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# EGG QUALITY CHARACTERISTICS AS INFLUENCED BY DIFFERENT BODY SIZES IN FOUR CLOSE-BRED FLOCKS OF JAPANESE QUAILS *(Coturnix coturnix japonica)*

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## ABSTRACT

The present study was conducted to investigate some egg quality traits in four close-bred flocks of adult Japanese quails responded by different body sizes maintained at Avian Research and Training Centre, University of Veterinary and Animal Sciences, Lahore. A total of 432 adult (12 weeks-old) quails, comprising 108 males and 324 females were randomly divided into 108 experimental units, comprising one male and three females each. These experimental units were randomly assigned to 12 treatment groups having 4 close-bred flocks x 3 female body weights (heavy 300-350g, medium 250-300g and small 200-250g) with randomized complete block design in factorial arrangements having 9 replicates in each treatment. Egg weight (g), shell weight (g), shell thickness (mm), haugh unit, yolk index and blood and meat spots were studied. The significant ($p<0.05$) differences were noted in mean egg weight, shell weight, shell thickness and yolk index, whereas, haugh unit value was not significantly different in all the close-bred flocks of Japanese quails. With respect to body size categories, differences for egg weight, shell weight, shell thickness, yolk index and haugh unit value were significant ($p<0.05$). The interaction between flocks and body size was significant ($p<0.05$) in respect of all the above egg quality traits. The egg weight was higher in imported flock than local-1 and local-2 flocks and egg shell weight was higher in imported flock than in other local flocks. However, egg shell thickness and haugh unit were found to be higher in local-2 than local-1, 3 and imported flocks. The heavy weight quails had maximum egg weight, egg shell weight, shell thickness and yolk index followed by those in the medium and small size groups. Blood and meat spots were not observed during the course of this study.

**Key words:** Japanese quails, egg weight, shell weight, shell thickness, haugh unit, yolk index and blood and meat spots.

## INTRODUCTION

The egg quality traits possess great significance in poultry breeding due to their influence on production performance in next generations and their performance, breeding performance and quality and growth of the chicks (McDaniel *et al.* 1978; Altinel *et al.* 1996; Islam *et al.* 2001). Characteristics of an egg that affect it's acceptability to the consumer is known as egg quality. Poor egg quality causes economic losses at all production stages. Quality of an egg is influenced by many factors viz; breed, strain, variety, body weight, temperature, relative humidity, rearing practices and seasons (Pandey *et al.* 1986; Washburn 1990; Cook and Briggs 1997; Altan *et al.* 1998; Narushin and Romanov 2002; Khurshid *et al.* 2003; Roberts, 2004; Nwachukwu *et al.* 2006; Silversides *et al.* 2006; Wolanski *et al.* 2007; Lacin *et al.* 2008).

Japanese quail *(Coturnix coturnix japonica)* rearing at small-scale household level has still potential to open another avenue to provide an alternative source of animal protein and to offer the poor families as an income generation source by rearing a small unit of quails. Under optimum managemental conditions, the quail hens lay maximum number of eggs on the line similar to commercial egg layers. The quail production is also attractive because of its high reproductive traits with a small incubation period of about 17 days (North and Bell 1991; Minvielle 2004).

At present quail is one of the neglected components of the poultry sector in the country, so far little research work has been conducted on its different aspects. For this purpose four different close-bred flocks of Japanese quails (one imported and 3 local) have been maintained at Avian Research and Training Centre, Department of Poultry Production, University of Veterinary and Animal Sciences Lahore, Pakistan, with the objectives of studying the possibility of improving their growth and productive performance. However, little information is available on the internal egg quality traits of these strains of Japanese quails. Keeping this in view, the present study was undertaken to investigate some egg quality traits in 4 close-bred flocks of Japanese quails having different body size categories.

## MATERIALS AND METHODS

The present study involving 432 adult (12 weeks-old) quails, comprising 108 males and 324 females was conducted as a part of Ph.D. research work by the major author to examine some egg quality traits of 4 close-bred flocks of Japanese quails with different body weights, at Avian Research and Training Centre, University of Veterinary and Animal Sciences, Lahore, Pakistan. The birds were randomly divided into 108 experimental units (replicates comprising one male and three females of each) which were randomly assigned to 12 treatment groups having 4 close-bred flocks (imported, local 1, local 2, and local 3) x 3 female body weight with randomized complete block design in factorial arrangements having 9 replicates in each treatment. The body weight categories of heavy, medium and small quails of both the sexes have been presented in Table 1.

**Table 1. Different body weight categories (g)**

| Body weights | ♂ | ♀ |
|---|---|---|
| Heavy | 270-315 | 300-350 |
| Medium | 225-270 | 250-300 |
| Small | 180-225 | 200 -250 |

The experimental birds were tagged for their proper identification and maintained in specially remodeled individual compartments each measuring 30x20x15 cm in French made multi-deck cages (equipped with separate nipple drinkers) placed in one of the well ventilated octagonal shape quail houses measuring 10.05x3.65x2.74 meter. The maximum and minimum temperature of the quail house was recorded daily which ranged from $24^{0C}$ to $32^{0C}$. Natural day light was provided to the birds at the start of the experiment and then light hours were increased by half an hour weekly till 16 hours light per day. Fresh and clean drinking water was provided at all the times through automatic nipple drinkers. The birds were fed *ad libitum* a balanced quail breeder ration according to NRC standards (1994), containing Metabolizable energy 2900 kcal/kg, Crude protein 20%, Calcium 3% and available Phosphorus 0.4%.

The egg quality tests were performed on freshly collected eggs in the egg quality testing laboratory. For this purpose, one fresh egg from each replicate (108 eggs) was picked up randomly on the last day of each fortnight. From each replicate 14 eggs (total 1512 eggs from 108 replicates) were taken. The eggs were weighed individually on electronic digital balance and then broken into glass petri dishes. The data on egg weight, egg shell weight, egg shell thickness, haugh unit, yolk index and blood and meat spots were recorded to study the response of different body sizes from different close-bred flocks on egg quality parameters of Japanese quails. Haugh unit value was recorded by using the following formula (Haugh 1937);

$$HU = \frac{100 \text{ Log } H - \left[\sqrt{G}(30W^{.37} - 100) + 1.9\right]}{100}$$

Where,
HU = Haugh unit
H = Thick albumen height (mm)
G = (Constant) = 32.2
W = Weight of egg in grams

**Statistical Analysis:** The data thus collected were analyzed using ANOVA techniques (Steel *et al.* 1997) with Randomized Complete Block Design (RCBD) under factorial arrangement for further interpretation using general linear model (GLM) procedures (SAS 9.1, 2002-03) portable software. The mathematical model was assumed after Jatoi *et al.* (2013). The comparison of means was made using Duncan's Multiple Range (DMR) test (Duncan 1955).

## RESULTS AND DISCUSSION

**i. Egg weight (g):** The mean egg weight (g) in the imported flock of Japanese quails was significantly ($p<0.05$) different from local-1 and local-2 flocks, however, difference between imported and local-3 flock was not significant. The mean egg weight was also not significantly different in local-1 and local-2 flocks (Table 2). The results of the present study are close agreement with the earlier findings of Selim and Seker (2004); Haunshi *et al.* (2006); Gupta *et al.* (2007); Singh *et al.* (2008); Yadav *et al.* (2009) who reported breed and strain variation in egg weight of quails and chickens. The variation in egg weight between imported and other local flocks recorded in this study could be attributed to strain differences. The variation in egg weight of chickens has been suggested to be associated with breed, strain, size of the bird, rate of egg production, nutrition and other environmental conditions (Baishya *et al.* 2008; Zita *et al.* 2009). In the present study heavy weight category birds had maximum egg weight followed by medium and small size (Table 2). These results are in line with those of Nazligul *et al.* (2001) who stated that egg weight in Japanese quails increased with advancement of age and with increase in body size. Similarly, egg weight in birds has been reported to be related with their body size (Lacin *et al.* 2008). The results of the present study indicating statistically significant ($p<0.05$) difference between imported and different local close-bred flocks of Japanese quails disagree with the findings of Rehman (2006) who could not find significant differences in egg weight in the local and imported flocks of quails. The variation in these results could be attributed to difference in body size of quails used in both the studies. The quails of different weight sizes were used in the present study, whereas, quails of uniform size were maintained under the study conducted by Rehman (2006).

**ii. Egg shell weight (g):** The difference in mean egg shell weight (g) in the imported flock of Japanese quails was significant ($p<0.05$) than those of all the local flocks (Table 2). These results are substantiated by those of Silversides *et al.* (2006) who reported strain variation in egg shell weight of chickens, the largest strain producing higher egg shell weight than the lighter strains. Khurshid *et al.* (2003) reported that egg shell weight was positively correlated with egg length and width. It has been further indicated that genotype can influence egg shell weight (Zita *et al.* 2009). In the present study in respect to body size categories, there was significant ($p<0.05$) difference in their mean egg shell weight. Heavy weight category birds showed maximum egg shell weight followed by that of medium and small size birds. The interaction between flocks and body size was significant (Table 2). The variation in egg shell weight in different close-bred flocks and in different size of quails recorded in the present study could be attributed to variation in egg weight and shell thickness in these birds. The egg weight has been reported to be an indicator of egg shell weight and shell thickness (Selim and Seker 2004). The greater egg shell weight in heavy size birds has also been suggested to be due to their low egg production resulting in greater calcium deposition in egg shells (Wolanski *et al.* 2007).

**iii. Egg shell thickness (mm):** The results of the present study showed that the mean egg shell thickness (mm) in imported flock of Japanese quails was significantly ($p<0.05$) different from all other local flocks. However, difference between local-1, local-2 and local-3 flocks was not significant (Table 2). The similar findings indicating significant variation in egg shell thickness between strains (Dev and Mahipal 2004) and breeds (Haunshi *et al.* 2006) have been reported. Rehman (2006) also observed significant ($p<0.05$) differences in egg shell thickness among local and imported flocks of Japanese quails. In the present study, the maximum mean egg shell thickness was recorded in the heavy weight quails and minimum in the small quails. Egg shell thickness significantly ($p<0.05$) differed in different size of quails (Table 2). The greater egg shell thickness in heavy size quails observed in this study might be due to higher egg size and egg shell weight. The egg weight has been reported to be an indicator of egg shell weight and shell thickness (Selim and Seker 2004). Almost all internal egg quality traits changed at the significant levels depending on the change in the egg weight with respect to the external quality traits of the egg. As a result, it has been considered that it could be possible to use the egg weight in determining the egg shell weight, shell thickness and the shell ratio instead of using these traits that are the determinants of the egg shell quality of the quail eggs (Selim and Seker 2004). Onbasilar *et al.* (2011) reported that shell thickness was influenced by egg weight. However, the findings of the present study are not in line with those of Nazligul *et al.* (2001) who observed that egg shell thickness decreased in quails with increase in body weight and age. Lacin *et al.* (2008) could not find significant effect of body weight on shell strength and shell thickness.

**Table 2. Mean egg weight (g), egg shell weight (g) and egg shell thickness (mm) in 4 close-bred flocks of Japanese quails with different body weight categories**

| *CBF Categories | Imported | Local-1 | Local-2 | Local-3 | Mean |
|---|---|---|---|---|---|
| | | ------------- ♠EW(Mean ± **SE; g) --------------- | | | |
| Heavy | 12.94±0.07$^{a}$ | 12.75±0.07$^{a}$ | 12.84±0.09$^{a}$ | 12.86±0.05$^{a}$ | 12.85±0.03$^{E}$ |
| Medium | 12.44±0.06$^{b}$ | 12.31±0.06$^{b}$ | 12.36±0.07$^{b}$ | 12.41±0.07$^{b}$ | 12.38±0.03$^{F}$ |
| Small | 11.94±0.05$^{c}$ | 11.76±0.08$^{c}$ | 11.71±0.09$^{c}$ | 11.78±0.08$^{c}$ | 11.80±0.04$^{G}$ |
| Mean | 12.44±0.08$^{A}$ | 12.27±0.09$^{B}$ | 12.30±0.10$^{B}$ | 12.35±0.09$^{AB}$ | |
| | | --------------- ♠ESW(Mean ± **SE; g) -------------- | | | |
| Heavy | 1.35±0.022$^{a}$ | 1.28±0.013$^{b}$ | 1.28±0.015$^{b}$ | 1.31±0.010$^{b}$ | 1.30±0.009$^{E}$ |
| Medium | 1.29±0.018$^{b}$ | 1.23±0.014$^{c}$ | 1.21±0.009$^{c}$ | 1.20±0.009$^{c}$ | 1.23±0.008$^{F}$ |
| Small | 1.20±0.009$^{c}$ | 1.16±0.009$^{d}$ | 1.16±0.010$^{d}$ | 1.15±0.011$^{d}$ | 1.17±0.006$^{G}$ |
| Mean | 1.28±0.015$^{A}$ | 1.22±0.011$^{B}$ | 1.22±0.012$^{B}$ | 1.22±0.013$^{B}$ | |
| | | ----------------- ♥EST(Mean ± **SE; mm) ------------- | | | |
| Heavy | 0.30±0.003$^{cd}$ | 0.31±0.002$^{bc}$ | 0.33±0.005$^{a}$ | 0.32±0.004$^{ab}$ | 0.31±0.002$^{E}$ |
| Medium | 0.28±0.004$^{fg}$ | 0.30±0.006$^{cde}$ | 0.29±0.003$^{de}$ | 0.29±0.004$^{ef}$ | 0.29±0.002$^{F}$ |
| Small | 0.26±0.002$^{h}$ | 0.27±0.002$^{gh}$ | 0.27±0.002$^{gh}$ | 0.27±0.004$^{gh}$ | 0.27±0.001$^{G}$ |
| Mean | 0.28±0.003$^{B}$ | 0.29±0.003$^{A}$ | 0.30±0.005$^{A}$ | 0.29±0.004$^{A}$ | |

Different alphabets on means in a row show significant differences at $p<0.05$; *CBF = Close-bred flocks, **SE = Standard error, ♠EW = Egg weight, ♠ESW = Egg shell weight, ♥EST = Egg shell thickness.

**iv. Haugh unit:** The mean haugh unit value in imported and all local flocks of Japanese quails was not significantly different (Table 3). These findings are quite in agreement with the earlier findings of Rehman (2006) who observed not significant differences in haugh unit values among local and imported flocks of Japanese quails. Similar findings indicating non-significant differences in haugh unit values between different breeds (Haunshi *et al.* 2006) and strains (Baishya *et al.* 2008; Afifi *et al.* 2010) have been reported. In the present study, body size of quails significantly ($p<0.05$) influenced mean haugh unit value. The interaction between flocks and body size also showed significant ($p<0.05$) difference. The maximum mean haugh unit value was observed in local-3 flock with heavy weight category, while minimum in imported flock with small weight category (Table 3). These results are in line with those of Lacin *et al.* (2008) who reported significant effect of body weight on haugh unit values in chickens. Heavy body size birds had better internal egg quality than smaller ones (Ricklefs 1983). Haugh unit values have been reported to be related to body size (Renden and McDaniel 1984), production cycle and egg weight (Onbasilar *et al.* 2011) of the birds. However, the results of the present study did not agree with the findings of Nazligul *et al.* (2001) who observed decrease in haugh unit with increase in body size of quails. The variation in results of both the studies could be due to variation in size of quails used in both the studies.

**v. Yolk index:** The mean yolk index of imported flock of Japanese quails was significantly ($p<0.05$) different from local-2 and local-3 flocks except local-1 (Table 3). The similar results have been reported by Haunshi *et al.* (2006); Nwachukwu *et al.* (2006); Gupta *et al.* (2007); Tumova *et al.* (2007); Baishya *et al.* (2008); Nawar (2009) indicating significant ($p<0.05$) differences in yolk index among different genetic groups. However, contrary to the findings of the present study, non-significant differences in yolk index for different close-bred flocks of Japanese quails have been reported by Rehman (2006) which could be due to variation in the size of quails used in both the studies. The quails of different body weight categories were maintained during the present study, whereas, Rehman (2006) maintained quails of uniform size. During the present study, body size of quails significantly ($p<0.05$) influenced yolk index (Table 3). These observations are in line with those of Ricklefs (1983) who indicated that large birds had better internal egg quality than small birds. During the course of this study blood and meat spots in quail eggs of different close-bred flocks could not be detected.

**Table 3. Mean haugh unit and yolk index values in 4 close-bred flocks of Japanese quails with different body weight categories.**

| *CBF / Categories | Imported | Local-1 | Local-2 | Local-3 | Mean |
|---|---|---|---|---|---|
| | | | ----- ♣HU(Mean ± **SE) ----- | | |
| Heavy | 86.30±0.77$^{a}$ | 85.36±0.70$^{ab}$ | 86.35±0.67$^{a}$ | 86.37±0.58$^{a}$ | 86.09±0.33$^{E}$ |
| Medium | 84.87±0.53$^{bc}$ | 84.29±0.42$^{bcd}$ | 84.70±0.45$^{abc}$ | 84.18±0.55$^{bcd}$ | 84.51±0.24$^{F}$ |
| Small | 82.88±0.51$^{d}$ | 83.32±0.30$^{dc}$ | 83.28±0.28$^{dc}$ | 83.52±0.36$^{dc}$ | 83.25±0.18$^{G}$ |
| Mean | 84.68±0.44 | 84.32±0.32 | 84.78±0.36 | 84.69±0.37 | |
| | | | ----- ♣YI(Mean ± **SE) ----- | | |
| Heavy | 0.05±0.003$^{a}$ | 0.04±0.000$^{b}$ | 0.04±0.000$^{b}$ | 0.04±0.000$^{b}$ | 0.05±0.00$^{E}$ |
| Medium | 0.04±0.000$^{b}$ | 0.04±0.000$^{b}$ | 0.04±0.000$^{b}$ | 0.04±0.000$^{b}$ | 0.04±0.00$^{F}$ |
| Small | 0.04±0.000$^{b}$ | 0.04±0.000$^{b}$ | 0.04±0.000$^{b}$ | 0.04±0.000$^{b}$ | 0.04±0.00$^{F}$ |
| Mean | 0.049±0.001$^{A}$ | 0.048±0.000$^{AB}$ | 0.047±0.000$^{B}$ | 0.047±0.000$^{B}$ | |

Different alphabets on means in a row show significant differences at $p<0.05$; *CBF = Close-bred flocks, **SE = Standard error, ♣HU = Haugh unit, ♣YI = Yolk index

**Conclusion**: Imported flock of quails had significantly ($p<0.05$) better egg weight (g), shell weight (g) and yolk index. Egg shell thickness (mm) and haugh unit were better in local-2 flock, whereas, better egg quality traits were recorded in heavy quails. Based on the findings of the present study, it may be stated that imported and other local flocks of Japanese quails with different body weight sizes differed significantly ($p<0.05$) in terms of different egg quality parameters. This suggests need of improving egg quality characters in native quail of Pakistan.

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