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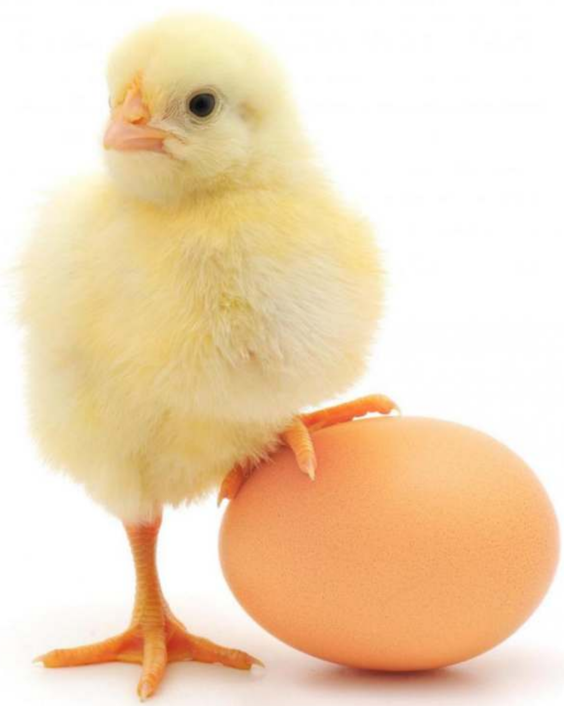

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Inheritance of Egg Quality Traits in the Japanese Quail

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Abstract: A total of 471 eggs were collected from 205 female Japanese quails at 20 weeks of age in 3 consecutive days. The mixed model least-squares and maximum likelihood computer programme of Harvey (1990) was applied to estimate heritability, genetic and phenotypic correlations of egg quality traits. The heritabilities of egg weight, egg length, egg width, egg shape index, shell thickness, albumen width, albumen height, Haugh unit, yolk width and yolk height were 0.37±0.09, 0.15±0.03, 0.40±0.17, 0.46±0.03, 0.52±0.03, 0.23±0.02, 0.27±0.14, 0.30±0.08, 0.11±0.03 and 0.11±0.02, respectively. The genetic correlations among egg quality traits ranged from -0.13 to 0.97. The phenotypic correlation between egg weight and albumen width, albumen height, yolk width and yolk height were positive and significant ($P<0.001$). The results indicate a Haugh unit that can support embryo development and successful hatching. It also suggests that selection would be effective in improving some egg quality traits.

Key words: Japanese quail, egg quality, heritability, genetic correlation

INTRODUCTION

An avian egg is a micro habitat in which the embryo develops to be ready for its life in the external environment. Quail egg is an inexpensive but highly nutritive food that is low in fat and cholesterol (Garwood and Diehl, 1987) which is of particular importance considering the increasing cases of cardiovascular diseases.

Egg quality traits determine the acceptability and market value of table eggs (Oluyemi and Roberts, 2000). Egg production enterprise is of great economic importance and its success depends on the total number of quality eggs produced. The physical characteristics of the egg play an important role in the process of embryo development and successful hatching (Narushin and Romanov, 2002). The most influential egg parameters for successful hatching in their order of importance as ranked by Tsarenko and Kurova (1989) are weight, shell parameters (particularly thickness and porosity), shape index and the consistency of its content. The consistency of the egg contents is estimated from the indices of albumen and yolk and Haugh units. Any major abnormality in the physical characteristics of the egg can lead to a collapse in its main physiological function of providing the best condition for the developing embryo (Narushin and Romanov, 2002).

Information on heritability and genetic correlation of egg quality traits is essential to show the amount of improvement to be expected through selection and use of appropriate breeding methods. Consequently, the objective of this study is to estimate the genetic parameters of egg quality traits of the Japanese quail.

MATERIALS AND METHODS

The study was conducted at the poultry unit of the Teaching and Research Farm of the Faculty of Agriculture, Kogi State University Anyigba, Nigeria. Eggs used for this experiment were collected from 20 weeks old quails pedigreed through three successive generations. A total of 471 eggs from 205 quails hens which were daughters of 30 sires were collected in three consecutive days. Chicks were brooded and then reared on the rearing pens on the floor using standard management procedures until 5 weeks of age. The females were then moved and placed individually in 25 x 35 x 30cm wooden wire mesh cages and monitored for egg production. Chicks were fed a diet containing 24% crude protein and 2741kcal/kg of feed from hatch to 5 weeks of age. There after; the birds were fed a diet containing 18% crude protein and 2707kcal/kg of feed as recommended by Dafwang (2006). Both feed and water were provided *ad libitum*.

The eggs collected were labeled to identify each female egg. The eggs were weighed on a sensitive electronic scale. Egg length and egg width were measured using a vernier caliper. Internal quality assessment was carried out using the destructive technique. By this method, the egg is gently broken and the content carefully poured on a flat platform. A vernier caliper was used to measure albumen length, albumen width and yolk width. A tripod micrometer sensitive to 0.01mm was used to measure albumen height and yolk height. The shells were washed under slightly flowing water to remove the albumen remains. The shells were then left to dry in the open air for 24 hours. Samples taken from

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the sharp, blunt and equatorial parts of the shell were measured with the aid of a micrometer screw gauge and the average shell thickness obtained from the average values of these three parts.

Some expressions used to determine some egg quality traits were:

$$\text{Egg shape index} = \frac{\text{Egg wigth}}{\text{Egg length}} \times \frac{100}{1}$$

$$\text{Yolk index} = \frac{\text{Yolk height}}{\text{Yolk width}} \times 100$$

Haugh unit (Hu) = 100log $(H+7.57-1.7W0^{37})$

where, H-Albumen height (mm), W = Egg weight (g) as proposed by Haugh (1937).

Data were analyzed using SPSS 14.0 (2004) .

The model used in the analysis was as follows:

Y_{ij} = $\mu+B_j+e_{ij}$

Y_{ij} = Individual observation

μ = Population mean

B_j = Effect of hatch (I = 1, ..3)

e_{ij} = Residual random error.

Data were further subjected to genetic analysis using the Mixed Model Least-Squares and Maximum Likelihood computer programme of Harvey (1990). The reduced sire model (Becker, 1992) was used to fit the data.

$$Y_{ij} = \mu+a_i+e_{ij}$$

Where:

Y_{ij} = Observation of the jth progeny of the ith sire

μ = Population mean

a_i = Random effect of the ith sire (I =1, ... 30)

e_{ij} = Residual random error

The Harvey programme computes estimates of genetic and phenotypic correlation as well as heritability of traits from sire variance components.

RESULTS AND DISCUSSION

Table 1 displays the descriptive statistics of external and internal egg quality traits of the Japanese quail. The values related to egg weight, egg length, egg width, shape index and average shell thickness were 7.73±0.06g, 3.04±0.01cm, 2.32±0.01cm, 76.29±0.35% and 0.232±0.001mm, respectively. Albumen width, albumen height, Haugh unit, yolk width, yolk height and yolk index recorded 3.11±0.03cm, 3.25±0.04mm, 85.63±0.22, 2.30±0.0lcm, 0.99±0.01cm and 45.41±0.38%, respectively.

The average egg weight obtained in this study is lower than the 11.28g and 11.06g reported by Kul and Seker (2004) and Sezer (2007), respectively. The characteristically smaller eggs observed in this study might be due to the effect of breed/strain and environment. The air temperature in February or March up to May or June in the experimental site reaches 36.2°C. It is well known that the comfort zone for layers is about 21°C and any increase in temperature above this comfort zone reduces feed consumption which in turn reduces egg weight . The mean egg length, shell thickness and shape index in this study agrees with the findings of Kul and Seker (2004) who reported values that ranged from 2.97-3.70cm, 0.192-0.282mm and 67.42-83.28% for egg length, shell thickness and egg shape index, respectively. Haugh unit reported in this study is similar to the 85.73 reported by Kul and Seker (2004) but lower than 90.90 and 89.98 reported by Ayorinde (1987) and Seker (2008). The Haugh unit reported in the present study gives an indication of a firm and strong albumen with a high density to support embryo development and successful hatching. The yolk index value reported is similar to the 36.80-56.42 reported by Sezer (2008). The differences between the results of the present findings and those of other researchers could have arisen from the genetic structure, health condition, flock age, use of different diets in feeding and differences in the care and management of the quails.

Table 2 presents the heritability estimates from sire variance component of egg quality traits in Japanese quail. The values varied and ranged from 0.11±0.03 for yolk width to 0.52±0.03 for shell thickness.

Table 1: Least-Squares Means±SEM and coefficient of variation (CV) of Egg quality traits in Japanese quail

Traits	Mean±SE	CV (%)
External:		
Egg weight (g)	7.73±0.06	9.58
Egg length (cm)	3.04±0.01	5.48
Egg width (cm)	2.32±0.01	5.75
Shape index (%)	76.29±0.35	5.60
Average shell thickness (mm)	0.232±0.001	1.64
Shell thickness (blunt region) (mm)	0.228±0.001	2.10
Shell thickness (sharp region) (mm)	0.243±0.001	2.79
Shell thickness (equatorial region (cm)	0.225±0.001	1.47
Internal:		
Albumen width (cm)	3.11±0.03	11.44
Albumen height (mm)	3.25±0.04	14.60
Haugh unit	85.63±0.22	3.16
Yolk width (cm)	2.30±0.01	5.95
Yolk height (cm)	0.99±0.01	8.79
Yolk index (%)	45.41±0.38	10.22

Table 2: Heritability Estimates of Egg Quality traits from sire variance components in Japanese Quail

Parameter	h^2
External:	
Egg weight	0.37±0.09
Egg length	0.15±0.03
Egg width	0.40±0.17
Egg shape index	0.46±0.03
Shell thickness	0.52±0.03
Internal:	
Albumen width	0.23±0.02
Albumen height	0.27±0.14
Haugh unit	0.30±0.08
Yolk width	0.11±0.03
Yolk height	0.11±0.02

Table 3: Genetic (Below diagonal) and Phenotypic (above diagonal) correlations among egg quality traits in Japanese quail

	EG	EL	EW	SI	ST	AW	AH	HU	YW	YH
EG		0.74***	0.59***	-0.10	0.02	0.29***	0.34***	0.08	0.43***	0.30***
EL	0.82		0.41***	-0.49***	-0.14	0.22**	0.28***	0.09	0.31***	0.11
EW	0.38	0.73		0.54***	0.05	0.20*	0.09	-0.08	0.35***	0.23**
SI	-0.56	0.55	0.95		0.17	-0.01	-0.17*	-0.15	0.04	0.11
ST	0.31	-0.48	-0.16	0.19		0.03	-0.03	-0.04	0.03	0.26**
AW	-0.20	-0.50	0.70	0.90	0.21		0.57***	0.52***	0.31***	0.08
AH	0.47	-0.29	0.38	0.73	0.32	0.81		0.96***	0.16	0.16
HU	0.21	-055	0.28	0.51	0.17	0.90	0.97		0.05	0.09
YW	0.44	0.83	-0.32	-0.41	0.12	0.62	0.63	0.56		0.28***
YH	0.92	1.01	0.52	-0.51	0.06	0.70	-0.13	-0.72	0.94	

* = (p<0.05); ** = (p<0.01); *** = (p<0.001).

EG: Egg weight; EL: Egg length; SI: Shape index; ST:= Shell thickness; AW: Albumen width; AH: Albumen height; HU: Haugh unit; YW: Yolk width; YH: Yolk height.

The heritability estimates reported for egg weight is lower than the values of 0.63±0.11 and 0.83±0.01 reported by Zang *et al.* (2005) and Sezer (2007). The heritability estimates for shell thickness is similar to that reported by Sezer (2007) but differed from the findings of Zang *et al.* (2005). The heritability estimates for egg width and Shape index were slightly lower than the values obtained by Sezer (2007). The heritability estimates for Haugh unit reported in this study is higher than the 0.183 reported by Ikeobi (1998). It is however lower than the values of 0.41±0.10 and 0.38±0.035 reported by Zang *et al.* (2005) and Sezer (2008). The low heritability estimates for egg length, yolk width and yolk height indicate that environmental factors such as feed, management and temperature may have more effect on these traits than the additive genetic effect. The moderate to high heritability estimates exhibited by the remaining egg quality traits suggest that response to mass selection by those traits may be rapid.

The genetic and phenotypic correlations among egg quality traits are shown in Table 3. The genetic correlation ranged from -0.13 to 0.97. There was positive and very high significant (P<0.001) phenotypic correlation between egg weight and egg length, egg weight and egg width, egg length and egg width and egg width and shape index. There was positive and very highly significant (P<0.001) phenotypic correlation between albumen width and albumen height, albumen width and Haugh unit, albumen width and yolk width, albumen height and Haugh unit, yolk width and yolk height. Egg weight was positive and had very highly significantly (P<0.001) phenotypic correlation with albumen width, albumen height, yolk width and yolk height but not significantly correlated with Haugh unit.

The positive genetic correlation of egg weight with shell thickness and egg weight with albumen height reported in this study were similar to those reported by Zang *et al.* (2005), Sezer (2007) (2008). Although the phenotypic correlation between egg weight and shell thickness was low, the genetic correlation was moderate. Though heavier eggs tend to have thinner shells, the positively moderate genetic correlation between egg weight and egg shell thickness suggests that selection based on egg weight might improve shell thickness. The large and positive genetic and phenotypic correlation between albumen height and Haugh unit agrees with the findings of Zang *et al.* (2005) and Sezer (2008). This result suggests that in addition to egg weight, albumen height was a major factor affecting Haugh unit. Egg shape index and egg weight are important traits from the point of mechanical handling of eggs. Egg weight had negative genetic and phenotypic correlation with egg shape index. Similar results have been reported by Choprakarn *et al.* (1998) and Sezer (2007). The positively significant genetic and phenotypic correlation between yolk height and yolk width suggests that selection for increased yolk width would increase yolk height. The yolk is the concentrated source of nutrition for the embryo and such favourable correlations could potentially be used to increase the hatchability and chick quality.

Conclusion: The egg quality characteristics evaluated revealed indices that make Japanese quail eggs withstand both handling and incubation pressures. The high Haugh unit reported is indicative of firm and strong albumen with high density to support embryo development and successful hatching. Heritability estimates of egg weight, egg width, shape index, shell thickness, albumen width, albumen height and Haugh unit were moderate to high. This suggest that improvement of these traits by selection would be effective. The low heritability estimates for egg length, yolk width and yolk height imply that additive genetic factors have little effect on these traits.

REFERENCES

Ayorinde, K.L., 1987. Physical and Chemical characteristics of the eggs of four indigenous guinea fowl in Nigeria. Nig. J. Anim. Prod., 14: 125-128.

Becker, W.A., 1992. Manual of Quantitative Genetics. 5th Edn., USA, Academic Enterprise Pullman, Pages: 189.

Choprakarn, K., I. Salangam and K. Tanaka, 1998. Laying performance, egg characteristics and egg compositions in Thai Indigenous hens. J. Nati. Res. Council, Thailand., 30: 1-17.

Dafwang, I.I., 2006. Nutrient requirements and Feeding regiment in quail production. A paper presented at the National Workshop on quail production for sustainable household protein intake. NAERLS, Ahmadu Bello University Zarai. Sept. 11-13, pp: 12-19.

Garwood, V.A. and R.C.J. Diehl, 1987. Body volume and density of live coturnix quail and associated genetic relationships. Poult. Sci. J., 66: 1269-1269.

Harvey, W.R., 1990. Mixed Model Least-Squares and Maximum Likelihood Computer programme. Ohio State University Columbus (Mimeo).

Haugh, R.R., 1937. The Haugh unit for measuring egg quality. US Egg Poult. Mag., 43: 522-555, 572-573.

Ikeobi, C.O.N., 1998. Estimates of genetic parameters of some performance characters in egg-type chicken. Nig. J. Sci. Tech., 1: 154-160.

Kul, S. and I. Seker, 2004. Phenotypic correlations between some external and internal egg quality traits in the Japanese quail. Int. J. Poult. Sci., 3: 400-405.

Narushin, V.G. and M.N. Romanov, 2002. Egg physical characteristics and hatchability. World Poult. Sci. J., 58: 297-303.

Oluyemi, J.A. and F.A. Roberts, 2000. Poultry production in Warm wet climate .2nd Edn., Spectrum Books, Ibadan, Nigeria, Pages: 244.

Sezer, M., 2007. Heritability of exterior egg quality traits in Japanese quail. J. Appl. Bio. Sci., 1: 37-40.

Sezer, M., 2008. Heritability of Interior egg quality traits for Japanese quail. Int. J. Nat. Engr. Sci., 2: 77-79.

SPSS, 2004. Statistical package for social sciences. Release 14.0 for windows. IL 60611. Chicago.

Tsarenko, P.P. and G.M. Kurova, 1989. Quality control of chicken eggs. In: Effective technologies of poultry production. Agropromizdat, Moscow, Russia, pp: 97-102.

Zang, L.C., Z.H. Ning, G.Y. Xu, Z.C. Hou and N. Yang, 2005. Heritabilities and genetic and phenotypic correlations of egg quality traits in Brown egg dwarf layers. Poult. Sci. J., 84: 1209-1213.