

COMPARATIVE STUDY OF PERFORMANCE PARAMETERS IN HENS FROM TWO DIFFERENT GENOTYPES

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Abstract

A comparative study on the main performance parameters and morphology of eggs of layer hens (line “L”) and dual purpose cross “Salmon” with poorer vision was carried out. The experiment was conducted in the Institute of Animal Science- Kostinbrod, with 12 pens each containing 35 birds at a stocking density of 5 birds/m² for each of the genotypes for the period 32-44 weeks of age. The feed conversion and the laying performance of the hens were determined. Analysis of the morphology of eggs from “M” category was performed at the beginning (32 wk) and at the end of the experiment (44 wk). During the experimental period, except on 37 week, the feed conversion was significantly higher in Salmon hens, as the latter showed lower laying performance. The percentage of albumen decreased with the age of the hens, however, it remained higher in the birds of line L. On the other hand, the percentage of yolk increased significantly with advancing of the age, regardless of the genotype. Considerable differences were found in regard to the percentage of the egg shell, as the values of this parameter was higher in the Salmon hens at the age of 32 weeks. In the latter, we observed lower egg shell thickness, in comparison to L line. The genotype and age interacted significantly in regard to the Haugh units, as this trait remained higher in Salmon at 32 weeks of age.

Key words: hens, genotype, age, performance, morphology of eggs

Introduction

At the end of the 1960s finished the long transition of the systems for production of hen eggs that developed from small scale village farms to large scale industrial enterprises, turning the egg production into a very important agricultural branch (Fröhlich et al., 2012). The increase of the scale of the farms lead to changes in production systems, and due to hygienic and economic reasons, the latter became more intensive. Thus in 1970s, placing of layer hens in conventional cages was indicated as a defining innovation. At the same time, public concern about the intensification of the industry began to grow, especially after publications such as “Animal Machines” (Harrison, 1964), initiated a new type of animal welfare legislation. This forced the agriculture to adapt, responding to new consumer demands (Makdisi and Marggraf, 2011). An initial push was given to the development of a new (alternative) type of rearing systems for laying hens and a return to the floor-type rearing systems that provided greater freedom of movement and conditions for natural behavior (Fröhlich et al., 2012). Over time, this type of egg production system was imposed and reaches the situation of the complete rejection of the conventional type of cell systems within some countries (Germany and France) in 2022, setting deadlines for the rest of the EU member states until 2027 (Albert Schweitzer Foundation, 2021; BBC, 2021).

The strictly specialized layer hybrids, which are mainly based on ancestral lines adapted to existence in cages (Nordskog et al., 1972), however, are found to be ill-adapted to the new demands of the consumers. The main reason for this is the short-sightedness of the breeders of nearly 40 years ago, who in the early 1980s eliminated or adapted all layer progenitor lines to cage systems. The only one that preserved similar type of lines is the selection center of Lohmann Tierzucht in Cuxhaven (Flock, 2009), where under the guidance of Prof. Flock, several lines of layer type with higher live weight are preserved. This will later allow the creation of four-line hybrids, such as Lohmann Dual and Lohmann Traditional (Kaufmann and Andersson, 2013; Icken and Schmutz, 2013; Damme et al., 2015; McDougal, 2018), which are hybrids adapted to floor and extensive systems (Lambertz et al., 2018; Jorga, et al., 2020), such as the alternative types of systems (Belorechkov, 2010). On the other hand, the selection that was carried out in conditions of low lighting leads to an aggravation of the vision of all ancestral lines, which is also inherited by the final hybrids for eggs and meat (Aiala and Kiger, 1984). For this reason, when placed in an environment with high light intensity (the alternative systems), they become aggressive (Collins et al., 2011; Belorechkov, 2016), have lower performance and high mortality due to pecking (Star et al. al., 2008; Alrøe et al., 2001). Their high requirements for feed further increase the tendency to pecking and subsequent cannibalism (Belorechkov, 2011, 2016). Until recently, this did not apply to floor-raised birds, but in the last few years there has been a tendency to increase the lighting standards in buildings, which confronts breeders with a new problem related to the unsuitability of old lines and hybrids to the new conditions. According to some researchers (De Jong, 2007; Galster, 2011), crosses between lines with poorer vision and layers might give a good result in response to the new demands of the market. Thus, dual purpose hybrids or combinations that have good laying capacity in females (Bresse-Gauloise), with laying performance of 250 eggs per year and a live weight of 3 kg in males and 2.2 kg in females (De Jong, 2007; Galster, 2011), might be used in the alternative systems. In tests with a daylight-selected BB line, it was found That the birds had poorer vision than other birds, which, combined with its parentage, makes it suitable for a male form when forming egg combinations. Similar attempts were made by Ali and Cheng (1985), using a male line with a genetic mutation for poorer vision, allowing layer birds to remain indifferent to the irritation (Sandøe et al., 2014) that high intensity of sunlight induces in the laying hens (Sasstry, 2006).

The aim of the study was to compare the main performance traits and morphological qualities of the eggs in the conditions of a floor type rearing system in layers (Line "L") and dual purpose "Salmon" birds with poor vision.

Material and methods

The experiment was carried out in the experimental poultry farm of the Institute of Animal Science- Kostinbrod, Bulgaria. Two genotypes of hens were involved in the trial – dual-purpose “Salmon” and layer line “L”. The dual purpose cross “Salmon” was obtained after crossing of female layer Red Rhode Island (Line “L”) and dual-purpose males based on Bresse Gauloise breed (line BB). The birds have light pink to white colour of the plumage, white skin, light blue feet and blue abdominal membrane. They do not deposit abdominal fat during the intensive growth. Line “L” is a purebred layer line from the national gene pool of Bulgaria. The “L” birds are usually reared on floor, but it is possible to be raised in alternative systems as well.

For the purpose of the study, the birds were reared in pens on deep litter. The feed and water were provided “*ad libitum*” by gravity drinkers and bunker feeders. The birds were fed commercial feed for layers (20-45 wk of age) containing maize, wheat, soybean meal, sunflower meal (crude protein-16.056%; crude fat-5.288%; crude fibers -4.392 %; Lys-0.771%; Met-0.346%; Ca-3.199%; Na-0.367%, P-0.753%). The experiment was carried out into the period between the two

control morphological analyses (32-44 wk of age). The trial involved 12 pens each containing 35 birds at a density of 5 birds/m² for each of the examined genotypes (a total of 420 birds).

During the trial, the feed intake of the birds for each pen was controlled daily and weekly, the number of the laid eggs was recorded daily and weekly. Based on these data, the feed conversion and laying performance were calculated.

Morphology analysis of 15 randomly chosen eggs of “M” grade was performed for each of the groups. The analysis was carried out at the beginning (32 wk) and at the end (44wk) of the trial period. The parameters of interest were weigh of the eggs, % of the albumen, % of the yolk, % of the egg shell, shell thickness, Haugh units and colour (measured by Roche yolk fan). Data were statistically evaluated using the JMP v.7 software package. The differences in the performance parameters between the two genotypes were measured through t-test. For assessment of the morphological traits of the eggs, two-way ANOVA was applied, to determine the effect of the genotype and the age of the birds, as well as their interaction.

Results and discussion

Feed conversion and laying performance

During the whole trial period, except in the 37th week, the feed conversion remained significantly higher in the Salmon hens compared to line L (Fig.1). As seen on the figure, its values decreased in the course of the experiment, as the lowest were detected on the 44th week in both genotypes.

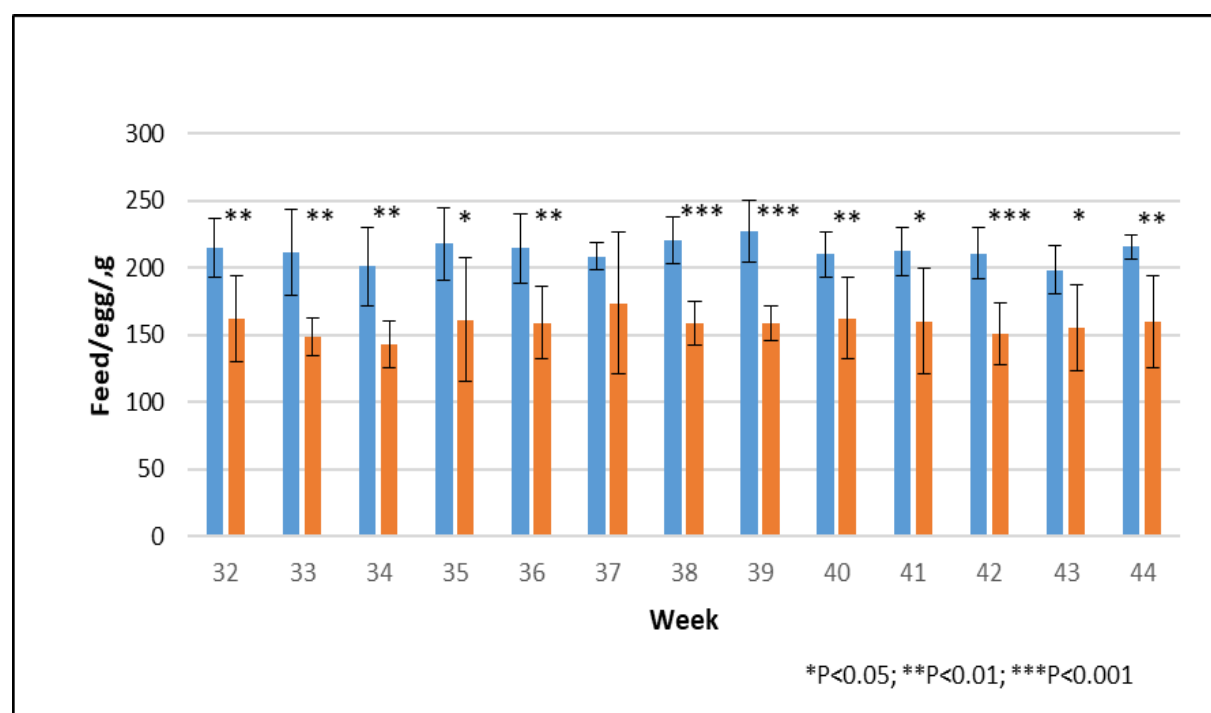


Figure 1. Feed conversion (Feed/egg, g) in the two genotypes during the experimental period (32-44 wk)

The results concerning the laying performance showed lower values of this parameter in Salmon hens in the course of the experiment (Figure 2). Except in the 37th week, the differences in the laying performance between the two genotypes are significant.

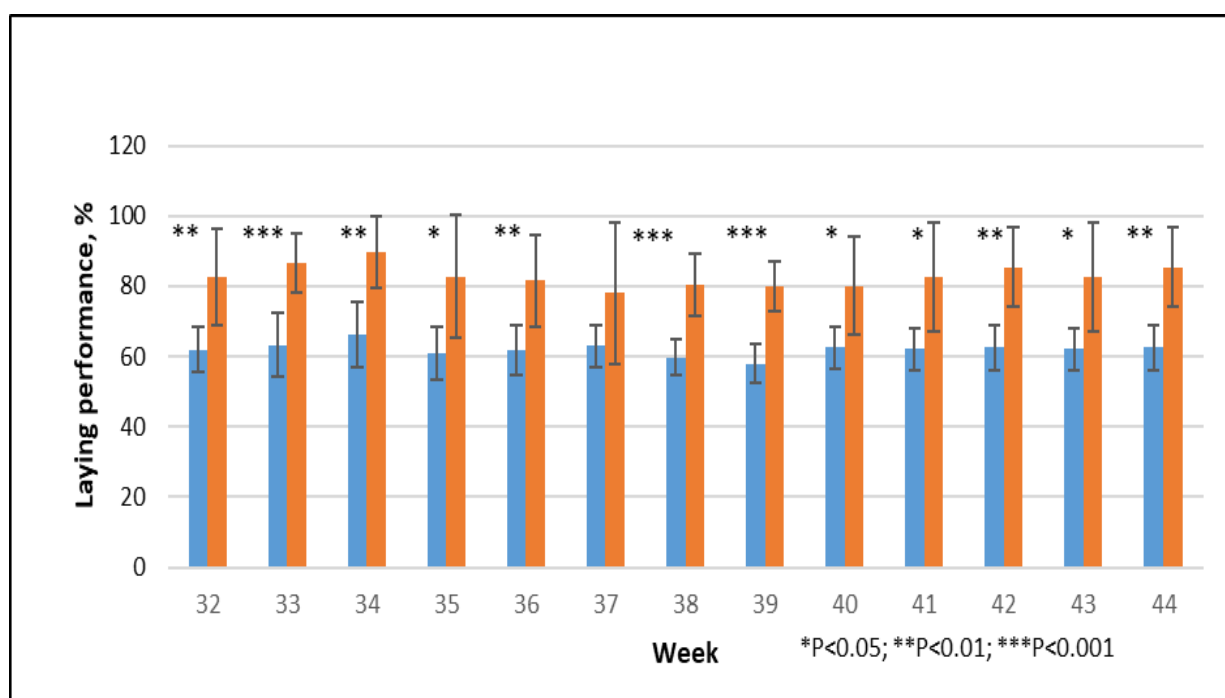


Figure 2. Laying performance of the genotypes during the experimental period (32-44 wk)

The results for the feed conversion and the laying capacity that we observed are due to the specifics of each of the genotypes. In a comparative study of the performance traits of dual purpose and layer hens, Gagnat et al. (2020) found higher feed conversion and lower laying capacity in the dual purpose birds from traditional breeds (Schweizerhuhn и Belgian Malines), that is in agreement with our results. On the other hand, the authors pointed that when comparing the classic Lohmann Brown layers with hens of Lohmann Dual, the latter showed significantly lower laying performance with similar feed conversion. Baldinger and Bussemas (2021) comparing the layer breed Sandy with the dual purpose Bresse and its crosses with White Rock and New Hampshire, reported the highest laying percentage in Sandy, the lowest in Bresse, as the crosses had intermediate position. The latter showed peak of the laying performance of 89 % and 87% during 37 and 31 week, respectively for Bresse × WR and WR × Bresse, as well as 88% and 84% during the weeks 35 and 27 for the Bresse × NH and NH × Bresse, respectively. These values were considerably higher than what we observed about the Salmon hens. On the other hand, Lambert et al. (2018), found close to our values of the laying performance of the Bresse x NH on 3week, however, decrease of this parameter was observed at 44th week.

Morphological analysis of the eggs

The results of the morphological analysis of the eggs (Table 1) showed significant interaction between the genotype and the age of the hens in regard to the weight of the eggs ($P=0.004$). It was found that at the age of 44 weeks of the birds, this parameter had higher values in the Salmon hens. In agreement with our results, Baldinger and Bussemas (2021) also found that the weight of the eggs was determined by the significant interaction of the genotype and the age, however, the authors did not detect significant differences in the weight of the eggs of the dual purpose and the layer hens. On the other hand, Gagnat et al. (2020) reported significantly lower weight of the eggs of dual purpose hens in comparison to layers. According to Schmidt and Damme (2017), the lower weight of the eggs of the dual purpose hens is a problem due to the negative impact for producing egg mass and its salability.

Table 1. Components and quality traits of eggs according to the genotype (G) and the age (A) of the hens

G	A	Weight, g	Albumen, %	Yolk, %	Shell, %	Shell thickness, mm	Haugh units	Roche
Salmon	32	52.50 ^{ab}	61.68	27.53	10.79a	0.378	93.60 ^a	8.80
	44	54.81 ^a	60.20	30.17	9.63b	0.371	89.27 ^b	8.67
L	32	54.31 ^{ab}	63.90	26.12	9.98b	0.403	89.53 ^b	8.93
	44	50.64 ^b	61.07	29.17	9.76b	0.390	91.33 ^{ab}	8.67
G	Salmon	53.66	60.94a	28.85	10.21	0.375 ^b	91.43	8.77
	L	52.47	62.49b	27.64	9.87	0.397 ^a	90.43	8.80
A	32	53.41	62.79a	26.82a	10.39	0.391	91.57	8.87
	44	52.72	60.64b	29.67b	9.69	0.381	90.30	8.70
Sig.	G	P=0.244	P=0.032	P=0.103	P=0.059	P=0.001	P=0.419	P=0.872
	A	P=0.499	P=0.003	P=0.0002	P=0.0002	P=0.107	P=0.308	P=0.421
	G x A	P=0.004	P=0.340	P=0.778	P=0.010	P=0.588	P=0.016	P=0.629
RMSE		3.89	2.72	2.81	0.68	0.024	4.77	0.80

Values least squares means; the values connected with different letters are significantly different ($P < 0.05$)

The genotype and the age of the birds affected significantly the percentage of the albumen, being higher in L hens, however its values decreased in both genotypes in the course of the experiment. The yolk percentage was affected only by the age of the birds, and was increased by the 44 weeks of age. Our results are in line with those of Baldinger and Bussemas (2021), who observed decrease in the percentage of the albumen and increase in the yolk with age regardless of the genotype. We found that the genotype and age interacted significantly in regard to the shell percent. The comparisons made showed considerably higher value of this parameter in the Salmon hens at the age of 32 weeks. The genotype affected significantly the egg shell thickness ($P=0.0007$), as it was found that in Salmon eggs the values of this parameter were lower in comparison to L. This confirms previous our observations on eggs of Bresse hens (unpublished data), that displayed higher size of the pores of the shell. Significant interaction between the genotype and the age was seen in regard to the Haugh units, as the trait had higher values in Salmon hens at the age of 32 weeks, when compared to line L at the same age. In addition, these values were higher when compared to 44 weeks of age in Salmon birds, as in line L there were no differences between the age groups. Discrepancies in this indicator between the different genotypes were observed by Almeida et al. (2021). The higher Haugh units are associated with higher quality of the eggs. According to USDA (2000), the eggs with Haugh units over 72 are considered of excellent quality. The values of the Haugh units in our study varied in the range 89.27-93.60, showing excellent quality of the eggs of the layer line L and the dual purpose Salmon.

Conclusion

The comparative study of the two genotypes of hens showed that the dual purpose Salmon birds had higher conversion and lower laying performance when compared to the layer line. L. Furthermore, these birds displayed higher percentage of the egg shell at the age of 32 weeks, whereas the line L eggs had thicker shell. The eggs of the L hens had higher percentage of albumen, while the yolk percentage was increased with age, regardless of the hens' genotype.

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