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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.

Reference

Kaul J, Jain K, Olakh D. 201). An Overview on Role of Yellow Maize in Food, Feed and Nutrition Security. International Journal of Current Microbiology and Applied Sciences, *8*(02), 3037–3048. https://doi.org/10.20546/ijcmas.2019.802.356

Lead A. 2016. Generation Seed Study Generation Seed Study. United States Agency for International Development or the United States Government, AID-OAA-A-13-00085.

Muzhingi T, Gadaga TH, Siwela AH, Grusak MA, Russell RM, Tang G. 2011. Yellow maize with high β-carotene is an effective source of vitamin A in healthy Zimbabwean men. American Journal of Clinical Nutrition, *94*(2),510–519. https://doi.org/10.3945/ajcn.110.006486

Nafziger ED. (n.d.). M ES PL C E O – PL C E O –. Growth and production of maize: mechanized cultivation. Crop Sciences, University of Illinois, Goodwin, Urbana IL 61801, USA.

Norsuzila Ya'acob, Mardina Abdullah, Mahamod Ismail, Medina, M, Talarico TL, Casas I A., Chung TC, Dobrogosz WJ, Axelsson L, Lindgren SE, Dobrogosz WJ, Kerkeni L, Ruano P, Delgado LL, Picco S, Villegas L, Tonelli F, Merlo M, Rigau J, Diaz D, Masuelli M. 1989. Maize nutritive value. Intechopen, DOI: http://dx.doi.org/10.5772/intechopen.88963.

Pulat Batirbaev, TaeYoung Kim, Rezvan Ma'ani, Ryung Shim, Jen Singer, Matt Snyder FY. 2013. Maize in Rwanda : A Value Chain Analysis. United Nations Industrial Development Organization (UNIDO), Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria

USAID, 2016. Early generation seed systems study, country report (Rwanda Egs country study). USAID Bureau of Food Security.