EFFECT OF EGG WEIGHT ON CHICK'S WEIGHT AND POST HATCHING GROWTH PERFORMANCE OF JAPANESE QUAIL (*Coturnix coturnix japonica*)

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ABSTRACT

The effect of egg weight on chick body weight and post hatching growth performance of Japanese quail (Coturnix coturnix japonica) was studied. A total of 2575 eggs were collected and sorted into three groups by weight; light (<10g), medium (10–12 g) and heavy (>12 g). Egg weight (EW), Egg length (EL), Egg circumference (EC), Shank Length (SL) and Body weight (BW) were taken on the corresponding egg groups. Data was analyzed using PROC GLM of SAS® to compare percent fertility, hatchability, hatch and rearing mortality over three egg groups while relationship among recorded variables was estimated using the CORR procedure of SAS®. Results showed that there were significant (P<0.05) differences in egg weight, egg length and egg circumference among the three groups. Mean chick weights at hatching in light, medium and heavy eggs were 8.75g, 11.19g and 13.14g respectively. High positive phenotypic correlation was observed between body weight and shank length (R>0.50) indicating that an improvement in body weight could lead to an improvement in shank length and vice-versa. BW increased with SL within groups. Egg size and chick weight were positively correlated with growth performance traits. There were also significant differences between the egg weight groups with regards to percentage hatchability which was found to be 58.02%, 90.89% and 76.23% respectively, with the medium weight being superior also for fertility (94.57 %) and rearing mortality (1.53%). Medium sized eggs (10–12 g) were superior for hatchability, fertility and good quality day old chicks post hatching performance.

Keywords: Egg weight, Chick weight, Japanese quail, Post-hatching performance

INTRODUCTION

In recent years, quail meat and eggs have been gaining much popularity among consumers. Generally, quails are small to medium sized birds, belonging to the same biological family of chickens and pheasants (*Phasianidae*), with the overall similarity of physical characteristics and behaviour. Quails which are commonly bred for human consumption belong to the species *Coturnix coturnix japonica* (Crawford, 1990).

Coturnix eggs are small speckled pearls and have been prized as a dietary and healing food packed with many biologically active substances (Smith, 2000). They are nearly identical in taste and nutritional quality to chicken eggs but differ in appearance, being speckled and mottled (Matlack, 2003).

Egg weight, shell weight, shell thickness, weight of egg yolk and albumen are the important traits influencing egg quality, chick weight and hatching performance if other management conditions and fertility are not the limiting factors. Small eggs produced smaller chickens with a lower performance than chickens hatched from

larger eggs (Farooq *et. al.*, 2001). Numerous studies have shown that there is strong positive correlation between pre-incubation egg weight, length of storage periods, hatching weight and growth performance of different poultry species (Farooq *et al.*, 2001; Heier & Jarp, 2001; King'ori, 2011; Dudusola, 2013; Adeyanju *et al.*, 2014) but the effect of egg weight on fertility, hatchability, chick weight and subsequent growth performance of quail have not been fully investigated. Hence there is a need to examine the effect of egg weight on fertility, hatchability, chick weight and subsequent growth performance of quail in order to determine the egg weight group that gives optimum performance in quail production. The objectives of the study, therefore, were to evaluate the effect of egg weight on chick weight and post- hatching performance and to investigate the effect of egg weight on fertility, hatchability, hatch and rearing mortality in Japanese quail.

MATERIALS AND METHODS

Experimental site

The data used for this study were obtained from an experiment conducted at the quail unit of Centre Songhai, Porto – Novo, Benin Republic.

Measurements

Body weight and egg weight were measured in grammes using a sensitive Mettler electronic scale with accuracy of 0.01g (Vali *et al.*, 2006). Egg length (EL) and egg circumference (EC) were measured using Vernier caliper.

Data Collection

Data included 2,575 records on growth performance and egg quality traits obtained from 400 females and 200 males. The records were further categorized into 3 classes based on the egg weight as follows:

<10g – Light (172 records)
10 – 12g – Medium (2136 records)
>12g – Heavy (267 records)

Fertility, hatchability of incubated eggs and hatchability of fertile eggs were calculated as follows:

$$\% \text{ fertility} = \frac{\text{number of fertile eggs}}{\text{total number of eggs set}} \text{x } 100$$

$$\% \text{ hatch} = \frac{\text{number of eggs hatched}}{\text{total number of fertile eggs}} \text{x } 100$$

$$\% \text{ hatchability of fertile eggs} = \frac{\text{number of fertile eggs hatched}}{\text{total number of fertile eggs}} \text{x } 100$$

$$\% \text{ mortality} = \frac{\text{number of dead birds}}{\text{total number of birds hatched}} \text{x } 100$$

Data Analysis

The data were analyzed with General Linear Model of SAS (2003) according to the following model

$Y_{ij} = \mu + a_i + e_{ij}$;
where
Y_{ij} = dependent variable; μ=overall means;
a_i = fixed effect of egg weight group and
e_{ij} = random error.
Means were separated using Duncan's New Multiple Range Test of SAS (2003). Correlation between the variables were obtained using CORR procedure of SAS (2003)

RESULTS AND DISCUSSION

Table 1 shows the mean egg weight, egg length and egg circumference of the light, medium and heavy egg weight groups. The egg groups were significantly ($p<0.001$) different from one another for all the parameters evaluated. This indicated that there was a difference in egg weight, egg length and egg circumference among the egg weight groups.

Table 2 presents least squares means showing the effect of grouping on body weight of quails hatched from different egg weight groups. There were significant ($p<0.05$) differences among the three egg weight groups for post-hatch body weight growth performance. Heavy weight group had superior mean values, intermediate in medium while the least mean values were recorded for light weight group from hatch to end of the study. This implied that the egg weight of quail used to hatch had positive effect on the subsequent body weight.

The means of shank length of Japanese quails hatched from different weight groups are presented in Table 3. There were significant ($p<0.05$) differences in shank length for the egg weight groups. Quails hatched from heavy weight group were observed to have higher shank length. Mean body weight and shank length as shown on Tables 2 and 3 indicated that there was progressive increase in body weight and shank length of birds as age of bird increases in all the groups which showed that there was physiological growth as age of bird increases. The weights were statistically significant ($p<0.001$) in all the groups. This result supported the findings of some researchers who reported that egg weight and chick weight were positively correlated. (Yannakapoulus and Tservesi – Gousi, 1987; Foo, 1995; Farooq *et al.*, 2001).

Table 1: Means (±SE) of egg quality traits of Japanese quail eggs belonging to three weight groups

TRAITS (Unit)	LIGHT	MEDIUM	HEAVY
Egg weight (g)	8.75 ± 0.04^{c}	11.19 ± 0.04^{b}	13.14 ± 0.04^{a}
Egg length (cm)	2.90 ± 0.02^{c}	3.17 ± 0.04^{b}	3.34 ± 0.04^{a}
Egg circumference (cm)	7.31 ± 0.02^{c}	7.85 ± 0.04^{b}	5.91 ± 0.04^{a}

* Means with different superscript along the same rows are significantly different (P<0.05); SE-Standard error

Table 2: Means of body weight (Mean ± SE) of Japanese quails hatched from different egg weight groups

AGE (weeks)	LIGHT	MEDIUM	HEAVY
At hatch	5.74 ± 0.079^{c}	7.37 ± 0.015^{b}	8.61 ± 0.06^{a}
1	15.65 ± 3.15^{c}	19.14 ± 0.07^{b}	21.03 ± 0.27^{a}
2	35.25 ± 1.01^{c}	39.04 ± 0.15^{b}	41.90 ± 0.45^{a}
3	66.23 ± 1.25^{c}	73.73 ± 0.20^{b}	76.52 ± 0.59^{a}
4	93.16 ± 1.11^{c}	100.53 ± 0.22^{b}	103.40 ± 0.75^{a}
5	127.80 ± 1.05^{c}	132.88 ± 0.20^{b}	135.75 ± 0.63^{a}
6	160.08 ± 1.04^{c}	100.53 ± 0.22^{b}	103.40 ± 0.75^{a}
7	195.73 ± 0.99^{c}	202.32 ± 0.24^{b}	205.27 ± 0.83^{a}

* Means with different superscript along the same rows are significantly different (P<0.05); SE-Standard error

Table 3: Means of Shank Length (Mean ± SE) of Japanese quails hatched from different egg weight groups

	Egg Groups		
AGE (weeks)	**LIGHT**	**MEDIUM**	**HEAVY**
At hatch	1.26 ± 0.01^{c}	1.41 ± 0.008^{b}	1.49 ± 0.008^{a}
1	1.64 ± 0.01^{c}	1.76 ± 0.002^{b}	1.84 ± 0.275^{a}
2	2.10 ± 0.02^{c}	2.16 ± 0.002^{b}	2.21 ± 0.01^{c}
3	2.60 ± 0.02^{b}	2.68 ± 0.014^{a}	2.69 ± 0.008^{a}
4	2.94 ± 0.016^{a}	2.98 ± 0.002^{a}	2.10 ± 0.007^{a}
5	3.15 ± 0.01^{b}	3.20 ± 0.002^{a}	3.23 ± 0.006^{a}
6	3.34 ± 1.01^{c}	3.39 ± 0.002^{b}	3.42 ± 0.006^{a}
7	3.53 ± 0.06^{b}	3.62 ± 0.018^{a}	3.62 ± 0.009a

* Means with different superscript along the same rows are significantly different (P<0.05); SE-Standard error

Tables 4, 5 and 6 show the correlation between egg quality traits and growth traits at hatch for light, medium and heavy egg groups. In the light group, egg weight was positively (P<0.05) correlated with shank length and chick weight (Table 4). It shows high and positive correlation (R=0.61) between egg weight and egg length while there was medium correlation (R=0.31) between egg weight and egg circumference. Table 5 shows high correlation (R=0.70 and 0.62) between egg weight, egg length and egg circumference and medium correlation between egg weight, chick weight and shank length. In Table 6, there was medium correlation (R=0.34 and 0.16) between egg weight and other traits except egg circumference which had low correlation. In the medium and heavy egg groups, egg weight was positively (p<0.001) correlated with shank length and chick weight. High correlation values of 0.99, 0.85 and 0.99 between shank length and chick weight are shown in light, medium and heavy egg groups respectively.

Table 4: Correlation between egg quality and growth traits at hatch for Light egg group

Parameters	**EW**	**EL**	**EC**	**BWH**	**SLH**
EW					
EL	0.61***				
EC	0.31***				
	0.30***				
BWH	0.25*	0.16*			
	0.27***				
SLH	0.23*	0.17*	0.99***		
	0.24***				

*** Significant at P<0.001; ** Significant at P<0.01; * Significant at P<0.05

EW – Egg weight, EL – Egg length, EC – Egg circumference, BWH – Body weight at hatch, SL – Shank length at hatch

Table 5: Correlation between egg quality traits and growth traits at hatch for Medium Egg group.

Parameters	EW	EL	EC	BWH	SLH
EW					
EL	0.70***				
EC	0.62***				
	0.49***				
BWH	0.31***	0.22***			
	0.10***				
SLH	0.19***	0.02	0.15***		
			0.85***		

*** Significant at P<0.001, ** Significant at P<0.01, * Significant at P<0.05
EW – Egg weight, EL – Egg length, EC – Egg circumference, BWH – Body weight at hatch, SL – Shank length at hatch

Table 6: Correlation between egg quality traits and growth traits at hatch for Heavy Egg group

Parameters	EW	EL	EC	BWH	SLH
EW					
EL	0.34***				
EC	0.16***	- 0.01			
BWH	0.31***	0.04			
	0.22***				
SLH	0.31***	0.05	0.99***		
	0.23***				

*** Significant at P<0.001, ** Significant at P<0.01, * Significant at P<0.05
EW – Egg weight, EL – Egg length, EC – Egg circumference, BWH – Body weight at hatch, SL – Shank length at hatch

Correlations between egg weight and growth performance traits for light egg group are presented in Table 7. Egg weight was positively correlated ($p<0.05$) with shank length and chick weight. Correlation values for most of the traits ranged from medium to high. Hatching weight and shank length was positively ($p<0.001$) correlated with 2nd, 3rd, 4th, 5th, 6th, and 7th week. Egg weight was positively ($p<0.001$) correlated with day – old body weight and 1st week shank length but positively ($p<0.05$) and became weakly correlated with body weight and shank length for 1st, 2nd, 3rd, 4th, 5th, 6th and 7th week.

Table 8 shows correlation among egg weight and growth performance traits from day old to 7th week for medium egg group. All traits were positively correlated ($p<0.001$) with one another. Correlation between egg weight and body weight range from 0.32 to 0.40 from day old to 7th week.

Table 9 shows correlation among egg weight and growth performance traits for heavy egg group. Day-old body weight was positively ($p<0.001$) correlated with 2nd, 3rd, 4th, 5th, 6th and 7th week. Egg weight was positively ($p<0.001$) correlated with day-old body weight and shank length, there was also a high correlation between shank length and body weight.

Positive correlation was observed between egg size and chick hatching weight for the light, medium and heavy egg category in this study. The positive correlation observed between egg size and chick weight clearly identified the advantage of initial bigger size at the time of setting. This observation agrees with the findings of Abiola (2008) and Grzegrzolka & Gruszczynska (2019). In this study, the correlation between body

weight and shank length are mostly positive, indicating that an improvement in body weight will likely lead to improvement in shank length and vice versa. Although Ibe (1995) concluded that selection based on shank length may not be useful in improving overall body growth of an animal unless selection is designed to improve specific body areas of prime economic values. According to El-Labban (1999), positive correlation among traits could be as a result of pleiotropic and linkage effects of genes which operate on these traits. Therefore, any attempt to perform phenotypic selection for one trait will consequently result in improvement of the other.

Percent hatch, hatchability, fertility and rearing mortality over the three egg groups are shown on Table 10. Percent hatch, hatchability, fertility and rearing mortality for the light, medium and heavy groups were 44.19, 58.02, 76.16 and 5.26 %; 85.67, 90.89, 94.57 and 1.53 %; and 69.66, 76.23, 91.39 and 1.61 %, respectively. The highest hatchability and fertility was found in the medium weight group. Results obtained on hatchability in the present study conformed with earlier findings which recommended the setting of average sized eggs for the purpose of incubation (Uddin *et al.* 1994; Deeming, 1995; Sarica and Soley, 1995; Gonzalez *et al.* 1999; Dudusola, 2013). Rearing mortality was found lowest in the medium egg group which agrees with the findings of (Szczerbinka and Zubrecki, 1999)

CONCLUSION

This study concludes that medium sized (10 – 12g) eggs are the most appropriate for incubation since they gave better results in terms of fertility, hatchability and rearing mortality. The result also showed positive correlation between body weight and shank length which implied that the two traits are associated with each other and are controlled by linked-genes.

Table 7 Correlation between egg weight and growth performance traits for Light Egg group

Traits	WT0	SL0	WT1	SL1	WT2	SL2	WT3	SL3	WT4	SL4	WT5	SL5	WT6	SL6	WT7	SL7
WT0																
SL0	0.99***															
WT1	0.94***	0.94***														
SL1	0.97***	0.97***	0.96***													
WT2	0.96***	0.95***	0.98***	0.97***												
SL2	0.97***	0.97***	0.97***	0.99***	0.99***											
WT3	0.96***	0.96***	0.98***	0.99***	0.98***	0.98***										
SL3	0.97***	0.91***	0.97***	0.99***	0.98***	0.98***	0.99***									
WT4	0.96***	0.91***	0.97***	0.99***	0.98***	0.98***	0.99***	0.99***								
SL4	0.96***	0.91***	0.97***	0.99***	0.98***	0.98***	0.99***	0.99***	0.99***							
WT5	0.97***	0.92***	0.97***	0.99***	0.98***	0.98***	0.99***	0.99***	0.99***	0.99***						
SL5	0.97***	0.92***	0.97***	0.99***	0.98***	0.98***	0.99***	0.99***	0.99***	0.99***	0.99***					
WT6	0.96***	0.92***	0.97***	0.99***	0.98***	0.98***	0.99***	0.99***	0.99***	0.99***	0.99***	0.99***				
SL6	0.96***	0.92***	0.96***	0.98***	0.97***	0.97***	0.98***	0.98***	0.98***	0.98***	0.98***	0.98***	0.98***			
WT7	0.97***	0.92***	0.97***	0.99***	0.98***	0.98***	0.99***	0.99***	0.99***	0.99***	0.99***	0.99***	0.99***	0.98***		
SL7	0.97***	0.92***	0.96***	0.99***	0.98***	0.98***	0.99***	0.99***	0.99***	0.99***	0.99***	0.99***	0.99***	0.98***	0.99***	
EW	0.24**	0.22**	0.18**	0.19**	0.19**	0.21**	0.22**	0.24**	0.24**	0.23**	0.23**	0.24**	0.24**	0.24**	0.24**	0.24**

*** Significant at P<0.001, ** Significant at P<0.01, * Significant at P<0.05

BW0, BW1……BW7 – Body weights at hatch and weekly intervals till 7th week of age

SL0, SL1……SL7 – Shank length at hatch and weekly intervals till 7th week of age; EW – Egg weight

Table 8 Correlation between egg weight and growth performance traits for Medium Egg group

Traits	WT0	SL0	WT1	SL1	WT2	SL2	WT3	SL3	WT4	SL4	WT5	SL5	WT6	SL6	WT7	SL7
WT0																
SL0	0.85***															
WT1	0.88***	0.76***														
SL1	0.93***	0.82***	0.93***													
WT2	0.86***	0.75***	0.96***	0.92***												
SL2	0.81***	0.77***	0.97***	0.93***	0.95***											
WT3	0.80***	0.76***	0.93***	0.94***	0.96***	0.96***										
SL3	0.87***	0.70***	0.81***	0.85***	0.83***	0.97***	0.86***									
WT4	0.90***	0.77***	0.92***	0.94***	0.94***	0.97***	0.98***	0.87***								
SL4	0.88***	0.80***	0.91***	0.96***	0.93***	0.96***	0.97***	0.88***	0.98***							
WT5	0.90***	0.78***	0.91***	0.95***	0.93***	0.97***	0.98***	0.88***	0.99***	0.99***						
SL5	0.88***	0.80***	0.91***	0.96***	0.93***	0.98***	0.97***	0.88***	0.98***	0.99***	0.99***					
WT6	0.90***	0.78***	0.92***	0.95***	0.94***	0.97***	0.98***	0.88***	0.99***	0.99***	0.99***	0.99***				
SL6	0.88***	0.80***	0.91***	0.96***	0.93***	0.99***	0.97***	0.88***	0.98***	0.99***	0.99***	0.99***	0.99***			
WT7	0.80***	0.78***	0.78***	0.95***	0.93***	0.98***	0.97***	0.88***	0.98***	0.99***	0.99***	0.99***	0.99***	0.99***		
SL7	0.90***	0.71***	0.81***	0.86***	0.84***	0.98***	0.91***	0.80***	0.88***	0.90***	0.89***	0.90***	0.90***	0.90***	0.90***	
EW	0.32***	0.19***	0.32***	0.32***	0.33***	0.29***	0.35***	0.18***	0.36***	0.21***	0.36***	0.21***	0.38***	0.22***	0.41***	0.17***

*** Significant at P<0.001, ** Significant at P<0.01, * Significant at P<0.05

BW0, BW1……BW7 – Body weights at hatch and weekly intervals till 7th week of age

SL0, SL1……SL7 – Shank length at hatch and weekly intervals till 7th week of age; EW – Egg weight

Table 9 Correlation between egg weight and growth performance traits for Heavy Egg group

Traits	WT0	SL0	WT1	SL1	WT2	SL2	WT3	SL3	WT4	SL4	WT5	SL5	WT6	SL6	WT7	SL7
WT0																
SL0	0.99***															
WT1	0.94***	0.94***														
SL1	0.97***	0.97***	0.96***													
WT2	0.96***	0.95***	0.98***	0.97***												
SL2	0.97***	0.97***	0.97***	0.99***	0.99***											
WT3	0.96***	0.96***	0.98***	0.99***	0.98***	0.98***										
SL3	0.97***	0.91***	0.97***	0.99***	0.98***	0.98***	0.99***									
WT4	0.96***	0.91***	0.97***	0.99***	0.98***	0.98***	0.99***	0.99***								
SL4	0.96***	0.91***	0.97***	0.99***	0.98***	0.98***	0.99***	0.99***	0.99***							
WT5	0.97***	0.92***	0.97***	0.99***	0.98***	0.98***	0.99***	0.99***	0.99***	0.99***						
SL5	0.97***	0.92***	0.97***	0.99***	0.98***	0.98***	0.99***	0.99***	0.99***	0.99***	0.99***					
WT6	0.96***	0.92***	0.97***	0.99***	0.98***	0.98***	0.99***	0.99***	0.99***	0.99***	0.99***	0.99***				
SL6	0.96***	0.92***	0.96***	0.98***	0.97***	0.97***	0.98***	0.98***	0.98***	0.98***	0.98***	0.98***	0.98***			
WT7	0.97***	0.92***	0.97***	0.99***	0.98***	0.98***	0.99***	0.99***	0.99***	0.99***	0.99***	0.99***	0.99***	0.98***		
SL7	0.97***	0.92***	0.96***	0.99***	0.98***	0.98***	0.99***	0.99***	0.99***	0.99***	0.99***	0.99***	0.99***	0.98***	0.99***	
EW	0.31***	0.31***	0.34***	0.33***	0.34***	0.32***	0.33***	0.33***	0.34***	0.33***	0.34***	0.33***	0.33***	0.33***	0.34***	0.33***

***** Significant at P<0.001, ** Significant at P<0.01, * Significant at P<0.05**

BW0, BW1……BW7 – Body weights at hatch and weekly intervals till 7th week of age

SL0, SL1……SL7 – Shank length at hatch and weekly intervals till 7th week of age; EW – Egg weight

Table 10: Percent hatch, hatchability, fertility and rearing mortality for egg groups

TRAITS (%)	LIGHT	MEDIUM	HEAVY
Hatch	44.19[c]	85.67[a]	69.66[b]
Hatchability	58.02[c]	90.89[a]	76.23[b]
Fertility	76.16[c]	94.57[a]	91.39[b]
Mortality	5.26[a]	1.53[c]	1.61[b]

* Means with different superscript along rows are significantly different

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