orta Anadolu Bölgesinde Tarımsal Kredi Kullanımı (Milyon TL)

	2002		2007		2012		2017		2022	
	TL	%	TL	%	TL	%	TL	%	TL	%
Kayseri	4	12,45	111	19,88	428	21,12	1.373	21,47	5.200	19,29
Yozgat	3	8,94	64	11,54	301	14,87	1.007	15,75	4.129	15,32
Aksaray	3	10,20	84	15,00	275	13,56	683	10,69	4.075	15,12
Kırşehir	2	4,88	44	7,92	164	8,08	825	12,90	3.727	13,83
Sivas	8	24,61	94	16,92	315	15,54	1.079	16,88	3.175	11,78
Niğde	4	11,12	64	11,47	260	12,85	684	10,70	2.968	11,01
Nevşehir	6	20,00	45	8,08	162	8,00	434	6,78	2.113	7,84
Kırıkkale	3	7,80	51	9,19	121	5,98	309	4,84	1.565	5,81
Toplam	32	100,00	557	100,00	2.027	100,00	6.393	100,00	26.952	100,00

Kaynak: TBB, 2023

Çizelge 9. Güneydoğu Anadolu Bölgesinde Tarımsal Kredi Kullanımı (Milyon TL)

	2002		2007		2012		2017		2022	
	TL	%	TL	%	TL	%	TL	%	TL	%
Şanlıurfa	3	8,81	64	18,66	493	27,80	1.580	25,41	7.283	28,23
Diyarbakır	3	7,32	57	16,82	295	16,66	1.188	19,10	5.721	22,18
Gaziantep	27	74,54	117	34,48	400	22,60	1.674	26,91	4.797	18,59
Mardin	1	1,73	33	9,76	253	14,25	570	9,16	2.319	8,99
Adıyaman	1	3,84	38	11,19	126	7,12	517	8,31	2.249	8,72
Batman	0,43	1,17	10	3,02	55	3,11	225	3,62	1.283	4,97
Siirt	1	1,97	4	1,09	32	1,82	184	2,96	994	3,85
Şırnak	0,03	0,09	4	1,07	25	1,39	83	1,34	712	2,76
Kilis	0,19	0,53	13	3,90	93	5,25	199	3,19	440	1,70
Toplam	36	100,00	341	100,00	1.772	100,00	6.220	100,00	25.796	100,00

Kaynak: TBB, 2023

Çizelge 10. Batı Marmara Bölgesinde Tarımsal Kredi Kullanımı (Milyon TL)

	2002		2007		2012		2017		2022	
	TL	%	TL	%	TL	%	TL	%	TL	%
Balıkesir	6	4,08	202	21,43	694	24,21	1.699	25,19	7.376	28,48
Tekirdağ	4	3,00	102	10,86	517	18,04	1.312	19,44	4.870	18,80
İstanbul	9	6,33	327	34,79	458	15,99	891	13,21	4.694	18,12
Edirne	112	79,56	133	14,17	530	18,51	1.115	16,53	3.479	13,43
Çanakkale	7	5,29	116	12,38	372	12,97	997	14,77	3.186	12,30
Kırklareli	2	1,75	60	6,38	295	10,28	733	10,86	2.297	8,87
Toplam	141	100,00	941	100,00	2.866	100,00	6.748	100,00	25.902	100,00

Kaynak: TBB, 2023

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Çizelge 11. Doğu Marmara Bölgesinde Tarımsal Kredi Kullanımı (Milyon TL)

	2002		2007		2012		2017		2022	
	TL	%	TL	%	TL	%	TL	%	TL	%
Bursa	150	89,04	264	37,06	954	46,38	2.058	39,15	6.638	33,94
Eskişehir	6	3,67	157	22,01	259	12,57	782	14,87	4.261	21,79
Sakarya	3	1,94	93	13,06	295	14,34	863	16,42	3.047	15,58
Kocaeli	2	1,46	32	4,52	149	7,25	492	9,35	1.905	9,74
Bolu	3	1,81	61	8,61	166	8,09	373	7,10	1.513	7,73
Düzce	1	0,63	29	4,01	92	4,46	361	6,86	1.137	5,81
Bilecik	2	1,19	54	7,59	91	4,40	212	4,03	658	3,36
Yalova	0	0,27	22	3,14	52	2,51	116	2,21	397	2,03
Toplam	168	100,00	712	100,00	2.057	100,00	5.256	100,00	19.556	100,00

Kaynak: TBB, 2023

Çizelge 12. Batı Karadeniz Bölgesinde Tarımsal Kredi Kullanımı (Milyon TL)

	2002		2007		2012		2017		2022	
	TL	%	TL	%	TL	%	TL	%	TL	%
Samsun	44	60,27	94	18,93	463	24,77	1.081	23,02	4.136	22,66
Çorum	5	7,39	73	14,83	292	15,59	840	17,89	3.195	17,50
Tokat	3	4,29	51	10,25	285	15,24	680	14,47	3.034	16,62
Amasya	5	6,47	46	9,25	251	13,43	649	13,82	2.282	12,50
Kastamonu	3	4,18	89	17,93	241	12,90	558	11,89	2.266	12,41
Çankırı	6	8,40	78	15,69	146	7,83	440	9,38	1.614	8,84
Sinop	3	3,58	15	3,01	76	4,06	190	4,04	630	3,45
Zonguldak	1	1,60	22	4,38	62	3,30	121	2,57	456	2,50
Karabük	2	2,61	21	4,24	31	1,67	71	1,51	393	2,15
Bartın	1	1,21	7	1,49	22	1,20	67	1,42	248	1,36
Toplam	73	100,00	494	100,00	1.869	100,00	4.696	100,00	18.254	100,00

Kaynak: TBB, 2023

Çizelge 13. Ortadoğu Anadolu Bölgesinde Tarımsal Kredi Kullanımı (Milyon TL)

	2002		2007		2012		2017		2022	
	TL	%	TL	%	TL	%	TL	%	TL	%
Malatya	18	79,99	79	47,11	301	35,02	862	32,28	2.633	28,77
Elâzığ	1	4,52	26	15,40	145	16,90	373	13,95	1.710	18,68
Van	0,205	0,90	18	10,66	94	10,97	372	13,92	1.260	13,77
Bitlis	1	3,91	17	9,92	142	16,60	345	12,90	1.104	12,07
Muş	1,808	7,94	14	8,36	82	9,58	386	14,46	1.061	11,60
Tunceli	0,378	1,66	6	3,74	42	4,84	126	4,71	615	6,73
Bingöl	0,245	1,08	3	2,04	37	4,36	134	5,02	441	4,82
Hakkâri	0,003	0,01	5	2,78	15	1,74	74	2,78	326	3,56
Toplam	23	100,00	168	100,00	858	100,00	2.672	100,00	9.150	100,00

Kaynak: TBB, 2023

Çizelge 14. Kuzeydoğu Anadolu Bölgesinde Tarımsal Kredi Kullanımı (Milyon TL)

	2002		2007		2012		2017		2022	
	TL	%	TL	%	TL	%	TL	%	TL	%
Erzurum	2	25,73	55	26,94	307	32,82	868	28,80	2.214	27,59
Kars	2	20,11	53	26,08	241	25,78	627	20,82	1.728	21,53
Erzincan	2	18,44	27	13,07	90	9,68	344	11,41	1.202	14,98
Ardahan	0	2,08	32	15,62	111	11,86	441	14,64	1.018	12,69
Ağrı	1	9,53	7	3,61	72	7,67	291	9,65	791	9,86
Iğdır	1	11,62	15	7,23	69	7,36	322	10,70	652	8,13
Bayburt	1	12,48	15	7,46	45	4,83	120	3,98	419	5,22
Toplam	10	100,00	203	100,00	934	100,00	3.013	100,00	8.024	100,00

Kaynak: TBB, 2023

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Çizelge 15. Doğu Karadeniz Bölgesinde Tarımsal Kredi Kullanımı (Milyon TL)

	2002		2007		2012		2017		2022	
	TL	%	TL	%	TL	%	TL	%	TL	%
Ordu	7	0,64	88	35,74	217	36,96	607	38,39	1.743	33,36
Trabzon	2	0,20	40	16,29	102	17,32	260	16,44	1.028	19,67
Giresun	1.117	97,11	56	22,48	93	15,90	349	22,06	975	18,66
Artvin	2	0,14	19	7,79	50	8,55	136	8,57	572	10,95
Gümüşhane	1	0,06	28	11,36	71	12,03	150	9,50	492	9,42
Rize	21	1,84	16	6,33	54	9,25	79	5,02	415	7,93
Toplam	1.151	100,00	247	100,00	587	100,00	1.580	100,00	5.224	100,00

Kaynak: TBB, 2023

Sonuç

Tarım sektörü toplumun bütün kesimlerini yakından ilgilendiren vazgeçilmez bir sektör niteliğindedir. Ancak tarım kendine has özelliklerinden dolayı diğer sektörlere göre kârlılık bakımından bazı olumsuzluklara sahiptir. Bu olumsuzluklar üretimde dalgalanmalara ve bunun doğal bir sonucu olarak da fiyatlarda dalgalanmalara neden olabilmektedir. Fiyatlarda meydana gelen dalgalanmalar ise üreticilerin gelirlerinde belirsizlikler yaratırken, işletmelerin sermaye yetersizliği, uzun vadeli planlama ve finansman sorunlarını sıkça yaşamalarına neden olmaktadır. Yaşanan sorunlar tarım işletmelerinde işletme dışı kaynaklara sıkça başvurulmasını zorunlu kılmaktadır. Bu nedenle tarımsal krediler işletmelerin sürdürülebilir üretim yapabilmeleri açısından büyük önem taşımaktadır. Ülkemizde tarımsal faaliyette bulunan işletmeler; kamu kredi kuruluşları, tarım kredi kooperatifleri, özel kredi kuruluşları, merkez bankaları gibi teşkilatlanmış kredi kaynaklarından ya da aracı, tüccar, esnaf, akraba, arkadaş, tefeci gibi teşkilatlanmamış kredi kaynaklarından ihtiyaç duydukları krediyi temin etmektedirler.

Türkiye'de kullanılan tarımsal kredi miktarı yıllar itibariyle artış göstermiştir. Üreticilerin tarımsal faaliyetleri ile ilgili girdi temini ve tarımsal üretime yönelik ihtiyaç duydukları kısa vadeli krediler ve tarım işletmelerinin gelişimi ve teknolojik tarım işletmelerinin oluşturulmasına yönelik orta ve uzun vadeli kredilerin oranı son yıllarda birbirine yaklaşmıştır.

Ülkemizde tarımsal krediler en çok Ege ve Akdeniz bölgelerinde kullanılmaktadır. Ege Bölgesi'nde; *İzmir*, Akdeniz Bölgesi'nde; *Antalya*, Batı Anadolu Bölgesi'nde; *Konya*, Orta Anadolu Bölgesi'nde; *Kayseri*, Güneydoğu Anadolu Bölgesi'nde; *Şanlıurfa*, Batı Marmara Bölgesi'nde; *Balıkesir*, Doğu Marmara Bölgesi'nde; *Bursa*, Batı Karadeniz Bölgesi'nde; *Samsun*, Ortadoğu Anadolu Bölgesi'nde; *Malatya*, Kuzeydoğu Anadolu Bölgesi'nde; *Erzurum*, Doğu Karadeniz Bölgesi'nde; *Ordu* ön plana çıkmaktadır. Kredi miktarları il bazında değerlendirildiğinde ise en çok tarımsal kredi kullanan iller Konya, İzmir, Ankara ve Antalya'dır.

Ülkemizde tarım işletmelerinin küçük ve dağınık yapıda olmaları, ölçek ekonomisi yapısından uzak olmaları kredinin izleme ve değerlendirilmesinde sorun oluşturabilmektedir. Ayrıca tarımsal kredi değerlendirmelerinde üretici verilerindeki yanlışlıklar ve hatalardan dolayı, üretici verilerini kullanan bankaların da değerlendirme sistemleri yanlış sonuç verebilmektedir. Buna bağlı olarak taleplerin zamanında, doğru olarak ve uygun miktarda belirlenememesi yanlış kredilendirmeye sebep olabilmektedir. Kredi kaynakları işletme ve yatırım sürecinde doğru ve etkin kullanılamamaktadır. Krediden beklenen etkinliğin sağlanamaması, bunun yanında kredilerin amaç dışı kullanılarak kaynak etkinliğinin azalması üretimi ve çiftçi gelir düzeyini olumsuz etkilemektedir.

Yaşanan sorunlar karşısında üretici verilerinin düzgün oluşturulması için gerekli alt yapının oluşturulması ya da iyileştirilmesi, çiftçi ve bankalar arasındaki iletişim ağının güçlendirilmesi, kredilerin amacına uygun kullanımının sağlanmasına yönelik mevzuat değişikliğinin yapılması ve izleme-değerlendirmenin kontrollü yapılmasının sağlanması gerekmektedir.

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Examining the Relationship between Risk Management and Cooperative Partnership in Agricultural Enterprises: The Case of Antalya Province

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Abstract

Due to the nature of agriculture, the farmer cannot find an environment with complete information on every subject while making her plans. The farmer produces the product today, but cannot sell it when farmer wants or plans. Conditions can be very different between the start of production and the time of sale. For example, prices may change, the expected price may not occur in the market, and bad weather conditions may cause product losses. Therefore, the farmer, who has to make decisions about the future, is affected by the mentioned factors. For this reason, knowing the existing risk sources in agricultural production and determining the risk management strategies to be applied emerge as very important issues. In this study, it was aimed to determine the risks faced by the farmers who are partners and non-partners of the agricultural cooperatives in the province of Antalya in the production process and the risk management strategies they apply against these risks. In this context, a questionnaire was applied to the producers in a total of 80 enterprises, 40 of which are partners in agricultural cooperatives and 40 producers who are not partners, in the villages of the districts of Antalya between December 2018 and March 2019. In the study, first of all, the socio-economic characteristics of the farmers were examined, then the risk sources they encountered in agricultural production and the risk management strategies they applied were revealed. Risk sources and strategies according to farmers were evaluated with a Five-point Likert scale. According to the results obtained from the research; It has been determined that 52.5% of the farmers in the enterprises are 50 years old and over, and the average experience period is 27 years. When the enterprises are evaluated in general, the most important risk sources faced by the farmers are listed as changes in product prices, changes in input costs, low yield due to plant diseases and pests, and changes in the economic situation of the country. The risk management strategies applied by the farmers against these risks are to plan the expenditures, to produce at the lowest possible cost and to have information about the previous product prices.

Key Words: *Risk, Risk Management, Agriculture, Cooperative, Antalya*

Tarım İşletmelerinde Risk Yönetimi ve Kooperatif Ortaklığı İlişkisinin İncelenmesi: Antalya İli Örneği

Özet

Tarımın doğası gereği, çiftçi planlarını yaparken her konuda tam bilgiye sahip bir ortam bulamaz. Çiftçi ürünü bugün üretir, ancak istediği veya planladığı zaman satamaz. Üretimin başlamasıyla satış zamanı arasında koşullar çok değişik olabilir. Örneğin fiyatlar değişebilir, pazarda beklenen fiyat oluşmayabilir ve kötü hava koşulları ürün kayıplarına neden olabilir. Dolayısıyla gelecekle ilgili karar almak zorunda olan çiftçi belirtilen faktörlerden etkilenmektedir. Bu nedenle tarımsal üretimde var olan risk kaynaklarının bilinmesi ve uygulanacak risk yönetimi stratejilerinin belirlenmesi oldukça önemli konular olarak ortaya çıkmaktadır. Bu çalışmada; Antalya ilinde tarımsal amaçlı kooperatife ortak olan ve ortak olmayan üreticilerin üretim sürecinde karşılaştıkları riskler ve bu risklere karşı uyguladıkları risk yönetimi stratejilerinin belirlenmesi amaçlanmıştır. Bu kapsamda; Antalya ilinin ilçelerine ait köylerde Aralık 2018-Mart 2019 döneminde, tarımsal amaçlı kooperatife ortak olan 40, ortak olmayan 40 üretici olmak üzere toplam 80 işletmede üreticilere anket uygulanmıştır. Çalışmada; öncelikle üreticilerin sosyo-ekonomik özellikleri incelenmiş, daha sonra tarımsal üretimde karşılaştıkları risk kaynakları ve uyguladıkları risk yönetimi stratejileri ortaya konulmuştur. Üreticilere göre risk kaynakları ve stratejileri beşli likert ölçeği ile değerlendirilmiştir. Araştırmadan elde edilen sonuçlara göre; işletmelerde üreticilerin %52,5'inin 50 yaş ve üzerinde olduğu, ortalama deneyim sürelerinin 27 yıl olduğu belirlenmiştir. İşletmeler genel olarak değerlendirildiğinde, üreticilerin karşılaştıkları en önemli risk kaynakları ürün fiyatlarındaki değişiklikler, girdi maliyetlerindeki değişiklikler, bitki hastalıklarından ve bitki zararlılarından dolayı verim düşüklüğü, ülkenin ekonomik durumundaki değişimler olarak sıralanmıştır. Üreticilerin bu risklere karşı uyguladıkları risk yönetimi stratejileri ise harcamaları planlamak, mümkün olduğunca en düşük maliyetle üretim yapmak ve geçmiş dönem ürün fiyatları hakkında bilgi sahibi olmaktır.

Anahtar Kelimeler: *Risk, Risk Yönetimi, Tarım, Kooperatif, Antalya*

Giriş

Tüm dünyada vazgeçilmez bir sektör niteliğinde olan tarım sektörü; toplumun bütün kesimlerini yakından ilgilendirmektedir. Ancak tarımın doğası gereği üretimden pazarlamaya kadar olan süreçte çok sayıda risk faktörünün de etkisi altındadır. Dolayısıyla çiftçi planlarını yaparken her konuda tam bilgiye sahip bir ortam bulamaz. Çiftçi ürünü bugün üretir, ancak istediği veya planladığı zaman satamaz. Üretimin başlamasıyla satış zamanı arasında koşullar çok değişik olabilir. Örneğin fiyatlar değişebilir, pazarda beklenen fiyat oluşmayabilir ve kötü hava koşulları ürün kayıplarına neden olabilir. Dolayısıyla gelecekle ilgili karar almak zorunda olan çiftçi belirtilen faktörlerden etkilenmektedir. Bu nedenle tarımsal üretimde var olan risk kaynaklarının bilinmesi ve uygulanacak risk yönetimi stratejilerinin belirlenmesi oldukça önemli konular olarak ortaya çıkmaktadır.
Risk, genel olarak tarımsal üretimde yapılan planların gerçekleşmeme ihtimali olarak ifade edilmektedir. Tarımsal üretimde; üretim, pazarlama, finansman, teknoloji, politika ve iklim koşulları başlıca risk faktörleridir. Tarım işletmelerinde görülen bu riskler ve belirsizlikler nedeniyle optimum planlardan sapmalar, karar almada güçlükler, ekonomik kayıplar, üreticilerin rekabet gücünde ve gelir düzeylerinde azalmalar meydana gelmektedir. Tarımsal işletmelerin etkisi altında olduğu risk ve belirsizlikler yalnızca üreticileri değil, ülke ekonomisini de olumsuz etkilemektedir. Tarımsal risklerin oluşturduğu zararlar ve öngörülemeyen belirsizlikler kaynakların etkin kullanımını, sürdürülebilir tarımı ve sürdürülebilirlik ilkesi kapsamında kaliteye dayalı üretimi engellemektedir.
Çiftçilerin riske yönelik algı ve tutumlarının değerlendirilmesi, belirsiz bir durumla karşı karşıya kaldıklarında çiftçilerin kararlarını şekillendiren önemli faktörlerdir *(Akçaöz ve Özkan, 2005)*. Çiftçilerin aldıkları kararlar, riskli ve belirsiz durumlarda, risk algıları ve riske yönelik tutumları dikkate alınarak analiz edilebilir *(Lucas ve Pabuayon, 2011)*. Sosyal, ekonomik ve demografik faktörlerin çiftçilerin risk algıları ve risk tutumları üzerindeki etkilerine ilişkin önceki çalışmalar farklı sonuçlar ortaya koymaktadır. Tarım işletmelerinin özellikleri ile çiftçi ve ailesinin özellikleri; çiftçilerin risk algılarını ve risk tutumlarını etkiler. Eğitim durumu ve tarımsal deneyim; çiftçilerin tarımsal faaliyetlerinde karşılaştıkları risk kaynaklarını algılamaları üzerinde etkili faktörlerdir. Bu risklerin görülme sıklığı ve etkileri; çiftçilerin algılarını etkiler ve riski daha verimli bir şekilde yönetme yeteneklerini geliştirir. Konuyla ilgili önceki çalışmalarda çiftçilerin risk tercihlerinin; yaşa *(Kammar ve Bhagat, 2009; Kisaka-Lwayo ve Obi, 2012; Ashraf ve Routray, 2013; Iqbal ve ark., 2016)*, eğitim düzeyine *(Khan ve ark., 2010; Dadzie ve Acquah, 2012)*, gelire *(Einav ve ark., 2010)*, tarımsal deneyime *(Lucas ve Pabuayon, 2011)*, tarım dışı gelire *(Ullah ve ark., 2015)*, sözleşmeli üretim yapma durumuna *(Lu ve ark., 2017)* ve çiftlik büyüklüğüne *(Lucas ve Pabuayon, 2011; Iqbal ve ark., 2016)* bağlı olarak önemli ölçüde farklılaştığı *(Flaten ve ark., 2005)* bulunmuştur. Tarımda iklim değişkenliğinden kaynaklanan üretim riskinin yönetilmesinde iklim bilgisi büyük önem taşımaktadır *(Chaudhary ve Aryal, 2009)*. Çiftçilerin yayım çalışanlarına erişimi, etkili risk yönetimi stratejilerinin benimsenmesi yoluyla tarımsal risklerin anlaşılmasına ve yönetilmesine olanak sağlar *(Arce, 2010; Akhtar ve ark., 2018)*.
Tarımdaki riskler Knight (2002) tarafından risk analizi çerçevesinin çizildiği 1933 yılından bu yana dünya çapında bir endişe konusu olmuştur. Tarımsal risk alanındaki literatürün analizi *(Halter ve Dean, 1971; Dillon, 1971, Hardaker ve ark.,2004; Ladanyi, 2003)* tarımda risklerin değerlendirilmesi ve yönetilmesinin zor olduğunu göstermektedir. Tarım işletmeleri çok sayıda belirsizlikle baş etmek zorundadır. Tarım ekonomisi literatürü, çiftçi risk tercihlerini tahmin etmeye yönelik bir dizi çalışmayı açıklar *(Gomez-Limon ve ark., 2003; Isik ve Khanna, 2003; Toledo ve Engler, 2008)* ve bir çiftçinin bir dizi rastgele seçim arasında nasıl karar verdiğini anlamak için modeller sağlar *(Hardaker ve ark., 2004; Bradshaw, 2004; Girdziute, 2012)*. Tarım işletmelerinde, risk kaynakları ve risk yönetim stratejilerine ilişkin çiftçilerin tutum ve davranışlarını inceleyen geniş bir literatür bulunmaktadır.
Tarımsal üretimde karşılaşılan problemlerin çözümünde tarımsal kooperatiflerin rolü önemlidir. Tarım kooperatifi tarım alanında daha verimli olmayı sağlamak adına gönüllülük esasıyla bir araya gelen ve ortak çıkarlara sahip olan bir gruptur denilebilir *(Bianchi ve Vietta, 2020; Nalcı, 2022)*. Tarımsal kooperatifler Türkiye'de küçük işletmelerin sosyal ve ekonomik gelişimlerinde faydalı olmuştur. Üretimin sürdürülebilirliğini ve üreticilerin aracılardan uzaklaşmasını desteklemektedir. Üreticilerin birleşmesi; üretimin sürekliliğini ve kalitesini de artırmıştır *(Köroğlu, 2003; Gümüş, 2022)*. Bu çalışmada; Antalya ilinde tarımsal amaçlı kooperatife ortak olan ve ortak olmayan üreticilerin üretim sürecinde karşılaştıkları riskler ve bu risklere karşı uyguladıkları risk yönetimi stratejilerinin belirlenmesi amaçlanmıştır.

Materyal ve Yöntem

Çalışmanın materyalini birincil ve ikincil kaynaklardan elde edilen veriler oluşturmuştur. Antalya ilinin Serik ve Aksu ilçelerine ait köylerde, tarımsal amaçlı kooperatife ortak olan ve olmayan üreticilerden anket yoluyla derlenen veriler çalışmanın birincil kaynağıdır. Anket uygulaması Aralık 2018-Mart 2019 döneminde gerçekleştirilmiştir. Bu kapsamda kooperatife ortak olan 40, ortak olmayan 40 üretici olmak üzere toplam 80 işletmede üreticilere anket uygulanmıştır. Anket uygulaması ile elde edilen veriler SPSS paket programı kullanılarak değerlendirilmiş ve elde edilen sonuçlar çizelgelerde özetlenmiştir. Araştırmanın ikincil kaynakları ise ulusal ve uluslararası alanda yapılmış benzer çalışmalar ile konuyla ilgili kurum ve kuruluşlardır.

Bulgular ve Tartışma

Sosyo-Ekonomik Özellikler

Araştırmada incelenen işletmelerde cinsiyet, yaş, eğitim, deneyim süresi gibi özellikler incelenmiş ve elde edilen veriler Çizelge 1'de verilmiştir. İncelenen işletmelerde toplam nüfus 309 olup, bu nüfusun %50,81'ini erkek, %49,19'unu kadın bireyler oluşturmaktadır. Araştırma kapsamında anket uygulanan üreticilerin %98,75'inin erkek, %1,25'inin kadın olduğu belirlenmiştir. Anket uygulanan üreticilerin %47,5'i 15-49 yaş aralığında, %52,5'i 50 ve üzeri yaş aralığındadır. Kooperatife ortak olan üreticilerin %57,5'i, kooperatife ortak olmayan üreticilerin ise %47,5'i 50 yaş ve üzeri gruptadır. Kooperatife ortak olan üreticilerin %50'si ilkokul, kooperatife ortak olmayan üreticilerin ise %57,5'i ilkokul mezunudur. İncelenen işletmelerde üreticilerin ortalama deneyim süresi 27 yıl olup bu değer kooperatife ortak olan üreticiler için 30 yıl, kooperatife ortak olmayan üreticiler için 24 yıldır.

Araştırma kapsamındaki işletmelerde aile nüfusunun %64,72'si kendi işletmesinde tarımsal işlerde çalışmaktadır. Kooperatife ortak olan işletmelerde aile nüfusunun %68,97'sinin, kooperatife ortak olmayan işletmelerde ise %60,98'inin işletmede çalıştığı belirlenmiştir. İşletmeler genel olarak değerlendirildiğinde aile nüfusunun %5,5'i, kooperatife ortak olan işletmelerde %4,14'ü, kooperatife ortak olmayan işletmelerde ise nüfusun %6,71'i işletme dışında tarımsal işlerde çalışmaktadır. Araştırmada anket uygulanan üreticilerin %10'u işletme dışında tarımsal işlerde çalışırken, bu oran kooperatife ortak olan üreticiler için %7,5, kooperatife ortak olmayan üreticiler için ise %12,5'dir. Araştırmada işletmeler genel olarak değerlendirildiğinde üreticilerin %36,25'inin tarım dışı işlerde çalıştığı belirlenmiştir. Kooperatife ortak olan üreticilerin %32,5'i, kooperatife ortak olmayan üreticilerin ise %40'ı tarım dışı işlerde çalışmaktadır (Çizelge 2).

Çizelge 1. İncelenen İşletmelerde Demografik Özellikler

	Ortak Olan		Ortak Olmayan		Genel	
	Kişi	%	Kişi	%	Kişi	%
Aile Nüfusunun Cinsiyete Göre Dağılımı						
Erkek	69	47,59	88	53,66	157	50,81
Kadın	76	52,41	76	46,34	152	49,19
Toplam	145	100,00	164	100,00	309	100,00
Üreticilerin Cinsiyete Göre Dağılımı						
Erkek	39	97,50	40	100,00	79	98,75
Kadın	1	2,50	0	0	1	1,25
Toplam	40	100,00	40	100,00	80	100,00
Aile Nüfusunun Yaş Gruplarına Göre Dağılımı						
0 - 6	7	4,83	5	3,05	12	3,88
7 - 14	12	8,28	24	14,63	36	11,65
15 - 49	82	56,55	101	61,59	183	59,22
50 +	44	30,34	34	20,73	78	25,24
Toplam	145	100,00	164	100,00	309	100,00
Üreticilerin Yaş Gruplarına Göre Dağılımı						
15 - 49	17	42,50	21	52,50	38	47,50
50 +	23	57,50	19	47,50	42	52,50
Toplam	40	100,00	40	100,00	80	100,00
Ortalama Yaş	49,25		46,98		48,11	
Aile Nüfusunun Eğitim Durumu						
Okur Yazar Değil	8	5,52	5	3,05	13	4,21
Okur Yazar	6	4,14	6	3,66	12	3,88
İlkokul Mezunu	56	38,62	64	39,02	120	38,83
Ortaokul Mezunu	18	12,41	37	22,56	55	17,80
Lise Mezunu	32	22,07	23	14,02	55	17,80
Üniversite Mezunu	25	17,24	29	17,68	54	17,48
Toplam	145	100,00	164	100,00	309	100,00
Üreticilerin Eğitim Durumu						
İlkokul Mezunu	20	50,00	23	57,50	43	53,75
Ortaokul Mezunu	8	20,00	7	17,50	15	18,75
Lise Mezunu	7	17,50	6	15,00	13	16,25
Üniversite Mezunu	5	12,50	4	10,00	9	11,25
Toplam	40	100,00	40	100,00	80	100,00
Üreticilerin Ortalama Deneyim Süresi						
Yıl		30		24		27

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Çizelge 2. İncelenen İşletmelerde Nüfusun Çalışma Durumu

	Ortak Olan		Ortak Olmayan		Genel	
	Kişi	%	Kişi	%	Kişi	%
Aile Nüfusunun İşletmede Çalışma Durumu						
Evet	100	68,97	100	60,98	200	64,72
Hayır	45	31,03	64	39,02	109	35,28
Toplam	145	100,00	164	100,00	309	100,00
Aile Nüfusunun İşletme Dışı Tarımsal İşlerde Çalışma Durumu						
Evet	6	4,14	11	6,71	17	5,50
Hayır	139	95,86	153	93,29	292	94,50
Toplam	145	100,00	164	100,00	309	100,00
Üreticilerin İşletme Dışı Tarımsal İşlerde Çalışma Durumu						
Evet	3	7,50	5	12,50	8	10,00
Hayır	37	92,50	35	87,50	72	90,00
Toplam	40	100,00	40	100,00	80	100,00
Aile Nüfusunun Tarım Dışı İşlerde Çalışma Durumu						
Evet	27	18,62	43	26,22	70	22,65
Hayır	118	81,38	121	73,78	239	77,35
Toplam	145	100,00	164	100,00	309	100,00
Üreticilerin Tarım Dışı İşlerde Çalışma Durumu						
Evet	13	32,50	16	40,00	29	36,25
Hayır	27	67,50	24	60,00	51	63,75
Toplam	40	100,00	40	100,00	80	100,00

Risk Kaynakları

Araştırma kapsamında incelenen işletmelerde risk kaynakları *üretim riski*, *finansman riski*, *pazarlama ve fiyat riski*, *kişisel risk*, *politik ve yasal risk* olmak üzere 5 başlık altında ele alınmıştır. Araştırmada kooperatife ortak olan işletmelerde en önemli görülen üretim riski kaynakları bitki hastalıklarından dolayı verim düşüklüğü (1,48) ve bitki zararlılarından dolayı verim düşüklüğüdür (1,50). Yangın nedeniyle ürünün zarar görmesi (3,13) ve toprak kayması (3,10) ise kooperatife ortak olan üreticiler tarafından nötr olarak değerlendirilmiştir. Kooperatife ortak olmayan işletmelerde ise ürün verimlerindeki değişiklikler (1,53) daha önemli görülen üretim riski kaynağıdır. Bunu bitki zararlılarından dolayı verim düşüklüğü (1,55) ve bitki hastalıklarından dolayı verim düşüklüğü (1,58) izlemektedir. Yangın nedeniyle ürünün zarar görmesi (3,48) ve hırsızlık (3,23) ise kooperatife ortak olmayan üreticiler tarafından nötr olarak ifade edilmiştir (Çizelge 3).

Araştırma kapsamında incelenen işletmelerde her iki grup için de önemli görülen finansman riski kaynakları girdi maliyetlerindeki değişiklikler ve enflasyondur. Bunun yanı sıra kooperatife ortak olan üreticiler borçluluk durumu (2,08), borç yapısı (2,08) ve faiz oranlarındaki değişiklikleri (2,10) de önemli olarak değerlendirirken, kooperatife ortak olmayan üreticiler finansman yetersizliğini (2,48) önemli, borçluluk durumu (2,53) ve borç yapısını (2,58) nötr olarak değerlendirmişlerdir (Çizelge 4).

İncelenen işletmelerde kooperatife ortak olan üreticilerin önemli gördükleri pazarlama ve fiyat riski kaynakları ürünlerin fiyatlarındaki değişiklikler (1,50) ve ürünlerin pazar garantisinin olmamasıdır (1,85). Üreticiler sözleşmeli üretimin olmamasını (3,88), soğuk hava deposu yetersizliğini (3,83) ve paketlemede karşılaşılan sorunları (3,83) önemli değil olarak değerlendirmişlerdir. Kooperatife ortak olmayan işletmelerde ise en önemli görülen pazarlama ve fiyat riski kaynağı ürünlerin fiyatlarındaki değişikliklerdir (1,38). Üreticiler ürünlerin pazar garantisinin olmamasını önemli olarak görürken, sözleşmeli üretimin olmamasını (3,35) ve soğuk hava deposu yetersizliğini (3,78) önemli değil olarak belirtmişlerdir (Çizelge 5).

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Çizelge 3. İncelenen İşletmelerde Üretim Riski Kaynakları

Üretim Riski Kaynakları	Ort.	Std. Sapma	Ölçek (%)					
			1	2	3	4	5	Toplam
Kooperatife Ortak Olan İşletmeler (N=40)								
Bitki hastalıklarından dolayı verim düşüklüğü	1,48	0,60	57,50	37,50	5,00	-	-	100,00
Bitki zararlılarından dolayı verim düşüklüğü	1,50	0,60	55,00	40,00	5,00	-	-	100,00
Ürün verimlerindeki değişiklikler	1,63	0,54	40,00	57,50	2,50	-	-	100,00
İklim koşullarında meydana gelen değişiklikler	1,75	0,59	30,00	67,50	-	2,50	-	100,00
Don olayı	1,78	0,95	47,50	35,00	12,50	2,50	2,50	100,00
Yağışın gereğinden fazla olması	1,93	0,66	22,50	65,00	10,00	2,50	-	100,00
Yağışın yetersiz olması	1,95	0,71	22,50	65,00	7,50	5,00	-	100,00
Pazara uygun çeşit ve kalitede ürün yetiştirememe	2,13	1,04	25,00	55,00	7,50	7,50	5,00	100,00
Üretim yöntemi ile ilgili bilgi eksikliği	2,15	0,83	17,50	60,00	12,50	10,00	-	100,00
Sel nedeniyle ürünün zarar görmesi	2,25	1,28	37,50	27,50	12,50	17,50	5,00	100,00
Hasat sırasında meydana gelen ürün kayıpları	2,35	1,17	20,00	52,50	7,50	12,50	7,50	100,00
Üretim planlamasının olması	2,35	0,86	7,50	65,00	15,00	10,00	2,50	100,00
İşletme kayıtlarının tutulmaması	2,38	1,15	20,00	47,50	15,00	10,00	7,50	100,00
Analiz laboratuvarlarının yetersizliği	2,40	1,15	20,00	45,00	17,50	10,00	7,50	100,00
Tarımsal alet ve makinelerin yetersizliği	2,58	1,01	2,50	65,00	12,50	12,50	7,50	100,00
İşletme ölçeğinin küçük olması	2,60	0,98	10,00	42,50	27,50	17,50	2,50	100,00
Hırsızlık	2,85	1,08	5,00	37,50	37,50	7,50	12,50	100,00
Toprak kayması	3,10	0,87	2,50	17,50	55,00	17,50	7,50	100,00
Yangın nedeniyle ürünün zarar görmesi	3,13	0,88	2,50	17,50	52,50	20,00	7,50	100,00
Kooperatife Ortak Olmayan İşletmeler (N=40)								
Ürün verimlerindeki değişiklikler	1,53	0,55	50,00	47,50	2,50	-	-	100,00
Bitki zararlılarından dolayı verim düşüklüğü	1,55	0,60	50,00	45,00	5,00	-	-	100,00
Bitki hastalıklarından dolayı verim düşüklüğü	1,58	0,64	50,00	42,50	7,50	-	-	100,00
Pazara uygun çeşit ve kalitede ürün yetiştirememe	1,68	0,62	40,00	52,50	7,50	-	-	100,00
Don olayı	1,90	0,96	40,00	40,00	10,00	10,00	-	100,00
İklim koşullarında meydana gelen değişiklikler	1,95	0,71	25,00	57,50	15,00	2,50	-	100,00
Yağışın gereğinden fazla olması	2,10	0,96	25,00	52,50	12,50	7,50	2,50	100,00
Yağışın yetersiz olması	2,28	1,04	20,00	50,00	17,50	7,50	5,00	100,00
Sel nedeniyle ürünün zarar görmesi	2,63	1,21	20,00	27,50	32,50	10,00	10,00	100,00
Üretim planlamasının olması	2,65	0,86	2,50	50,00	30,00	15,00	2,50	100,00
Üretim yöntemi ile ilgili bilgi eksikliği	2,75	0,93	2,50	47,50	25,00	22,50	2,50	100,00
Hasat sırasında meydana gelen ürün kayıpları	2,83	0,90	5,00	35,00	32,50	27,50	-	100,00
Analiz laboratuvarlarının yetersizliği	2,98	1,07	7,50	27,50	32,50	25,00	7,50	100,00
İşletme kayıtlarının tutulmaması	3,00	1,28	12,50	27,50	22,50	22,50	15,00	100,00
Tarımsal alet ve makinelerin yetersizliği	3,03	1,03	2,50	37,50	20,00	35,00	5,00	100,00
Toprak kayması	3,03	0,89	2,50	22,50	52,50	15,00	7,50	100,00
İşletme ölçeğinin küçük olması	3,05	1,01	2,50	32,50	30,00	27,50	7,50	100,00
Hırsızlık	3,23	1,12	5,00	25,00	25,00	32,50	12,50	100,00
Yangın nedeniyle ürünün zarar görmesi	3,48	1,01	2,50	10,00	45,00	22,50	20,00	100,00

Ölçek*: 1: Çok Önemli, 2: Önemli, 3: Nötr, 4: Önemli Değil, 5: Hiç Önemli Değil

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Çizelge 4. İncelenen İşletmelerde Finansman Riski Kaynakları

Finansman Riski Kaynakları	Ort.	Std. Sapma	Ölçek (%)					
			1	2	3	4	5	Toplam
Kooperatife Ortak Olan İşletmeler (N=40)								
Girdi maliyetlerindeki değişiklikler	1,48	0,60	57,50	37,50	5,00	-	-	100,00
Enflasyon	2,03	1,03	32,50	45,00	15,00	2,50	5,00	100,00
Borçluluk durumu (Borç miktarı)	2,08	1,05	30,00	50,00	5,00	12,50	2,50	100,00
Borç yapısı (Vadesi, kaynağı)	2,08	1,05	30,00	50,00	5,00	12,50	2,50	100,00
Faiz oranlarındaki değişiklikler	2,10	1,08	30,00	47,50	10,00	7,50	5,00	100,00
Finansman yetersizliği	2,23	0,70	5,00	75,00	15,00	2,50	2,50	100,00
Öz sermayesiz finansman	2,35	0,80	5,00	67,50	17,50	7,50	2,50	100,00
İşletme sermayesindeki yetersizlik	2,35	0,83	7,50	62,50	20,00	7,50	2,50	100,00
Arazi fiyatlarındaki değişiklikler	2,53	1,11	17,50	40,00	17,50	22,50	2,50	100,00
Kredi kaynaklarının kapasitesi/ bulunabilirliği	2,60	1,08	5,00	60,00	15,00	10,00	10,00	100,00
Kooperatife Ortak Olmayan İşletmeler (N=40)								
Girdi maliyetlerindeki değişiklikler	1,48	0,68	60,00	35,00	2,50	2,50	-	100,00
Enflasyon	2,10	0,78	20,00	55,00	20,00	5,00	-	100,00
Finansman yetersizliği	2,48	0,96	7,50	60,00	12,50	17,50	2,50	100,00
Borçluluk durumu (Borç miktarı)	2,53	1,04	12,50	47,50	17,50	20,00	2,50	100,00
Borç yapısı (Vadesi, kaynağı)	2,58	0,98	7,50	52,50	17,50	20,00	2,50	100,00
Öz sermayesiz finansman	2,60	0,90	2,50	57,50	20,00	17,50	2,50	100,00
İşletme sermayesindeki yetersizlik	2,68	1,00	5,00	50,00	22,50	17,50	5,00	100,00
Faiz oranlarındaki değişiklikler	2,78	0,97	2,50	50,00	17,50	27,50	2,50	100,00
Kredi kaynaklarının kapasitesi/ bulunabilirliği	2,85	0,89	2,50	37,50	35,00	22,50	2,50	100,00
Arazi fiyatlarındaki değişiklikler	3,48	1,22	5,00	22,50	15,00	35,00	22,50	100,00

Ölçek*: 1: Çok Önemli, 2: Önemli, 3: Nötr, 4: Önemli Değil, 5: Hiç Önemli Değil

Çizelge 5. İncelenen İşletmelerde Pazarlama ve Fiyat Riski Kaynakları

Pazarlama ve Fiyat Riski Kaynakları	Ort.	Std. Sapma	Ölçek (%)					
			1	2	3	4	5	Toplam
Kooperatife Ortak Olan İşletmeler (N=40)								
Ürünlerin fiyatlarındaki değişiklikler	1,50	0,51	50,00	50,00	-	-	-	100,00
Ürünlerin pazar garantisinin olmaması	1,85	0,83	32,50	57,50	5,00	2,50	2,50	100,00
Pazarlama ve satış konusunda bilgi eksikliği	2,58	1,06	10,00	50,00	17,50	17,50	5,00	100,00
Toptancı halinde alt yapı eksikliğinin olması	2,63	1,15	7,50	57,50	10,00	15,00	10,00	100,00
Taşımada karşılaşılan sorunlar	3,08	1,27	5,00	40,00	17,50	17,50	20,00	100,00
Satış yerine uzaklık	3,10	1,26	5,00	40,00	12,50	25,00	17,50	100,00
Muhafazada karşılaşılan sorunlar	3,65	1,12	5,00	10,00	25,00	35,00	25,00	100,00
Paketlemede karşılaşılan sorunlar	3,83	1,03	2,50	5,00	32,50	27,50	32,50	100,00
Soğuk hava deposu yetersizliği	3,83	1,11	2,50	7,50	32,50	20,00	37,50	100,00
Sözleşmeli üretimin olmaması	3,88	1,28	10,00	7,50	5,00	40,00	37,50	100,00
Kooperatife Ortak Olmayan İşletmeler (N=40)								
Ürünlerin fiyatlarındaki değişiklikler	1,38	0,49	62,50	37,50	-	-	-	100,00
Ürünlerin pazar garantisinin olmaması	1,78	1,07	50,00	37,50	2,50	5,00	5,00	100,00
Toptancı halinde alt yapı eksikliğinin olması	2,55	0,93	5,00	57,50	17,50	17,50	2,50	100,00
Pazarlama ve satış konusunda bilgi eksikliği	2,93	1,05	5,00	37,50	22,50	30,00	5,00	100,00
Taşımada karşılaşılan sorunlar	2,95	0,99	-	42,50	27,50	22,50	7,50	100,00
Satış yerine uzaklık	3,13	1,14	5,00	32,50	17,50	35,00	10,00	100,00
Muhafazada karşılaşılan sorunlar	3,45	0,88	-	12,50	42,50	32,50	12,50	100,00
Paketlemede karşılaşılan sorunlar	3,58	0,96	2,50	7,50	37,50	35,00	17,50	100,00
Soğuk hava deposu yetersizliği	3,78	0,83	-	2,50	40,00	35,00	22,50	100,00
Sözleşmeli üretimin olmaması	4,35	0,89	-	7,50	5,00	32,50	55,00	100,00

Ölçek*: 1: Çok Önemli, 2: Önemli, 3: Nötr, 4: Önemli Değil, 5: Hiç Önemli Değil

Araştırma kapsamında kooperatife ortak olan işletmelerde işletme sahibinin veya işçinin sağlık/sakatlık/ölüm durumu (2,13), yabancı işgücü bulmada karşılaşılan güçlükler (2,23) ve işletmede meydana gelen iş kazaları (2,28) önemli görülen kişisel risk kaynakları iken, kooperatife ortak olmayan işletmelerde önemli görülen kişisel risk kaynakları işletme sahibinin veya işçinin sağlık/sakatlık/ölüm durumu (2,03) ve işletmede meydana gelen iş kazalarıdır (2,30). İşletmelerde aile işgücünün yetersizliği ve aile ilişkilerindeki sorunlar/anlaşmazlıklar ise her iki grup için de nötr olarak değerlendirilmiştir (Çizelge 6).

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Araştırma kapsamında politik ve yasal risk kaynakları değerlendirilmiştir. Her iki grupta da ülkenin ekonomik durumundaki değişimler ve hükümetin uyguladığı politikalardaki değişiklikler (genel ve tarım) önemli olarak değerlendirilen risk kaynaklarıdır. Kooperatife ortak olan üreticiler tüm politik ve yasal risk kaynaklarını önemli görürken, kooperatife ortak olmayan üreticiler ise üretici örgütlenmesindeki yetersizlikler (2,63) ve hükümet desteğinin olmaması/yetersiz olmasını (2,50) nötr olarak ifade etmişlerdir (Çizelge 7).

Araştırma kapsamında incelenen işletmelerde risk yönetimi stratejileri; üretim riski yönetimi stratejileri, finansman riski yönetimi stratejileri ve pazarlama ve fiyat riski yönetimi stratejileri olmak üzere 3 başlık altında ele alınmıştır. Kooperatife ortak olan işletmelerdeki üreticiler üretim riski konusunda tarımsal girdilere yönelik desteklerin artırılması (1,73), hastalıklara karşı ilaçla mücadele yapma (1,80) ve kooperatife ortak olma (1,90) stratejilerini önemli olarak değerlendirirken, işletme arazisini küçültme stratejisini (4,10) önemsiz, sera sigortası yaptırma (3,38) ve işletmede çeşitlendirme yapmak (3,33) stratejilerini ise nötr olarak değerlendirmişlerdir. Kooperatife ortak olmayan işletmelerde ise hastalıklara karşı ilaçla mücadele yapmak (1,53) ve tarımsal girdilere yönelik desteklerin artırılması (1,93) üreticiler tarafından önemli görülen üretim riski yönetimi stratejileridir. Üreticiler işletme arazisini küçültmek (3,90) ve kooperatife ortak olmak (3,88) stratejilerini ise önemsiz olarak ifade etmişlerdir (Çizelge 8).

Çizelge 6. İncelenen İşletmelerde Kişisel Risk Kaynakları

Kişisel Risk Kaynakları	Ort.	Std. Sapma	Ölçek (%)					
			1	2	3	4	5	Toplam
Kooperatife Ortak Olan İşletmeler (N=40)								
İşletme sahibinin veya işçinin sağlık/sakatlık/ölüm durumu	2,13	0,79	15,00	65,00	15,00	2,50	2,50	100,00
Yabancı işgücü bulmada karşılaşılan güçlükler	2,23	1,14	27,50	45,00	10,00	12,50	5,00	100,00
İşletmede meydana gelen iş kazaları	2,28	0,91	7,50	72,50	12,50	-	7,50	100,00
İşletmecilerin teknik bilgi eksikliği	2,35	1,05	15,00	57,50	10,00	12,50	5,00	100,00
İş bölümünün olmaması	2,50	0,96	7,50	55,00	22,50	10,00	5,00	100,00
Aile ilişkilerindeki sorunlar/anlaşmazlıklar	2,63	0,87	2,50	52,50	27,50	15,00	2,50	100,00
Aile işgücünün yetersizliği	2,73	1,11	7,50	50,00	10,00	27,50	5,00	100,00
Kooperatife Ortak Olmayan İşletmeler (N=40)								
İşletme sahibinin veya işçinin sağlık/sakatlık/ölüm durumu	2,05	0,71	17,50	65,00	12,50	5,00	-	100,00
İşletmede meydana gelen iş kazaları	2,30	0,94	15,00	52,50	25,00	2,50	5,00	100,00
İşletmecilerin teknik bilgi eksikliği	2,53	0,96	5,00	60,00	17,50	12,50	5,00	100,00
Yabancı işgücü bulmada karşılaşılan güçlükler	2,70	1,22	12,50	42,50	20,00	12,50	12,50	100,00
İş bölümünün olmaması	2,80	1,04	7,50	37,50	27,50	22,50	5,00	100,00
Aile ilişkilerindeki sorunlar/anlaşmazlıklar	3,08	1,00	5,00	25,00	32,50	32,50	5,00	100,00
Aile işgücünün yetersizliği	3,13	1,11	-	47,50	-	45,00	7,50	100,00

Ölçek*: 1: Çok Önemli, 2: Önemli, 3: Nötr, 4: Önemli Değil, 5: Hiç Önemli Değil

Çizelge 7. İncelenen İşletmelerde Politik ve Yasal Risk Kaynakları

Politik ve Yasal Risk Kaynakları	Ort.	Std. Sapma	Ölçek (%)					
			1	2	3	4	5	Toplam
Kooperatife Ortak Olan İşletmeler (N=40)								
Ülkenin ekonomik durumundaki değişimler	1,65	0,53	37,50	60,00	2,50	-	-	100,00
Hükümetin uyguladığı politikalardaki değişiklikler (Genel ve Tarım)	1,80	0,79	35,00	55,00	7,50	-	2,50	100,00
Üretici örgütlenmesindeki yetersizlikler	2,20	0,97	22,50	47,50	20,00	7,50	2,50	100,00
Hükümet desteğinin olmaması/yetersiz olması	2,23	0,80	12,50	60,00	22,50	2,50	2,50	100,00
Kooperatife Ortak Olmayan İşletmeler (N=40)								
Ülkenin ekonomik durumundaki değişimler	1,78	0,53	27,50	67,50	5,00	-	-	100,00
Hükümetin uyguladığı politikalardaki değişiklikler (Genel ve Tarım)	1,90	0,67	27,50	55,00	17,50	-	-	100,00
Hükümet desteğinin olmaması/yetersiz olması	2,50	0,91	10,00	45,00	32,50	10,00	2,50	100,00
Üretici örgütlenmesindeki yetersizlikler	2,63	1,00	12,50	35,00	32,50	17,50	2,50	100,00

Ölçek*: 1: Çok Önemli, 2: Önemli, 3: Nötr, 4: Önemli Değil, 5: Hiç Önemli Değil

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Risk Yönetimi Stratejileri

Araştırma kapsamında kooperatife ortak olan işletmelerde önemli görülen finansman riski kaynakları harcamaları planlamak (1,50), mevcut kaynakların aşırı kullanımını düzenlemek (1,50) ve tasarruf yapmaktır (1,60). Üreticiler ailenin yaşam standardını düşürmek ve sermaye varlıklarını satmak (4,23) stratejilerini önemsiz olarak ifade etmişlerdir. Kooperatife ortak olmayan işletmelerde ise mümkün olduğunca en düşük maliyetle üretim yapmak (1,43) en önemli görülen finansman riski yönetimi stratejisi iken, harcamaları planlamak (1,58) ve tasarruf yapmak (1,60) önemli, sermaye varlıklarını satmak (4,35) ve ailenin yaşam standardını düşürmek (4,28) üreticiler tarafından önemsiz olarak görülen stratejilerdir (Çizelge 9).

Araştırmadaki işletmelerde hem kooperatife ortak olan hem de kooperatife ortak olmayan üreticiler için önemli görülen pazarlama ve fiyat riski kaynakları geçmiş dönem ürün fiyatları hakkında bilgi sahibi olmak, ürünün satılacağı pazar hakkında bilgi sahibi olmak ve taşıma/ulaşım olanaklarını iyileştirmektir. Her iki grup da sözleşmeli üretim yapmak stratejisini önemsiz olarak değerlendirmiştir (Çizelge 10).

Çizelge 8. İncelenen İşletmelerde Üretim Riski Yönetimi Stratejileri

Üretim Riski Yönetimi Stratejileri	Ort.	Std. Sapma	Ölçek (%)					
			1	2	3	4	5	Toplam
Kooperatife Ortak Olan İşletmeler (N=40)								
Tarımsal girdilere yönelik desteklerin artırılması	1,73	0,55	32,50	62,50	5,00	-	-	100,00
Hastalıklara karşı ilaçla mücadele yapmak	1,80	0,52	25,00	70,00	5,00	-	-	100,00
Kooperatife ortak olmak	1,90	0,74	22,50	72,50	-	2,50	2,50	100,00
İşletme kayıtlarını düzenli olarak tutmak	2,25	1,19	30,00	40,00	10,00	15,00	5,00	100,00
Tarım danışmanıyla çalışmak	2,48	1,15	12,50	57,50	10,00	10,00	10,00	100,00
Arazi toplulaştırması yapmak	2,50	0,93	7,50	55,00	20,00	15,00	2,50	100,00
İşletme arazisini büyütmek	2,55	0,96	7,50	52,50	20,00	17,50	2,50	100,00
Bölgesel üretim planlaması yapmak	2,55	0,93	5,00	55,00	25,00	10,00	5,00	100,00
Ürün sigortası yaptırmak	3,03	1,14	7,50	32,50	17,50	35,00	7,50	100,00
İşletmede farklılaştırma yapmak (Birden çok ürüne yer vermek)	3,20	1,34	10,00	32,50	2,50	37,50	17,50	100,00
İşletmede çeşitlendirme yapmak (Birden çok çeşide yer vermek)	3,33	1,27	7,50	27,50	7,50	40,00	17,50	100,00
Sera sigortası yaptırmak	3,38	1,17	5,00	25,00	12,50	42,50	15,00	100,00
İşletme arazisini küçültmek	4,10	0,78	-	-	25,00	40,00	35,00	100,00
Kooperatife Ortak Olmayan İşletmeler (N=40)								
Hastalıklara karşı ilaçla mücadele yapmak	1,53	0,51	47,50	52,50	-	-	-	100,00
Tarımsal girdilere yönelik desteklerin artırılması	1,93	0,83	30,00	52,50	15,00	-	2,50	100,00
İşletme arazisini büyütmek	2,78	1,21	10,00	42,50	20,00	15,00	12,50	100,00
Arazi toplulaştırması yapmak	2,78	1,19	20,00	17,50	32,50	25,00	5,00	100,00
İşletme kayıtlarını düzenli olarak tutmak	2,80	1,45	30,00	15,00	10,00	35,00	10,00	100,00
Bölgesel üretim planlaması yapmak	2,90	1,13	7,50	35,00	27,50	20,00	10,00	100,00
Sera sigortası yaptırmak	2,95	1,47	27,50	12,50	10,00	37,50	12,50	100,00
Ürün sigortası yaptırmak	3,08	1,27	17,50	15,00	17,50	42,50	7,50	100,00
İşletmede çeşitlendirme yapmak (Birden çok çeşide yer vermek)	3,15	1,17	-	42,50	17,50	22,50	17,50	100,00
Tarım danışmanıyla çalışmak	3,20	1,38	7,50	35,00	15,00	15,00	27,50	100,00
İşletmede farklılaştırma yapmak (Birden çok ürüne yer vermek)	3,28	1,24	5,00	32,50	10,00	35,00	17,50	100,00
Kooperatife üye olmak	3,88	0,82	2,50	-	25,00	52,50	20,00	100,00
İşletme arazisini küçültmek	3,90	0,87	-	5,00	27,50	40,00	27,50	100,00

Ölçek*: 1: Çok Önemli, 2: Önemli, 3: Nötr, 4: Önemli Değil, 5: Hiç Önemli Değil

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Çizelge 9. İncelenen İşletmelerde Finansman Riski Yönetimi Stratejileri

Finansman Riski Yönetimi Stratejileri	Ort.	Std. Sapma	Ölçek (%)					
			1	2	3	4	5	Toplam
Kooperatife Ortak Olan İşletmeler (N=40)								
Harcamaları planlamak	1,50	0,64	57,50	35,00	7,50	-	-	100,00
Mevcut kaynakların aşırı kullanımını düzenlemek	1,50	0,60	55,00	40,00	5,00	-	-	100,00
Tasarruf yapmak	1,60	0,59	45,00	50,00	5,00	-	-	100,00
Mümkün olduğunca en düşük maliyetle üretim yapmak	1,68	0,83	47,50	42,50	7,50	-	2,50	100,00
Ödeme gücünü arttırmak	1,93	0,80	27,50	57,50	12,50	-	2,50	100,00
Borçlanmayı azaltmak	2,05	0,78	17,50	67,50	10,00	2,50	2,50	100,00
Sermaye kaynaklarını bulmak	2,23	0,70	7,50	67,50	22,50	-	2,50	100,00
Finansal analizler yapmak	2,30	0,82	5,00	72,50	15,00	2,50	5,00	100,00
İşletme dışı yatırım yapmak	2,83	1,32	10,00	47,50	10,00	15,00	17,50	100,00
Aile bireylerinin işletme dışında çalışması	3,25	1,26	10,00	25,00	7,50	45,00	12,50	100,00
Borç yönetiminin uzman kişilerce (Muhasebeci, Ziraat Müh. vb.) yapılması	3,33	1,05	2,50	22,50	27,50	35,00	12,50	100,00
İşletme sahibinin işletme dışında çalışması	3,38	1,27	5,00	32,50	2,50	40,00	20,00	100,00
Sermaye varlıklarını satmak	4,23	0,80	-	2,50	15,00	40,00	42,50	100,00
Ailenin yaşam standardını düşürmek	4,50	0,82	2,50	-	5,00	30,00	62,50	100,00
Kooperatife Ortak Olmayan İşletmeler (N=40)								
Mümkün olduğunca en düşük maliyetle üretim yapmak	1,43	0,55	60,00	37,50	2,50	-	-	100,00
Harcamaları planlamak	1,58	0,55	45,00	52,50	2,50	-	-	100,00
Tasarruf yapmak	1,60	0,50	40,00	60,00	-	-	-	100,00
Mevcut kaynakların aşırı kullanımını düzenlemek	1,65	0,58	40,00	55,00	5,00	-	-	100,00
Borçlanmayı azaltmak	1,88	0,79	32,50	52,50	10,00	5,00	-	100,00
Ödeme gücünü arttırmak	2,20	0,72	15,00	52,50	30,00	2,50	-	100,00
Sermaye kaynaklarını bulmak	2,40	0,63	-	65,00	32,50	-	2,50	100,00
Finansal analizler yapmak	2,55	0,90	2,50	60,00	22,50	10,00	5,00	100,00
Aile bireylerinin işletme dışında çalışması	3,10	1,08	-	40,00	22,50	25,00	12,50	100,00
İşletme dışı yatırım yapmak	3,25	1,28	7,50	27,50	17,50	27,50	20,00	100,00
İşletme sahibinin işletme dışında çalışması	3,33	1,37	-	47,50	5,00	15,00	32,50	100,00
Borç yönetiminin uzman kişilerce (Muhasebeci, Ziraat Müh. vb.) yapılması	3,60	1,03	2,50	12,50	27,50	37,50	20,00	100,00
Ailenin yaşam standardını düşürmek	4,28	0,88	2,50	2,50	5,00	45,00	45,00	100,00
Sermaye varlıklarını satmak	4,35	0,89	-	5,00	12,50	25,00	57,50	100,00

Ölçek*: 1: Çok Önemli, 2: Önemli, 3: Nötr, 4: Önemli Değil, 5: Hiç Önemli Değil

Çizelge 10. İncelenen İşletmelerde Pazarlama ve Fiyat Riski Yönetimi Stratejileri

Pazarlama ve Fiyat Riski Yönetimi Stratejileri	Ort.	Std. Sapma	Ölçek (%)					
			1	2	3	4	5	Toplam
Kooperatife Ortak Olan İşletmeler (N=40)								
Geçmiş dönem ürün fiyatları hakkında bilgi sahibi olmak	1,73	0,68	37,50	55,00	5,00	2,50	-	100,00
Ürünün satılacağı pazar hakkında bilgi sahibi olmak	2,00	0,91	25,00	62,50	2,50	7,50	2,50	100,00
Taşıma/ulaşım olanaklarını iyileştirmek	2,33	0,83	7,50	65,00	17,50	7,50	2,50	100,00
Ürün satışlarını zamana yaymak	2,55	0,93	10,00	40,00	40,00	5,00	5,00	100,00
Ürünü işleyerek satmak	3,18	1,24	7,50	22,50	37,50	10,00	22,50	100,00
Muhafaza olanaklarını iyileştirmek	3,33	1,25	7,50	20,00	27,50	22,50	22,50	100,00
Sözleşmeli üretim yapmak	4,13	0,99	2,50	7,50	5,00	45,00	40,00	100,00
Kooperatife Ortak Olmayan İşletmeler (N=40)								
Geçmiş dönem ürün fiyatları hakkında bilgi sahibi olmak	1,70	0,97	52,50	35,00	5,00	5,00	2,50	100,00
Ürünün satılacağı pazar hakkında bilgi sahibi olmak	2,03	0,70	15,00	75,00	2,50	7,50	-	100,00
Taşıma/ulaşım olanaklarını iyileştirmek	2,33	0,83	7,50	65,00	17,50	7,50	2,50	100,00
Muhafaza olanaklarını iyileştirmek	2,63	0,84	5,00	42,50	40,00	10,00	2,50	100,00
Ürün satışlarını zamana yaymak	2,68	0,94	7,50	37,50	40,00	10,00	5,00	100,00
Ürünü işleyerek satmak	3,55	1,32	5,00	22,50	20,00	17,50	35,00	100,00
Sözleşmeli üretim yapmak	4,48	0,68	-	-	10,00	32,50	57,50	100,00

Ölçek*: 1: Çok Önemli, 2: Önemli, 3: Nötr, 4: Önemli Değil, 5: Hiç Önemli Değil

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Sonuç

Toplumun bütün kesimlerini yakından ilgilendiren tarım sektörü üretimden pazarlamaya kadar olan süreçte birçok risk faktörünün etkisi altındadır. Başlıca risk faktörleri; üretim, pazarlama, finansman, teknoloji, politika ve iklim koşulları olarak sıralanabilmektedir. Söz konusu faktörler tarımda gelir dalgalanmalarına neden olmaktadır. Çünkü risk ve belirsizlik unsurlarının etkisiyle verim ve fiyatlarda büyük bir dalgalanma meydana gelmekte, bu da tarımsal gelirde yıldan yıla önemli farklılıklar yaşanmasına neden olmaktadır *(Akçaöz ve Akdemir, 2001)*. Tarımsal üretimde meydana gelen risklerin tamamen ortadan kaldırılması mümkün olmasa da azaltılması gerekmektedir. Ancak riskler karşısında uygulanan çeşitli stratejilerle; ortaya çıkacak problemler transfer edilebilir, kontrol altına alınabilir veya etkisi azaltılabilir. Tarımsal üretimde karşılaşılan problemlerin çözümünde de tarımsal kooperatiflerin rolü önemlidir. Bu çalışmada, Antalya ilinde tarımsal amaçlı kooperatife ortak olan ve ortak olmayan üreticilerin üretim sürecinde karşılaştıkları riskler ve bu risklere karşı uyguladıkları risk yönetimi stratejilerinin belirlenmesi amaçlanmıştır. Bu kapsamda, Antalya ilinin ilçelerine ait köylerde tarımsal amaçlı kooperatife ortak olan 40, ortak olmayan 40 üretici olmak üzere toplam 80 işletmede üreticilere anket uygulanmıştır. Çalışmada, öncelikle üreticilerin sosyo-ekonomik özellikleri incelenmiş, daha sonra tarımsal üretimde karşılaştıkları risk kaynakları ve uyguladıkları risk yönetimi stratejileri ortaya konulmuştur. Üreticilere göre risk kaynakları ve stratejileri beşli likert ölçeği ile değerlendirilmiştir.

Araştırmadan elde edilen sonuçlara göre; işletmelerde üreticilerin %52,5'inin 50 yaş ve üzerinde olduğu, ortalama deneyim sürelerinin 27 yıl olduğu belirlenmiştir. Araştırmada kooperatife ortak olan işletmelerde en önemli görülen risk kaynakları; bitki hastalıklarından dolayı verim düşüklüğü, girdi maliyetlerindeki değişiklikler, ürünlerin fiyatlarındaki değişiklikler, ülkenin ekonomik durumundaki değişimler ve işletme sahibinin veya işçinin sağlık/sakatlık/ölüm durumu olarak belirlenmiştir. Kooperatife ortak olan üreticilerin bu risklere karşı uyguladıkları risk yönetimi stratejileri ise harcamaları planlamak, tarımsal girdilere yönelik desteklerin artırılması ve geçmiş dönem ürün fiyatları hakkında bilgi sahibi olmak şeklinde ifade edilmiştir. Kooperatife ortak olmayan üreticilerin karşılaştıkları en önemli risk faktörleri ise ürünlerin fiyatlarındaki değişiklikler, girdi maliyetlerindeki değişiklikler, ürün verimlerindeki değişiklikler, ülkenin ekonomik durumundaki değişimler ve işletme sahibinin veya işçinin sağlık/sakatlık/ölüm durumudur. Kooperatife ortak olmayan üreticiler karşılaştıkları bu risklere karşı mümkün olduğunca en düşük maliyetle üretim yapmak, hastalıklara karşı ilaçla mücadele yapmak ve geçmiş dönem ürün fiyatları hakkında bilgi sahibi olmak stratejilerini uyguladıklarını ifade etmişlerdir.

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The Role of Olive Producers in Quality Olive Oil Production

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Abstract

Olive oil production is of great importance in terms of health, nutrition, economy, culture and environment. Olive oil is affected by most of the production stages starting from the decision of olive production, harvesting of olives and storage of olives as olive oil after pressing. In this respect, quality olive production and harvesting is an important issue for the production of quality extra virgin olive oil. However, problems encountered at many stages from harvest to the final product negatively affect this process. Turkey is among the most important producer countries in the world in terms of olive trees, table olives and olive oil production. However, unfortunately, it is desired to emphasise production quantity instead of quality among olive producers. Therefore, the main objective of this study is to investigate the production conditions required in olive production for a quality olive oil production. These conditions focus on various stages such as growing conditions of olive trees, harvesting process, olive processing techniques, oil extraction methods, storage conditions and final product quality. On the other hand, it is also important to raise awareness of producers for the sustainability of quality in olive oil production. In this study, national and international sources investigating quality criteria in olive oil production were utilised and it is estimated that the results obtained will benefit producers, consumers and industrialists for quality olive oil production.

Key Words: *Olive oil, olive oil production, production conditions, harvesting process, olive oil quality*

Kaliteli Zeytinyağı Üretiminde Zeytin Üreticilerinin Rolü

Özet

Zeytinyağı üretimi, sağlık, beslenme, ekonomi, kültür ve çevre açısından büyük bir öneme sahiptir. Zeytinyağı; zeytin üretim kararından başlayıp zeytinlerin hasadından, sıkım sonrası zeytinyağı olarak depolanmasına kadar uzanan üretim safhalarının çoğundan etkilenmektedir. Bu açıdan kaliteli natürel zeytinyağı üretimi için kaliteli zeytin üretimi ve hasadı önem taşıyan bir konudur. Ancak, hasattan nihai ürüne kadar pek çok aşamada karşılaşılan sorunlar bu süreci olumsuz etkilemektedir. Türkiye, zeytin ağaç varlığı, sofralık zeytin ve zeytinyağı üretiminde dünyanın en önemli üretici ülkeleri arasındadır. Ancak maalesef zeytin üreticileri arasında kalite yerine üretim miktarının öne çıkarılması istenilmektedir. Bu nedenle bu çalışmanın temel amacı, kaliteli bir zeytinyağı üretimi için zeytin üretiminde gerekli olan üretim koşullarının araştırılmasıdır. Bu koşullar, zeytin ağaçlarının yetiştirilme şartları, hasat süreci, zeytin işleme teknikleri, yağ elde etme yöntemleri, depolama koşulları ve son ürün kalitesi gibi çeşitli aşamalara odaklanmaktadır. Diğer yandan zeytinyağı üretiminde kalitenin sürdürülebilirliği için üreticilerin bilinçlendirilmesi de önem taşımaktadır. Çalışmada zeytinyağı üretiminde kalite kriterlerini araştıran ulusal ve uluslararası kaynaklardan yararlanmış olup elde edilen sonuçların kaliteli zeytinyağı üretimi için üretici, tüketici ve sanayicilere fayda sağlayacağı tahmin edilmektedir.

Anahtar Kelimeler: *Zeytinyağı, zeytinyağı üretimi, üretim koşulları, hasat süreci, zeytinyağı kalitesi*

Giriş

Tarih boyunca Akdeniz Havzası'nda sürdürülen geleneksel zeytin yetiştiriciliği, bugün dünya genelinde önemli bir endüstri haline gelmiştir. Uluslararası Zeytin Konseyi (IOC), 47'den fazla ülkede 11 milyon hektardan fazla zeytin ağacının bulunduğunu bildirmektedir (Anonim, 2023). Bu alanın çoğunluğu (%97,9), Akdeniz ülkelerinde bulunmaktadır. Ancak son yirmi yılda, Akdeniz dışında, özellikle Avustralya, Kuzey ve Güney Amerika gibi bölgelerde, yeni zeytin bahçelerinin tesis edildiği de bildirilmektedir (Rallo et al., 2018).

Zeytin meyvesi (Olea europaea), ekzokarp (dış kabuk), etli mezokarp (tüketilebilir kısım) ve taşlı endokarptan (çekirdek) oluşan bir sert çekirdekli meyve türüdür. Zeytin meyvesi, diğer sert çekirdekli meyvelerden, örneğin şeftali, kayısı, kiraz ve erik gibi meyvelerden farklıdır çünkü doğrudan tüketilemez. Bu durum, zeytin meyvesinin mezokarp tabakasında bulunan ve baskın fenolik bileşik olarak kabul edilen oleuropein adlı sekoiridoid glukozidinin varlığından kaynaklanır (Ünlüel ve Aydın, 2016). Oleuropein, zeytinin güçlü acı tadını oluşturan ana bileşiktir.

Zeytin meyvesinin diğer önemli özellikleri arasında düşük şeker içeriği bulunur. Genellikle %3,5 ila 6 arasında değişen şeker oranı, zeytinin doğrudan tüketilmesini engeller. Ayrıca, zeytin meyvesi olgunlaştıkça yüksek yağ içeriği birikir (Bodoira et al., 2015).
Ülkemizde, zeytin üretiminde yaygın bir eğilim, miktarın kalitenin önüne geçtiği bir yaklaşımı benimsemektir. Buna karşılık, özellikle son on yılda İtalya, İspanya ve Yunanistan gibi ülkelerde, kalitesi düşük olan çok miktarda üretim yerine, az miktarda ama yüksek kaliteli ürün üretimine odaklanan bir anlayış yükselmektedir (Koyuncu ve Cabaroğlu, 2020). Ancak bu yüksek kaliteli üretim anlayışı, Türkiye için daha yeni bir yaklaşım olup, ülkemizdeki üreticiler henüz bu konuda önder ülkelerle aynı seviyede değildirler.
Ülkemizde zeytinyağının pazarlanmasında, asitlik derecesi öncelikli bir kriter olarak kabul edilir. Bu bağlamda, genellikle marketlerde bulunan zeytinyağları, asitlik değerlerine göre "natürel sızma," "natürel birinci" ve "riviera" zeytinyağı gibi kalitelerine göre sınıflandırılır.
Zeytin meyvelerinin hasadından önceki süreçler, zeytinyağının hammaddesi olan "taze" zeytin meyvelerinin kalitesini doğrudan etkiler. Bu nedenle, zeytinyağının nihai kalitesi, çeşitlere, olgunlaşma aşamasına ve zeytin bahçelerinin yönetimine büyük ölçüde bağlıdır. Zeytin meyvelerinin hasadına kadar geçen süreçler, son ürün olan zeytinyağının lezzet, aroma ve kimyasal özellikleri üzerinde önemli bir etkiye sahiptir. Bu süreçler, zeytin meyvelerinin olgunlaşma fizyolojisi, genetik özellikleri, çevresel faktörler ve agronomik uygulamalar gibi bir dizi faktörü içerir. Zeytin hasadına kadar olan bu aşamaların titizlikle yönetilmesi, zeytinyağı kalitesinin yükseltilmesi ve optimize edilmesi için kritik bir öneme sahiptir. Bu çalışma, zeytin meyvesinin üretim kararından başlayıp hasadına kadar olan süreçlerin zeytinyağı kalitesi üzerindeki etkilerini ele almaktadır. Çalışmanın ülkemizdeki zeytinyağı kalitesinin arttırılması için yapılacak tarımsal yayım çalışmaları açısından faydalı olması amaçlanmıştır.

Bulgular ve Tartışma

Zeytin Çeşidinin Zeytinyağı Kalitesine Etkisi

Zeytin çeşitleri, zeytinyağı kalitesini etkileyen bir dizi önemli özellik taşır. Bu özellikler arasında periyodisite (meyve olgunluğunun düzenliliği), içerdikleri yağ miktarı ve kimyasal bileşim yer alır. Aşırı derecede periyodisite gösteren zeytin çeşitleri, elde edilen zeytinyağı miktarını doğrudan etkileyebilir. Bu da, meyvedeki yağ oranından ziyade zeytin ağacından toplanan meyve miktarını ve sonuç olarak elde edilecek toplam yağ miktarını etkiler. Bu nedenle, periyodisiteye karşı hassas olan zeytin çeşitlerinden elde edilen zeytinyağı miktarı, yıllar arasında dalgalanabilir ve bu durum ticari açıdan bir kayıp olarak değerlendirilebilir (Tuncer, 2019).
Coğrafi işaretleme amacıyla gerçekleştirilen bir çalışmada, Ayvalık ve Memecik zeytinyağlarının karakterizasyonu yapılmıştır. Elde edilen sonuçlar, Memecik tipi zeytinyağlarının, Ayvalık tipi zeytinyağlarına kıyasla daha yüksek düzeyde oleik asit ve antioksidan madde içerdiği tespit edilmiştir. Öte yandan, Ayvalık tipi zeytinyağlarının, Memecik tipi zeytinyağlarına göre daha yüksek oranda doymuş yağ asitleri içerdiği belirlenmiştir. Memecik tipi zeytinyağlarının, antioksidan özellik gösteren tokoferol ve toplam fenolik madde miktarının yüksek olduğu ve tekli doymamış yağ asitlerinin miktarının fazla, doymuş yağ asitlerinin ise düşük olduğu gözlemlenmiştir. Bu durum, sağlık açısından Memecik tipi zeytinyağlarının daha üstün özelliklere sahip olduğunu işaret etmektedir (İlyasoğlu, 2009).

Ağaç Yaşının Zeytinyağı Kalitesine Etkisi

Zeytin ağaçlarının yaşının zeytinyağı özellikleri üzerinde etkisinin incelendiği çalışmada, asırlık ağaçlardan elde edilen zeytinyağının, oleik asit içeriği açısından daha yüksek (%79.3) olduğu ve genç ağaçlardan elde edilen yağa göre daha düşük bir oleik asit içeriğine (%74.1) sahip olduğu tespit edilmiştir. Bununla birlikte asırlık ve genç zeytin ağaçlarının fenolik bileşiklerin içeriği açısından da büyük bir farklılık gözlemlenmiştir. Asırlık ağaçlardan elde edilen zeytinyağı, genç ağaçlardan elde edilen yağa göre çok daha yüksek bir fenol içeriğine (%195) sahip olduğu ortaya konulmuştur (İsmaili et al., 2019).

Ekolojinin Zeytinyağı Kalitesine Etkisi

Zeytin yetiştiricilerine zeytin çeşidi seçiminde tavsiye verilirken, coğrafik konumun özellikle sıcaklık durumunun dikkate alınması önemlidir. Soğuk bölgelerde, sıcak bölgelere göre daha az kimyasal reaksiyon ve mikrobiyel aktivite meydana geldiğinden, bu bölgelerde zeytinyağlarının oleik asit seviyeleri genellikle daha yüksektir (Rouas ve diğerleri, 2016). Sıcak bölgelerde ise, zeytin yetiştiriciliği sırasında, genellikle palmitik ve/veya linoleik asit miktarları artarken, oleik asit içeriği azalır (Lombardo et al., 2008).
Lübnan'ın farklı bölgeleri (Bechmizine, Kfaraaka ve Kawkaba) ve farklı hasat dönemleri için toplanan antik ve yetişkin zeytin ağaçlarından elde edilen sızma yağlarının fizikokimyasal özelliklerinin incelendiği çalışmada, yetiştirme bölgeleri arasında belirgin farklılıklar olduğunu göstermektedir (El Chami et al., 2023).

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Sulamanın Zeytinyağı Kalitesine Etkisi

Zeytinde, verim artışının en önemli faktörlerinden biri sulamadır. Sulama, bitkilerin sadece su ihtiyacını karşılamakla kalmaz, aynı zamanda bitkilerin diğer önemli besin maddelerine daha iyi erişimini sağlayarak gübre ve diğer girdilerin etkinliğini artırır. Sulamanın temel amacı, bitki gelişimi için gereken suyun bitki kök bölgesinde homojen bir şekilde depolanmasını sağlamaktır (Çiçek, 2015).

Zeytin bitkisi, morfolojik özellikleri ve su stresine karşı olan fizyolojik mekanizmaları sayesinde su kıtlığı koşullarında etkili bir şekilde büyüyebilir (Fernandez, 2014). Ancak, sulama uygulamalarının zeytin üretimine olumlu etkilerini doğrulayan bir dizi araştırma bulunmaktadır. Sulamanın, bitkinin vegetatif büyümesi yanı sıra meyve boyutu, verim ve zeytinyağı kalitesi üzerinde olumlu bir etkisi olduğu gözlemlenmiştir (Pierantozzi et al., 2020).

Gübrelemenin Zeytinyağı Kalitesine Etkisi

Zeytin, yer altı yumruları sayesinde uzun ömürlü olma özelliğine sahip ve değişik koşullara uyum sağlayabilen ekonomik olarak değerli bir meyve türüdür. Ancak verim ve kalite artışı için bitki beslemeye özel bir önem verilmelidir.

Kaleci (2010), Ayvalık zeytin çeşidinin organik ve konvansiyonel yetiştirme yöntemleri altında yetiştirilen zeytinlerin meyve ve yağ özelliklerini incelemiştir. Bu çalışmada, konvansiyonel yetiştirme yöntemi kullanılan ağaçların daha yüksek verim sağladığı gözlemlenmiştir. Ayrıca, zeytinlerin pomolojik özellikleri, yağ asidi kompozisyonu ve tokoferol içeriği açısından her iki yetiştirme yöntemi arasında önemli bir farklılık bulunmadığını belirtmiştir.

Budamanın Zeytinyağı Kalitesine Etkisi

Zeytin ağacında yapılan budama ile güneş ışığına daha fazla maruz kalan ağaçlardan elde edilen ürünlerin fenolik madde içeriği ve yağ kalitesi genellikle yüksektir. Ayrıca, sık dikim zeytin yetiştiriciliğinin önemli bir sorunu olan Verticillium solgunluğunun kontrolünde ağaçların taç yapısı kritik bir rol oynamaktadır (Rallo et al., 2013).

Hasat Zamanı ve Şeklinin Zeytinyağı Kalitesine Etkisi

Zeytinlerin ideal hasat zamanı, çeşitlerine, coğrafi koşullara ve üretim amaçlarına bağlı olarak değişim göstermektedir (Kutlu ve Şen, 2011). Zeytinlerin ideal hasat evresi, alacalı rengin gözlemlenmeye başladığı dönemle kabuk ve etin iç kısmının renklenmesinin tamamlandığı dönemi içerir. Yeşil zeytinler daha acı bir tat profiline sahipken, olgunlaştıkça yağ içeriği artar ve daha yumuşak bir tat profili geliştirirler. Hasat zamanı, yağ asidi bileşimi, fenolik bileşenlerin miktarı ve toplam yağ verimi üzerinde önemli bir etkiye sahiptir (Topuz ve Durmuşoğlu, 2012).

Zeytinlerin hasat şekli, son ürünün kalitesi üzerinde önemli bir etkiye sahiptir. Zeytin hasadında sırık, makine ve el ile hasat yapma yöntemleri mevcuttur. El ile hasat genellikle en istenilen yöntem olup zeytinlerin daha az hasar görmesini sağlamaktadır. Ancak, bu yöntem yavaş olduğu için pratikte ekonomik nedenlerden dolayı tercih edilmememektedir (Gemicioğlu, 2016).

Hasat edilen zeytinlerin, mümkün olan en kısa süre içerisinde zeytinyağı işleme fabrikalarına ulaştırılması sağlanmalıdır. Zeytinlerin çuvallarda değil, kasalarda taşınması ve işlenmeye bekletilmeden hemen işlenmesi gerekmektedir. Aksi takdirde, zeytin ve zeytinyağı kalitesini olumsuz etkileyebilecek faktörler olan ısı, ışık ve oksijenle temas gibi etkenlerle karşılaşabilir (Yavuz, 2008). Bu nedenle, zeytinlerin hızlı ve uygun şekilde işlenmesi, zeytinyağının kalitesini korumak için kritik bir öneme sahiptir.

Sonuç

Kaliteli bir zeytinyağı üretimi, öncelikle kaliteli zeytinlerin temin edilmesi ve bunların yağa dönüştürülme süreçlerinde titizlikle işlenmesine dayanır. Bu bağlamda, önemli olan, istenmeyen kalitedeki zeytinlerden yüksek kaliteli zeytinyağı üretmenin mümkün olmadığı gerçeğini akılda tutmaktır. Ancak, iyi kalitede zeytinlerin varlığına rağmen, uygun teknolojik ve hijyenik şartlara uyulmazsa, sonuç istenmeyen kalitede bir zeytinyağı olabilir. Zeytinyağı kalitesinin artırılması ve korunması için, bu yaklaşımın her zaman göz önünde bulundurulması gereklidir.

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Determination Of The Efficiency Of Some Plant Growth- Promoting Bacteria In Strawberry Growing Under Cover And Field Conditions Organically Single And Dual Applications On Plant Development And Good Production Parameters

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Abstract

With this study, in 2010 and 2011; bacteria species belonging to *Pseudomonas fluorescens* RC77, *Bacillus pumilus* RC23, *Bacillus megaterium* RC07, *Bacillus subtilis* RC521, *Pantoea agglomerans*, RCYE58, *Burkholderia pyrrocinia* RCYE64, *Paenibacillus polymyxa* RCYE283, *Stenotrophomonas acidaminiphila* RCYE47, which promotes some plant growth in greenhouse and field organic conditions, isolates were used. Frigo strawberry seedlings (Fern cv.) were used for 60 minutes before planting, for 60 minutes *B. megaterium* RC07, *B. pumilus* RC23, *B. subtilis* RC521, *B. pyrrocinia* RCYE64, *P. polymyxa* RCYE283, *P. fluorescens* RC77, *S. acidaminiphila* RCYE47 (single solution-7 pieces), (*B. pumilus* RC23 + *P. agglomerans* RCYE58, *B. subtilis* RC521 + *S . acidaminiphila* RCYE47, *P. polymyxa* RCYE283 + *B. pyrrocinia* RCYE64 ve *P. fluorescens* RC77 + *B. megaterium* RC07 (dual solution-4 pieces). At the end of the study, *B. subtilis* RC521 + *S . acidaminiphila* RCYE47 was obtained from application, while the highest fruit yield per plant was obtained from *B. pumilus RC23* + *P. agglomerans* RCYE58 application with 99.68g. The best average fruit weight was obtained from *S. acidaminiphila* RCYE47 application with 6.70 g, while the highest total fruit yield was obtained from *B. pyrrocinia* RCYE64 application with 1155 g. *P. polymyxa* RCYE283 application had the highest chemical content in the fruit (23.07%) and at the end of the 1st year (12.43%), while in terms of ascorbic acid content (84mg/100g) and at the end of the 1st year (1000ppm) it was found to be the highest. Obtained from *Bacillus pumilus* RC23 application. In the study; It was determined that the bacterial applications provided an increase in the macro and micro nutrient content of the strawberry leaves under the cover and in the open field, and these increases were statistically significant.

Key Words: *Strawberry, PGPR, root and leaf application, yield.*

Örtü Altı Ve Açık Alandaki Organik Çilek Yetiştiriciliğinde Bitki Gelişimini Teşvik Edici Bazı Bakterilerin Tekli Ve İkili Kombinasyon Uygulamalarının Bitki Gelişimi İle Verim Parametrelerine Etkinliklerinin Belirlenmesi

Özet

Bu çalışma ile, 2010 ve 2011 yıllarında; örtü altı ve açıkta organik koşullarda bazı bitki gelişimini teşvik eden *Pseudomonas fluorescens* RC77, *Bacillus pumilus* RC23, *Bacillus megaterium* RC07, *Bacillus subtilis* RC521, *Pantoea agglomerans*, RCYE58, *Burkholderia pyrrocinia* RCYE64, *Paenibacillus polymyxa* RCYE283, *Stenotrophomonas acidaminiphila* RCYE47 türlerine ait bakteri izolatları kullanılmıştır. Fern çeşidine ait frigo çilek fideleri dikimden önce 60 dakika süreyle *B. megaterium* RC07, *B. pumilus* RC23, *B. subtilis* RC521, *B. pyrrocinia* RCYE64, *P. polymyxa* RCYE283, *P. fluorescens* RC77, *S. acidaminiphila* RCYE47 (7 adet tekli), (*B. pumilus* RC23 + *P. agglomerans* RCYE58, *B. subtilis* RC521 + *S . acidaminiphila* RCYE47, *P. polymyxa* RCYE283 + *B. pyrrocinia* RCYE64 ve *P. fluorescens* RC77 + *B. megaterium* RC07 (4 adet ikili) izolat içeren solusyonlarda 60 dk bekletilmiş ve dikilmiştir. Yapılan çalışma sonunda yılların genel ortalamasına göre en fazla yaprak alanı 25,28cm^2 ile *B. subtilis* RC521 + *S . acidaminiphila* RCYE47 uygulamasından elde edilirken, bitki başına en yüksek meyve verim 99,68g ile *B. pumilus* RC23 + *P. agglomerans* RCYE58 uygulamasından elde edilmiştir. Ortalama meyve ağırlığının en iyi olduğu uygulama 6,70g ile *S. acidaminiphila* RCYE47 uygulaması iken en fazla toplam meyve verimi 1155g ile *B. pyrrocinia* RCYE64 uygulamasından elde edilmiştir. Meyvedeki kimyasal içerik açısından en yüksek SÇKM (%23,07) ve 1. yıl sonunda (%12,43) *P. polymyxa* RCYE283 uygulamasından elde edilirken, askorbik asit içeriği bakımından (84mg/100g) ve 1. yıl sonunda (1000ppm) ile *Bacillus pumilus* RC23 uygulamasından elde edilmiştir. Çalışmada; bakteri uygulamalarının örtü altında ve açık alanda çilek yapraklarının makro ve mikro besin elementi içeriklerinin büyük bir kısmında artış sağladığı, bu artışların da istatistiksel olarak önemli olduğu belirlenmiştir.

Anahtar Kelimeler: *Çilek, PGPR, kök ve yaprak uygulaması, verim unsurları*

Introduction

Turkey's climate and soil conditions have provided the opportunity to grow a large number of fruit genus and fruit cultivars, so that our country has been among the important fruit producer countries of the world in terms of both fruit species and varieties and production amount. One of these fruit species is strawberry. *Fragaria vesca*, known as forest strawberries in the early days, has been cultivated with the frustration and since the 1970s, it has started to be grown economically (Yılmaz 2009).

The strawberry belongs to the *Rosaceae* Family of the *Rosa* genus and the north (*F. virginiana*) and the south (*F. chiloensis*) hemispheres at the end of the 18th century emerged as a result of coincidental hybridization in France. For this reason, strawberry (*Fragaria* × *Pineapple* Duch.) Is one of the youngest fruit species in the world (Hancock, et al., 2008, Demirsoy and Serçe 2016).

Strawberry, which is a species that can be grown in a wide range of ecological conditions and in a wide area in the world, is generally spread in the northern hemisphere, but also in all areas of agriculture from the tropics to the Arctic regions and in the areas of 2000 m from sea level to 2000 m It is a species that can be produced (Aslantaş and Karakurt, 2007). Since the investments in production return in a short time, the earnings from the unit area are higher than many other products. All of this has led to a continuous increase in interest in strawberry cultivation and its production in the world has increased every year. The high adaptation capability and variety richness plays an important role in the fact that strawberries can be grown in such a wide range (Demirsoy and Serçe, 2016).

In the control of diseases and pests in plant production, the use of unconscious chemical fertilizer and pesticide ultimately causes deterioration of soil health and environmental pollution (Glick 1995; Keles and Ertürk 2021; Ertürk 2022). In particular, the increase in environmental pollution and the increasingly contamination due to the synthetic inputs used in the production activities of agricultural areas have revealed the recipe of organic cultivation. Organic agriculture is an important tool for reducing the negative impact of intensive synthetic chemicals on soil quality and ensuring sustainability (Çakmakçı and Erdoğan 2005).

In recent years, studies on alternative applications and inputs have increased to reduce chemical fertilizer requirements. The most remarkable application in these studies, which focuses on the use of organic materials, stands out as the use of microorganisms (Ertürk 2022). There are many common microorganism groups in the soil, including bacteria, fungus, actinomyst, protozoa and algae. Microorganisms, which are used as free-living, promoting plant growth, used as biologic agents or biological fertilizer, are called Plant Growth-Promoting Rhizobacteria = PGPR), which promotes plant growth and development. These bacteria are mostly more *Acetobacter, Acinetobacter, Achromobacter, Aereobacter, Agrobacterium, Alcaligenes, Artrobacter, Azospirillum, Nitrotobacter, Bacillus, Burkholderia, Clostridium, Enterobacter, Erwinia, Flavobacterium, Klebsiellalla, Pseudomonas, Rhizobium, Serratia* and *Xanthomonas*. This group of microorganisms make significant contributions to cultivation by using different mechanisms in the development process of the plant.

The first group of bacteria that increase plant growth; It manufactures direct growth substances (hormones, vitamins, enzymes and siderofor, etc.), prevents ethylene synthesis, fixes atmospheric nitrogen, increases iron uptake, organic and inorganic phosphate solubilisation, increases the durability of plants against drought, salty, metal toxide and pesticide harm; The second group reduces the harmful effects of phytopatogenic microorganisms (Glick 2012, Bashan et.al 2014, Ertürk 2022).

Increased inorganic and organic phosphate solubilisation and mineralisation with microbial metabolites encourages plant development. In particular, the production of bacterial organic acid and acid phosphatase increases the uptake of nutrients (Çakmakçı et al. 2006; 2007, Ertürk 2022). Bacterial treatments that encourage plant development are carried out in laboratory, greenhouse and field conditions, but some conditions that cannot be predicted in field trials sometimes make it difficult to obtain appropriate results (Miransari 2013; Ahemad and Cabret 2014, Keles and Ertürk 2021). Infections in the soil, pH changes, high temperature, low rainfall and humidity deficiency in growth period, nutritional deficiencies, such as non-appropriate conditions reduce bacterial colonization. As a matter of fact, the effectiveness of these bacteria is affected by the soil and environmental factors (Çakmakçı 2005, Miransari 2013; Ertürk 2022).

Some bacteria, which may be effective in controlled conditions, may be insufficient in field conditions. PGPR (Plant Growth-Promoting Rhizobacteria) activity emerged during the early development of the plant and contributed especially on vegetative development (Çakmakçı 2005, Ertürk 2022). In recent years, some fruit (hazelnuts, bananas, apricots, rosehip, cherry, citrus fruits, blueberry, strawberry, kiwi, apple, etc.) species have increased in numerically.

Especially in garden plants where perennial and woody plant species are high compared to field plants, the activities of these applications are more variable and long-term due to the fact that they are tried in different ecologies in terms of all species (Çakmakçı et al. 2010a, Ertürk 2022). Bacterial applications, especially in different ecologies, especially in different ecologies, affected many parameters such as vegetative development of some bacterial breeds, leaf area, yield, nutritional intake, fruit quality and content, some bacterial breeds were neutralized, some bacterial races were found ineffective. It has come to the forefront with their binary or triple

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usage rather than single use (Vestberg et al.. Equalgen 2018; Ünal 2019, Ertürk et al. 2021; Ertürk and Çakmakçı 2022)

With this study; In recent years, it is aimed to determine bacterial applications that can be used in increasing organic strawberry cultivation in Erzincan and its region and their effects on yield -related elements. It has been found that the size of the bacterial isolates used can contribute positively under organic conditions. Additionally, this study; For the first time under field conditions and under the cover in Erzincan, it is the first in terms of the application of some bacterial isolates in terms of single and dual application.

Materyal ve Yöntem

Bacterial Isolates

This study was conducted on 11 different biological fertilizer formulations (*Pseudomonas fluorescens* RC77, *Paenibacillus polymyxa* RCYE283, *Stenotrophomonas acidaminiphila* RCYE47, *Bacillus pumilus* RC23, *Bacillus megaterium* RC07, *Bacillus subtilis* RC521, *Burkholderia pyrrocinia* RCYE64, *Pseudomonas fluorescens* RC77 + *Bacillus megaterium* RC07, *Paenibacillus polymyxa* RCYE283,+ *Burkholderia pyrrocinia* RCYE64, *Bacillus subtilis* RC521+ *Stenotrophomonas acidaminiphila* RCYE47 ve *Bacillus pumilus* RC23+ *Pantoea agglomerans* R RCYE58) plant in the Fern strawberry variety grown under greenhouse and open field under organic conditions. This study was carried out to determine the development, yield and yield elements and its effect on leaf macro and micro nutrient content. *P. fluorescens* RC77 (Çakmakçı et al. 2008; Çakmakçı et al. 2013a) and *B. pumilus* RC23 (Ertürk et al. 2010), used as biological fertilizer, were obtained from wild raspberry rhizosphere soil; *B. megaterium* RC07 from wheat rhizosphere (Çakmakçı et al. 2006, 2007), *B. subtilis* RC521 isolate from saline-calcareous wild grapevine rhizosphere soil (Çakmakçı et al. 2013a, Çakmakçı et al. 2013b); *P. agglomerans*, RCYE58, *B. pyrrocinia* RCYE64 and *P. polymyxa* RCYE283 from acidic tea rhizosphere soils of the Eastern Black Sea Region (Çakmakçı et al. 2011, 2012, 2013a,bc,d); *S. acidaminiphila* RCYE47 was isolated from the acidic wild strawberry rhizosphere soil of Rize Hemşin region (Çakmakçı et al. 2010; Çakmakçı et al. 2013 d) and was characterized by some biochemical properties. Diagnosis, characterization and some test results of bacteria tested on different plants in previous studies are given in Table 1.

Table 1. Some laboratory test results of the bacterial isolates used in the study.

MIS Identification	**Oxydase test**	**Catalase test**	**Growth in N-free media**	**Sucrose Test**	**Growth in NBRIP-BPB media**	**Amylase Test**	**ACC-Deaminase Test**
Bacillus megaterium RC07	-	+	SP+	-	SP+	WP+	+
Bacillus pumilus RC23	-	SP+	SP+	-	+	-	+
Bacillus subtilis RC521	-	SP+	SP+	+	-	+	+
Burkholderia pyrrocinia RCYE64	+	WP+	SP+	WP+	SP+	-	+
Paenibacillus polymyxa RCYE283	-	+	SP+	+	WP+	WP+	+
Pantoea agglomerans R RCYE58	-	+	SP+	+	SP+	-	ND
Pseudomonas fluorescens RC77	SP+	SP+	SP+	WP+	+	-	+
Stenotrophomonas acidaminiphila RCYE47	+	SP+	WP+	-	-	-	ND
Bacterial Formulations/Combinations							
Paenibacillus polymyxa RCYE283+ *Burkholderia pyrrocinia* RCYE64							
Bacillus subtilis RC521+ *Stenotrophomonas acidaminiphila* RCYE47							
Bacillus pumilus RC23+ *Pantoea agglomerans* R RCYE58							

**SP+: strong positive, WP+: weak positive, -: negative, +: positive, ND: Not Determined*

The strawberry seedlings used in this study belong to the Fern cultivar with day-neutral characteristics, bred by the University of California, and this variety, which does not have a strong vegetative structure, is recommended for cultivation in our country, especially in high-altitude plateau areas. The field studies of this research were carried out in the open and in a high tunnel (roof height 3m) on the producer land in Çayırlı district of Erzincan province in 2010-2011. Laboratory studies were carried out in the laboratories of Atatürk University, Faculty of Agriculture, Department of Horticulture and Soil-plant Nutrition .

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In the experiment, black plastic mulch with UV additive was used as standard in the tubes both in the field and in the high tunnels, and the mulching process was carried out before planting the seedlings. Seedlings were planted and cared for on tubes equipped with a drip irrigation system in which an automatic watering unit was mounted.
The study was carried out with a total of 864 frigo-seedlings of the Fern cv. 432 under cover and 432 in the field, with 4 parcel for greenhouse and field, 3 separate applications in each tube, 3 repetitions in each application and 12 plants in each repetition. .
Animal manure and 200 kg of elemental sulfur were applied to the rollers at the rate of 3 tons per decare to regulate the soil structure.

PGPR suspension preparation and Application

48-hour cultures were used in the preparation of the bacterial solution, and a loopful of each growing bacteria was taken and transferred to a conical flask containing 250 ml of nutrient broth. Liquid media inoculated with bacteria were incubated in a shaker at 91 rpm for 24 hours. The prepared bacterial suspensions were diluted with sterile pure water and the final concentration was adjusted to 108 CFU ml-1 by spectrophotometric measurement. Before planting, frigo strawberry seedlings of Fern variety were treated with *B. megaterium* RC07, *B. pumilus* RC23, *B. subtilis* RC521, *B. pyrrocinia* RCYE64, *P. polymyxa* RCYE283, *P. fluorescens* RC77, *S. acidaminiphila* RCYE47, *B. pumilus* RC23 + *P. agglomerans* RCYE58, *B. subtilis* RC521 + *S . acidaminiphila* RCYE47. They were kept in solutions containing, *P. polymyxa* RCYE283 + *B. pyrrocinia* RCYE64 and *P. fluorescens* RC77 + *B. megaterium* RC07 for 60 minutes and planted.
After planting, solutions containing bacterial isolates were evenly injected into the root rhizosphere. No application was made to the parcel designated as control. In the study, under the title of evaluations regarding efficiency; yield per plant (g/plant), average fruit weight (g) and total fruit yield (g); regarding the chemical composition of the fruit, SSC (%) and ascorbic acid (vitamin C) values were determined.
Also in the research; regarding the physical and chemical properties of the leaf, leaf area (cm^2) and macro and micronutrient contents in the leaf were determined. In the research; All studies were conducted according to the randomized parcel trial design. Values in all parameters were analyzed using SPSS package program with analysis of variance in 1 (variety) x 2 (growing medium) x 11 (application) factorial order.
The difference between the means was subjected to Duncan's multiple comparison test. In characters where interactions are important, interactions are explained with a simple main effect. Statistical analyzes were performed using the Duncan multiple comparison test to see the differences between the average values.

Results and Discussion

In the yield parameters examined, it was determined that bacterial applications had a positive effect on fruit yield in strawberries both in the open and under cover. The applied *B. pumilus* RC23 + *P. agglomerans* RCYE58 combination increased the yield per plant (99.16 g) according to the general average of the years, average fruit weight (6.70 g) with the *S. acidaminiphila* RCYE47 isolate, and total fruit yield (6.70 g) with the *B. pyrrocinia* RCYE64 isolate. 1155 g) were the isolates that provided the highest yield increase (table 2). The values obtained at the end of the study are similar to other studies.
As a matter of fact, Ertürk et al. (2012) reported fruit yield per plant in strawberry as 1.98-20.85%, average fruit yield as 3.05-19.26%; Equalken et al (2010), Koç et al (2016) reported that fruit yield in strawberry was significantly increased with bacterial applications. While the differences between applications in yield values are significant, the reason for the very low yield obtained in different regions can be shown to be that the applications are carried out under organic conditions. It is possible that the mentioned isolates have very different functions, such as nitrogen fixation, phosphate solubilization, and ACC deaminase activity (table 1), resulting in more balanced nutrition of the treated plants and thus increases in the values of yield and yield parameters.
The effect of the applications on the TSS rate and the general average in the 1st and 2nd years was found to be statistically very significant. At the end of the trial, the general average of the years (23.07%) and the highest TSS rate at the end of the 1st year (12.43%) were obtained from the *P. polymyxa* RCYE283 application, and in the 2nd year, the highest rate was obtained from the *P. fluorescens* RC77 + *B. megaterium* RC07 application. The TSS rate (11.37%) was reached.
In the determination of ascorbic acid (vitamin C), which we used to determine the chemical content of the fruits, it was determined that they contained more Ascorbic acid (vitamin C) than the control group, according to the general average of the applications (table 3), and this was statistically significant ($p < 0.01$). Among the treatments, especially *B. pumilis* RC23 and *P. fluorescens* RC77 isolates increased their vitamin C content (table 3). In the study, bacterial isolates applied to strawberries, especially *B. subtilis* RC521 and *B. subtilis* RC521+*S. acidaminiphila* RCYE47 It was determined that increased leaf area both under cover and in the field condition (table 2). These bacteria are reported to have nitrogen-fixing and phosphate-solubilizing properties in laboratory tests (table 1). It is highly likely that there will be increases in leaf chlorophyll content and leaf area in plants that

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are well nourished in terms of nitrogen (Marschner 2012). Similar studies have also revealed that bacteria increase the leaf area. Sudhakar et al. (2000) observed that the leaf area of the mulberry plant increased with *Azotobacter* application, and in another study, De Silva et al (2000) stated that the leaf area of blueberries increased with *P. fluorescens* Pf5. Also; Ertürk et al. (2012), in their studies conducted with the same variety under Çoruh Valley conditions, reported that the leaf area increased with almost all bacterial applications, and accordingly the yield increased. It can be said that the bacteria we applied directly or indirectly increased the leaf area by increasing the plant's nutrient uptake from the soil. It was determined that bacteria-treated strawberry leaves contained more macro and micro (P, K, Ca, B, Cu, Fe, Mg, Mn, Na, S, Zn) nutrients than the control, and these values were found to be statistically significant (table 3). In similar studies, researchers detected similar effects in different plant or strawberry varieties to which they applied bacterial isolates.

As a matter of fact, Equalken et al. (2003) reported that with bacterial applications in apricot, N, P, K, Ca and Mg contents in the leaves of trees increased compared to the control; Jaizme-Vega et al. (2003) *Bacillus spp*. into two banana varieties grown under in vitro conditions. As a result of the application, they found that the nutritional content of both varieties increased compared to the control.

Çakmakçı et al. (2009) reported that 236 of 281 original bacterial isolates could fix free nitrogen, 177 isolates could solubilize phosphate, and 152 could both fix nitrogen and dissolve phosphate. In a parallel study they conducted, they observed that bacterial application in tea clones made significant contributions to the development parameters as a result (Çakmakçı et al. 2010). Similarly, Ertürk et al. (2011) reported that the bacteria applied to Tombul hazelnut cultivar had an effect on the plant nutrient content (N, P, K, Ca, Mg, Mn, Zn, Fe, Na), and Eşitken et al. (2010) reported that they reported that the N, P, K, Fe, Mn and Zn contents of the leaves of Fern cv. increased significantly as a result of bacterial application to the strawberry variety.

Since the applied bacteria have different functions such as dissolving phosphate in the rhizosphere, fixing atmospheric nitrogen, and producing hormones such as IAA that increase plant growth (table 1), they significantly contributed to the nutrient content of leaf plants.

In conclusion; the effects of bacterial isolates on yield per plant, average fruit weight, total fruit yield, plant leaf area and chemical content values varied according to years and growing environments. Especially considering the physiology of perennial plants, it is reported that it takes time to observe the effects of bacterial applications completely and homogeneously and may vary depending on soil ecology and climate (Çakmakçı 2005; Turan et. al. 2009, Miransari 2013, Bashan et.al 2014, İpek et. al 2014, Pehluvan and Güleryüz 2014, Kumar et.al 2015, Kurokura et.al. 2017, Geçer et al. 2018, Ertürk 2022). However, applications include *B. subtilis* RC521, *B. pyrrocinia* RCYE64, *B. pumilis* RC23+*P. agglomerans* RCYE58, it has been observed that isolates are promising, make a positive contribution to data on yield and yield elements, and cause significant increases in leaf nutrient element contents. In the light of these evaluations, it has been concluded that the mentioned isolates can be used as biological fertilizer in strawberry cultivation in the Erzincan region under organic conditions, since organic strawberry cultivation is becoming increasingly widespread and therefore biological fertilizer alternatives are needed.

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Observation Evaluation of the Empowerment Stunting Prevention Program at the Samata Health Center

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Abstract

The purpose of this observation was to evaluate the stunting prevention programs and programs that had been created to reduce the number of stunting incidents carried out at the Health Center. This qualitative research was conducted from May 3 to May 13, 2023, at the Samata Health Center, Gowa Regency, South Sulawesi. The participants in this study were nutrition staff, midwives, and cadres at two Health Centers and the community around the Samata Health Center. Data were collected through direct in-depth interviews using the prepared questionnaires. This community empowerment program also aims to encourage people to pay more attention to nutritional health status with specific programs aimed at pregnant women, lactating women, and children aged 0-24 months so that they can grow into quality human beings.

Keywords: *Evaluation, Stunting, Children, Nutritional Status, Islamic Empowerment.*

Introduction

Empowerment originates from the word *power*, which means power or ability. Empowerment can interpret terminology as an acquisition process of power or ability by those who are lacking in power, Temporary that's what the people say in Language English is *Society*, which means friend. Bond social: This makes someone alive. Thus, empowerment public refers to the concept of summarizing social development values for an increased level of life public going to progress. (Sany, UP2019).

Islam views the public as a mutual individual and relates to each other 'sneeds and support. The gap income economy is potentially utilized for growing friendships. Islam recommends that implementation strengthen public follow three main principles: ukhuwwah, ta'awun, and equality. (Sany, UP2019). The third principle is explained as follows:

- Principle Brotherhood: This means in the Language Arab Brotherhood. Principle: This emphasizes that every Muslim is you for others, although they are not related. The sense of brotherhood behind this is a sense of empathy and friendship in society.
- Principle ta'awun or gotong cooperate; can Also Can interpret one synergy between the different interests of the holder to realize optimum empowerment. All parties helped to reach the objective. Government No Can finish the problem alone without the other side, like zakat institutions, scholars, Islamic organizations, and various non-governmental organizations can Work The same in integration strength finance, management, resources, power man, method, and determination to create effective synergy in implementation empowerment and completion poverty.
- Principle of equality between humans. Glory of Allah alone based on faith and piety. Islamic to emphasize that the difference between wealth and wealth, in essence, No. Before Allah, all his servants were the same.

Stunting disorder experienced growth and development: child consequence nutrition bad, infection repetition, and psychosocial stimulation, which is not adequate. (WHO, 2015). According to the WHO in 2020 there are 149.2 million children below 5 years of age experience stunting, which means approximately 22.0% of all children under 5 years of age experience stunting. (WHO, 2021).

Based on the results of the Indonesian Nutritional Status Survey (SSGI) in 2022, as many as 4,558,899 children will be stunted in Indonesia. This experience has declined since 2021, with as many as 5,253,404 children experiencing stunting. Temporary amount children experiencing stunting in Gowan Regency, South Sulawesi in 2022 were recorded as many as 20,435 children with numbers incident highest in the group aged 24-35 months A total of 4,766 experienced stunting. This decrease compared to 2021, with total stunting incidents in Gowan Regency as many as 21,047 children. (Directorate Promotion Health & Empowerment Society 2023).

There are four effects of stunting on children: weak cognitive and psychological inhibition, difficulties in controlling science and achievement in sport, more easily caught disease degenerative, and source power quality human being low. Dasman, H. (2019). Stunting usually occurs due to a lack of nutrition for 1000 days First life a child. 1000 days counting started from the fetus until 2nd year of life. Therefore, action prevention must be performed as early as possible. (Ministry of Health, RI) 2018).

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Causes of Stunting Adoptions site Nutrition states that stunting develops in the long term because of a combination of some or all of the following factors:

- Not enough nutrition chronic in long time
- retardation intrauterine growth
- No enough protein in proportion of total calorie intake
- Change stimulated hormone by stress
- Often, a child suffers an infection at the start of life.

The development of stunting is a slow, cumulative process that does not mean that the current food intake is inadequate. A growth failure may have occurred in the past. (Ministry of Health, RI) 2018).

Stunting symptoms are usually caused by the following:

- Child body shorter for child his age
- Proportion body tend to be normal but child looked more young / small for his age
- Heavy body low for child his age
- Growth bone delayed. (Indonesian Ministry of Health) 2018).

Regulation President No. 72 of 2021 about accelerating holistic, integrative, and quality reduction of stunting through coordination, synergy, and synchronization among holder interests. (PERPRES No. 72, 2021).

This shows that for a lower number, stunting is a necessary synergy among all parties involved. Minister Budi Gunadi 's Health Sadikin focuses on 11 intervention programs Specific For reducing stunting. The 11 programs focused on 2 phases growth namely the mother pregnant before and after giving birth to age the baby–0-24 months. The second group was the teenager's daughter grades 7-10, who was giving additional tablets of blood to prevent anemia. (BKPK Public Relations, 2023).

Importance empowerment This is a step beginning for lower number stunting incidence in the region around public health center Samata with existence empowerment; this public will follow role active in effort stunting prevention, besides that will form source power quality, healthy human beings physical and spiritual. The targets of this program were (1) Group Mother pregnancy, (2) mother breastfeeding and children aged 0-6 months, and (3) mothers breastfeeding and children aged 0-23 months. Disks. Bali Province. (2022).

In this study, activity observations related to the stunting prevention program at the Community Health Center Samata were conducted through activity interviews to determine whether the program is capable of effectively reducing the number of stunting incidents in the region around public health center Samata. Interviews and observations: This involves power nutrition, midwives, and cadres.

Research conducted by Sri et al. (2018) at the Community Health Center Jatinangor form an evaluation empowerment cadre health stunting in children: (1) Evaluation empowerment of inputs covers energy, funds, means, material, and method empowerment. (2) Evaluation to increase knowledge, understanding, and awareness of cadres and services health at the health center in frame stunting prevention. (3) Evaluation towards the output Not yet in accordance with the objectives of the stunting prevention program through enhancement quality cadre health Because Still Lots children who experience stunting. Results studies This state There is enhancement knowledge cadre from activity empowerment carried out by this show that cadre health capable do prevention and management such as preventing stunting. (Chandrawati 2018).

Other research conducted by Nurbaya et al. (2022) at the Community Health Center Panambungan This aims to increase the knowledge and skills counseling cadre Integrated Healthcare Center in counseling nutrition in society. Activity is conducted through method lectures and discussions in three stages: (1) Stage preparation and coordination, that is, team coordination with the Head Service Control Population and Family Planning (DPPKB) of Makassar City. (2) Stage Education and training for 33 participants, viz. cadre Integrated Healthcare Center about stunting and giving food for babies and children (IYCF) through a method lecture. (3) Stage discussion and evaluation in the form ask for answers. Results from this study show that cadres can answer questions well after they have received education through a method lecture. (Nurbaya et al, 2022).

In research conducted by Dyah et al. (2021) in Kelurahan, Muktiharjo aimed For How babies under two risky years stunt devotion public, providing various intervention nursing programs for families with children at risk of stunting. There are three stages: (1) Socialization. (2) Execution activities. (3) Monitoring and evaluation. Results from implementation activity: This accompaniment by power healthcare professionals plays a significant role in preventing the risk of stunting in children under two years. (Sari et al. 2021).

Research conducted by Febri et al. (2022) at the Halmahera Community Health Center aims to implement the zinc empowerment program as an intervention nutrition specific to the prevention of stunting in the First 1000 Days Movement Program Life (HPK). In study is done by method qualitative descriptive with informants main, which is the officer nutrition Halmahera Health Center and health cadres with an informant's triangulation, which is two mother stunting clowns. Variable study This includes: (1) input, including Source Power People (HR), materials, and methods. (2) Process variables, including planning, organizing, implementing, and controlling. (3) Output variables. Results obtained from this study This is giving zinc to clowns in the work area Halmahera Health Center

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can be said to be 100% successful, because of the total number of stunting children, the target is two children fulfilled. (Iqbal 2022).

In another study conducted by Ratna et al. (2022) at the Community Health Center, Bangsri II. This study aimed to determine an evaluation of 1000 HPK in the Work Public Health Center, Bangsri II. Method: This study used a descriptive qualitative analysis conducted through in-depth interviews. Eight informants were selected through *purposive sampling.* The results of the evaluation study of this 1000 HPK program show that the aspect source power man still lacks source power for service nutrition, necessary supporting facilities and infrastructure, and aspect-constrained mobility because a lack of participants is present. (Wahyuningtias & Zainafree , 2022).

Gina et al. (2019) conducted research at the Community Health Center Hold New. To conduct an analysis and evaluation of the implementation of stunting prevention programs reviewed from the intervention nutrition Specific 1000 HPK Movement. Method used: There were 2, namely: (1) Interview deep. (2) Observation and focus group discussions (FGD). Based on the results obtained, which include three variables: (1) Input, there are no special funds for intervention nutrition specific, still lack of power nutrition, and not yet there are guidelines and SPO regarding handling *growth faltering*. (2) Process, planning not yet done in a manner bottom up, and not yet all intervention nutrition specific have recording reporting. (3) Toddlers who receive vitamin A capsules and pregnant women with insufficient chronic energy (KEK) who have received PMT already meet the achievement targets, and there is still an intervention program for nutrition-specific implementation. (Muthi et al ., 2020).

The existing activity evaluation of the stunting prevention program at the Health Center so matter This can become a motivation for enhancing empowerment through the observation process of existing programs walking. Objective from empempempempempory-based Islamic This can also increase awareness of the importance of nutritional status in children related to the verses of the Koran or hadith from Rasulullah SAW.

Evaluating this big hope for a lower incidence of stunting in children. The deep stunting period has a long impact not only on the growth of the flower child but also on the development of emotions that result in a loss of the economy. Start from fulfillment of good nutrition for 1000 days. First life child until guard environment to stay clean and healthy. (Ministry of Health, RI) 2018).

Activity observation: This was done to evaluate stunting prevention programs as well as programs that have made for lower-number stunting incidents carried out at the health center Samata Regency Gowa, South Sulawesi.

Expected outcome from exists activity observation empowerment based Islamic This is enhancement understanding public about nutritional status For prevent stunting, increase quality service cadre Public health center For push decline stunting rate. Finally, material evaluation for stewardship policy regarding what program should be There is, nor should it be improved in frame stunting prevention in Indonesia.

The utility study observations of the stunting prevention program at Health Center Samata include the following:

- *For Academics:* Update and expand knowledge about the stunting prevention program from previous studies to increase outlook related to stunting prevention programs.
- *For Public:* Increased knowledge and understanding about the importance of good nutritional status for preventing stunting in children. In addition, it empowers and follows the public, as well as in various stunting prevention programs.

Method Observational Study

Studies This is activity evaluation with qualitative or deep observation through the observation process right in the field. Activity: This was done by method interview in a manner directly with the officer's nutrition, midwife, or involved cadres in the stunting prevention program at the Health Center samata.

Activity observation: This study was carried out at the Community Health Center, Samata, District Gowa, South Sulawesi. Subject in study: This is a power executor nutrition Community Health Center, midwife Health Center, and cadres in each region of the public health center, as well as the public around that is pregnant woman, new childbirth woman, and babies ages 0-24 months.

Instruments used in activity observation through activity observation interviews. By giving list questions to officers, they will perform documentation. Analysis data from interview results were poured into notes written and grouped in accordance with fields that will be analyzed, and data interpretation was performed in a manner that is narrative and interpretation new, and compared to the standard Ministry of Health, there is and theory from various sources.

Results

Inputs

Power

The power involved in the stunting prevention program at the Community Health Center Samata includes officer nutritionists, midwives and cadres. Results studies show that there are three officers, two midwives, and two

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stunting cadres. Regarding education officer nutrition, two of them are Bachelor of Health graduate Society and one is D3 Nutrition graduate, for midwife First is D4 Nutrition graduate and midwife second is Health SI graduate Public, whereas cadre, cadre First is D3 Nutrition graduates and cadres second Bachelor of Law graduate. The Officer Public Health Center Work, similar to cadres, started in 2019.
Before the power, the implementation of a stunting prevention program carried out training for officer nutritionists, midwives, and cadres. Nutrition officers, midwives, and cadres received training before starting the stunting prevention program.

"Training *carried out that is related to stunting/ STOP stunting action. Training obtained from province, Department of Health, meeting with BKKBN at the BKKBN office. (Officer Nutrition: 1. S, 38 years old)*

"Ever follow training, we joined the PKK, and midwives in the same district. Usually 2 times deep a year in an office camat. The training process is content absent, hear material, and a question-and-answer session. (Midwife 1. M, 35 years old)

"Once, I often participated in training almost every year, there were only cadre representatives for each Posyandu who participated in the training. The training is sometimes at the Health Center, at the Regent's office."".....(Cader 1. F, 48 years old)

" It is the female cadres at Posyandu who socialize this program."...(M, 33 years)

Means
Based on the results, observations and interviews were conducted at the health center of Samata Regency Gowa. In the Posyandu activities carried out on May 5, 2023, there are facilities in the form of Infantometers, Stature meters, LILA measuring instruments, head circumference measuring instruments, and blood pressure devices, the results of which will be entered in the KIA book. Apart from that, there was also provision of additional food in the form of biscuits and food prepared by the cadres, such as moringa leaf pulp.
"Parties involved in procurement means support is Ministry of Health, sub-district which held it alone at Posyandu. Means used, such as tool anthropometry (tool measure) and food intervention (food addition factory) (Officer Nutrition,1. S, 38 years old)

"There are means from government form scales, tools measure LILA, tool tension. Regarding facilities if there is no stunting, facilities the we still use it. (Midwife 1. M, 35 years old)

"These facilities are jointly borne by the district and city governments, and there is also self-help from the community".....(Cader 1. F, 48 years old)

' Yeah, my child aged 1 year and 4 months came to weigh in at the Posyandu so he would know the weight so he would not get stunted. "...(A, 30 years old)

Funds
This shows that at the Health Center, Samata-related funds for the stunting prevention program come from the BOK, but these funds are managed by the Health Center treasurer, nutrition officers, midwives, and cadres, who only receive facilities and materials. Whether these funds are sufficient is still unknown because this program has only been running for one month with an initial target of three months.

"Funding obtained from BOK (Help operational health) is used for visit accompaniment education for at - risk families. Liquid funds the month for year this, that sets it up treasurer No officer nutrition, if the funds have not liquid then the program will still be executed. (Officer Nutrition: 1. S, 38 years old)

"No there are actually funds from Self-subsistent Community, midwife only supervise the PMT creation process, right? managing funds" (Midwife 1. L, 35 years old)

"As for funding, frankly we don't know because yesterday at the time of planning it had not been explained how much the funds would be. So they provide it and we only implement it."...(Cader 1. F, 48 years old)

Material
These materials were used in the stunting prevention program at the Health Center Samata, including biscuits from the Ministry of Health and local food ingredients such as fish, moringa vegetables, and rice.

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"Materials used covers biscuits from the Ministry of Health, and materials local from culture local. Materials used because it has already become a national program. Material available every month and no once finished distributed by the Ministry of Health through Service Health Province" ... (Officer Nutrition:1. S, 38 years old)

"PMT food, made porridge in which it is mixed leaf come on, vegetables mix, spinach, beans, various type vegetables, tofu, tempeh, bananas and sweet potatoes. For 90 days, material is given in accordance portions and targets after we do data collection very a month so that already clear the target' (Midwife 1. M, 35 years old)

' Ingredients for additional food in the form of rice, eggs, fish, and others, the cadre will cook them in the Dahsyat kitchen according to the specified schedule. (Cadre 1. P, 48 years old)

"There is a mother who gives Moringa porridge and biscuits to the children at the Posyandu, so they don't get stunted. "...(S, 40 years old)

Process

Planning

Based on the results of interviews and observations related to the planning of the stunting prevention program at the Samata Health Center, it was found that the target audience for this program was 1,000 HPK, pregnant women, toddlers under two years of age, young women, and families at risk of stunting. The giving of biscuits and making local food will be processed by cadres according to a predetermined schedule. Processed food was distributed to the target. Previously, stunting data were validated based on the results of measurements performed at Posyandu. Validation was carried out in February, and in March, another measurement was carried out to obtain accurate stunting data, after which the program was created.

"Planning is carried out by taking data from the Posyandu from the results of measurements of height, weight, LILA, and head circumference, for example, obtained in February, then validation will be carried out in March"....(Nutrition Officer 2. R, 40 years old)

"We don't know much about planning and other things, because we midwives here only carry out things, such as taking measurements and so on."...(Midwife 2. S. 50 years old)

"Actually, we, these cadres, are just disseminating information to the community, so we are not the ones who created this program, but we are the ones who have the task of conveying and processing this material to the community."".....(Cadre 2. M, 45 years old)

Implementation

Distribution: Distribution package biscuits and local food addition by midwives and stunting cadres. Distribution: This new started this 5th month and will continue for 90 days from May, June, and July. The target was pregnant Mother KEK. However, this will continue until the end year. For now, is distribution This has appropriate target or not yet, then Not yet can confirmed Because distribution This new held month this. It is hoped that this will be done distribution, and this food can lower the number of stunting incidents.

"Start 5th month, right? If the PMT toddler starts walking for 3 months, starting from May June until July for 90 days. Maintain average acceptance of mother pregnant KEK. (Officer Nutrition; 2. R, 40 years old)

"So, this program right new walk month this, early May so that We also distribute it do bang to bang to houses So besides shared at the time Integrated Healthcare Center took place "... (Cadre 2. M, 45 years old)

" Fine, so if We come to Integrated Healthcare Center That given There is biscuits There is Also porridge usually for given to child so Good That nutrition yes" (MY, 41 years old)

Monitoring: At stage monitoring duty: monitor the way distribution the in-officer nutrition Community Health Center. This needs to be monitored periodically to see how assigned cadres process material food locally for distribution. Therefore, from that's necessary monitored for ensure is materials used in processing Already in accordance recipes and portions, and whether registered toddlers obtain food. For this monitoring stage, myself, not yet can be held because of this program's new execution; however, this did documentation activities.

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"So, need We watch Also in a manner periodically How This right Later its processing assigned cadres For cooking and distributing Eat addition local this" .... (Officer Nutrition; 2. R, 40 years old)

"So that, we are midwives Also watch, right moment moms This come Keep going We weigh his son That right we know the data So from that data we monitor is target the ingredients This Already appropriate target or not yet" .... (Midwife 2. S, 50 years old)

Recording and reporting: Recording and reporting by officer nutrition. Recording: This was conducted from February to August. In addition, recording the needs of her parents in the KIA book can reveal the child's development. The recording process started from the measurement data at Paysandú, if a toddler constrained come so can come over his house for measurement. After obtaining the data, they will be input into the application and will be validated and published. Recording This must be done so that you can publish so that the village heads in the local region can know the stunting incident data.

"If No note, us Also No Can-do Publication For village, so must do recording" .... (Officer Nutrition; 2. R, 40 years old)

"I am note, so if after weighed noted later the results are in the KIA book so that you know heavy the weight The same its height so prevents from stunting" .... (M, 33 years old)

Outputs

Accuracy target

The results of this study show that the stunting prevention program carried out by the Samata Community Health Center has been right on target, with the main targets being pregnant women and toddlers under 2 years old, because in its implementation it goes directly to the target, so it does not go through intermediaries. The standards used to determine whether a child is stunted or not follow the WHO and Minister of Health Regulation number. 2 of 2020. To ensure that information regarding stunting is received by the community, cadres carry out outreach through the mobile Posyandu.

"We use it standard from WHO and Permenkes No. 2 of 2020, because of course standard this is recommended by the Ministry of Health "…. (Officer Nutrition; 2. R, 40 years old)

"So right if moms come, we weigh that Formerly heavy body son, measure its height Also So if There are those who have the potential for stunting and then we intervene more continued" .... (Midwife 2.S, 50 years old)

"So, this is the program we are targeting to Mother pregnant and child under 2 years old" .... (Cadre 2. M, 45 years old)

"So, for this program very help very deck, because Integrated Healthcare Center come directly in the villages So easy reachable" .... A, 30 years old)

Program coverage

The results of in-depth interviews conducted with nutrition officers from the Samata Community Health Center and the community that received this stunting prevention program show that this program is a national program that must be implemented and that cross-sectors must be involved in it. The BKKBN often holds workshops every three months to monitor such activities. The community will be educated to come to Posyandu to monitor their children's progress.

Data on stunting results from January to April included 173 children. The scope of this program includes all people in the Samata area, especially at-risk family stunting, with a target of 14%. However, it cannot be determined whether this program can meet this target because it has just begun to run.

" Stunting is cross-sectoral, so the BKKBN often holds workshops."...(Nutrition Officer 2. R, 40 years)

"Always join Posyandu, there is a lot of enlightenment specifically on stunting so we participate so we can prevent it."...(S, 40 years old)

"The program carried out by the Health Center is very good, because every month it is arranged, every date is ready, if there is a delay then the officers will convey it before the D-day".....(A, 30 years old)

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"I'm glad Ki Dek is participating, because he knows about stunting ".....(M, Y, 41 years)

"I just joined the program, I just heard about it from Posyandu."...(A, M, 37 years)

Based on the results of interviews with the surrounding community, it shows that previously there was counseling about stunting and the " Dahsat " program made by the Samata Health Center just started running in May. Dahsyat stands for Healthy Kitchen Overcome Stunting, which is a program where cadres are assigned to process local food ingredients such as rice, eggs, moringa leaves, vegetables, and fruits. This processing is accompanied by a midwife, whose job is to provide recipes and portion sizes according to nutritional needs.

Discussion

Inputs

Power

Health workers are a component of the main giver service health to the public in frame, achieving objective development of health. Staff on duty in planning, executing, and coordinating health programs. (Matsya, et al 2022).

According to Law No. 36 of 2014 Article 1, Health Workers are everyone who dedicates themselves to field health as well as their own knowledge and skills through education in the field of health for type certain need authority for do effort health. (Indonesia, I.2014)

The energy in the stunting prevention program at Health Center Samata consisted of three officers, two midwives, and two stunting cadres. Officer nutrition on duty for record and report number stunting incident, while midwives on duty do measurement anthropometry as well as inspection to mother pregnant, cadre also join in help midwives in measurements, and also on duty processes and distribute food addition to the target. Regarding education officer nutrition, two of them are Bachelor of Health graduate Society and one is D3 Nutrition graduate, for midwife First is D4 Nutrition graduate and midwife second is Health SI graduate Public, whereas cadre, cadre First is D3 Nutrition graduates and cadres second Bachelor of Law graduate.

This is in line with research conducted by Yusma Indah Jayadi et al. (2022), who stated that energy in the implementation of the awarding program food addition covers officer nutritionists, cadres, and midwives. (Indah JY et al 2022)

Connection between stunting and giving food addition This own close relationship, because Wrong One factor the cause of stunting is poor nutrition so that with it giving food addition, this will lower potency affected by stunting in children

The power the has followed training prevention of stunting and for cadres who have not followed training can still follow the program with cadres and midwives who have joined the program. Giving training: This aims to increase power knowledge about What That stunting, causes, symptoms, and prevention. Training: This was followed by officers' nutrition, midwives, and cadres, twice a year.

Other studies conducted by Purnamasari et al. (2020) found that training cadres shows positive results in enhancing knowledge and practice cadre integrated healthcare centers in effort to prevent cases of stunting in toddlers. (, Purnamasari et al. 2020).

Means

According to the KBBI, all things can be used as tools to reach meaning or purpose. Based on the results of observations and interviews with the workers at the Community Health Center Samata, for the means used in stunting prevention programs include infant meter, stature meter, tool measure LILA, Tool measuring circumference heads, and tools measuring blood tension, results measurement the will enter into the MCH book. Means given by the Ministry of Health for measurement anthropometry for detecting initial symptoms of stunting.

Research conducted by Mursidah, AS (2022), shows that nutritional status assessment in a manner anthropometry which includes measurement Tall Body, Weight Body, or Long Body become one parameter in determining whether the child is experiencing stunting or not. (Mursidah, USA 2022).

Other research conducted by Yusma Indah Jayadi et al. (2022) related the means used in the measurement of nutritional status by the public health center Kolonodale, including digital scales, scales body stand, weigh baby, measurement tall body, and the LILA ribbon works well. (Indah JY et al 2022)

This was in accordance with the Ministry of Health. In two of 2020, regarding standard anthropometry, the children mentioned that anthropometrics is a method used to evaluate the size, proportion, and composition of the human body. Standard Anthropometrics Child is a collection of data about size, proportion, and body composition as a reference for assessing nutritional status and child growth trends. (Permenkes No. 2 2020).

Fund

According to KBBI, funds are provided for something necessary.

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Evaluation empowers stunting prevention programs in community health centers samata related to funding for the stunting prevention program from BOK, but these funds were arranged by the Treasurer Health Center, officers' nutrition, midwives, and cadres only accept facilities and materials. For Enough or not, the funds Still Not yet are known because program This new run for one month with the initial target for three months.

Based on data from the Ministry RI finances in 2022, the government allocated funds amounting to IDR 44.8 trillion to support the Accelerated Stunting Prevention Program. Budget the consists from spending spread across 17 Ministries and Institutions amounting to IDR 34.1 trillion and the Regional Government through Allocation Funds Special (DAK) Physical amounting to IDR 8.9 trillion as well as Non-physical DAK amounting to IDR 1.8 trillion. (Indonesian Ministry of Finance). 2022).

This is in line with the research conducted by Yusma Indah Jayadi et al. (2022), who obtained information that the funds received from public health centers addressed for health program operations in the soul public health center Samata sourced from BOK and JKN funds. The amount of money received from public health centers must ensure that the program is run. With these funds, various need inhabitant public health centers fulfilled in the implemented program, for example, mission outside country and costs operational training personal center Health Society. (Indah JY et al 2022)

A study conducted by Mutia et al. (2019). In matter financing, health programs cover intervention nutrition Specific from Service Health to Public health centers using realized BOK funds from the center on the fourth moon every year, yet there is a budget or financing special for nutrition-specific intervention programs. Availability of special funds from government for intervention programs nutrition Specific very needed in activities carried out for example activity visit House For monitoring mother start pre-conception until the baby is 2 years old, or procurement of more promotional media innovative. (Muthi et al ., 2020).

Material

Evaluation empowerment of stunting prevention programs in health centers samata-related material for the stunting prevention program provided by the cadre Integrated Healthcare Center or cadre health region local origin from the Ministry of Health and distributed through service health such as biscuits and ingredients local from local culture, such as porridge mixed with various types of vegetables.

This is in line with research conducted by Yusma Indah Jayadi et al. (2021). The mockup Food Addition forms biscuits in addition to cooked food from porridge peanut greens and Manado porridge. (Indah JY et al 2021)

Other studies are consistent with those of Nabilah et al. (2022). Type Giving Food Supplement (PMT) exists in two types: PMT recovery and PMT counseling, both of which have the same goal of fulfilling the need substance the required nutrition by the toddler. Supplementation nutrition, which is more practical and guarantees composition substance nutrition, can also be provided by food addition manufacturers. Food addition counseling aim: To fulfil the need substance the required nutrition by toddlers. (Nalah , et al 2022).

Process

Planning

Based on planning stunting prevention programs at Community Health Centers Samata, the targets of this program are 1000 HPK, pregnant mothers, toddlers under 2 years old, teenagers' daughters, and families at risk of stunting. Planning was Also performed by fetching data from the Integrated Healthcare Center around the Public Health Center Samata to detect early stunting symptoms in children. Furthermore planning done by setting distribution biscuits as well as making food local will cooked by the cadres in accordance timetable Then will distributed to target above. Before starting this program, we will perform a stunting data validation to determine the number of stunting incidents.

Research conducted by Yusma Indah Jayadi et al (2022) in the planning process by doing detection early For find problem health soul more beginning so that can is known in a manner Certain is There is member experiencing family disturbance soul. (Indah JY et al 2022)

This is in line with research by Nur Wafiq Azizah et al. (2021), where the giving program food addition is a government program in effort prevention and recovery of nutrition deficiency and stunting in toddlers. In the implementation of the PMT program, Health Cadre Village Pakuncen supposedly functioned as a PMT program in the form of biscuits held by the Ministry of Health through field programs service health nutrition public held based on planning according to the number of cases of nutrition lack and stunting in Pakuncen village. Similarly, the program food addition form held milk by area in accordance with planning special amount case nutrition bad and stunting in the area Regency Wonosobo in a manner whole. (Azizah & Hermawan , 2021)

Implementation

Distribution: Based on the results, interviews were conducted with stunting cadres for distribution package biscuits and local food addition by midwives and stunting cadres. Distribution: This new started in the 5th month and will continue for 90 days from May, June, to July. The target was the pregnant Mother KEK. However, the distribution will still walk until the end year.



This is in line with the research conducted by Yusma Indah Jayadi et al. (2022) regarding the Giving Program Food Addition given by the Public Health Center every month for three months or 90 days in a row. (Indah JY et al 2022)

Who supports studies This study was conducted by Mardiana Nur Agustin et al. (2022) in which giving is also done in food addition form giving biscuits pumpkin yellow. Milk and porridge . (Mardiana et al , 2022).

Giving food addition distributed locally by cadre is more effective in declining stunting rate, because if only distribute biscuits from the Ministry of Health That Not yet Enough For fulfil number need nutrition.

Monitoring: At stage monitoring on duty, monitor the way distribution is the officer nutrition Community Health Center. Monitoring this need is done periodically to see how assigned staff process material food locally for distribution. Therefore, monitoring is carried out to ensure that the materials used in processing are in accordance with the recipes and portions, and what registered toddlers obtain food. For this monitoring stage, myself cannot yet be held because of this progra's new execution; however,ethisididne documentation activities.

For activity monitoring, a little different from research conducted by Yusma Indah Jayadi et al. (2022) for monitoring carried out every three months , different from monitoring for stunting performed every time it is held posyandu. (Indah JY et al 2022)..)

This is a little different from research done by Gina Mutia et al., where supervision was done through sexy nutrition and wellness form monitoring activities carried out one month in a manner tiered starting from center to province, province to district, and district to health center. Supervision involves all over program and list holders sectoral so that activities that have not yet been carried out or experience constraints can be known since early and soon done effort. (Mutia et al ., 2020).

Recording and reporting: Results: Recording and reporting by officer nutrition. Recording This start was done from February to August, in addition to recording Also need done by her parents each in the MCH handbook for can see the development child. The recording process started from the measurement data at Posyandu; if there is troubled toddler come, so can come over his house For do measurement. After obtaining the data, they will be inputted to the application, validated, and published. Recording: This must be done so you can published so that the village heads in the local area can know the data on stunting incidents.

This finding is consistent with the results reported by Muin et al. (2021). System recording and reporting of integrated health centers (SP2TP) are activities that report general data, facilities, personnel, and effort service health in society. Development system information recording and reporting of nutritional status this stunting toddler can accessed online via computers and android mobile phones, so that the process of recording and reporting can done in a manner accurate, fast, and easy used When just as well as anywhere, use can help monitor nutritional status toddlers and adoption level decisions managerial. The interview results showed that the system recorded and reported monthly made or by nutrition programs. Good manual and online reports. For monthly reports, the manual can appropriate time; however, for a report that is an entry that depends on a good or bad network. The report enters the public health center, which continues to service health. (Muin and Marwati 2021).

However, the results differ from those of Yusma Indah Jayadi ddk (2021), which shows that parents from small No children make notes daily. Registration is performed daily by expert nutrition or midwives according to technical instructions, where the mother makes notes daily simply about accepting additional food, which is checked every Sunday by cadres and midwives in the village. (Jayadi et al., (2021).

Outputs

Accuracy target

The implemented stunting prevention program by Public Health Center Samata has an appropriate target with the target mainly being mother pregnant and toddler under 2 years, because in implementation his direct to target So No through intermediary. The standard used for see is child the stunted or no following the WHO and Permenkes number. 2 of 2020. To ensure that information related to stunting is accepted by the public, cadres counsel through the Integrated Healthcare Center .

This was supported by research conducted by Yusma Indah Jayadi et al. (2021), where officer monitoring anthropometry such as measurement of heavy body and height body every month was performed to ensure program targets have been right. (Jayadi et al., (2021).

Results studies This Also in line with research Daughter Angraini Oktavianty (2023) related group target repair nutrition public toddler stunted status already appropriate that is Mother pregnant, Mother breast-feed as well as toddler, look in activity movement program innovation overcome stunting with breast milk (GUSI) in the community Already follow participation active in activities carried out in Sungai Pandan District. (Oktavianty , PA 2022)

Program coverage

The scope of this program loads all communities residing in the Samata region, specifically families at risk of stunting, with a target of 14%. However, For moment, it is not yet possible to determine what program can meet that target because the new start is executed. The target of this program covers pregnant mother babies under 2

years of age. The Integrated Healthcare Center goes around so that you can reach the public to ensure that this program is known by the public.

This is in line with research by Steady Pambudi Mukti and Muhammad Khozin (2022), who achieved objective program stunting prevention in the sub-districts of Pandowoharjo, giving enough start to good in-run programs. The Cadres companion Integrated Healthcare Center decides that stunting figures that appear Can said reasonably tall will but cadres want to make sure by trying to present return party Public Health Center For do weigh repeat toddlers and measured repeat that turns out the result different, indicated numbers more A little compared to initial data. This is Wrong One, which cadres companion Integrated Healthcare Center, truly implements for a successful achievement program. (Mukti & Khozin , 2023).
Unlike the results of research conducted by Yusma Indah Jayadi et al. (2021), who stated that the target of the program is still below the target, on the other hand, the stunting prevention program at Health Center Samata Not yet is known is has target or Not yet because of the program being executed. (Jayadi et al., (2021).

Conclusions And Recommendations

Evaluation power in the stunting prevention program, especially for cadres, still needs to be improved because there are a number of cadres who have not followed training; however, the program was allowed to join the program directly with midwives and existing cadres. Evaluation for means, spelled out Already complete only needs calibration; for example, tools such as scales and tension still work fine or no. Evaluation For ingredients, " Powerful " innovation (Kitchen Healthy Overcome Stunting) provides a positive impact because the public not only accepts biscuits manufacturers, but food processed fresh by cadres according to recipes and portions needs nutrition. Evaluation towards funds, midwives and cadres should notified about the amount of funds they have thank you, inside matter This cadres and midwives at the Community Health Center Samata only given material food raw For they process and distribute to society. Evaluation of the process, that is, planning needs food addition for toddlers at the health center Samata as well as means supporters need calculated well to be precise targets. For recording and reporting, the amount is not yet known because of the new program start run so that Still Keep going done data collection at Posyandu. An evaluation of the output is that this program can lower the number of stunting incidences, but the expected target is a stunting rate that can be reduced by up to 14%.

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Effects of Different Processing Methods on Bioactive Components and Their Bioaccessibility in Red Beet

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Abstract

Red beet (*Beta vulgaris*) is a valuable vegetable known for its bioactive components such as betalains, polyphenols, antioxidants, vitamins, minerals, and dietary fibers, and their potential health benefits. However, the bioaccessibility of these beneficial components can be influenced by different processing methods. This study aims to investigate the effects of several processing techniques, including jam and marmalade production, drying, pickling, freezing, and beverage production, on the bioactive components and their bioaccessibility in red beet. Literature findings indicate that the processing methods had varying effects on the retention and bioaccessibility of bioactive components in red beet. Jam and marmalade production appeared to preserve antioxidants and phenolic compounds, while drying exhibited a significant loss of heat-sensitive nutrients. Pickling resulted in altered mineral content, while freezing showed minimal impact on the bioaccessibility of bioactive compounds. Interestingly, the processing of fruits and vegetables into beverages has been found to enhance the bioaccessibility of bioactive components through the breakdown of cell walls and increased solubility. Moreover, the changes in the bioaccessibility of bioactive components were associated with modifications in the microstructure of red beet samples observed through scanning electron microscopy (SEM) imaging. The breakdown of cellular barriers and the formation of new structures during processing played a crucial role in determining the bioaccessibility of these bioactive compounds. Understanding the impact of processing methods on bioactive components and their bioaccessibility in red beet is vital for optimizing its nutritional value and potential health benefits for consumers. These findings have important implications for the food industry and can aid in the development of novel processing strategies that preserve or enhance the bioaccessibility of bioactive compounds in red beet-based products. Additionally, it can inform consumers about the potential impact of processing methods on the bioactive components in red beet and help them make informed choices regarding their consumption. Further investigations are needed to explore the influence of these processed red beet products on human health.

Keywords: *Red beet, bioactive components, bioaccessibility, processing methods*

Farklı İşleme Yöntemlerinin Kırmızı Pancardaki Biyoaktif Bileşenler ve Bunların Biyoerişilebilirliği Üzerine Etkileri

Özet

Kırmızı pancar (*Beta vulgaris*), betalainler, polifenoller, antioksidanlar, vitaminler, mineraller ve diyet lifleri gibi biyoaktif bileşenleriyle ve bunların potansiyel sağlık faydaları ile bilinen değerli bir sebzedir. Ancak, bu faydalı bileşenlerin biyoerişilebilirliği, farklı işleme yöntemlerinden etkilenebilir. Bu çalışmanın amacı, reçel ve marmelat üretimi, kurutma, turşuya işleme, dondurma ve içecek üretimi gibi çeşitli işleme tekniklerinin pancarın bioaktif bileşenleri ve bunların biyoerişilebilirlikleri üzerindeki etkilerini incelemektir. Literatür bulguları, işleme yöntemlerinin pancardaki bioaktif bileşenlerin korunması ve biyoerişilebilirliği üzerinde değişken etkileri olduğunu göstermektedir. Reçel ve marmelat üretimi, antioksidanları ve fenolik bileşikleri korumaya yardımcı olurken, kurutma işlemi, ısıya duyarlı besin maddelerinin önemli bir kaybına neden olmuştur. Turşuya işleme, mineral içeriğinde değişikliklere yol açarken, dondurma işlemi biyoerişilebilirlik üzerinde minimal bir etki göstermiştir. İlginç bir şekilde, meyve ve sebzelerin içeceğe işlenmesiyle, hücre duvarlarının parçalanması ve çözünürlüğün arttırılması sayesinde biyoaktif bileşenlerin biyoerişilebilirliği artmıştır. Ayrıca, bioaktif bileşenlerin biyoerişilebilirliğindeki değişiklikler, taramalı elektron mikroskopu (SEM) görüntüleme yoluyla gözlemlenen pancar örneklerinin mikroyapısındaki değişikliklerle ilişkilendirilmiştir. İşleme sırasında hücresel engellerin parçalanması ve yeni yapıların oluşumu, bu bioaktif bileşiklerin biyoerişilebilirliğini belirlemede kritik bir rol oynamaktadır. Pancarın bioaktif bileşenleri ve biyoerişilebilirlikleri üzerinde işleme yöntemlerinin etkisini anlamak, tüketiciler için besin değerini optimize etmek ve potansiyel sağlık faydalarını artırmak açısından önemlidir. Bu bulgular, gıda endüstrisi için önemli sonuçlar doğurmakta ve pancar bazlı ürünlerde biyoaktif bileşiklerin biyoerişilebilirliğini koruyan veya artıran yeni işleme stratejilerinin geliştirilmesine yardımcı olabilmektedir. Ayrıca, tüketicilere işleme yöntemlerinin pancardaki bioaktif bileşenlere olan etkisi konusunda bilgi vererek, tüketimleri konusunda bilinçli seçimler yapmalarına yardımcı olabilir. İnsan sağlığı üzerindeki etkisini değerlendirmek için daha fazla araştırmaya ihtiyaç vardır.

Anahtar Kelimeler: *Kırmızı pancar, biyoaktif bileşenler, biyoerişilebilirlik, işleme yöntemleri*

Giriş

Günümüzde beslenmeye bağlı olarak artan sağlık sorunlarıyla beraber tüketicilerin besin değeri yüksek ve daha az işlem görmüş fonksiyonel gıdalara olan ilgisi giderek artmaktadır. Fonksiyonel gıda kavramı ile insanlar beslenme alışkanlıklarını değiştirmeden daha sağlıklı ürünler tüketebileceklerdir. Bir gıdanın 'fonksiyonel gıda' olarak adlandırılması için, sahip olduğu besin öğelerinin dışında insan vücuduna bir veya birden fazla fizyolojik yararının olması ve aynı zamanda hastalık riskini azaltması gerekmektedir. Sonuç olarak insanların beslenirken sağlık açısından daha kaliteli gıdalar tüketmesi ve beslenmenin neden olduğu hastalıkların görülme sıklığını azaltmak, kontrol altına alabilmek için günlük diyetin fonksiyonel özelliğe sahip gıda bileşenleriyle zenginleştirilmesi büyük önem arz etmektedir (Öztürk ve Çopur,2008; Karaduman, 2011). Bu gıdalar insan sağlığına olumlu etkilere sahip, yüksek konsantrasyonda biyoaktif bileşikler içeren besinlerdir. Biyoaktif bileşikler, bitkisel veya hayvansal kaynaklarda bulunan veya bunlardan türetilen doğal olarak oluşan kimyasal bileşiklerdir. Örneğin polifenoller gibi biyoaktif fitokimyasallar bitkisel gıdalarda bulunan ikincil metabolitlerdir. Sağlığa yararlı gıdalara duyulan ihtiyaç göz önüne alındığında gıda üretiminde uygulanan işlemlerin gıda içerisinde yer alan fonksiyonel bileşenleri üzerindeki olumsuz etkileri gıda endüstrisini endişelendirmektedir. Endüstride gıdaların kalitesini ve güvenliğini korumak, raf ömrünü uzatmak, gıdayı daha dayanıklı hale getirmek ve tüketiciye çeşitli, hızlı ve güvenilir gıda sunmak için birçok yöntem mevcuttur. Sterilizasyon, pastörizasyon, pişirme, kurutma ve haşlama gibi ısıl işlemler, çeşitli özellikteki paketleme teknikleri (vakum paketleme, MAP vs..) bu yöntemlerden birkaçıdır. Bu gibi geleneksel ısıl gıda işleme teknolojileri enzimatik ve mikrobiyolojik inaktivasyonu sağlarken, yüksek sıcaklık, gıdaların besin değeri, lezzet, renk ve duyusal özelliklerini olumsuz yönde etkilemektedir. Kırmızı pancar içerisinde çok miktarda biyoaktif bileşik içeren bir sebzedir. İçerdiği biyoaktif bileşikler sebebiyle sağlığa yararlı birçok özelliği bulunan kırmızı pancarın mükemmel fizyolojik özelliklere sahip sebze olarak ifade edilmekte ve antioksidan özelliği yüksek ilk 10 sebze arasında yer almaktadır. Tüm bu sağlık yararlarından faydalanmak amacıyla kırmızı pancar çeşitli şekillerde (çiğ, turşu, reçel, meyve suyu vs.) tüketilmektedir. Çiğ haricinde tüketilebilir hale getirilebilmek için kırmızı pancara çeşitli işlemler uygulanmaktadır. Özellikle ısıl işlem olmak üzere birçok işleme ve muhafaza yöntemi kırmızı pancarın içerisinde bulunan biyoaktif bileşiklerin miktarını değiştirmektedir (Göksu ve Bölek.,2023). Bu derlemede farklı işleme yöntemlerinin kırmızı pancardaki biyoaktif bileşenler ve bunların biyoerişilebilirliği üzerine etkilerinden bahsetmek amaçlanmıştır.

Kırmızı Pancar

Pancar (*Beta vulgaris* L.) Chenopodiaceae ailesine ait iki yıllık otsu bir bitki olarak sınıflandırılmaktadır. Asya ve Avrupa kökenli olan sebze ılıman bölgelerde yetişmektedir. Pancar 105 cinse ayrılmış yaklaşık 1400 tür içermektedir (Sakhare ve ark.,2019; Nirmal ve ark.,2021; Shuaibu ve ark.,2020; Salamatullah ve ark.,2021; Evanuarini ve ark.,2023). Biyoaktif bileşikler açısından zengin bir sebze olan kırmızı pancar sağlık üzerinde olumlu etkileri bulunan betalainlerin potansiyel bir kaynağıdır (Sakhare ve ark.,2019; Demirbaş.,2023). Kırmızı pancarın kendine özgü cezbedici rengi, bir betalain olan betaninden kaynaklanmaktadır.Kırmızı pancar önemli bir vitamin kaynağıdır. A, C ve E gibi antioksidan özellikteki vitaminleri içermesinin yanı sıra K ve B vitaminlerinide içermektedir. B vitamini grubundan; B2-riboflavin, B3-niasin, B1-tiamin, B9-folatlar, B5-pantotenik asit, B6-piridoksin ve B12-siyankobalamin'i yapısında bulundurmaktadır. Folik asit içeriği de yüksek bir sebzedir. Yapısında yer alan mineraller ise potasyum, manganez, demir, magnezyum, sodyum, bakır, kalsiyum, çinko ve fosfordur. Kırmızı pancar vitamin ve minerallerin yanında antioksidan özelliğe sahip, besleyici özellikteki fenolik bileşikleride yapısında büyük miktarlarda içerdiği bilinmektedir. Kırmızı pancar flavonoidler grubundan; kaempferol, rhamnocitrin, rhamnetin, astragalin ve tiliroside içermektedir. Bunların yanı sıra yapısında fitosterolleri, askorbik asitleri ve karotenoidleri bulundurmaktadır. Kırmızı pancar yapısında pektin ve selüloz lifleri bulunmaktadır (Babarykın ve ark., 2019). Temel şekeri sükrozdur. Az miktarda glikoz ve fruktozda içerdiği bilinmektedir. Bu konuda düşük enerji değerine sahip şekerler içerdiği söylenebilmektedir. Bunların yanısıra kırmızı pancar valin, glutamik asit, alanin, fenilalanin, prolin, treonin, metiyonin gibi aminoasitleri, saponinleri, tanenleri ve alkaloidleri içermektedir (Kale ve ark.,2018; Chhikara ve ark.,2019; Ceclu&Nistor.,2020). Kırmızı pancarın bu zengin içeriği sebebiyle in vitro ve klinik öncesi çalışmalarla kanıtlanmış birçok sağlık yararları bulunmaktadır. Anti-hiperkolesterolemik, anti-nefrotoksisite, anti-mutajenik, anti- hipertansif, hematopoetik etkilerinin yanısıra radyo-koruyucu, anti-depresan, anti-oksidatif stres, anti-hiperglisemik ve anti-kanserojen özellikleri bulunmaktadır. Güçlü antiviral, antifungal ve antibakteriyel özelliklere sahiptir. Antioksidan, aninflamatuar, hepato-koruyucu ve antikanserojenik özellikleri ile kardşyovasküler, diyaber veya hipertansiyon gibi hastalıkların önlenmesine yardımcı olmaktadır (Nowacka ve ark.,2019). Balgam ve idrar söktürücü ve gaz giderici gibi özellikleri vardır. Yüksek nitrat ve şeker içeriği ile sporcularda enerjiyi yükseltmektedir (Sakhare ve ark.,2019). Kırmızı pancar antioksidan bir bileşik olan alfa lipoik asiti içermektedir. Bu asit diyabetli hastalarda glikoz seviyesini düşürmeye, insülün duyarlılığını arttırmaya ve oksidatif stres sebebiyle meydana gelen olumsuz

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değişiklikleri önlemeye yardımcı olmaktadır. İçerdiği kolin ise öğrenme ve hafıza gelişimine olumlu katkı sağlamakta ve kas hareketine yardımcı olmaktadır. Ayrıca kolin hücre zarlarının yapısının korumada, sinir uyarılarının iletilmesinde, yağın emiliminin kolaylaştırılmasında görev almaktadır (Shuaibu ve ark.,2020). İçerdiği çeşitli B vitaminleri ile beyine giden kan akılını arttırmakta ve bu işlevle bunama ve hafıza kaybının etkisinin azalmasına yardımcı olmaktadır. Yapısında yer alan selüloz lifi bağırsak hacmini arttırır ve gastrointestinal sistemde boşaltımı kolaylaştırırmaktadır. Sebzenin içerdiği fitokimyasalların yemek borusu, cilt, karaciğer ve akciğerde meydana gelebilecek kanser çeşitlerine karşı koruyucu etkisi mevcuttur. Potasyum mineraline sahip olduğu için bu sebze, beslenme ile tüketilen sodyumun zararlı etkilerini azaltmaktadır (Ceclu&Nistor.,2020).

Kırmızı pancar; çiğ, pancar suyu,salata, haşlanmış, fırınlanmış cips halinde ya da kurutulmuş veya diğer kombinasyonlarda tüketilebilmektedir (Ceclu&Nistor.,2020). *B. maritima, B. vulgaris* ve *B. adanensis* dahil olmak üzere üç *Beta vulgaris* alt türü piyasada yer almaktadır. Kırmızı pancar çeşidi olan *Beta vulgaris subsp. vulgaris conditiva* ise tüm dünyada turşu, salata veya meyve suyu yapımında yaygın olarak kullanılmaktadır (Nowacka ve ark.,2019). Tüm bu ürünlerin yapımı sırasında kırmızı pancara birçok gıda işleme tekniği uygulanmaktadır. Haşlama, kurutma, pişirme, pastörizasyon bu işlemlerden bazılarıdır. Bu gibı gıda işleme uygulamaları sebzelerin fiziksel özelliklerinde ve kimyasal bileşiminde bir takım değişiklikler meydana getirmekte ve yapılarında bulunan sağlığa yararlı biyoaktif bileşiklerin miktarında değişikliğe sebep olabilmektedir.

İşleme Tekniklerinin Gıdalar Üzerine Etkileri

Gıdanın muhafaza süresinin uzun olması tüketiciler için en önemli faktörlerden birisidir. İşleme gıdayı daha güvenli, daha lezzetli ve daha dayanıklı hale getirmek amacıyla uygulanmaktadır. Uygun işleme yöntemleri ile sebzenin fonksiyonel özellikleri maksimum düzeyde tutulabilir ve işlenmiş ürünün ticarileştirilmesi, tüketiciye sağlık açısından faydalı bir ürün sağlamanın bir yolu olabilmektedir. Fakat gıdayı korumak amaçlı uygulanan işlemler sırasında gıdanın beslenme değerinden daha çok güvenliği ve kalitesi ön olanda tutulmaktadır (Göksu ve Bölek.,2023; Öztürk ve Çopur,2008; Karaduman, 2011). Gıdaların muhafaza süresi boyunca bozulmasını önlemek, mikrobiyolojik aktivitenin durdurulması ve kimyasal ve biyokimyasal reaksiyonların kontrol altına alınabilmesi ile sağlanabilmektedir. Bu amaçla kullanılan yaygın proses tekniklerinden biri ısıl işlemdir. Isıl işlem mikroorganizma ve enzimlerin inaktivasyonunu sağlamaktadır. Kurutma, pastörizasyon, buharlaştırma ve yüksek sıcaklıkta sterilizasyon gibi geleneksel gıda teknolojileri ürünlerinin mikrobiyolojik güvenliğini veya stabilitesini garanti edebilir ancak ısıya duyarlı biyoaktif bileşikler gibi fonksiyonel gıda bileşenlerini degradasyona uğratabilmektedir (Göksu ve Bölek.,2023; Karabacak.,2015; Zhang.,2018). Isıl işlem yöntemlerinde, aşırı veya uzun süreli sıcaklık uygulamaları nedeniyle önemli besin kayıpları meydana gelebilmektedir. Ayrıca gıdalar işlenirken uygulanan yüksek sıcaklıklar sonucunda işlem süresinin uzunluğu sağlığı tehdit eden serbest radikaller oluşabilmekte veya tat-aroma kayıpları görülebilmektedir. Isıl işlemlerin yetersiz olması durumunda ise, mikrobiyolojik tehlikeler meydana gelebilmektedir (Karabacak.,2015 Zhang ve ark., 2018). Günümüzde beslenme kaynaklı hastalıklar giderek artmaktadır. İnsanların yedikleri veya yemedikleri gıdalardan dolayı hastalandıkları gerçeği dünyada iyice kabul görmeye ve buna bağlı olarak da beslenmenin önemi giderek daha iyi anlaşılmaya başlanmıştır (Öztürk ve Çopur,2008; Karaduman, 2011). Bu sebeple tüketiciler doğala yakın özellikleri bulunan, daha az işleme maruz kalmış fonksiyonel gıdalara yönelik taleplerini arttırmaktadırlar (Göksu ve Bölek.,2023). Dolayısıyla bilinçli tüketiciler sağlıklı bir yaşama sahip olmak ve sürdürebilmek için beslenirken aynı zamanda iyi hali koruyan, geliştiren ve hastalık oluşturma riskini de azaltan sağlığa yararlı gıdalar ile beslenmek istedikleri için tercihlerini insan sağlığı üzerinde faydalı etkiler gösteren yüksek konsantrasyonda biyoaktif bileşikler içeren fonksiyonel gıda ürünleri yönünde yapmaktadır (Öztürk ve Çopur 2008; Reis ve Abu-Ghannam 2014; Döner ve İçier, 2018). Dolayısıyla gıda işleme sırasında biyoaktif bileşenlerin degredasyona uğramaması için yeni uygulamalar gerekmektedir. Bu durumdan yola çıkılarak gıda endüstrisinde düşük işlem sıcaklıkları ve kısa işlem süresine sahip yeni termal olmayan teknolojiler geliştirilmektedir (Zhang vd., 2018). Isıl olmayan işleme teknolojileri, gıdayı ısının olumsuz etkisinden koruyarak gıdanın fiziksel, besin değeri ve duyusal niteliklerini muhafaza eden, mikrobiyal inaktivasyonu gerçekleştiren yeni alternatif gıda işleme teknikleridir. Günümüzde vurgulu elektrik alan (PEF), yüksek hidrostatik basınçlı işleme (HHP), kızılötesi ısıtma (IR) ve ohmik ısıtma (OH) gibi geleneksel ısıl işlemlere alternatif olarak geliştirilen teknolojiler mevcuttur. Çevrenin korunması, enerji verimliliği, besin değerinin korunması ve işleme süresinin kısaltılması güncel gıda işleme teknolojilerinin kullanılmasının temel faydalarıdır (Göksu ve Bölek.,2023). Örneğin elma suyu gibi ürünlere PEF uygulanmış ve maya hücrelerinde 5,03 log azalma sağladığı gösterilmiştir. Isıl olmayan teknolojiler, gıdalardaki lipoksijenaz (LOX), polifenoloksidaz (PPO), peroksidaz (PO) ve pektin esteraz (PE) gibi enzimlerin aktivitesini inhibe edebilmektedir. Isıl olmayan teknolojilerin mekanizmasında ilk olarak mikroorganizmanın düzenleyici işlevini ortadan kaldırılmakta, ikinci aşamada ise mikroorganizmanın genetik materyallerini yok edilerek metabolik bozukluklara neden olmaktır (Zhang ve ark.,2018).

Isıl işlemin bir dalı olan kurutmanın çeşitli türleri mevcuttur. Çeşitli kurutma teknikleri arasında; vakumlu mikrodalga kurutma ile konvektif kurutma, güneşte kurutma, vakumlu mikrodalga kurutma, düşük basınçlı kızgın buhar kurutma, ısı pompalı kurutma, radyo frekansı kurutma, dondurarak kurutma, akışkan yataklı kurutma, mikrodalga kurutma, mikrodalga destekli konvektif kurutma, kırılma pencere kurutma ve kızılötesi kurutma gibi bir çok teknik bulunmaktadır (Bulut,2021).

Kurutma işleminin meyve ve sebzelerdeki biyoaktif bileşenler üzerindeki etkilerine bakıldığında tekniğin çeşidine bağımlı olarak birçok farklılık meydana getirdiği bildirilmiştir. Örneğin yapılan araştırmalar sonucunda tropikal meyvelerde dondurarak kurutma sonucunda önemli C vitamini kayıpları görüldüğü belirtilmiştir. (Marques ve ark., 2006). Asami ve ark. (2003), dondurarak kurutma yönteminin çilek ve mısırdaki toplam fenolik bileşiklerin sıcak hava ile kurutma yöntemine kıyasla daha yüksek olduğunu belirtmiştir. Yapılan bir başka çalışmada dondurarak kurutma uygulanmış yaban mersini ve ahududunun hava ile kurutma yöntemi uygulanmış benzerlerine kıyasla antosiyanin, fenolik bileşikler ve antioksidan kapasitelerinin daha yüksek olduğu ve hatta bazı durumlarda biyoaktif bileşen miktarındaki artış yaşandığı ifade edilmiştir (Sablani ve ark., 2011). Bunun dışında genel olarak sıcak hava ile kurutmanın güneşte kurutma ile karşılaştırıldığında toplam fenolik bileşik içeriği ve antioksidan kapasitesi açısından ürünlerin kalitesini önemli ölçüde azalttığı bildirilmiştir (Melgar-Almanza ve ark., 2015).

Pişirme, ısı uygulanan ve gıdanın yapısında değişiklikler meydana getiren bir işlemdir. Yapılan bir çalışmada haşlama, buhar ve sous vide pişirme teknikleri kullanılarak, havuçlar her teknik için üç farklı sürede pişirilmiştir. Taze havuç ve pişmiş havuç örneklerinde antioksidan aktivite, toplam fenolik madde ve β-karoten analizleri yapılarak sonuçlar karşılaştırılmıştır. Çalışmada karotenoidlerin meyve ve sebzelerde sarı, kırmızı ve turuncu renkten sorumlu olan bileşikler olduğu, pişirme ile miktarı değişim gösterdiği, yüksek sıcaklık, ışık, oksijen ve pH değişimleri gibi fiziksel ve kimyasal faktörler karotenoidlerin bozunmasında etkili olabileceği ve bu nedenle, zaman ve sıcaklık gibi pişirme koşullarına bağlı olarak, karotenoidler az veya çok etkilenip, miktarlarının artmasına veya azalmasına neden olabileceği ön bilgisi verilmiştir. Çalışmanın sonuçlarına göre sous vide ve haşlama yöntemleri havuçtaki β-karoten miktarını arttırırken, buharda pişirmenin önemli bir etkisi olmadığı belirtilmiştir. Çalışmada farklı pişirme tekniklerinin, uygulanan sıcaklık ve sürenin havuçlardaki biyoaktif bileşikler ve antioksidan aktivite üzerinde önemli etkilere sahip olduğu ve havuçlarda buharda pişirmenin antioksidan aktivite ve fenolik bileşiklerdeki kaybın azaltılmasında en etkili yöntem olduğu saptanmıştır. Uygulanan ısıl işlem süresinin biyoaktif özellikler üzerinde önemli bir etkiye sahip olduğu belirtilmiştir (Özer ve Tepe.,2019).

İşleme Tekniklerinin Kırmızı Pancar Üzerine Etkileri İlgili Yapılan Çalışmalar

Literatür incelendiğinde kırmızı pancarın birçok farklı ürünlere işlenerek çalışmlarda sıkça kullanıldığı görülmüştür.

Wang ve ark., (2020) yaptığı çalışmada kırmızı pancar reçele işlenerek proses sırasında uygulanan işlemlerin kırmızı pancarın yapısında bulunan fenolik bileşiklerin, flavanoidlerin ve betalainlerin miktarları üzerindeki etkileri incelenmiştir. Çalışmada toplam fenolik madde içeriği, toplam flavonoid madde içeriği, toplam betalain içeriği, antioksidan kapasite ve biyoerişebilirlik analizleri gerçekleştirilmiştir. Sonuçlarda toplam fenolik madde içeriğinin azaldığı belirtilmiştir.. Özellikle ön haşlama işleminden sonra kaybın ~%11.2 olduğu ifade edilmiştir. Çalışmada bu sonucun, konsantrasyonun toplam fenolik madde içeriğinin zenginleştirilmesi için teorik olarak faydalı olmasına rağmen, ısıl işlemin polifenoller üzerinde önemli ölçüde yıkıcı etkiye sahip olduğunu gösterdiği belirtilmiştir. Literatürde uygun bir asit veya şeker takviyesinin, polifenol oksidaz enziminin aktivitesini inhibe ederek fenoliklerin bozulmasını önleyebileceğini bildirmiştir. Ancak çalışmada analiz sonuçları ile karşılaştırıldığında karıştırma aşamasında sukroz ve sitrik asit eklenmesine rağmen toplam fenolik madde içeriğinin hala %3,1 oranında azaldığı belirlenmiştir. Çalışmada 75 ◦C'de 30 dakika pastörizasyondan sonra kırmızı pancar reçelinin toplam fenolik madde içeriğinin taze kırmızı pancarınkinin %86.2'si kadar olduğu belirtilmiştir. Bu nedenle, hücre yapısının tahribatına ek olarak, tüm reçel işleme sırasında toplam fenolik madde içeriğinin azalmasının esas olarak termal hasarın neden olduğu enzimatik olmayan oksidasyondan kaynaklandığı sonucuna varılabildiği ifade edilmiştir. Depolama süresi ve sıcaklığının da toplam fenolik madde içeriği üzerinde olumsuz bir etkiye sahip olduğu gözlemlenmiştir. 90 günlük depolama süresince, depolama süresi arttıkça toplam fenolik madde içeriği kademeli olarak düştüğü gözlemlenmiştir. 4, 25 ve 37 ◦C'de 90 gün saklandığında kırmızı pancar reçelinde toplam fenolik madde içeriğindeki azalma sırasıyla %33.9, %41.6 ve %51.9 olduğu bildirilmiştir. Sindirilmemiş örneklerle karşılaştırıldığında hem kırmızı pancar hem de reçeli sindirim aşamasında önemli bir fark göstermiştir. Oral sindirimden sonra, pancardaki ve reçelindeki toplam fenolik madde içeriği önemli ölçüde azalmıştır. Çalışmada bu durumun polifenolik bileşiklerin a-amilaz ile etkileşiminden kaynaklanabileceği ifade edilmiştir. Analiz incelendiğinde toplam fenolik madde içeriğinin gastrik fazda en yüksek olduğu ancak bağırsak sindiriminden sonra en aza indiği belirtilmiştir. Bağırsak sindiriminden sonra toplam fenolik madde içeriğinin azalması, fenolik bileşiklerin bağırsak yolunun hafif alkali ortamına karşı oldukça duyarlı olması nedeniyle pH'daki artışa bağlı olarak gerçekleştiği şeklinde yorumlanmıştır.

Pancar reçelinin toplam flavanoid içeriğine bakıldığında taze örneklerle karşılaştırıldığında, toplam flavanoid içeriği haşlama sırasında %23,2 artmıştır. Çalışmada bunun nedeni yumuşatıcı hücreler tarafından pancar matrisinden daha fazla flavonoid salınmasından kaynaklanabileceği düşünülmüştür.
Karıştırma sırasında sakkaroz (%25 w/w) ilavesi reçel örneğinin toplam katı içeriğini arttırdığından, toplam flavanoid içeriğinin karıştırmadan sonra önemli bir azalma gösterdiği beliritilmiştir.
Pastörizasyonun ise önceki işlemlere kıyasla toplam flavonoid içeriğinde önemli bir azalmaya neden olmadığı, ancak depolama süresi ve sıcaklığının toplam fenolik madde içeriği sonuçlarına benzer şekilde, toplam flavonoid içeriği üzerinde olumsuz bir etkiye sahip olduğu bildirilmiştir. Toplam fenolik madde içeriğindeki değişikliklerin aksine mide sindiriminde toplam flavonoid içeriği önemli ölçüde azalmış ve ardından bağırsak sindiriminden sonra önemli bir artış olduğu bildirilmiştir. Bağırsak sindirimi sırasında toplam fenolik madde içeriğinin artması, matriksle birleşen flavonoidlerin salınımını hızlandırabilen bağırsak enzimlerinin ve safra tuzlarının etkisine bağlı olabileceği ifade edilmiştir. Flavonoidlerin çözünürlüğü ve biyoerişilebilirliği ayrıca pH'a ve demir, lif veya proteinler gibi diyet bileşenleri ile etkileşime bağlı olduğu da belirtilmiştir. Karıştırma hariç tüm reçel işleme aşamalarının toplam betalain içeriğinde önemli bir azalmaya yol açtığı belirtilmiştir. Çalışmada sonuç olarak, fenolikler, flavonoidler ve betalainler dahil olmak üzere kırmızı pancarın ana biyoaktif bileşiklerinin reçel işleme ve depolama sırasında kısmen korunabileceği ifade edilmiştir.
Trych ve ark. (2022) yaptığı bir çalışmada süperkritik karbondioksit (SCCD) ve yüksek hidrostatik basıncın (HHP) pancar suyu matrisindeki betalainlerin biyoerişilebilirliği üzerindeki etkisini incelenmiştir. Isıl işleme göre HHP ve SCCD'nin betalain içeriği üzerine etkisine bakıldığında her iki termal olmayan tekniğin uygulandığı meyve suyunun betalain bileşimi üzerinde önemli bir etkisi olmadığı ifade edilmiştir.
Sawicki ve ark., (2019) yaptığı çalışmanın bir kısmında kırmızı pancar ürünlerinin farklı teknolojik işleme yöntemlerinin (kaynatma, fermantasyon ve mikrodalga-vakumlama) betalain içeriği üzerinde etkisi incelenmiştir. Araştırmada kırmızı pancar ürünlerinin her birinin kendine özgü betalain bileşiği profiline sahip olduğunu ve betalainlerin toplam içeriğinin bireysel kırmızı pancar ürünleri arasında önemli ölçüde farklılık gösterdiği bilgisi verilmiştir. İşleme yöntemleri karşılaştırıldığında mikrodalgayla vakumlama işleminde en düşük betalain degredasyonun meydana gelmesi sebebiyle en iyi işleme tekniği olduğu ifade edilmiştir.

Sonuç

Bu çalışmada, kırmızı pancarın biyoaktif bileşenleri ve bu bileşenlerin ve biyoerişilebilirliklerinin sebzenin işlenmesi sırasında nasıl etkilendiği değerlendirilmiştir. Kırmızı pancarın biyoaktif bileşenlerinin çeşitli işleme yöntemleriyle değiştiği ve biyoerişilebilirliğinin farklı işleme koşullarına bağlı olarak değişebileceği görülmektedir. Isıl işlemler, kırmızı pancardaki biyoaktif bileşenlerin miktarını azaltabilir ve bu bileşenlerin bazı özelliklerini olumsuz yönde etkileyebilir. Özellikle yüksek sıcaklıklar, biyoaktif bileşenlerin stabilitesini azaltabilir ve bu da besin değerini düşürebilir. Ancak, işlem süreleri ve sıcaklıkları kontrol edilerek, biyoaktif bileşen kaybı minimize edilebilir. Ayrıca, bazı işleme yöntemleri, biyoaktif bileşenlerin daha iyi çözünmesini sağlayabilir, bu da vücut tarafından daha iyi emildikleri anlamına gelir. Kırmızı pancarın farklı işleme yöntemleriyle nasıl işlendiğine ve hangi işleme koşullarının biyoaktif bileşenleri en iyi koruduğuna dair daha fazla araştırma yapılması gerekmektedir. Bu, kırmızı pancarın sağlık yararlarından en iyi şekilde faydalanmak isteyen tüketiciler ve gıda endüstrisi için önemlidir. Sonuç olarak, fonksiyonel gıdaların sağlık açısından faydalı biyoaktif bileşenlerini korumak ve biyoerişilebilirliğini artırmak için uygun işleme yöntemlerinin geliştirilmesi gerekmektedir. Kırmızı pancar gibi biyoaktif bileşenlerle zenginleştirilmiş gıdaların sağlık üzerinde olumlu etkileri olabileceği için, bu alandaki araştırmaların devam etmesi önemlidir

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