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A STUDY ON THE INTERNAL QUALITY TRAITS AND HERITABILITY FOR JAPANESE QUAIL EGGS

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ABSTRACT

Internal quality characteristics and Heritability of Japanese quail eggs were investigated using Restricted Maximum Likelihood Procedure soft ware at the Poultry unit of University of Maiduguri Teaching and Research Farm. The traits considered were egg weight, albumen length, albumen height, albumen width, albumen weight, yolk height, yolk diameter, yolk weight, albumen ratio, yolk diameter, yolk ratio, Haugh unit and albumen index at 10,12,14,16,18 and 20 weeks of age. The least square means of egg, albumen and yolk weights seem to increase alongside the laying age which suggests that changes in interior egg quality traits could be expected during egg production period in quail. Similarly, both yolk and albumen ratios constituted over 90 % of total egg weight in all ages. Thus, albumen and yolk weights covered high proportion of total egg weight. The heritability estimates of internal quality traits were generally moderate to high pointing to the possibility of improving internal quality traits in Japanese quail through individual selection. Over the ages, estimates of albumen traits were more heritable than yolk qualities; an indication that albumen traits may respond better to selection.

INTRODUCTION

Among the small and medium scale poultry producers in Nigeria, quail production is gradually becoming an important business. This could be based on the fact that the birds can be kept easily and successfully in relative large numbers in a small facility (1). *Coturnix* is one the most widely domesticated sub-group of quail family while Japanese quail has become a pilot animal in the field of research due to its easy maintenance, early sexual maturity, shorter generation interval and high rate of egg production (2).

According to Sogut *et al*. (3), the productivity and quality of the breeding eggs have an overall significance for the continuity of the flocks and for economic breeding. Thus, the content and composition of an egg are capable of having a direct effect on hatchability, chick quality and future performance of the flock (4). It has been reported that several factors such as hen age, season, breed and lines within breed affected the proportion of egg components (5, 6).

Egg composition was established to be associated with egg weight (6, 7). Among the internal quality traits of egg, albumen eight was a more reflective index of egg weight than the yolk weight (7). In contrary, positive relationship observed between yolk/albumen ratio and egg weight is an indication that heavier eggs had high yolk proportion (6).

Knowledge of genetic parameters is an essential tool in any breeding programme to effect genetic change in economically important characteristics of domestic animals with a view to optimizing gain in performance (8). Heritability, among other genetic parameters determines the genetic progress that can be made by selecting superior individuals as parents of the next generation (9).

Scientific investigations into the genetics of egg production in other galliforms especially quail are extremely sparse (10, 11). This thus justifies the intent of this study which sought to examine internal egg quality traits and their heritability estimates in Japanese quail.

MATERIALS AND METHODS

Experimental location: The study was conducted at the Poultry unit of University of Maiduguri Livestock Teaching and research Farm, Maiduguri. Maiduguri, the capital of Borno State, Nigeria falls within the Sahelian (Semi-arid) region of West Africa on latitude 11.38^0 N and 37.17^0 E at an altitude of 354 m above sea level. The temperature of the area ranges from 24.0^0 C to 40.7^0 C (12).

Experimental birds and management: 80 Japanese quail chicks (20 males and 60 females) were purchased from National Veterinary Research Instuituite, Vom, Plateau State. These served as base population. 300 eggs were collected for hatching in a forced air incubator. The resulting quail chicks were raised in quail brooder till four weeks of age. After sexing, female birds were caged individually in 40x30x30 cm wire mesh cages. The birds were provided with feed and water ad libitum. They were given quail diet containing 25 % CP and 3000 Kcal ME/Kg in the first six week and later reduced to24 % CP and 2750 KCal ME/Kg. constant sanitation of the pen including the feeder were carried out.

Data collection: A total of 1,320 eggs were collected at 10, 12, 14, 16, 18 and 20 weeks of age and were used for the egg quality traits analysis. Egg weight was taken using a 0.01 g sensitive electronic scale. The eggs were broken on a white tile. The measurement of yolk height and diameter, albumen length, width and height were taken using a pair of vernier calipers. Thereafter, the yolk was carefully separated from the albumen and then the yolk weight was measured with the scale. These data were used to determine the additional internal quality traits of eggs with the following formulae:

$$Albumen\ index\ (\%) = albumen\ height (mm) (albumen\ lenght\ (mm) + \ albumen\ width\ / \ 2) X\ 100$$

$$Albumen\ ratio\ (\%) = albumen \frac{weig\ ht(g)}{egg} weight\ (g)\ X\ 100$$

$$Albumen\ weight\ (\ g) = egg\ weight(g) - (yolk\ weight\ (\ g) + \ shell\ weight\ (g)\ ))$$

$$Haugh\ unit\ (HU) = 100 \log(H + 7.57 - 1.7\ W\ ^{0.37}$$

Where H= albumen height (cm), W= egg weight (g)

$$yolk\ index\ (\%) = yolk \frac{heig\ ht(cm)}{} \ \ yolk\ diameter\ (cm) X\ 100$$

$$yolk\ rtatio\ (\%) = (yolk\ weight(g) / \ egg\ weight\ \ (g) X\ 100$$

Statistical analysis

Variance and co-variance components were estimated using Restricted Maximum Likelihood (REML) Procedure software (13). Heritability was estimated for sire component according to Becker (14) as follows:

$$\mathrm{h}^2{}_s = \frac{4\sigma^2}{\sigma^2{}_s - \sigma^2{}_D - \sigma^2{}_W}$$

Where

h^2 = heritability,

$\sigma^2{}_s$ = variance component of sire,

$\sigma^2{}_D$= variance component of dam,

$\sigma^2{}_W$ = error variance component.

Standard error (S.E.) for h^2 estimates was approximated following the method of Dickson (15):

$$S.E.(\mathrm{h}^2{}_s) = \sqrt{\frac{\frac{2}{\mathrm{K}^2{}_3}\left(\frac{MS^2{}_s}{S-1} + b_n \sin \frac{MS^2{}_D}{d-1}\right)}{\overline{4\,\sigma^2\,\mathrm{T}}}}$$

Where,

$MS^2{}_s$= Means squares of sire

$MS^2{}_D$= Means squares of dam

K $_3$= Number of progeny per sire

S= Number of sire

d= Number of dam

σ^2 T= total variance

RESULTS AND DISCUSSION

The descriptive statistics related to the internal quality traits of the examined eggs in this study are shown in Table 1. The least square means for egg weight in different ages (12,14.16,18 and 20 weeks) were 9.19 g ± 0.69, 9.20 g ± 0.08, 9.33 g ± 0.08, 9.47 g ± 0.07, 9.61 g ± 0.07 and 9.77 g ± 0.07, respectively. The corresponding values for albumen weight were 5.13 g ± 0.07, 5.11 g ± 0.07, 5.20 g ± 0.07, 5.25 g ± 0.07, 5.33 g ± 0.06 and 5.45 g ± 0.06 while those for yolk weight were 3.21 g ± 0.01, 3.27 ± 0.04, 3.30 g ± 0.04, 3.35 ± 0.04, 3.40 g ± 0.04 and 3.41 g ± 0.04, respectively. The means of the three variables seem to increase with age of lay. Similarly, both the yolk and the albumen ratios constituted over 90 % of total egg weight in all the ages. This is a clear indication that albumen and yolk weight cover the higher proportion of total egg weight (16). The least square means obtained in the present study for egg weight (9.19 g – 977 g) were within the range (9.60 g – 9.83 g) reported by (17) in Bob white quail. These were also similar to the range 7 g -11.00 g by (18) in Japanese quail. However, they were generally lower than the report of (16) and (2) both in Japanese quail. Slight differences among the reports for traits related with egg qualities in this study and those of other authors could be expected because of the differences in genetic structures, age of the flock, content of diets and management (19).

The increase in the means of egg weight with ages was in line with the observation of (18) in Japanese quail. This suggests that changes in the interior egg quality traits could be expected during egg production. The means of albumen weight ranged from 5.13 g to 5.45 g are lower than those of other researchers (6.35 g, (20); 6.73 g, (16); 7.80 G, (2). The lower means reported in this study pointed out that the birds might be affected by hot climatic conditions of the experimental location. On the other hand, the range of yolk weight means as obtained in this study (3.21 g – 3.41 g) agree well with 3.69 g and 3.38 g reported, respectively by (20) and (16). (2) however reported higher mean (4.47 g) for the same traits in Japanese quail. These higher means are not unexpected as the birds used by the authors were selected for body weight and dam age at first age. The high proportion of albumen and yolk as revealed in this study is advantageous for this has positive influence on the weight of newly hatched chicks as well as hatching performance (21).

Heritability estimates of internal egg quality characteristics as shown in Table 2 were generally moderate to high. Such high estimates of heritability pointed to the possibility of improving internal quality traits of egg in Japanese quail through individual selection. The highest heritability estimate (0.98 ± 0.13) was recorded for albumen ratio at 20th week of age while the lowest (0.03 ±0.13) was observed with yolk index at 14th week of age. It appears that the heritability estimates of traits related with albumen were generally more heritable than the traits related with yolk. The result thus suggests that albumen traits may respond better to selection than the yolk related traits.

Highest heritability (0.98 ±0.32) among the albumen related traits was obtained for albumen ratio while albumen length had the lowest (0.16± 0.17), obtained at 20th week and 12th week of age, respectively. On the other hand, the highest estimate (0.95 ± 0.32) was recorded for yolk ratio and the lowest (0.04 ± 0.13) for yolk index, among the yolk traits both at the 14th week of age. Individual selection of traits with high heritability estimates optimizes selection progress while improvement of traits with low heritability has to be accompanied by other form of selection.

At the age of 12 week, the heritability estimate of 0.52 obtained for albumen height in this study is not very far from 0.42 reported by (22) in chickens and 0.40 obtained by (16) in Japanese quail at the same age. This value is however higher than 0.14 and 0.08 reported by (17) in Bob white quail. The similarity between the estimates in this study and those observed in chickens pointed that quantitative genetics of egg production parameters in other galliforms generally appear similar to corresponding parameters in the domestic fowls (23).

In general, most heritability estimates obtained for internal egg traits in this study are similar to the reports of other researchers (6, 17, 22). The correspondence in the reports is an indication of no evidence of important maternal/dominant effects on the traits while the differences in the reports may not be unconnected with differences in genetic makeup of the stocks, management, climatic conditions and period of study as well as differences in data sizes and method of analysis (24).

The estimates above unity (outside the parameter space) obtained in this study were obviously abnormal. However, such values have been equally observed by other investigators in different species of farm animals (25, 26, 27). Small data-size, methods of estimation, effects of selection, inbreeding and maternal effects, was recognized as being contributory factors. Those reported in this study could be attributable to small data set and possibly presence of other variation apart from additive genetic variation.

CONCLUSION

The findings of this study revealed that the means of egg, albumen and yolk weights seem to increase with age of lay which suggests changes in the interior egg qualities during egg production period. The yolk and albumen ratios constituted over 90 % of the total egg weight at all ages, an indication that albumen and yolk weight cover higher proportion of total egg weight. Generally, heritability was moderate to high which pointed to the possibility of improving internal quality traits of egg in Japanese quail through individual selection. Heritability of albumen traits was (generally) more heritable than yolk traits, indicated better response to selection by albumen traits.

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Table 1: Descriptive statistics for internal quality characteristics of Japanese quail egg (X±SE) at different ages

	Age (Weeks)					
Traits (N=220)	10	12	14	16	18	20
Egg weight (g)	9.19± 0.09	9.20±0.08	9.33±0.08	9.47±0.08	9.61±0.07	9.77±0.07
Albumen length (cm)	4.48±0.04	4.33±0.03	4.43±0.03	4.41±0.03	4.37±0.03	4.38±0.04
Albumen height (cm)	3.50±0.04	4.40±0.05	4.48±0.45	4.40±0.04	4.19±0.04	3.95±0.04
Albumen width (cm)	3.33±0.01	3.38±0.03	3.46±0.04	3.42±0.03	3.42±0.03	3.46±0.04
Albumen weight (g)	5.13±0.07	5.11±0.07	5.20±0.07	5.25±0.07	5.33±0.06	5.45±0.06
Yolk height (cm)	0.98±0.01	0.98±0.01	1.03±0.01	1.03±0.01	1.00±0.01	1.00±0.01
Yolk diameter (cm)	2.42±0.01	2.44±0.01	2.44±0.01	2.44±0.01	2.49±0.01	2.48±0.01
Yolk weight (g)	3.21±0.01	3.27±0.04	3.30±0.04	3.36±0.04	3.40±0.04	3.41±0.04
Albumen ratio (%)	55.64±0.43	55.41±0.41	55.57±0.43	55.32±0.39	55.19±0.48	55.72±0.38
Yolk index (%)	40.43±0.32	4.28±0.38	42.28±0.41	42.45±0.31	40.38±0.39	40.59±0.32
Yolk ratio (%)	35.17±0.40	35.69±0.39	35.40±0.41	35.54±0.38	35.63±0.43	34.98±0.36
Haugh unit (%)	91.05±0.25	90.99±0.24	91.12±0.24	90.57±0.24	89.28±0.25	87.77±0.26
Albumen index (%)	91.05±0.25	90.99±0.24	91.12±0.24	90.57±0.24	89.28±0.25	87.77±0.26

Table 2: heritability estimates (h^2) of internal quality characteristics of Japanese quail at different ages

Age	Egg weight	Albumen length	Albumen height	Albumen width	Albumen weight	Yolk height	Yolk diameter	Yolk weight	Albumen ratio	Yolk index	Yolk ratio	Haugh unit	Albumen index
10	0.51 ±0.30	0.62 ±0.27	1.02 ±0.32	1.22 ±0.35	0.92± 0.31	0.35± 0.21	0.47± 0.24	0.88± 0.31	1.20± 0.35	0.18 ±0.17	1.09± 0.34	0.96± 0.32	0.72± 0.28
12	0.39 ±0.27	0.16 ±0.17	0.52 ±0.25	0.29 ±0.19	0.90± 0.31	0.61± 0.27	0.44± 0.23	0.49± 0.24	0.88± 0.31	0.59 ±0.26	0.76±	0.56± 0.26	0.19± 0.17
14	0.61 ±0.33	0.28 ±0.19	1.02 ±0.33	0.72 ±0.28	1.21± 0.35	0.43± 0.23	1.10± 0.34	0.52± 0.25	1.18± 0.35	0.04 ±0.13	0.95± 0.32	1.02± 0.33	0.47± 0.24
16	0.72 ±0.36	0.66 ±0.27	0.62 ±0.27	0.71 ±0.28	1.26± 0.35	0.62± 0.27	0.61± 0.26	0.54± 0.25	1.25± 0.35	0.50 ±0.24	1.32± 0.33	0.61± 0.27	0.65± 0.27
18	0.26 v0.22	0.78 ±0.29	1.31 ±0.36	0.83 ±0.30	1.00± 0.32	0.67± 0.37	0.81± 0.31	0.36± 0.21	0.81± 0.30	1.56 ±0.37	0.66± 0.27	1.34± 0.36	0.58± 0.26
20	0.33 ±0.24	0.91 ±0.31	1.75 ±0.37	0.72 ±0.28	0.97± 0.32	1.02± 0.33	0.60± 0.26	0.40± 0.22	0.98± 0.32	0.77 ±0.29	0.84± 0.30	1.69± 0.37	0.77±

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