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Comparison of Rapid and Slow Feathering Egg Layers with Respect to Egg Production and Hatchability Parameters

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Abstract: This study was conducted to develop slow and rapid feathering strains and to find out the effects of speed of feathering on production and hatchability parameters in slow and rapid feathering strains of Line-54 of brown layers. Slow and rapid feathering genotype Line-54 brown egg layer strains were used as animal material. Significant differences were found between the groups with respect to sexual maturity, live weight at sexual maturity, egg production and egg weight ($p<0.01$) but not in egg mass ($p>0.05$). No difference in hatchability characteristics such as hatchability and middle period embryonic mortality was found between the slow and rapid feathering layers ($p>0.05$). Fertility, late period embryonic mortality ($p<0.05$), hatchability of fertile eggs and early embryonic mortality differ between the genotypes ($p<0.01$). The results of the present study suggested that slow feathering affected some production and hatchability parameters in layers.

Key words: Laying hens, slow and rapid feathering, hatchability, egg production

INTRODUCTION

Sex determination was an unknown process in hatchery until 1925. Later, different methods, such as biochemical, histological, auto sexing, watching cloak and other instruments have been used to differentiate female and male chicks (Goger and Durmus, 2005). In auto sexing, wing feather colour and the speed of feathering at wing are criteria for sex determination (Wilson *et al*., 2007).

In day old chicks, the speed of wing and tail feathering is determined by the genes K and k alleles which are located in Z sex chromosomes as informed firstly by Waren (Aksoy *et al*., 2002).

Sex determination based on slow and rapid feathering in egg layer chicks is widely used in poultry breeder farms in USA. In this method, the length of primer and secondary feathers at wing is measured. If slow feathering hens are husbandired with rapid feathering cocks, female hatchlings are rapid feathered while males are slow feathered. However, chicks having slow feathering gene show late sexual maturity and reduction in egg production and need a higher amount of dietary energy (Wilson *et al*., 2007).

Saleh *et al*. (1987) found that axe combed white rapid feathering Leghorns reached to sexual maturity earlier and produced more eggs compared to slow feathering Leghorns.

Dunninngton and Siegel (1986) determined that the effects of rapid and slow feathering alleles on first egg age and egg yield were not different between rapid and slow feathering groups.

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Bacon *et al*. (1986) reported that there was no relationship between slow feathering and immunity. Fotsa *et al*. (2001) found out that slow (K gene) and rapid (k^+ gene) feathering in leghorn and brown layers in different ambient temperatures did not affect weight gain and fattening. White Rock chickens showing rapid and slow feathering were not different from each other with respect to feed conversion ratio and growth traits while mortality rates were higher in slow feathering chickens (15%) than in rapid feathering (6%) ones (Thiagarajon, 1977). Lowe and Garwood (1981) reported that feathering genotype did not affect hen-day egg production, body weight and egg weight in Rhode Island Red and White leghorn hybrids. Dunninngton *et al.* (1986) demonstrated that chicks having k gene (K) were more sensitive to *E. coli* infection.

Khosravinia (2009), who worked with broilers allowing sex determination based on slow and rapid feathering, reported that live weight and carcass weights of rapid feathering broilers were significantly higher than those of slow feathering ones.

Low and rapid feathering strains were obtained from brown layers Line-54 at the Poultry Research Institute in Turkey. This study aimed at investigating the effects of the speed of feathering on some production and hatchability traits in these two strains.

MATERIALS AND METHODS

This study was carried out at the Poultry Research Institute in Turkey date of between 01 June, 2004 and 20 September, 2008. Animal material was composed of rapid and slow feathering strains produced from Line-54 pure lines according to the wing feathering speed. Feed material was composed of feeds, whose nutrient compositions is shown in Table 1.

The available brown layer has a feathering gene frequency of L-54 pure line that is 55% rapid and 45% slow. Considering this feature, 1800 eggs obtained from this line were incubated. On the first day, the chicks were divided into two groups: the ones feathering slowly and the ones feathering rapid without looking at their sex. Later, the chicks underwent

Table 1: Chemical compositions of feed materials fed to hens in the study

	Weeks				
Nutrients	0-3	4-10	11-16	17-40	41-46
Dry matter (min) (%)	88	88	88	88	88
Crude ash (max) (%)	8	8	8	15	15
Crude protein (min) (%)	19	18	16	18	17
Metabolic energy (min) (kcal kg^{-1})	2900	2800	2700	2800	2700
Calcium (min-max) (%)	1-1.2	1-1.1	0.9-1	3.5-4	3.8-4.2
Available phosphorus (min) (%)	0.45	0.42	0.40	0.40	0.37
Lysine (min) (%)	1.15	0.98	0.72	0.75	0.75
Methionin (min) (%)	0.55	0.47	0.35	0.47	0.42
Methonin+cystein (min) (%)	0.85	0.76	0.58	0.78	0.72
Triptophan (min) (%)	0.20	0.19	0.17	0.20	0.19
NaCl (min-max) (%)	0.35-0.50	0.35-0.50	0.35-0.50	0.35-0.50	0.35-0.50
Crude cellulose (max) (%)	4.5	5	6	6	6
Linoleic acid (min) (%)	1.5	1.25	1.0	1.7	1.5
Vitamin A (IU kg^{-1})	13000	13000	10000	12000	12000
Vitamin D_3 (IU kg^{-1})	3000	3000	2000	2500	2500
Vitamin E (mg kg^{-1})	20	20	20	20	20
Vitamin K_3 (mg kg^{-1})	2	2	2	2	2
Vitamin B_2 (mg kg^{-1})	5	5	5	5	5
Vitamin B_{12} (mg kg^{-1})	0.02	0.02	0.01	0.01	0.01
Niacin (mg kg^{-1})	60	60	30	25	25
Mangan (mg kg^{-1})	100	100	100	60	60
Zinc (mg kg^{-1})	70	70	70	40	40

a sex separation system and 250 female chicks and 40 male chicks from each group were selected. A total of 500 female chicks and 80 male chicks were collected and numbered. When the chicks reached their 10th day, their tail feathers were checked. After chicks were reared, the productivity of the eggs was noted and the ones with a lower capacity were separated until the chicks reached their 43rd week. Forty families were established from each group consisting of 5 hens and 1 cock. The hens were artificially inseminated and the eggs obtained were incubated. The chicks obtained were checked due to their family based feathering and the ones, which showed some differences, were separated. The process, which was applied to the first generation, was again applied to this generation. When the chickens reached the 43 week egg productivity, a homozygote test was applied to the ones whose feathers grew slowly and the ones that had the heterozygote (Kk) gene type were separated. After these processes, similar families were established and the same process for the second generation was applied to the third generation. In this generation looking at the L-54 pure line looking the feathering condition formed again the two strains.

In this study, at a total of 250 hens and 50 cocks coming from every strain formed of 125 hens and 25 cocks were obtained with the process mentioned above.

Hatching eggs produced from the hens obtained with this method were put in incubation and chickens were raised for 16 weeks following hatching and then were transported to the cages. Hens were exposed to natural daylight during the growing period and from the 19th week lighting time was increased by 1 h for each week and finally was fixed at 16 h. Feed and water were given *ad libitum*.

From the beginning of laying period to the end of 43rd week age

- **Sexual maturity (day):** For both lines were determined by taking the duration between hatching date and beginning of egg yielding into consideration
- **Sexual maturity weight:** Sexual maturity weights for both lines were determined by weighing the hens with a scale of 5.0 g sensitivity at the beginning of egg production
- **Egg production:** Hen-day egg yields for both lines were determined by determining the egg counts during the production period up to the 43 weeks age
- **Egg weight:** Average egg weights were determined by weighing two successive eggs for every 4 weeks from the beginning of 28th week in each line separately
- **Egg mass:** Egg mass was calculated by multiplying total egg counts by average egg weights in each line separately

After having obtained production records at 43 weeks old, flocks having either slow and rapid feathered were kept 1 cock +5 hens with 25 replications. The hens were inseminated artificially with their cocks in their family twice a week. After the second insemination, eggs were collected for 10 days and stored in a room having 12°C ambient temperature with 80% relative humidity. After the collection of the eggs, they were subjected to pre-heating with 23°C ambient temperature and 75% relative humidity for 8 h in prior to hatching. After optimum hatching conditions were reached, eggs were detected by lamp for fertility, by cracking eggs for determining early and middle period embryonic mortality at 18 days of hatching and transferred from developer to hatcher. Infertile and dead embryos were discarded and healthy ones were transferred to hatcher with pedigree boxes. After 21 days of hatching period, healthy chicks and late embryonic mortalities were determined.

$$\text{Hatchability} = \left(\frac{\text{Alive hatched chick numbers}}{\text{Placed eggs into hatching machine}}\right) \times 100$$

$$\text{Hatchability of fertile eggs} = \left(\frac{\text{Alive hatched chick numbers}}{\text{Placed fertile eggs into hatching machine}}\right) \times 100$$

$$\text{Fertility} = \left(\frac{\text{Fertile eggs}}{\text{Placed eggs into hatching machine}}\right) \times 100$$

$$\text{Early embryonic mortality} = \left(\frac{\text{Dead embryos during the period of 0-6 days of hatching}}{\text{Fertile eggs}}\right) \times 100$$

$$\text{Middle period embryonic mortality} = \left(\frac{\text{Dead embryos during the period of 7-18 days of hatching}}{\text{Fertile eggs}}\right) \times 100$$

$$\text{Late period (under shell) embryonic mortality} = \left(\frac{\text{Dead embryos during the period of 19-21 days of hatching}}{\text{Fertile eggs}}\right) \times 100$$

Statistical Analysis

This study was conducted according to the randomized block experimental design and data were tested for distribution normality and homogeneity of variance. One way ANOVA was used to determine the differences each traits. Data in percentages were subjected to arcsin transformation ($180/\pi \text{x} \arcsin\sqrt{P}$) (Düzgüneş *et al*., 1987).

RESULTS

Hen-day egg production, egg weight, sexual maturity and live weight at sexual maturity were affected by slow and rapid feathering genotype ($p<0.01$), but egg mass was not ($p>0.05$). Rapid feathering hens were better than slow ones with respect to production parameters, except for egg weight and egg mass (Table 2).

With respect to current hatchability and middle period embryonic mortalities, there were no significant differences between rapid and slow feathering chickens ($p>0.05$). Fertility ($p<0.05$), early embryonic mortality and hatchability of fertile eggs ($p<0.01$) were affected significantly by slow and rapid feathering genotypes. Hatchability and middle period embryonic mortalities were similar in both groups. However, fertility, early and late embryonic mortalities and hatchability parameters were higher in rapid feathering group than slow feathering group (Table 3).

Table 2: Means±SE of some productive traits of rapid and slow feathering layer genotypes

	Some productive traits at 43 weeks old				
Feathering	Hen-day production	Egg weight (g)	Sexual maturity (day)	Body weight at sexual maturity (g)	Egg mass (g)
Rapid	135.99±0.57a	54.79±0.22a	148.23±0.41a	1600.4±9.04a	7.45±0.04
Slow	132.85±0.90b	55.85±0.34b	153.33±0.65b	1645.3±14.8b	7.41±0.06

a, b: p<0.01

Table 3: Means±SE of some hatching parameters of rapid and slow feathering layer genotypes

	Some hatching parameters (%)					
Feathering	Fertility (*)	Early embryonic mortality (**)	Middle period embryonic mortality	Late embryonic mortality (*)	Hatchability of fertile egg (**)	Hatchability
Rapid	96.40±0.48a	6.60±0.67a	2.07±0.36	6.94±0.70a	84.56±1.05a	81.40±1.05
Slow	97.96±0.62b	9.10±0.91b	1.83±0.42	9.37±1.04b	79.54±1.53b	77.90±1.58

a, b: *p<0.05, **p<0.01

DISCUSSION

With respect to sexual maturity, slow feathering pullets reached sexual maturity 5 days later than did the rapid feathering pullets. This affected egg production negatively in this study. However, it was expected that hens would compensate the reduction in egg production when experiment would have continued further.

While the present findings are in agreement with those of Wilson *et al.* (2007) and Saleh *et al.* (1987) they are in disagreement with those of Lowe and Garwood (1981) and Dunninngton and Siegel (1986).

Hen-day egg production and body weight at sexual maturity were better in the rapid feathering group than the slow feathering group. Low body weight at sexual maturity in the rapid feathering group can be advantageous for feed consumption. Although, egg weight was higher in the slow feathering group, egg production was lower. This led to similar egg mass values in both feathering groups.

Early and late embryonic mortality in rapid feathering genotype was lower than in slow feathering chickens as evidenced by higher hatchability in the former group. This was reflected to a higher hatchability in rapid feathering eggs. Also, lower early and late period embryonic mortalities helped this positive result for rapid feathering hens. Hatchability was not affected by slow and rapid feathering. Insignificant differences in obtained parameters were more likely because of chance.

In breeder enterprises, sex determination is a very important subject. Although, sex determination is done with different methods, especially wing feathering is quite widespread in the parent stock enterprises. As shown in current findings, some productive traits started to decline in slow feathered genotypes when slow and rapid feathered chicken breeders were bred separately. However, there were differences in production parameters, these differences were not reflected in egg mass, which is regarded as the total value of production parameters. The egg mass values of both feathering groups were found similar (Table 2).

Hatchability is a result of hatching in hatchery. Hatchability must not be below 89% for commercial hatchery. This value varies depending on parent stock, grand parent stock and pure breeds for their hatchery results. In the current study, rapid and slow feathering flocks which were obtained by selection showed 80% hatchability.

With respect to hatching traits, there were significant differences between slow and feathering chickens but hatchability was not affected by slow and rapid feathering genes.

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