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Productivity and Egg Quality of Two Commercial Layer Hybrids Kept in Free-Range System

Muhittin Tutkun, Muzaffer Denli*, Ramazan Demirel

Department of Animal Science, Faculty of Agriculture, Dicle University, 21280 Diyarbakır, Turkey

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*Corresponding Author:
E-mail: muzaffer.denli@gmail.com

ABSTRACT

The purpose of this study was to compare the performance and egg quality parameters of two layer hybrids (Lohmann Brown and Atak-S) which were reared in free-range system. The experiment was carried out with a total of 300 laying hens. From 18 to 50 weeks of age Lohmann Brown (LB) and Atak-S (AS) were housed in two groups of 150 hens in a poultry house with a stocking density of 7 hens/m^2. The 2 trial groups were formed from 10 repetitions each consisting of 15 hens. At the 20, 30, 40 and 50 weeks of ages, the production performance and egg quality parameters were evaluated. Mean daily feed intake and feed efficiency through the trial were 111.2 g vs 124.3 g, and 2.46 vs 2.58 respectively for LB and AS hybrids ($P<0.05$). The AS had a significantly higher body weight (2.200.5 g and 2.022.2 g respectively) than LB hen age at 50 weeks ($P<0.05$). Mortality exhibited a similar pattern to that of laying performance. There was no significant difference concerning the egg production between two hybrids ($P>0.05$). However, egg weight was significantly higher in LB genotype than AS genotype ($P<0.05$). Similarly, no significant difference was found between two hybrids in terms of egg quality characteristics throughout the experiment ($P>0.05$). In conclusion, our results showed that hybrid selection is important for productivity of laying hens rearing in free-range system.

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Introduction

Egg production system is probably one of the most important challenges for the egg producing industry in the last decade. There are various factors including diseases, behaviour, nutritional value, genetics and air conditions in poultry houses affecting the level of welfare laying hens (Denli et al., 2016).

Housing in the cage is the most common system for growing of laying hens. In the world, the great majority of egg chickens are grown in cages. However, the results obtained from scientific studies in recent years have revealed that chickens raised in traditional cages may not meet the physiological and behavioural requirements (Bozkurt, 2009).

This has brought about alternative raising systems that keep animal welfare in the forefront. Animal welfare is a definition that prescribes the quality of life of an animal by creating the conditions that animals can show their natural behaviour. After finding that the raising conditions in conventional cages affected the animal welfare negatively. The European Parliament passed the decision "to ban the use of cages" in 1999 and it was decided to be implemented until 2012. After this directive (1999/74/EC), it is permitted for the use of enriched cages (Lumvery, 1999). After the ban in 2012, the search for alternative raising systems for laying hens has accelerated.

The use of enriched cages instead of the traditional cage system has come to the forefront. Other alternative raising systems that keep animal welfare in the forefront are free-range and aviary systems. In some countries such as Germany and the Netherlands, the poultry industry has a tendency towards fully alternative raising systems while the enriched cage system in the UK, Belgium and Sweden has come to the forefront (Rodenburg et al., 2005).

In alternative raising systems, chickens are able to exhibit many natural behaviours, walking and have enough exercises. Among the factors influencing the selection of raising systems are epidemic diseases, behaviour, nutritional value, genotype and environmental conditions (Denli et al., 2016). However, due to some disadvantages and other problems in the animal welfare of the conventional cage raising system, various alternative systems have been carried out in order to minimize negative effects of conventional cage. Free-range and enriched cage systems are acceptable alternative raising systems in terms of alleviating the problems of

conventional cage systems. Laying hen's performance and production parameters such as egg weight, feed efficiency, daily feed intake, and mortality may be influenced by the different housing systems (Taylor and Hurnik, 1996; Batkowska et al., 2014), genotype and age (Zita et al., 2009) and environmental conditions (Hester, 2005). Moreover, egg quality may also be affected by the housing systems (Vits et al., 2005) as well as the age of the laying hens (Silversides et al., 2006)

In Turkey, various arrangements for the common agricultural policies in the process of accession to the EU have performed and it is still going on. One of the important applications is animal welfare regimes. The EU directive on "Laying hen's welfare" was adopted in 1999 and it was decided to be implemented in poultry farms before 2012. With this directive, the conventional cage system has been removed and replaced with enriched cages or free-range systems. The Ministry of Food, Agriculture and Livestock has informed that the layer hen enterprises operating will be replaced with the old type conventional systems until 2015 to conform to EU norms. In Turkey, foreign hybrids are mostly used in poultry production and efforts to develop of native hybrid hybrids continues.

Up to now, the production performance and egg quality characteristics of many laying hens' hybrids in different housing systems have been compared (Abrahamsson and Tauson, 1997; Van Den Brand et al., 2004; Mallet et al., 2006). Atak-S (AS) is a Turkish indigenous egg laying hybrid has been developed by Ankara Poultry Research Institute in 2004 (Goger et al., 2016) and because of many reasons AS hybrids are preferred by farmers. However, there is no enough knowledge on the performance of Atak-S (AS) hybrid in different housing systems. In this study, we aimed to determine and compare indices of production and egg quality parameters of native (Atak-S) and foreign (Lohmann Brown) laying hybrids reared in free-range systems.

Materials and Methods

A total of three hundred 18-wk-old Lohmann Brown and Atak-S hens were housed in free-range systems (n= 300; 10 house pens; 15 hens per pen; floor space 200 cm2/hen) to 50 wk. of age. Hens were fed the same diet which was formulated based on National Research Council (NRC, 1994) containing 17.5% CP, 2800 ME/kg, 3.6% Ca and 0.90% available P. Throughout the experiment lightening was on a 16L:8D schedule. Feeders were filled manually every day and egg collection was conducted daily during the morning hours. Egg weight, feed intake and feed efficiency were determined weekly throughout the experiment period. Egg production per group, per-house-hen-day production and quality parameters were performed at of 20, 30, 40 and 50 wk. of age on the random sample of 30 eggs per treatment. Totally 30 eggs were collected (in the morning) from each group for 2 consecutive days and stored at 4°C overnight and then broken onto a level surface. Percentage of cumulative mortality of laying hens were recorded during the rearing and at wk. 30, 40 and 50 of laying periods. Egg length (L), width (W) were measured by screw from Mitutoyo ®. Egg shape index (ESI) was determined according to Anderson et al. (2004) as given with the formula: ESI=(W/L)×100. The height of the albumen and yolk (Yh) were measured by using tripod micrometre. The shell thickness were measured by digimatic (MDC-SX) micrometre from Mitutoyo ® according to Chowdhurry, (1990). The width of the albumen and yolk (Yw) were measured by using a standard caliper. The yolk index (YI) was calculated using yolk height (Yh) and yolk width (Yw) data as given the formula: YI=(Yh/Yw)×100. Yolk colour was measured with a Roche yolk colour fan (Roche scale). Statistical analysis was performed using the mixed model and t-test procedure of SPSS 16.0. A significant difference was at $P<0.05$.

Results and Discussion

Housing systems in layer have an important influence on the productive performance (Moorthy et al., 2000; Singh et al., 2009) and egg quality parameters of laying hens (Vits et al., 2005). Research results relating to hen-egg production, feed intake, feed efficiency and mortality was presented in Table 1. LB had higher egg production than AS at wk. 20 and wk. 30, However, the egg production of AS hens was higher than that of LB hens at wk. 50 ($P<0.05$). Feed intake of AS hens was found higher than LB at week 40 and 50 ($P<0.05$). The observation concerning egg production of LB hens made in this study was agree to those obtained by Küçükyılmaz et al. (2012). In addition, a significant effect of hybrid on feed efficiency was found in all examined age periods ($P<0.05$). On the other hand, the LB hens had a lower mortality rate (0.7 % and 1.8 % respectively) than AS hens at wk. 30 ($P<0.05$). At the end of the study, 7 and 8 hens were died in LB and AS groups respectively.

Table 1 Production performance of Lohmann Brown and Atak-S hens housed in free-range (20 to 50 wk of age)

Period	Hen-egg production rate (%)		Hen-egg production (egg/hen/day)		Daily Feed intake (g/hen)		Feed efficiency (g of feed/g of egg)	
	LB	AS	LB	AS	LB	AS	LB	AS
Wk. 20	$36.4^{a}\pm1.4$	$22.8^{b}\pm1.1$	0.36	0.23	100.2±0.9	100.1±0.6	$2.61^{b}\pm0.07$	$2.78^{a}\pm0.01$
Wk. 30	95.4±1.2	95.2±1.4	0.95	0.96	113.4±0.1	118.8±0.7	$2.49^{b}\pm0.06$	$2.62^{a}\pm0.08$
Wk. 40	$95.7^{a}\pm1.1$	$93.9^{b}\pm1.4$	0.96	0.94	$118.6^{b}\pm0.7$	$126.4^{a}\pm0.1$	$2.37^{b}\pm0.01$	$2.56^{a}\pm0.08$
Wk. 50	$85.3^{b}\pm1.1$	$87.3^{a}\pm1.3$	0.85	0.87	$113.4^{b}\pm0.5$	$124.3^{a}\pm0.2$	$2.33^{b}\pm0.01$	$2.42^{a}\pm0.09$

^{a,b}Means± SE within each period with different superscript letters are significantly different ($P<0.05$). LB = Lohmann Brown; AS= Atak-S

Table 2 Weight, shape index, shell weight and shell thickness of eggs of Lohmann Brown and Atak-S laying hens housed in free-range from 20 to 50 wk. of age

Period	Egg weight (g)		Shape index		Shell weight (g)		Shell thickness (mm)	
	LB	AS	LB	AS	LB	AS	LB	AS
Wk. 20	46.3±0.12	44.1±0.12	78.2±0.31	77.0±0.29	5.10±0.04	4.85±0.02	0.34±0.007	0.33±0.007
Wk. 30	58.4^{a}±0.22	54.8^{b}±0.33	78.1±0.42	75.8±0.29	6.38±0.04	5.90±0.07	0.33±0.008	0.34±0.006
Wk. 40	64.9^{a}±0.28	60.1^{b}±0.52	76.1±0.38	74.9±0.46	7.17±0.07	6.38±0.05	0.34±0.005	0.36±0.004
Wk. 50	65.4^{a}±0.42	61.8^{b}±0.38	76.2±0.62	76.3±0.42	7.16±0.12	6.71±0.15	0.32±0.004	0.31±0.006

^{a,b}Means± SE within each period with different superscript letters are significantly different (P<0.05). LB = Lohmann Brown; AS= Atak-S

Table 3 Albumen height and width, yolk height and width of eggs of Lohmann Brown and Atak-S laying hens housed in free-range from 20 to 50 wk. of age

Period	Albumen height (mm)		Albumen width (cm)		Yolk Index	
	LB	AS	LB	AS	LB	AS
Wk. 20	9.6±0.10	9.8±0.12	6.4±0.12	6.6±0.12	49.7±0.58	48.9±0.37
Wk. 30	9.6±0.11	9.3±0.11	6.7±0.15	6.7±0.18	48.5±0.44	47.4±0.41
Wk. 40	9.5±0.09	9.8±0.10	6.5±0.12	7.0±0.23	46.8±0.52	46.4±0.46
Wk. 50	9.3±0.09	9.5±0.11	7.3±0.20	7.8±0.12	44.8±0.48	44.3±0.38

^{a,b}Means± SE within each period with different superscript letters are significantly different (P<0.05). LB = Lohmann Brown; AS= Atak-S

Table 4 Cracked, dirty eggs and yolk color of LB and AS laying hens housed in in free-range from 20 to 50 wk. of age

Period	Cracked eggs (%)		Dirty eggs (%)		Yolk colour	
	LB	AS	LB	AS	LB	AS
Wk. 20	2.44^{a}±0.06	0.54^{b}±0.01	0.00±0.00	0.00±0.00	11.0±0.14	11.2±0.08
Wk. 30	1.04±0.05	1.14±0.01	0.12±0.001	0.19±0.001	11.4±0.16	11.8±0.13
Wk. 40	0.10±0.01	0.78±0.01	0.00±0.001	0.00±0.000	12.1±0.12	12.0±0.13
Wk. 50	0.85±0.02	0.89±0.01	0.0±0.00	0.0±0.00	12.0±0.14	12.2±0.11

^{a,b}Means± SE within each period with different superscript letters are significantly different (P<0.05). LB = Lohmann Brown; AS= Atak-S

Shell and internal quality of egg are important for the economic success of a producer and also consumer demands (Singh et al., 2009). Egg quality may be influenced by several factors such as housing systems, hen hybrid and nutritional factors. There are differences in egg quality parameters between different hybrids (Hocking et al., 2003). Türker et al. (2017) reported that the shell thickness of Atak-S eggs was not low but, the shell breaking resistance was very weak. In this study, there was no significant difference between the egg shape index, shell weight and shell thickness regarding appearance from 20 to 50 wk. of age (Table 2). However, the egg weight of LB hens was higher than that of AS hens at wk. 30, 40 and 50 (P<0.05). Similar results were reported by Basmacıoğlu and Ergul (2005). However, results of shell thickness of egg were shown difference from Küçükyılmaz et al. (2012), who found the egg shell thickness of eggs from LB hens were higher than that of eggs from AS layer hens in conventional and organic rearing systems. Our results in terms of shape index were similar to those of Şekeroğlu et al. (2010) reported that the shape index of eggs obtained in the free system from Atak-S hens was 76.05.

The hybrid has effects on yolk and albumen quality characteristics of eggs (Tumova et al., 1993). The effects of hybrids on albumen height, albumen width, and yolk height and yolk width was shown in Table 3. In the study, It was found no significant differences between hybrids housed in furnished cages at wk 20, 30, 40 and 50 (P>0.05). Similarly, Türker et al. (2017) obtained similar results with respect to albumen index, yellow index and yellow colour characteristics. In contrast, Leyendecker et al. (2001) found significantly higher yolk weight in white egg chickens (Lohmann LSL) in comparison with the Brown Lohmann. Dikmen et al. (2017) found the egg shell weight, yolk weight, albumen weight, albumen index, and Haugh unit were higher for Lohman Brown in the FR system but were similar in the conventional and furnishes cage systems. The hybrid influenced cracked and dirty egg numbers in a marked manner (Table 4). The cracked egg numbers from LB hens at 20 wk. was found higher than those from AS hens (P<0.05). Eggs from LB and AS hens have shown similar yolk colour.

Conclusions

According to the experiment results, the hybrid selection is important for productivity of laying hens rearing in free-range system. Furthermore, it can be concluded that performance of LB laying hens was better than AS hens in free-range system. In order to minimize negative effects of conventional cage, the Free-range systems are acceptable as an alternative raising system in terms of alleviating the problems of conventional cage systems.

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