

## Recent studies and future expectations in broiler breeding in Turkey

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### Abstract

Turkey ranks in the top 10 in broiler production in the world. Almost all of the genetic material used in production in our country is provided by commercial international breeding companies. In order to reduce complete external dependency in this field and to have improved genetic stocks, broiler breeding studies have been restarted in Turkey since 2010. The studies, which started with a project (TÜBİTAK 109O334) to produce slow-growing broiler parents, have been put into practice by the Ministry of Agriculture and Forestry, General Directorate of Agricultural Research and Policies.

In 2015, with the purchase of 2 sire and 3 dam pure line parent material from an international breeding company, the studies were shifted to the fast growing broiler parent production and breeding field at Eskişehir Transitional Zone Agricultural Research Institute (EGKTAE). Studies were carried out in the fields of reproduction, selection, grand parent and parent production in pure lines between 2015-2025. On the other hand, the parents obtained were shared with the private sector. Doctoral and master's theses, international and national publications were made by utilizing the existing pure lines related to breeding studies. The material used in broiler breeding studies was registered as Anadolu-T. Within the scope of research and development studies, a device that provides automation of individual feed utilization test was developed at EGKTAE and started to be used in breeding studies. When the appropriate reproduction processes of the existing material are carried out, there is a potential for 25-30% of the genetic material used in broiler production in our country to be provided from Anadolu-T parents. In particular, in terms of epidemic diseases and pandemics seen in humans and animals, security risks and reducing external dependency, protecting the material and developing similar characteristics to commercial genotypes are important in terms of food safety.

**Keywords:** *Anadolu-T, Breeding studies, feed utilization test unit, food safety*

### Introduction

The majority of the increase in poultry meat production in the world originates from Asian countries. Especially the production increases in China, India, Japan, South Korea, Turkey and Iran have a significant contribution to this increase. While the market shares in North America and Europe have declined in poultry meat production, Brazil has become one of the important centers of poultry meat production in South America. Chicken meat production level in the world ranks second after pork. However, with the increases in chicken meat since 2010, the share of poultry meat in meat production rose to the first place in 2017. The majority of poultry meat comes from chicken meat. Considering that the increase in production in some species has stopped, in others there has been a decline and that some importing countries do not consume pork, poultry meat production is expected to increase in the future. Only two of the top 10 countries in world chicken meat production in 1970 were developing countries (Brazil and China). During this period, the USA provided approximately 31% of the world poultry meat production. In 2005, five of the top 10 countries were developing countries (China, Brazil, Mexico, India, and Iran) and three of them in Asia. Although the USA still maintains its leading position, China and Brazil ranked 2nd and 3rd. No other EU country produces chicken meat as much as Türkiye. Important chicken meat importing countries are in the Middle East, Africa, Central Asia, the Caucasus and some regions of the Russian Federation. In these markets, Turkey needs to compete with classical exporting countries such as Brazil, the USA and EU countries, as well as with Iran and Russia (Sarıca et al, 2018).



Table 1. Countries ranking first in chicken meat production (1000 tons)

Countries	1970	1980	1990	2000	2010	2015	2020	2021	2022	2023
USA	4.465	6.487	10.759	16.416	16.563	18.402	20.515	19.004	19.984	19.902
China	971	1.663	3.740	12.689	12.550	12.075	15.294	15.413	15.000	15.477
Brazil	378	1.397	2.422	6.125	12.312	13.149	13.747	14.329	14.524	14.833
EU	3.533	5.611	6.355	8.204	9.202	11.415	11.037	10.765	10.791	11.066
Russia	-	-	-	754	2.310	4.087	4.577	4.617	5.308	5.340
India	81	112	361	864	2.650	3.263	4.473	4.461	4.995	5.019
Indonesia	56	168	498	804	1.465	2.030	3.642	3.456	4.109	4.444
Mexico	192	399	750	1.825	2.822	2.962	3.579	3.669	3.782	3.888
Japan	490	1.128	1.391	1.194	1.417	2.132	2.332	2.343	2.371	2.384
Türkiye	97	240	402	643	1.420	1.909	2.138	2.246	2.418	2.329
Argentina	177	281	322	958	1.680	1.969	2.219	2.294	2.319	2.287
Iran	87	211	380	803	1.666	2.053	2.430	2.106	2.090	2.067
England	495	615	790	1.215	1.376	1.521	1.794	1.841	1.847	1.851
Thailand	196	287	575	1.045	1.220	1.713	1.748	1.796	1.807	1.845
Total	11.218	18.599	28.745	53.539	68.653	78.680	89.525	88.430	91.345	92.732
Others	1.922	4.298	6.671	5.153	18.729	25.121	30.936	31.991	32.537	33.798
World	13.140	22.897	35.416	58.692	87.382	103.801	120.461	120.421	123.882	126.530

FAO, 2025.

Almost all of the hybrid material of chicken meat and eggs produced in Türkiye is imported as parents or partially grandparents. Parent stock (PS) and partially grand-parent (GP) stock are imported in increasing numbers every year for the production of hybrids used in egg and chicken meat production. Although Türkiye is among the few countries in the world in commercial egg and broiler chicken production, no significant progress has been made in breeder production to date. Breeding material is provided from abroad at a rate of 95.0-97.5% in egg production and 98.0% in poultry meat production (Sarica et al., 2011; Sarica et al., 2012; Sarica et al., 2018; Sarica et al., 2019a).

Based on these studies, broiler chicken breeding studies were restarted in 2015 at Eskişehir Transitional Zone Agricultural Research Institute (EGKTAE). These studies are still continuing with the selection of 3 dam and 2 sire lines, as well as grandparent and parent production. The first parent production was carried out in 2018 and shared with the private sector. The parent material, registered as ANADOLU-T, continued to be shared with the private sector until 2023. Especially in 2022, breeding companies have declared that they will reduce their breeding material exports to Turkey by 25-30%, which once again shows the importance of these breeding operations.

### Breeding Studies with Pure Lines (2015-2025)

At the meeting held on 21.06.2011 at the General Directorate of Agricultural Research and Policies (TAGEM) with the participation of private sector, public and university partners, it was decided to restart broiler chicken breeding studies. It is planned to start the studies with the production of slow-growing broiler chicken parents. For this purpose, a poultry unit affiliated with Eskişehir Transitional Zone Agricultural Research Institute (EGKTAE) was established. The aim of the project is to provide a fast growing dam line and to bring the BAR and RIR lines in Ankara Poultry Research Institute into operation. Attempts to provide genetic material resulted in the importation of 3 fast growing dam and 2 sire lines. Therefore, the studies were changed to realize commercial broiler production. Multiplication processes were provided in the first year with the incubation of hatching eggs in August 2015, and processes such as selection, parent production and hybrid tests are continuing between 2016-2024 (Sarica et al., 2016a; Sarica et al., 2017; Sarica et al., 2019b, Sarica et al., 2019c).

#### Description of the Breeding Unit

The application area of the broiler parent breeding project is located within the borders of Mahmudiye district of Eskişehir province. Breeding farm consists of a pure line breeding unit and a hatchery 1 km away. Farm planned to be established on a land of 80 decares;

*Administrative unit:* It consists of dining hall, laboratory, personnel entrance disinfection unit, guest house and offices.

*Chick rearing houses:* There are 4 fully controlled rearing houses, each with 176 cages. Each poultry house has a capacity of 2000-2500 chicks. There is 1 rearing poultry house added to these poultry houses with 378 cages (5000-6000 chick capacity).

*Pure line breeding house:* It consists of 5088 cage units and 700 cock cage units. Broiler chickens between 5-10 weeks of age are reared in this house. .

*Pedigree houses:* There are 2 poultry houses with 160 family pens for 9-12 hens with 1 cock.

*Pure line rooster houses:* There are 2 poultry houses with 950 individual floor pens for individual rearing of cocks.



**Grand-parent houses:** There are 4 houses: 1 grower house (capacity of 5500 chickens), 1 dam line laying house (capacity of 5500 chickens), 2 sire line houses (capacities of 2000 chickens).

**Hatchery:** It is planned as a separate unit with a hatching capacity of 110.000 chicks, where the desired conditions for egg storage can be met. It has an automatic vaccination system.

**Other units:** There is an 800 m<sup>2</sup> closed warehouse, 2 hygiene units where 26 people can shower at the same time, vehicle hygiene entrance and security guard building.

**Personnel:** There is 1 coordinator Veterinarian, 6 Zootechnicians Agricultural Engineers and 1 Technician who provide management and research services in the breeding unit. Operations in the chicken houses are carried out by 35 workers, the number of whom varies according to periods. There is 1 Veterinarian and 9 technical personnel in the hatchery. There are permanent security personnel in the poultry house and hatchery units.

### Characteristics of Pure Lines

Some characteristics of the pure lines used in breeding studies and numerical values of the base population are given in Table 2.

Table 2. Characteristics of imported parental lines and the number of first chicks produced (Sarica et al., 2016b; Noubandiguim et al., 2021)

Pure line	Wing feathering	Number of chicks
Main dam line (A1)	Slow feathering	2086
Dam line (A2)	Fast feathering	371
Dam line (A3)	Slow feathering	188
Main sire line (B1)	Fast feathering	546
Sire line (B2)	Fast feathering	928

### Selection Methods

Selection for each pure line is carried out in 3 stages. In the first stage, selection is applied according to body weight in pure lines that are ad libitum-fed until 3 weeks of age. In the second stage, selection is applied according to body weights at 5 or 6 weeks of age. In the third stage, the selection index value for cocks and hens is created by determining the breast width and length with the individual FCR test between 5-8 weeks of age. Families of 1 cock and 10 hens are formed for pedigreed production from selected cocks and hens. During the laying period, a selection is made at the family level according to the fertilization capacity of the cocks, and the final selection is applied by taking into account the egg production of the dam lines.

The material was registered as "ANADOLU-T" with the Official Gazette of the Republic of Turkey dated December 5, 2020 and numbered 31325.

### Some Characteristics of the Pure Lines

Data on the parental characteristics of pure lines has been received since 2016. Instead of the results obtained in the breeding enterprise (EGKTAE), data obtained from a doctoral thesis were used in this study (Erensoy, 2022).

Table 3. Growth and laying period characteristics of pure lines (Erensoy, 2022; Erensoy and Sarica, 2022; M: Male, F: Female)

Traits	Sex	Dam lines			Pure lines	
		A1	A2	A3	B1	B2
Body weight (8 weeks, g)	M	491.1	584.9	558.4	570.0	574.1
	F	465.7	536.5	551.2	540.2	544.6
Body weight (23 weeks, g)	M	3117.7	3319.7	3167.0	3445.7	3368.3
	F	2525.9	2562.2	2479.5	2691.5	2639.8
Body weight (60 weeks, g)	M	4586.0	4456.0	4002.0	4472.0	5042.0
	F	4034.6	4724.0	4488.6	4290.1	4855.3
Feed intake (g, 0-23 weeks)	M	11564	11438	11480	11172	11200
	F	9555	9632	9583	9506	9597
Livability (% , 0-23 weeks)		100	93.3	100.0	96.7	96.7
Livability (% , 24-64 weeks)		100	91.7	100.0	93.8	100.0
Egg production (24-64 weeks)		188	160	160	120	124
Egg weight (g)		66.6	67.9	65.1	67.3	68.2
Feed intake (g/day, 24-64 weeks)	M	140.1	150.1	140.1	137.5	137.5
	F	160.75	157.7	160.6	157.1	157.1



### Some Characteristics of the Parents

Parents produced in the breeding enterprise were given to some integrated enterprises for trial purposes, and the parent efficiency was not tested in the breeding enterprise. All two-way crossed parental lines (6 sire lines and 2 dam lines) that could be obtained by reciprocal crossbreeding in pure lines were tested in a doctoral study (Erensoy, 2022). The genotype, which also allows sexing in day-old chicks according to wing feathering rate, is coded as ANADOLU-T. Some growth and laying period characteristics of these parent lines produced up to 64 weeks of age are given in Table 3 and 4.

Table 3. Growth and egg production characteristics of the female parents (Erensoy, 2022; Erensoy and Sarica, 2022)

Traits	Dam line	Sire line
Body weight (8 weeks, g)	967.9	1340.4
Body weight (23 weeks, g)	2586.7	3329.8
Body weight (60 weeks, g)	4117.3	4463.2
Feed intake (g, 0-23 weeks)	11361	9093
Livability (% , 0-23 weeks)	88.9	96.7
Livability (% , 24-64 weeks)	96.3	100
Egg production (24-64 weeks)	161.9	-
Egg weight (g)	65.2	-
Feed intake (g/day, 24-64 weeks)	159.1	140.0

Table 4. Hatching results of ANADOLU-T and Ross-308 parents at 32 and 52 weeks of age (2 hatchings; Erensoy, 2022; Erensoy and Sarica, 2022)

Genotype	Fertility (%)		Hatchability of fertile eggs (%)		Hatchability of set eggs (%)	
	32 weeks	52 weeks	32 weeks	52 weeks	32 weeks	52 weeks
ANADOLU-T	100.0	90.8	92.4	76.1	91.7	69.2
ANADOLU-T commercial	94.2	85.0	80.8	79.4	70.0	67.5
Ross-308	96.7	78.2	90.0	87.4	82.5	69.2

(Hatching eggs of ANADOLU-T commercial breeders were purchased from the private sector).

### Broiler characteristics and comparison with commercial genotypes

Chicks obtained after selection in pure lines since 2016 are compared with a commercial genotype (Ross or Cobb) in terms of broiler characteristics. In addition to growth characteristics, carcass characteristics and body defects are also considered in these studies. The data obtained is also used for selection studies for the next generations. In the sire lines, 10-12 chicks from each family were also compared for broiler traits. The growth characteristics of ANADOLU-T hybrid produced from 12 hybrid groups by Erensoy (2022), ANADOLU-T Commercial and Ross-308 hybrids obtained from commercial enterprises at 42 days of age are given in Table 5.

Table 5. Performance of ANADOLU-T pure lines, commercial broilers and Ross-308 at 42 days of age (male-female mixed; Erensoy, 2022; Erensoy and Sarica, 2023)

Genotype	Body weight (g)		Feed intake (g)		FCR		Livability (%)	
	32 weeks	52 weeks	32 weeks	52 weeks	32 weeks	52 weeks	32 weeks	52 weeks
A1-dam line	2307.7	2736.1	3971.0	4597.3	1.713	1.681	95.3	98.3
A2-dam line	2505.0	2333.8	4138.0	3954.7	1.653	1.695	93.3	98.3
A3-dam line	2371.5	2492.2	4130.1	4168.0	1.743	1.673	98.7	100.0
B1-sire line	2763.9	2773.6	4628.4	4756.2	1.687	1.718	95.3	96.7
B2-sire line	2663.8	2677.0	4558.3	4494.4	1.733	1.686	96.0	90.0
Anadolu-T-hybrid	2790.1	2784.6	4636.2	4709.9	1.660	1.692	96.0	100.0
Anadolu-T-hybrid	2773.3	2858.0	4695.7	4800.9	1.697	1.680	96.7	96.7
Ross-308	2961.2	3136.2	4422.2	4485.5	1.520	1.430	97.3	100.0

### Conclusion and Recommendations

Promising results were obtained from the studies carried out with pure lines introduced to Turkey in 2015. More than 250.000 parent stock breeders were given to the private sector between 2018-2023. It is thought that 10-15% of the broiler breeders requirement of our country can be met from this material by developing the current capacity at the grand-parent level. For these;





- Slaughtering broilers at an earlier age (33-35 days) due to the lack of feed efficiency at late slaughter (42 days),
- Compensating for vaccination-induced mortality in the first weeks by vaccination during hatching,
- Developing more effective selection strategies for feed efficiency and reproduction traits,
- By establishing a larger grand-parent facility, commercial companies can be provided with chicks at the desired capacity at any time of the year.

Considering these issues, a lifetime feed efficiency unit was developed and started to be used in 2023 with the TÜBİTAK-TAGEM project. On the other hand, genomic studies on pure lines will be initiated in 2024 and it is aimed to be used together with the classical selection practices.

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