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Determination of Growth Performance and Carcass Characteristics of ATAK-S Male Chicks in Different Raising Systems[#]

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A R T I C L E I N F O

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Research Article

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A B S T R A C T

In this study, meat production performance of male chicks of the ATAK-S genotype, which is an egg-yielding line, were examined in both indoor and free range raising systems. The study was carried out at the Kahramanmaras Sutcu Imam University (KSU), Animal Production Application and Research Centre for 12 weeks. Each treatment was represented by 3 replications containing of 28 male chicks (84 male chicks per treatment). During the indoor treatment, the chicks were raised in floor pens in a conventional house (3.7 birds/m^2). In the free-range treatment, the chickens were housed in a similar indoor house (3.7 birds/m^2); in addition, they also had a free-range clover paddock (0.9 birds/m^2). All birds were provided with the same diets as ad-libitum. Results showed that the thigh rate of the chickens in the free-range treatment were higher than that of the chickens in the indoor floor treatments, but the neck rate of the chickens in the free-range treatment were lower than that of the chickens in the indoor floor treatments. There was no significant effect of the free-range raising system on live weight, feed intake, feed conversion ratio, survival rate, eviscerated carcass, breast, thighs, wings, back rates, edible giblets, testes weight, rectal temperature and tonic immobility.

Tavukçuluk Araştırma Dergisi 17(2): 56-62, 2020

ATAK-S Erkek Civcivlerinin Farklı Yetiştirme Sistemlerinde Büyüme Performansları ve Karkas Özelliklerinin Belirlenmesi

M A K A L E B İ L G İ S İ

Araştırma Makalesi

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Besi performansı
Karkas özellikleri
Refah

Ö Z

Bu çalışmada, yumurta verim yönlü bir hat olan ATAK-S genotipi erkek civcivlerinin kapalı ve serbest (free range) yetiştirme sistemlerinde et verim yönü incelenmiştir. Çalışma, Kahramanmaraş Sütçü İmam Üniversitesi (KSÜ), Hayvansal Üretim Uygulama ve Araştırma Merkezinde,12 hafta süre ile yürütülmüştür. Kapalı yetiştirme sistemi grubunda 3 tekerrür, her tekerrür için 7,5 m² kapalı alan, serbest (free range) yetiştirme sistemi grubunda yine 3 tekerrür, her tekerrür için 7,5 m² kapalı alan ve buna ilave olarak 31,25 m² yonca ekili serbest gezinti alanı bırakılmıştır. Her tekerrürde 28 adet, toplam 168 adet civciv kullanılmıştır. Her iki muamele grubuna aynı yemler sınırsız verilmiştir. Çalışmada kapalı ve serbest yetiştirme sistemi için; canlı ağırlık, yem tüketimi, yem dönüşüm oranı, yaşama gücü, karkas-parça oranları, yenilebilir iç organ ağırlıkları-oranları, testis ağırlıkları-oranları, rektal sıcaklık ve tonik immobilite süreleri incelenmiştir. İncelenen özelliklerden but oranı serbest yetiştirme sisteminde daha fazla, boyun oranı ise kapalı yetiştirme sistemde daha fazla bulunmuş, incelenen diğer özellikler arasında istatistiki olarak fark bulunmamıştır.

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Introduction

The poultry industry is one of the most developed and fastest growing industries in agriculture all over the world. This growth is associated with the increase in demand for poultry meat and eggs (Bolan et al., 2010) and therefore, intensive broiler production in the world is increasing day by day. There are changes in product and production systems; however, taking into account the changes in consumer demands (Sarica et al., 2014). The free range raising system, which is an alternative to the intensive production, is a technique in which chickens benefit from sunlight and exhibit their natural behaviour in the naturally green area. In free range house, chicks are exposed to relatively less stress and meat and eggs of chickens using green stuff are more demanded by consumers. However, there are some disadvantages such as lower live weight gains and higher feed costs due to long feeding period increase costs in chickens that are fed longer than normal broilers and grow slowly (Yenilmez and Uruk, 2016). Even if expensive, consumers can pay more for chicken meat produced in the free range and organic systems, considering that it is more natural, healthy and suitable for animal welfare (Sarica and Yamak, 2010). The demand for chicken meat produced in the free-range system is increasing in European countries as well (Stadig et al., 2016), in France, for instance, had the Label Rouge concept accepted by the government in 1965, and today, the local poultry meat has a 30% share in the French market (Westgren, 1999).

Recently chicken meat produced in free range systems has been increased in Turkey. Considering these developments, male chicks of ATAK-S layer genotype, which is the most preferred free range layer in recent years, were used in this study. Instead of culling these chicks, they were growed in conventional or free range systems. The aim of the current experiment was to investigate the effect of raising system on meat yield characteristics, carcass and parts rates, giblets weights and some welfare parameters of ATAK-S male chicks.

Materials and Methods

In this study, 168 day-old male chicks of the layer genotype ATAK-S line were used. Chicks were obtained from a commercial breeder located in Malatya province, Turkey. This experiment was carried out in the greenhouse tent type house in Kahramanmaras Sutcu Imam University (KSU) Animal Production Application and Research Centre (HAYMER) with the permission of KSU Faculty of Agriculture, Animal Experiments Local Ethics Committee (2018/7-1). The house is 25×7 m in size, the wall height is 2 m and the ridge height is 3.80 m. The tent-type house is made of 3 layers of cover material and consists of 1100 denier, white colour, tarpaulin on the outside, air foam insulation material in the middle and a thin tarpaulin at the innermost. The house is divided into two equal parts, leaved 1 m service road at the middle towards the length. For each closed repetition, there were 3 closed sections in total 7.5 m² of area (3 m×2.5 m). For each free range repetition, there were 3 closed sections of 7.5 m², plus 31.25 m² of area (2.5 m×12.5 m) of free range. As a closed area, and the settlement density for animals has been determined as 3.73 hen/m². The settlement density for animals in the free range area has been determined as 0.90 hen/m². Clover was planted in the promenade and a green area was created. The chicks were grown at the same house for three weeks. At the end of the third week chicks were divided into experimental groups with three replications. 28 male chicks were allocated randomly for each repetition. The trial was conducted between June 27-September 19, 2019 and lasted for 12 weeks.

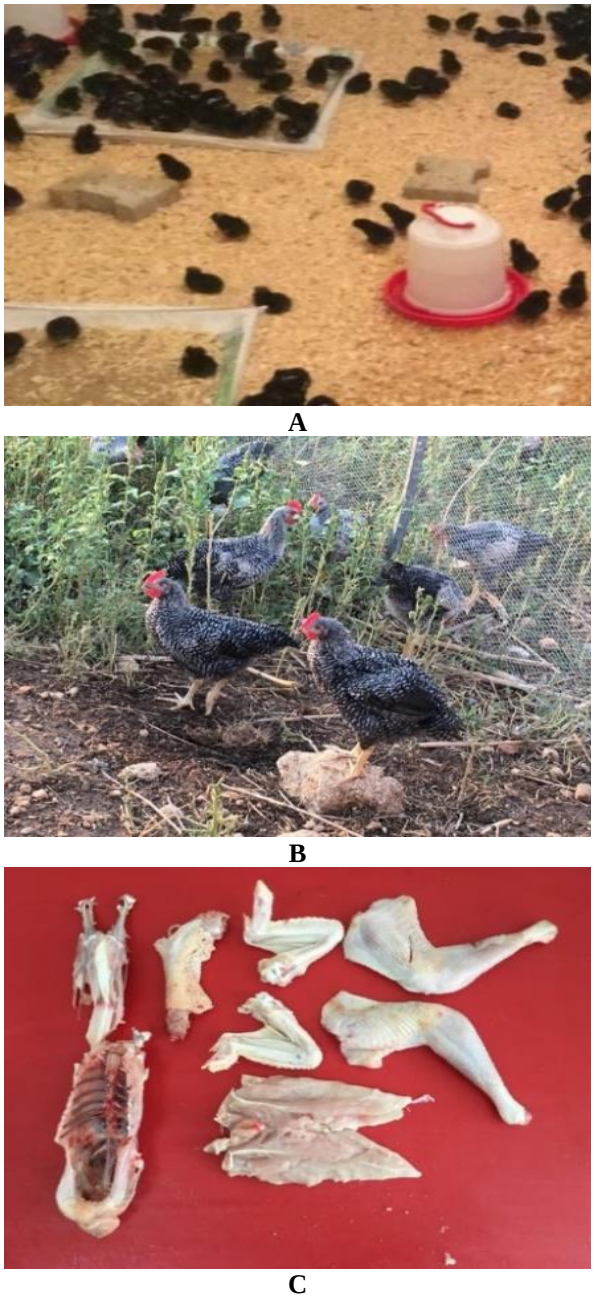
The experimental house is naturally ventilated using 20 windows in the size of 45×75 cm in the house. There are 4 ventilation shafts of 40×40 cm and 60 cm height in the house. There are 2×2.5 m doors on both short sides of the house. In addition, there are doors of 45×75 cm in which chickens can enter and exit the open space in free range house. Feed intake in the first three weeks has been taken collectively and shared equally with the cumulative feed intake. Data of each recurrence were recorded separately in the fourth week and the following weeks. In the first three weeks, chick feeders of 50×70 cm size were used. One tube feeder was placed for each replication in the fourth week and after. The feeding periods (day) and nutrient contents of the feed are given in Table 1. Chick drinkers were used in the first three weeks of the trial. In the fourth week, water was supplied to the chicks distributed to replications with the nipple drinker system with 10 nipples. Pine wood shavings of 4-5 cm height were used as litter material in the study. Chicks were subjected to lighting program (23L: 1D). The heating of the chicks was conducted using electric thermostat heaters during the first two-week period. Chicks were vaccinated at 11th day Newcastle (B1), 13 and 22nd day Gumboro (D78) and 30th day Newcasttle (Lasota) vaccinations with drinking water. In the fourth week, chickens were allowed to enter the place where clover was planted. At the beginning of the experiment, all chicks placed in the poultry house were weighed in bulk for the first three weeks. The chicks divided into groups at the end of the third week were weighed one by one at the end of the fourth week and the following weeks, and their average live weight was calculated. Weekly weightings were made in the afternoon on the last day of each week. Before the weighing started, the remaining feeds in each group were weighed and feed was given by weighing again after each repetition. At the end of the experiment, rectal temperature measurements were made on 10 birds for each replication.

The thermometer was started by placing it in 3 cm cloaca and kept until the digital thermometer gave the signal that the measurement was completed. Tonic immobility tests were performed on 10 birds for each replication. The birds taken for the test was laid on its back on the area with sawdust, except the partition, and when it became immobile by pressing its breast lightly for a few seconds, it was released and followed from a distance of one meter and the time the birds got up was measured with a stopwatch. Birds were tested for up to 10 minutes of tonic immobility, and birds that remained immobile for more than 10 minutes were not taken.

Table 1. Types of feeds provided and nutritional profile of the chicks according to the age

Nutrient content	0-21 days	22-63 days	64-84 g/days
Dry matter (%)	88	88	88
Crude protein (%)	20	18	18
Crude fiber (%)	3.70	4.30	2.90
Crude ash (%)	6.60	6.60	4.30
Crude fat (%)	5.00	3.30	5.40
Calcium (%)	1.00	1.00	0.60
Phosphorus (%)	0.70	0.80	0.50
Sodium (%)	0.20	0.20	0.20
Lysine (%)	1.20	1.00	1.00
Methionine (%)	0.50	0.40	0.40
Metabolic Energy (Kcal kg^{-1})	2800	2750	3200

At the end of the experiment (on the 84th day), birds were weighed after 12 h of feed withdrawal. Four chickens from each replication were randomly selected for slaughter and their live weights were determined. The slaughter process of the broilers was carried out manually in the cutting funnels, after 30 seconds in 54°C water, their feathers were removed mechanically. Carcasses were kept in 22°C water pool for 20 minutes, and then were opened from the abdomen for their internal organs were removed. Heart, liver, gizzard and testes of each bird were weighed. The hot carcass and abdominal fat of the chickens were weighed and the value of each chicken was recorded. These carcasses were kept in the refrigerator at +4°C for 24 hours, each carcass was weighed again and cold carcass weights were taken. Cold carcasses were cut into parts by hand according to Turkish Standards Institute the rules of chicken carcass cutting up (TSE 1997) and the weights of the parts were recorded. Percentage of thighs, bony breast, wings, neck, back and boneless breast weights to whole cold carcass were determined. Used in the study; day-old male chicks, 12-week-old male birds at the end of the experiment and carcass parts obtained after slaughter are shown in Figure 1. Growth data, carcass and part rates, edible giblets and testes weights, tonic immobility, rectal temperature values were examined by t test. SPSS V22.0 statistical package program was used in the analyses (SPSS, 2013).



A

B

C

Figure 1. Used in the Experiment Chicks (A) 12 Weeks-old Male Birds (B) and Carcass Parts (C)

Results and Discussion

Live Weight

Weekly live weight gains and cumulative live weights obtained at the end of the 12-week study are given in Table 2. In the study, which was initiated by dividing the chicks into repetitions at the 3rd week, no statistical difference was found between the live weights. At the beginning of the experiment, it is seen that both groups were equalized in terms of live weight. Live weight gains in chicks raised both in indoor raising system and free-range system continued increasingly until the 9th week, and the highest live weight gain was obtained at the 9th week. After that week, weekly live weight gains decreased steadily until the end of the trial (Table 2). At the end of the trial, there was no significant difference in terms of weekly live weight gains and cumulative live weight gains and cumulative live weights.

Table 2. The effect of raising system on the live weight gain of ATAK-S male chicks (g) *(n=84)*

Age (week)	Indoor		Free-range	
	Weekly gain	Cumulative	Weekly gain	Cumulative
Initial		222.60±2.43		219.49±2.25
4	115.57±4.77	338.07±3.67	113.33±1.15	332.83±3.61
5	127.47±4.33	465.50±5.01	123.10±1.60	455.90±4.71
6	132.03±0.73	597.52±6.30	138.77±3.46	594.68±6.78
7	156.03±1.92	753.52±7.98	150.37±9.65	745.10±8.64
8	167.18±3.21	920.77±9.42	163.00±14.41	908.10±10.60
9	179.99±2.98	1100.76±11.10	185.01±8.78	1093.10±11.54
10	163.15±6.84	1264.02±11.64	163.55±11.13	1256.63±12.45
11	151.54±8.87	1415.52±13.71	154.23±19.79	1410.86±13.09
12	140.63±8.11	1556.28±14.23	138.54±2.57	1549.39±13.23

Values are mentioned as means ± SE

Table 3. The effect of raising system on the feed intake of ATAK-S male chicks (n=84)

Age (week)	Indoor		Free-range	
	Weekly	Cumulative	Weekly	Cumulative
4	291.10±3.33	719.80±3.75	276.70±4.48	709.17±5.18
5	315.50±1.95^{b*}	1035.30±2.74	338.47±7.63^{a*}	1047.63±10.18
6	392.30±16.97	1427.60±18.96	384.27±16.10	1431.90±6.20
7	426.13±8.12	1853.73±15.01	433.93±11.29	1865.83±5.18
8	548.47±27.12	2402.20±28.08	551.40±21.66	2417.23±26.78
9	612.53±28.23	3014.33±47.76	659.47±15.61	3076.70±31.75
10	660.30±11.44	3675.03±45.04	696.13±26.96	3772.83±53.35
11	701.60±4.50	4376.63±41.83	743.10±22.78	4515.93±73.20
12	733.27±18.59	5109.90±24.16	773.60±4.13	5289.53±77.22

Values are mentioned as means ± SE, letter(s) in the same row with different superscripts are significantly different. *P< 0.05.

In the current study, the live weight obtained in the 12 weeks were 1556.28 and 1549.39 which are higher than that reported by (Barac, 2016) who reported that the live weight was 1384.7 g. (Almasi et al., 2015), in their 70-day study using male chicks of Tetra HB Colour and Shaver Farm breeds in closed and free range systems, they found the average live weight of the indoor and free range system to be 2900g for Tetra HB Colour and 2781g for Shaver Farm. They reported that there is significant difference between indoor and free range raising system (P<0.05). Czajka et al. (2017), at the end of their 20-week study, obtained 1710.4 g live weight in the closed system in the Yellow leg Partrige genotype, and 1862.7 g live weight in the organic system. For Rhode Island Red genotype, they reported that live weights as 2012.5 g in closed system and 2144.4 g in organic system (Hoan and Khoa, 2016) reported that the live weight as 824.1g on the 49th day and 1919.0 g on the 90th day in with Sasso male chicks in a free range system. Wang et al. (2009), at the end of their 16-week study in Gushi genotype, they found that live weight was 1610.5 g in closed rearing system and 1419.4 g in free-range system. They reported that the live weight of the chickens in the open rearing system was significantly lower than the chickens in the closed house (P<0.05).

Feed Intake

Weekly and cumulative feed intakes of ATAK-S male chicks are given in Table 3. In terms of weekly feed intake, it was found to be 338.47±7.63 g in free-range in the 5th week, while this value was found 315.50±1.95 g in indoor group, the difference between the groups was significant (P<0.05). There was no difference between the groups in terms of weekly feed intake for other weeks. At the end of the study, while 5109.90±24.16 g feed intake per male in the indoor treatment, 5289.53±77.22 g feed per male was consumed in the free-range treatment.

It was determined that the free-range group consumed more feed than the indoor group (Table 3), and this difference is thought to be a reflection of the difference in weekly feed intake after the 9th week since the free-range chicks have more mobility. However, there was no statistical difference between the two groups in terms of cumulative feed intake. The feed intake of chicks in the current study was considerable higher than that reported by Barac (2016) who found that feed intake was 4406.9 g for chicks fed ad-libitum. Czajka et al. (2017), in the study they conducted on Yellow leg Partridge (YP) and Rhode Island Red (RIR) breeds, they found feed intake on the 140th day for YP; 7638.6 g in the convectional system, 7741.4 g in the organic system and for RIR; They reported that they found feed intake 7703.9g in the convectional system and 7762.7 g in the organic system.

Feed Conversion Ratio (FCR)

Cumulative FCR, was calculated as 3.284±0.03 for indoor group at the end of the experimental period, and was found as 3.413±0.03 for the hen grown in free-range group. Although FCR of indoor group was tend to be slightly higher, the difference between two groups was not remarkable (P>0.05) There was no difference between the groups in terms of weekly and cumulative FCR in all weeks.

Table 4. The effect of raising system on feed conversion ratio of ATAK-S male chicks (n=84)

Age (week)	Indoor		Free-range	
	Weekly	Cumulative	Weekly	Cumulative
4	2.526±0.08	2.130±0.04	2.442±0.05	2.131±0.03
5	2.479±0.06	2.225±0.05	2.752±0.09	2.298±0.03
6	2.970±0.11	2.389±0.02	2.771±0.13	2.408±0.02
7	2.733±0.08	2.460±0.03	2.920±0.27	2.505±0.04
8	3.277±0.11	2.609±0.05	3.420±0.23	2.662±0.04
9	3.407±0.19	2.740±0.07	3.574±0.12	2.815±0.04
10	4.065±0.22	2.908±0.05	4.303±0.39	3.002±0.05
11	4.658±0.24	3.093±0.06	4.935±0.11	3.200±0.04
12	5.264±0.44	3.284±0.03	5.588±0.46	3.413±0.03

Values are mentioned as means ± SE

However, in terms of cumulative FCR, the difference between the groups at 12 weeks approached to be statistically significant (P=0.054). Weekly and cumulative feed conversion ratios (FCR) are given in Table 4. Barac, (2016) found the feed conversion rate of 3.30 in the ad-libitum feed group at the end of a 12-week study in ATAK-S males, and reported a result consistent with this study.

Czajka et al. (2017) found that the feed conversion ratio in the Yellow leg Patrige breed was 4.466 in the conventional system and 4.156 in the organic system, while in the Rhode Island Red breed; they found it as 3.828 in conventional system and 3.620 in organic system. They reported that FCR Organic cultivation system gave better results (P<0.01). The cumulative FCR graph of ATAK-S male chicks is given in Figure 2.

Vitality

No mortality was recorded during the whole experimental period for both indoor and free-range groups.

Carcass and Parts

The values obtained after the slaughter at the end of the 12-week study are given in Table 5. The differences between indoor and free-range groups were found to be similar (P>0.05) when hot-cold carcass, bony breast, breast meat, wing and back rates were compared. A notable differentiation was detected for thigh and neck rates between the experimented groups (P<0.05).

The thigh percentages were recorded as 32.54±0.44% and 33.67±0.29% for the indoor and free-range group respectively and the difference between these two groups was remarkable (P<0.05). This could be due to the fact that leg muscles of free-range treatment chicks, which were given the opportunity for roaming freely in the free range area, had better opportunity to develop more leg muscles. In contrast to the thigh rate, a noteworthy higher rate (7.02±0.20%), was determined for the neck rate in indoor group (P< 0.05). Carcass percentages of the current study were found around 68-71% for both groups, although relatively lower carcass percentage (66.0%) for ATAK-S male was reported (Barac, 2016). For other parameters examined in this study, Barac (2016) reported similar results. It was emphasized that the difference in neck percentage was significant (P<0.05) in the limited feed and pasture group, and there was no difference between carcass and other part percentages. The thigh percentage of ATAK-S was observed as to be similar to the findings of Siekmann et al. (2018) who worked on the carcass parameters of Lohman Dual genotype; although the breast rate was relatively lower (12.7%).

Wang et al. (2009) did not find a statistically significant difference between carcass and part percentages in their 16-week closed and free-range systems in Gushi genotype. Poltowicz and Doktor (2012), in the chickens obtained by crossing the slow growing Hubbard meat type chickens and the local Yellow leg Partridge Polish chickens, after 84 days of growth work. Furthermore, parallel to the results of current work they reported carcass percentage 70.7%, breast percentage 20.3% and thigh percentage 21.2% for same animals (Poltowicz and Doktor, 2012). Almasi et al. (2015), in their 70 days of work in closed and free range growing systems, they reported the carcass percentage as 68.1%, the thigh percentage as 33.7% and the breast percentage as 25.4% for Tetra-H genotype.

Abdominal Fat Giblets and Testes Weights-Rates

At the end of the 12-week study, the abdominal fat, gizzard, heart and liver weights-percentage obtained after slaughtering in ATAK-S male in the indoor and free-range groups are given in Table 6. There was no statistically significant difference between abdominal fat, gizzard, heart, liver and testes weights and percentages between experimental groups.

On contrast to the results of current study, Barac (2016) reported that differences between the gizzard, hearth and liver weights were notably significant (P<0.05) for chicks fed ad-libitum feeding and limited feeding + pasture for 12-week study in ATAK-S males. Almasi et al. (2015), in a 70-day study in closed and free range growing systems, reported that the growing systems affected the abdominal fat weight in the Tetra-H genotype (P<0.05). Hoan and Khoa, (2016) found that the abdominal fat rate was 0.7% after 90 days of working in the free range raising system on Sasso males.

At the end of the 12-week study, no difference was observed between indoor and free-range treatment in ATAK-S males in terms of rectal temperature and tonic immobility. Eleroglu et al. (2013) reported the rectal temperature as 41.8°C and 41.7°C, tonic immobility as 85s and 86s in Hubbard Gray Barred JA and Hubbard S575 JA males, respectively, at the end of 14 weeks in two different genotypes that develop slowly. Eleroglu and Yıldırım, (2019) reported that in the Guinea fowl genotype, in organic growing system, the rectal temperature at the 14th week was 41.54°C and tonic immobility was 253.9s.

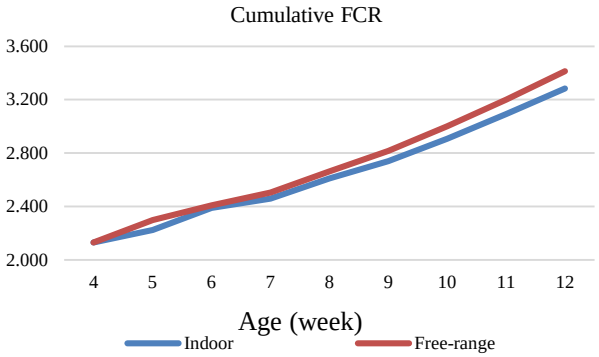


Figure 2. Cumulative Feed Conversion Ratio (FCR) of ATAK-S Male Chicks in indoor and Free-range

Table 5. The effect of raising system on the carcass parameters of ATAK-S male birds (n=12)

Parameters	Indoor	Free-range
Hot carcass (%)	70.87±0.35	71.50±0.25
Cold carcass (%)	68.00±0.29	68.34±0.25
Thigh (%)	32.54±0.44^{b*}	33.67±0.29^{a*}
Bony breast (%)	24.47±0.35	25.29±0.72
Breast meat (%)	17.47±0.33	16.83±0.23
Wing (%)	13.22±0.18	12.94±0.11
Back (%)	22.13±0.29	21.65±0.43
Neck (%)	7.02±0.20^{a*}	6.35±0.20^{b*}

Values are mentioned as Means ± SE, letter(s) in the same row with different superscripts are significantly different. *P< 0.05.

Table 6. The effect of raising system on abdominal fat and giblets of ATAK-S male birds (n=12)

Parameters	Indoor	Free-range
Abdominal F.W (g)*	7.08±1.20	4.83±0.89
Abdominal fat (%)	0.64±0.10	0.43±0.08
Gizzard weight (g)	28.58±1.36	31.33±1.02
Gizzard rate (%)	2.62±0.08	2.80±0.08
Heard weight (g)	6.42±0.23	6.58±0.26
Heard percentage (%)	0.59±0.02	0.59±0.02
Liver weight (g)	25.33±1.25	28.50±1.14
Liver percentage (%)	2.33±0.08	2.55±0.08
Testes weight (g)	7.83±1.19	5.42±0.88
Testes percentage (%)	0.50±0.07	0.34±0.05

Abdominal F.W: Abdominaal fat weight; Values are mentioned as Means ± SE

Table 7. The effect of raising system on rectal temperature (°C) and tonic immobility (s) of ATAK-S male birds (n=30)

Parameters	Indoor	Free-range
RT (°C)	41.81±0.04	41.85±0.07
Tİ (s)	172.23±28.59	133.17±18.59

RT: Rectal temperature; TI: Tonic immobility; Values are mentioned as Means ± SE

Rectal Temperature and Tonic Immobility

At the end of the study (12 weeks), rectal temperatures and tonic immobility in indoor and free-range treatments are given in Table 7.

As a result, in recent years, both sensitivity to animal welfare has increased and the demand for eggs and meat of chickens raised under conditions suitable for the nature and behaviour of chickens has increased. Chickens that have a more developed muscle structure and can be boiled for a long time are demanded by a part of the society. In line with these demands, it is thought that ATAK-S male chicks can find a market by raising their meat in family businesses and small commercial enterprises. It has been demonstrated that ATAK-S male chicks can yield results similar to indoor raising conditions for 12 weeks of rearing under free range conditions.

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