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Changes in Some Egg Quality Parameters According to Plumage Colour in Quails and Their Relationships

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ABSTRACT

The effect of plumage colours of Japanese quails (*Coturnix coturnix japonica*) on some egg quality parameters and their relations amongst were studied in this study. A total of 144 hatching eggs which were obtained from middle-aged (13 week) quail breeders having two different (original and white) plumage colours (77 orginal and 77 white) were used in the experiment. Egg weight (EW), egg length (EL), egg width (EWd) and shape index (SI) were studied parameters for egg quality. Coefficient correlation and regretion were analyzed for relation among these parameters. In the study, from the eggs of quail with original and white plumage, average EW; 10.79 g and 9.54 g, EL; 31.59 mm and 31.57 mm, EWd; 25.85 mm and 24.68 mm, SI; 81.86 and 78.29 values were obtained respectively. EW, EWd and SI values were higher in quails with black feathers than those with white feathers ($P < 0.05$), but SI values were similar ($P > 0.05$) in both groups in the experiment. When the correlation coefficients were examined, it was found that the correlation coefficient between EW and SI were only significant in the birds with original plumage and between EW and SI in birds with white plumage ($P < 0.05$). From regression analysis, it was found that the EW values can be estimated more accurately by using the EL in original plumages and the EWd in quails with white-plumage. It is thought that carrying out more detailed and post-incubation studies will be beneficial for both academic and sectoral development.

Bıldırcınlarda Tüy Rengine Göre Bazı Yumurta Kalite Özelliklerindeki Değişim ve Aralarındaki İlişkiler

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ÖZET

Bu araştırmada Japon bıldırcınlarında (*Coturnix coturnix japonica*) tüy renginin yumurta kalitesini belirlemede kullanılan bazı özeliklere etkisi ve aralarındaki ilişkiler incelenmiştir. Araştırmada iki farklı tüy rengine sahip (77 orijinal ve 77 beyaz tüylü) orta yaşlı (13 hafta)

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damızlık bıldırcınlardan elde edilen toplam 144 adet kuluçkalık yumurta kullanılmıştır. Yumurta ağırlığı (YA), yumurta boyu (YB), yumurta genişliği (YE) ve şekil indeksi (Şİ) yumurta kalitesi açısından incelenen özellikler olmuş ve bu özellikler arasındaki korelasyon ile regresyon katsayıları incelenmiştir. Orjinal ve beyaz tüylü bıldırcın yumurtaları için sırasıyla 10.79 g ve 9.54 g YA, 31.59 mm ve 31.57 mm YB, 25.85 mm ve 24.68 mm YG, 81.86 ve 78.29 Şİ değerleri elde edilmiştir. Araştırma sonucunda siyah tüylü bıldırcın yumurtlarında YA, YG ve Şİ değerlerinin beyaz tüylülerden daha yüksek olduğu ($P < 0.05$), yumurta boylarının ise benzer olduğu ($P > 0.05$) bulunmuştur. Korelasyon katsayıları incelendiğinde sadece orjinal tüylü bıldırcınlarda YA ile YB, beyaz tüylülerde ise YA ile SI arasındaki korelasyon katsayısının önemli olduğu bulunmuştur ($P < 0.05$). Regresyon analizinde ise YA değerlerinin siyah tüylü bıldırcınlarda YB, beyaz tüylü bıldırcınlarda ise YG kullanılarak daha doğru tahmin edilebileceği tespit edilmiştir. Daha ayrıntılı ve kuluçka sonrasını da içine alan çalışmalar gerçekleştirilmesinin hem akademik hem de sektör gelişimi açısından faydalı olacağı düşünülmektedir.

Introduction

Quail is a widespread bird species bred in recent years in Turkey. As an important source of animal protein in human nutrition, its importance is on the raise everyday. Determining the external and internal quality characteristics of the eggs and to investigate the effective factors for the efficiency of the incubation studies is a necessity for science and commerce. (Stadelman, 1986; Seker et al., 2005). These properties provide information about the commercial value of the eggs and are used in the estimation of chick quality in breeding flocks. Egg characteristics affect the hatchability, chick quality and alter the performance of the flock in the rearing period (Stadelman, 1986; Yildirim and Yetisir, 1998; Altan et al., 1998).

Meanwhile, plumage colour is considered as a breed or line trait in quails. In the researches, the quail lines are named according to the plumage colour mutations. For the last decades, new lines with different plumage color mutations are being tried to be obtained by breeding practices (Cneg and Kimura 1990).

In the studies on egg quality in quails, egg weight was reported to be between 10.36 - 11.92 g and shape index value ranged between 75.15 - 80.54 in these studies (Altan et al., 1998; Yildirim and Yetisir, 1998; Ozcelik et al., 1999; Ozcelik et al., 2002; Nazligul et al., 2001; Orhan et al., 2001; Seker et al., 2005; Yoruk et al., 2008; Yilmaz and Caglayan, 2008; Sogut ve Sari, 2009; Alkan et al., 2010).

Different results were obtained in studies on the effect of plumage color on quail egg shape index. The shape index values of the original colored quails were found to be significantly higher statistically by some researchers (Inci et al., 2015) and similar in some studies (Ozcelik, 2002; Yilmaz and Caglayan, 2008).

One of the factors affecting the

productivity and hence the profitability of the hatchery in quail production is the weight of hatching eggs. It has been reported that the selection of eggs above 9.5 g (Sarica and Soley, 1995) or 10 g (Kucukyilmaz et al., 2001; Caglayan and Inal, 2006) are more appropriate for better incubation results.

The aim of this study was to determine the relationship between egg weight, egg length, egg width and shape index, and relation between these properties in Japanese quails hatching eggs (*Coturnix coturnix japonica*) having original and white plumage.

Material and Methods

The growing process was carried out in the quail breeding laboratory of Bolu Abant Izzet Baysal University (B.A.I.B.U) Faculty of Agriculture and Natural Sciences, Department of Poultry Science and Technology using 5-storey special quail cages (Cimuka BYK-03-5K, Cimuka Ltd. Co., Turkey) with 3 compartments of 0.135 m^2 each were used housing a pair of quails in each. The hatching eggs used in the experiment were collected from these quail breeders.

In this study, a total of 176 hatching eggs used in the experiment were collected from two 13-week-old quail breeder flocks having original and white plumage. Down-grade eggs were separated and removed from the experiment. Then selected 144 (77 original and 77 white plumage) hatching eggs to be set for incubation were numbered. The weight of these eggs were measured by precision (± 1 mg) scale (HZY-2200B; Densi Ltd. Co., Turkey), width and length values were determined by a micrometer (TCM234 990; Tchibo Gmbh, Germany). Then shape index values were calculated by using following formula (Formula 1).

Formula 1. Calculating fromula of shape index values.

$$SI = \frac{EWd, mm}{EL, mm}\ x\ 100$$

SI = shape index, EWd = egg width,
EL = egg length

Then correlation coefficient was used to evaluate the relations between properties and Pearson correlation coefficient was preferred (Formula 2).

Formula 2. Calculating formula of corelation (Pearson) coefficients on egg weight values.

$$r_{xy} = \frac{\sum_{i=1}^{n} x_i y_i - \frac{(\sum_{j=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{n}}{\sqrt{(\sum_{i=1}^{n} x_i^2 - \frac{(\sum_{i=1}^{n} x)^2}{n})(\sum_{i=1}^{n} y_i^2 - \frac{(\sum_{i=1}^{n} y)^2}{n})}}$$

x = egg weight
i = egg length
j = egg width
k = shape index
n = number of pairs of scores
Σx = sum of egg weight scores
Σi = sum of egg length scores
Σj = sum of egg width scores
Σk = sum of shape index scores
Σx^2 = sum of squared egg weight scores
Σi^2 = sum of squared egg length scores
Σj^2 = sum of squared egg width scores
Σk^2 = sum of squared shape index scores

After this, coefficient of determination was calculated to find accuracy of predictions and how one variable is predictable from other

variables. Egg weight was considered as main variable and egg length, egg width and shape index were taken as other variables in these analyses. Then slope of linear regression line (b) and y-intercept point of the regression line (a) values and finally, regression equations by regression analyses were calculated for evaluating the relations between these variables (Formula 3, 4 and 5).

Formula 3. Calculating formula of slope of regression line on egg weight values.

$$b_{xy} = \frac{\sum_{i=1}^{n} x_i y_i - \frac{\sum_{j=1}^{n} x_i \sum_{i=1}^{n} y_i}{n}}{\sum_{i=1}^{n} x_i^2 - \frac{(\sum_{i=1}^{n} x_i)^2}{n}}$$

b = slope of the regression line
x = egg weight
i = egg length
j = egg width
k = shape index
n = number of pairs of scores
Σx = sum of egg weight scores
Σi = sum of egg length scores
Σj = sum of egg width scores
Σk = sum of shape index scores
Σx^2 = sum of squared egg weight scores
Σi^2 = sum of squared egg length scores
Σj^2 = sum of squared egg width scores
Σk^2 = sum of squared shape index scores

Formula 4. Calculating formula of intercept point of regression line and y axis.

$$a_{xy} = \frac{\frac{(\sum_{j=1}^{n} y_i)(\sum_{i=1}^{n} x_i^2) - (\sum_{j=1}^{n} x_i)(\sum_{j=1}^{n} x_i y_i)}{n}}{\sum_{i=1}^{n} x_i^2 - \frac{(\sum_{i=1}^{n} x_i)^2}{n}}$$

a = the intercept point of the regression line and the y axis
x = egg weight
i = egg length
j = egg width
k = shape index
n = number of pairs of scores
Σx = sum of egg weight scores
Σi = sum of egg length scores
Σj = sum of egg width scores
Σk = sum of shape index scores
Σx^2 = sum of squared egg weight scores
Σi^2 = sum of squared egg length scores
Σj^2 = sum of squared egg width scores
Σk^2 = sum of squared shape index scores

Formula 5. Calculating formula of regression equations on egg weight.

$$y = a_{ijk} + b_{ijk} x_{ijk}$$

y = egg weight
a = the intercept point of the regression line and the y axis
b=slope of the regression line
i = egg length
j = egg width
k = shape index

Statistical analyses of the results were conducted using Minitab 16.1 statstical software (2013). Two-sample t - test were used to analyse differences between egg quality parameters (EW, EL, EWd and SI).

Formula 6. The formulas used in the calculation of t statistic value in the experiment.

$$t = \frac{(\mu_{\bar{x}} + \mu_{\bar{y}}) - \mu_D}{s_D}$$

$\mu_{\bar{x}}$ = means of original plumage colour
μ_D = means of differences between groups

$\mu_{\bar{y}}$ = means of white plumage colour
s_D = standard deviation

$$s_D = \sqrt{\frac{\sum d_{\bar{x}}^2 + d_{\bar{y}}^2}{(n_x - 1) + (n_y - 1)} * \frac{(n_x + n_y)}{n_x * n_y}}$$

$d_{\bar{x}}^2$ = sum of squares of original plumage colour$\mu_{\bar{x}}$
n_x= egg numbrs of original plumage colur
$d_{\bar{y}}^2$ = sum of squares s of white plumage colour
n_y= egg number of white plumage colour

In calculating the correlation coefficients and regression equation used to determine the relationships between these parameters, and calculating test statistic value were the formulas reported by Kocabas et al. (2013) were used (Formula 2, 3, 4, 5 and 6). P - values less than 0.05 were considered as statistically significant. All the data were given as means ± standard error of the means (M ± SEM).

Results and Discussion

In the first phase of the study, EW, EL, EWd and SI data of treatment groups were examined in hatching eggs (Table 1). In the light of these data, it can be told that the uniformity is high, EW values for original plumage colour is similar to other studies' data and slightly low for white (Ozcelik, 2002; Yilmaz and Caglayan, 2008; İnci et al., 2015). In addition, slightly pointed for original plumage colour and similar for white to SI values obtained in other researches (Ozcelik, 2002; Yilmaz and Caglayan, 2008).

EW and SI values of quails having original plumage colour were higher than white and the differences between the group wer significant (P < 0.05). However EL and EWd values of these groups were simialar (P > 0.05).

In the second phase of the study, relation between the egg quality parameters (EW, EL, EWd and SI) of treatment groups were examined in hatching eggs (Table 2).

According to the results of the correlation analysis, there was a positive correlation between the parameters examined at different levels, different degrees and generally (Table 2). When the correlations between the hatching egg quality parameters and the plumage colour were evaluated, it was found that the correlations between EW in original plumages only and EL with SI in white plumages were significant (P < 0.05).

When the results of the regression analysis were examined, it was found that EW can be estimated more accurately by using EL values in harlequins and EWd in quails with white plumage (Table 2).

In conlusion, it was found that there were different correlation levels for quails having original and white plumage colour. It is also believed that monitoring these effects on post-hatch performance of chicks and organizing more detailed, comprehensive researches is needed and will be beneficial for both academic and industrial evolution.

Table 1. The quality parameters of eggs obtained in the study
Tablo 1. Denemeden elde edilen yumurtalarda kalite parametreleri

	Plumage Colour		P Value
	Black	White	
Egg Weight, g	10.79 ± 0.14^{a}	9.54 ± 0.12^{b}	0.000
Egg Length, mm	31.59 ± 0.09	31.57 ± 0.15	0.888
Egg Width, mm	25.85 ± 0.09^{a}	24.68 ± 0.08^{b}	0.000
Egg Shape Index	81.86 ± 0.26^{a}	78.29 ± 0.36^{b}	0.000

[a,b] Different superscript letters show that the difference between the means of the groups are statistically significant ($P < 0.05$).

Table 2. Relations between egg weight (EW), egg length (EL), egg width (EWd) and shape index (SI) in quail eggs having original (harlequin brown) and white plumage colour.
Tablo 2. Kırçıllı kahverenkli (orjinal) ve beyaz tüylü bıldırcınlarda yumurta ağırlığı (EW), yumurta boyu (EL), yumurta eni (EWd) ve şekil indeksi (SI) arasındaki ilişkiler.

	Plumage Colour	
	Original (harlequin brown)	White
CV		
EW	7.980	8.560
EL	1.800	3.370
EWd	2.190	2.320
SI	2.040	2.970
r		
EW - EL	0.263	0.279
EW - EWd	0.139	0.322
EW - SI	0.241	-0.100
EL - EWd	0.012	0.064
EL - SI	0.095	-0.514
EWd - SI	0.210	-0.019
Regression Equations (y)		
General	-6.933 + 0.388 EL + 0.203 EWd	-7.530 + 0.199 EL + 0.438 EWd
Egg length	-1.760 + 0.390 EL	2.810 + 0.214 EL
Egg width	5.230 + 0.208 EWd	-1.810 + 0.462 EWd
Egg Shape index	0.600 + 0.122 SI	12.300 – 0.0351 SI
P Values		
r_{EWEL}	0.021	0.014
r_{EWEWd}	0.228	0.004
r_{EWSI}	0.035	0.389
r_{ELEWd}	0.915	0.580
r_{ELSI}	0.414	0.000
r_{EWdSI}	0.066	0.867

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