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Comparison of Egg Quality Characteristics of Different Quail Lines

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Abstract

This study was carried out to investigate external and internal egg quality traits of different quail lines housed in a multitier cage system. The study was performed on eggs of three different lines of quail as wild type, recessive white and black cross-line stock raised for commercial production. All flocks in the experiment were housed in the same environmental conditions for quail and fed the same diets during the experiment. A total of 60 eggs from each quail line were used to determine internal and external egg quality traits. The eggs from cross-line black coloured quails had significantly greater weight ($P<0.01$) and it needs more force to crack significantly than the other eggs to break ($P<0.012$). The black line of quails had significantly greater egg shell thickness than the other line quails ($P<0.001$). The white line quail eggs had significantly lowest egg length and highest shape index values ($P<0.001$, $P<0.001$). The egg yolk of white lines had a significantly lighter yellow than wild and black lines ($P<0.003$). In conclusion, it seems that the eggs of black coloured quails were relatively superior to wild and white coloured quail groups.

Key words: Quail, genotype, egg quality traits

Introduction

Quail is a popular animal model in numerous fields of scientific research[1] and is an important meat and egg source for consumers. However, compared to broiler meat or laying hen eggs, quail egg or meat consumption is very low. Producing value-added quail meat, eggs or live animals with different plumage color lines can be an effective way to improve marketing opportunities and consumer interest of quail.[2,3] Coturnix coturnix Japonica which is a very popular member of the Coturnix family, is raising commonly for quail egg production over the world.[4] Beside the pure line of Coturnix family, different plumage color variants of coturnix family as mutant birds or crossbreed birds are also raising in small numbers of flocks for different purposes.[5,6] The plumage color or genetic variation might play an im-portant role to egg quality on quail and there is a need for further investigations on determination of egg quality of different plumage color lines of quail. Although there is lots of research on different characteristics of different quail lines [7,8,9,10,11], the reported egg quality characteristics of quail are still very limited compared with the other poultry species, especially of different color variants. Moreover, the studies on quail have gradually diminished over the years.[12] Inci et al. [13] reported that significant differences were detected for egg weight, shape index, shell weight, albumen weight, yolk weight, albumen index, yolk index, and specific gravity among different feather colour groups of quail. Aryee et al.[14] showed that egg width, height, shape index, shell ratio and shell surface area were significantly influenced by the sizes of quail eggs. Cahyadi et al.[15] showed that brown plumage line has better both exterior and interior qualities of egg than black plumage line. Chimezie et al.[16] reported that brown Japanese quail is superior

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to white and black plumage of Pharaoh quail in most of the egg quality traits measured. Fathi et al.[17] recommended that raising grey quails for egg production under heat stress was better than white line. The purpose of this study was to investigate external and internal egg quality traits of different quail lines as pure line, recessive white and cross line black plumage coloured.

Material and Methods

The study was performed on eggs of three different lines of quail raised in the Quail Production Unit of the Research and Experimental Farm of the Faculty of Veterinary Medicine in Bursa Uludag University, Turkey. A total of 180 quail eggs from three different lines of Coturnix family (pure line/wild, white and black, each group contained 60 eggs) were used in this study to investigate internal and external egg quality traits. The recessive white quail appeared spontaneously in a wild-type quail flock. The cross line (black plumage colored) were obtained from pure line stocks of Coturnix coturnix japonica and pure line stocks of Bob White quail. This study doesn't require ethical permission according to Animal Experiments Ethics Committees Regulation on Working Procedures and Principles, Article 8 19-k.[18]

Quails, housing and management

The birds in all groups were the same age and all quails received identical care and management practices for quails throughout the whole experimental period. Quails were housed in five tier battery cages with 130 cm2 space per bird and exposed to a 16 h L :8 h D lighting schedule per day. In-house air temperature ranged from 18 to 21 Co during the study. Range of 40 to 60% relative humidity within the house was provided for all groups. Commercial layer rations formulated according to NRC[19] were used in the experiment. A laying ration containing 17% crude protein (CP) and 2800 kcal/kg metabolizable energy (ME) provided for all groups during the experiment. The feed and water were available ad libitum.

Egg Quality Measurements

The eggs were collected 5 consecutive days with a 15 days interval in each group and stored 24 hours at room temperature in the laboratory for analysis. Egg weight was weighed with a precision digital scale (0.01 precision). After weighing, the width and length of the eggs were measured with a caliper to 0.1 mm. Egg shape Index was calculated as egg width/egg length × 100. The egg shell breaking strength was measured using a cantilever system by applying increased pressure to the broad pole of the shell[20] and recorded as Newton (N) /cm2 force required to crack the shell surface. After all eggs were broken onto a flat surface, the height of thick albumen was measured using a tripod micrometer. The color of the yolk was determined with the DSM yolk color fan.[21] To measure shell thickness, pieces from three different points (two poles and equator) of each eggshell with intact membranes were measured with a micrometer to 0.01 mm. Hugh Unit was calculated according to the following formula:[22]

Haugh Unit = 100 Log ((Albumen Height+7.57) - (1.7 x Egg Weight 0.37)); H; is the albumen height (mm), W; is the egg weight (g).

The statistical analyses for all internal and external quality characteristics were performed using SPSS® computer software 13.00 by one-way ANOVA.[23] When the difference between the groups was found to be significant, the TUKEY test was applied as a post hoc test.[24]

Results

The external quality characteristics of the eggs produced from wild type, recessive white and black cross-line quails were presented in table 1. The egg weight (P<0.01), egg width (P<0.004), egg length (P<0.001), shape index (P<0.001), egg shell breaking strength (P<0.012) and shell thickness (P<0.001) were affected significantly by genotype.

Table 1. External quality characteristics of eggs from different quail lines.

		Mean	Std. Deviation	Std. Error	Minimum	Maximum	*P Value*
Egg weight (gr)	Wild	10,549[a]	,979	,117	7,87	12,89	0,010
	White	10,561[a]	1,021	,140	6,40	12,88	
	Black	11,036[b]	1,050	,132	8,64	13,51	
Egg width (mm)	Wild	24,653[a]	,797	,095	22,57	26,37	0,004
	White	24,783[ab]	,965	,132	20,59	26,95	
	Black	25,140[b]	,774	,097	23,73	27,08	
Egg length (mm)	Wild	31,578[b]	1,454	,173	28,00	35,50	<0,001
	White	30,748[a]	1,561	,214	24,94	33,09	
	Black	32,004[b]	1,553	,195	29,01	36,99	
Shape index	Wild	78,154[b]	2,605	,311	69,58	83,18	<0,001
	White	80,715[a]	3,413	,468	73,59	95,19	
	Black	78,658[b]	2,948	,371	69,72	84,36	
Egg shell breaking strength (N/m)	Wild	11,039[b]	3,020	,386	5,00	16,00	0,012
	White	11,848[ab]	2,838	,401	6,50	16,50	
	Black	12,747[a]	3,469	,444	5,00	21,00	
Shell thickness (mm)	Wild	0,2083[b]	,02279	,00274	,13	,25	<0,001
	White	0,2155[b]	,02147	,00295	,15	,26	
	Black	0,2280[a]	,02981	,00376	,16	,30	

a-b; within the same columns, values with different superscripts were found significantly different

The internal quality characteristics of the eggs produced from wild type, recessive white and black cross-line quails were presented in table 2. The yolk color of wild, white and black line quail was found to be significantly different (P<0.003). There were no significant differences for the albumen height and haugh unit values of eggs of three different quail lines.

Table 2. Internal quality characteristics of quail eggs of wild, white and black plumage color quails.

		Mean	Std. Deviation	Std. Error	Minimum	Maximum	*P Value*
Albumen height (mm)	Wild	4,281	,887	,106	1,70	6,17	0,597
	White	4,278	,884	,121	1,89	6,07	
	Black	4,139	,898	,114	2,33	6,25	
Yolk color	Wild	9,51[b]	1,106	,133	7	12	0,003
	White	8,96[a]	1,143	,157	7	11	
	Black	9,62[b]	1,023	,129	8	11	
Haugh Unit	Wild	89,010	5,456	,656	70,65	98,97	0,385
	White	88,989	5,307	,729	73,21	99,13	
	Black	87,862	5,017	,637	77,07	99,29	

Discussion and Conclusion

There are lots of factors affecting egg quality traits in quail such as layer age, increased body size, egg size, light intensity and dietary supplementation[14,25-28] The egg weight is a possible determinant of most of the external quality traits of quail eggs, and therefore it is a good indicator of egg shell quality in quail eggs.[29,30] The eggs from cross-line black coloured quails had significantly greater weight (P<0.01) and greater egg shell thickness than the eggs produced by wild and recessive white quails (P<0.001). In a study, Lan et al.[31] showed that egg weight over a 24-week laying period was superior in quails with wild-type and brown plumage colours. Chimezie et al.[16] reported that brown Japanese quail is superior to white and black plumage of Pharaoh quail in egg weight. In another study[32], the eggs produced from the quails with grey plumage were found to be heavier than those of brown, white and golden plumage color quail. The layer age x plumage color interaction for egg weight was significant in this study. In contrast to these findings, François et al.[33] showed that egg weight did not vary with the quail phenotype including white, spotted white, grey, and brown plumage color.

In this study, the eggs of black plumage quails need more force to crack significantly than the others due to more dense shell thickness (P<0.012). Some strains of the quails may be able to deposit calcium for the egg shell at a faster rate than the others. Eggshell structure or amount of shell matrix protein might be different in different quail lines. In another study,[17] a significant increase of egg shell strength was found in eggs produced from grey quails compared to white line. Yannakopoulos and Tserveni-Gousi[34] reported that the best criterion of the shell's strength was the egg shape and shell thickness. The shell thickness of eggs is determined by the length of time spent in the uterus and the proportion of calcium deposition during shell formation. The time of the day when the egg is laid, also determines the thickness of the egg shell.

Shape index has a significant effect on the proportion of shell's strength.[35] In this study, the eggs of white line quail had significantly lowest egg length and highest shape index values (P<0.001, P<0.001). Yılmaz et al. [36] showed that there were statistical differences regarding shape index among the different plumage color lines. François et al. [33] showed egg shape index did not vary with the quail phenotype. Lan et al.[31] showed that no significant differences for shape index of eggs produced different lines of quail as wild type, black, brown and white plumage. Sarı et al.[32] reported that the shape index of eggs of brown, white, golden and gray quails were 79.3, 78.9, 79.7 and 77.4 and significantly lowest in grey quail.

In a study, François et al. [33] found that the egg shells of white quails were thicker than those of others. In contrast with the findings of Sarı et al.[32] and Fathi et al.[17], there was a significant difference for shell thickness of eggs of different quail lines (P<0.001). The quail with black plumage had eggs with significantly higher values of egg shell thickness.

Egg yolk color is one of the most sensitive issues that consumers care about, and yolk color is mainly affected by nutrition. In this study, the egg yolk of white lines had a significantly lighter yellow than wild and black lines (P<0.003). Higher albumen height indicates denser albumen and it directly increases the value of Haugh unit since it is used in the formula. Haugh unit is the most widely used measure of albumen quality and reflects the internal quality, the freshness, of egg over the world.[37, 38] In this study there were no significant differences for the albumen height and haugh unit values of quail from different lines. Similar to a previous report[13] there were no significant differences for the haugh unit of the eggs produced from different quail lines. Whereas, Yılmaz et al. [36] and Sarı et al.[32] showed that there were statistical differences regarding haugh unit values among the different plumage color lines. François et al. [33] reported that grey quails laid eggs with the highest Haugh's index. The Haugh unit value ranges from 0-130 and eggs had 72 or more defined as AA quality. [39]

The external and internal egg quality in quails are affected different variety of factors such as genotype, body weight, inbreeding, nutrition, health, laying period, environment, egg storage and length. When all external and internal egg quality characteristics measured in this study were considered, the eggs of black coloured lines seemed superior to the other two groups (wild and white). However, more dense studies including production traits and economics are required when selecting the quail lines for production.

Author contributions

MP conceived the idea of this research, designed the experiments, supervised the study, and wrote the article. EÇ, FO and DY performed the analysis.

Competing interests

The authors declare that they have no conflict of interest for this manuscript.

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