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RESEARCH ARTICLE

Repeatability Estimates of Egg Quality Traits of Pharaoh Quail *(Coturnix Coturnix Japonica)* Reared In Derived Savanna Zone of Nigeria

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ABSTRACT

The study was carried out to determine the repeatability of egg quality traits in Pharaoh quail. Repeatability estimates of egg quality traits in Pharaoh quail *(Coturnix cortunix japonica)* were measured at 6, 7, 8, 9, 10 and 11 weeks of rearing period. A total of two hundred Japanese quail *(Coturnix coturnix japonica)* pullets were procured from a reputable farm for the study. The pullets were reared on the deep litter and were fed *ad libitum* with feed, clean and cool water. At the end of 6th, 7th, 8th, 9th, 10th and 11th weeks of age. Data were collected on Egg Weight (EW), Egg Length (EL), Egg Breadth (EB), Shell Thickness (ST), Haugh Unit (HU), Yolk weight (YW), Yolk Index (YI), Albumen Weight (AW), and Albumen Index (AI). All these were analyzed for fixed effect of repeatability estimate. The repeatability estimate for external egg traits reveals a range of 0.76 - 0.87 for EW, 0.9 - 0.99 for EL, 0.60 - 0.80 for ST, 0.52 - 0.82 for EB and 0.71 - 0.85 for HU. Therefore the repeatability for the entire estimate for external egg traits varies from 0.52 – 0.99. However, the repeatability estimate of internal egg quality traits in quail eggs also shows the YW varying from 0.70 - 0.84, AW ranged 0.82 - 0.92, YI varied 0.72 - 0.82 and AI ranged from 0.68 - 0.80. The variance component and overall repeatability estimate of egg quality traits reveals repeatability for EW with highest value of 0.972 with the least value obtained AI of 0.857. This repeatability estimate was high with a consistent increase in repeatability as laying age progressed from 6th week to 11 weeks of breeding period. Repeatability of EW, EL, EB, ST, HU, YW, YI, AW and AI showed a linear relationship with age. The general increase in repeatability of each variable with age reveals that fewer records would be required to adequately characterize the inherent producing ability of each quail hen for the traits as laying age progressed.

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INTRODUCTION

The breeding value of an individual for breeding prediction is very important as it enables the breeder to determine the transmitting ability of each individual desired economic trait. Early estimation of the most probable producing ability of each hen is of immense advantage from point of view of shortened generation interval and enhanced expected rate of animal genetic gain per generation. Traits such as birth weight and slaughter weight can only be measured once during the lifetime of an animal, whereas other traits like, body weight egg weight, egg number can be measure at several periods (Szwaczkowski, 2003).

Recently, Pharaoh or Japanese quail *(Coturnix cortunix japonica)* have become an important livestock across the globe. The advantages of Japanese quail, which have been widely used for biological and genetic studies (Tsudzuki, 1994; Narayan *et al.,* 1998) because it has a small body size, is easily handled, and large number of quails can be kept in limited space. Their sexual maturation is rapidly accomplished and turnover of

generations is rapid. Because of high egg production, many offspring can be available from certain number of parents. Being an oviparous animal, it is also, useful for embryological experiments (Ayasan and Okan, 2001).

Egg breakage still represents a major economic loss to the poultry industry. It was estimated that 13 to 20 percent of total egg production will break before reaching its final destination (Roland, 1988). Therefore, laying birds must be supplied with adequate calcium rich feed in their diet not only for the formation of shell but also for high quality of egg shell necessary for the prevention of breakage during handling and hatching. There is a dearth of information available in literature regarding repeatability of estimates of major traits of quails at 28week. But similar studies in other commercial chicken pullets were reported by (Ansah *et al.*, 1985*)* who indicated varying repeatability coefficient value for the egg quality traits at different seasons of the year and also noted a declining repeatability in the traits with increasing age in lay. Chineke (1999) however, observed an increase in the repeatability of same traits as laying progressed and decrease in maternal influence on the egg characteristics as laying period progress.

Bennerwitz *et al.* (2007) reported repeatability estimates in egg traits of quails to be 0.45 to 0.58 while Sooncharenying and Edwards (1989) reported repeatability coefficient of 0.80 for egg weight, 0.98 for shell weight and 0.85 for shell thickness in quails. Other studies in commercial pullets showed repeatability coefficient of haugh unit and shell thickness ranging from 0.39 to 0.72 and from 0.17 to 0.45 (Ibe 1984). Repeatability estimates for egg weight ranging from 0.57 to 0.78 had been reported by some other researchers for birds of different ages and genetic background (Ayorinde and Sado, 1988) whereas a range of 0.42 to 0.57 had been observed for the same traits by Wilhemson (1975). Soonchreying and Edwards (1989) reported that all traits of egg had high repeatability estimate.

Repeatability measures the degree of association between records in the same animal for traits expressed more than once in an animal life. Its estimate shows the gain in accuracy expected for multiple measurements (Falconer, 1989). Repeatability and heritability estimate reported for reproductive traits (Fertility and hatchability) and fitness traits related to them such as egg number, egg weight, shell thickness, and semen quality were generally low (Ansah *et al.*, 1985; Szwaczkowski, 2003). In consequence, selection effectiveness was generally low. The low repeatability and heritability estimate reported for these traits were attributed to huge influence of non-genetic factor (Falconer, 1989).The Improvement of egg production parameters is desirable because of their economic importance. This can be brought about by improvement by both genetic and non-genetic factor influencing egg production. Since egg production varies from one period to another, Knowledge of repeatability estimate will guide the breeder in designing an appropriate breeding plan for their improvement. The importance of this to breeding programme is to increase in the proportion of additive variance and improvement of selection. Therefore, the aim of this present study is to investigate the repeatability estimate of egg quality traits in Pharaoh quail in derived savanna zone of Nigeria.

MATERIALS AND METHODS

Experimental site

The research was carried out at the Poultry unit of Teaching and Research Farm Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. Ogbomoso is in derived savanna zone of Nigeria and lies within the latitude 8^0 15^1 North and longitude 4 ^{0} 15^1 East. The area has an annual rainfall of 1247mm with altitude between 300 and 600 meter above the sea level while the mean annual temperature is about 27 ^{o}C (Amao *et al.*, 2011).

Experimental animals and management

200 Japanese quail were purchased at day old from reputable farm. The poultry house was then washed and disinfected by the use of Izal and Diazintol. Wood shaving was then spread on the floor and drinkers and feeders provided in the poultry house before bringing in the birds. The birds were fed a ration containing 28% crude protein and 2800kcal/ME/kg at age 0 – 4weeks, 24% crude protein and 2800kcal/ME/kg at 4 – 8 weeks and 18% crude protein and 2700kcal/ME/kg at 8 weeks till the experiment was terminated. The birds were fed *ad-libitum* and given clean, cool and good water throughout the experiment. Also, multi – vitamin was given to them at every first week of each month to ease them off stress.

Data collection

The egg collection was twice daily at (9.00am and 5.00pm), respectively and a digital scale was used to measure the weight of each egg laid. 60 eggs were picked at random at week 1, 2, 3, 4, 5, and 6 for the estimate of repeatability. External egg traits are studied include: egg weight (g), shell weight (g), Shell thickness (mm), egg length (mm), egg breadth (mm) and haugh unit. Haugh unit was determined using the formula HU = 100 log ($H+7.51w^{0.37}$) while the internal egg traits examined are Yolk weight (g), Yolk length (mm), Yolk height (mm), Albumen weight (g), Albumen height (mm) and Yolk index.

Statistical analysis

The data collected were subjected to one way analysis of variance using general linear mode of SAS (2003). The following model was adopted.

Repeatability estimate using the following expression

$$R = \frac{\delta^2_R}{\delta^2_B + \delta^2_W}$$

Where

δ^2_B = variance component due to difference among individual bird

δ^2_W = error variance component within flock

The standard error will be calculated using the formula described by Becker (1984)

$$\left(\frac{2(1-R^2)(1+(K-1)R^2)}{K(K-1)(n-1)}\right)$$

K= Number of record per bird

N= Number of birds

R= Repeatability

Table 1: Repeatability estimates of external egg quality trait in quail eggs.

Age (Wk)	EW	EL	ST	SL	HU
1	0.76(0.02)	0.94(0.031)	0.60(0.01)	0.70(0.002)	0.71(0.006)
2	0.79(0.003)	0.95(0.004)	0.70(0.001)	0.60(0.003)	0.72(0.005)
3	0.83(0.001)	0.96(0.030)	0.73(0.002)	0.52(0.004)	0.74(0.004)
4	0.84(0.003)	0.98(0.002)	0.80(0.020)	0.71(0.003)	0.76(0.003)
5	0.85(0.004)	0.99(0.001)	0.70(0.002)	0.80(0.003)	0.80(0.003)
6	0.87(0.034)	0.99(0.003)	0.73(0.032)	0.80(0.034)	0.85(0.003)

EW = Egg Weight (g), EL = Egg Length (mm), ST = Shell Thickness (mm), SL = Shell Length (mm), HU = Haugh Unit

Table 2: Repeatability estimate of internal egg quality traits in quail eggs

Age (Wk)	YW	AW	YI	AI
1	0.70(0.003)	0.82(0.004)	0.72(0.040)	0.68(0.040)
2	0.74(0.004)	0.85(0.001)	0.75(0.030)	0.70(0.032)
3	0.76(0.001)	0.86(0.002)	0.76(0.004)	0.80(0.034)
4	0.78(0.003)	0.86(0.003)	0.77(0.003)	0.82(0.040)
5	0.82(0.003)	0.86(0.002)	0.80(0.002)	0.85(0.003)
6	0.84(0.004)	0.92(0.003)	0.82(0.003)	0.80(0.034)

YW = Yolk Weight (g), AW= Albumen Weight (g), YI = Yolk Index, AI = Albumen Index and Standard Error in bracket.

Table 3: Variance component and repeatability estimate of egg quality traits in quail eggs.

Parameters	δ^2_B	δ^2_W	R	SE
EW	0.0002	0.0142	0.972	0.0001
EL	0.003	00.0146	0.961	0.5800
ST	0.0500	0.0800	0.950	0.0080
SL	0.0840	0.6850	0.880	0.0050
HU	0.0010	0.6843	0.990	0.0010
YW	0.0150	0.5800	0.960	0.0320
YI	0.0106	0.6150	0.900	0.0350
AW	0.0002	0.0112	0.910	0.3200
AI	0.0031	1.0049	0.857	0.0040

EW = Egg Weight (g), EL = Egg Length (mm), ST = Shell Thickness (mm), SL = Shell Length (mm), HU = Haugh Unit, YW = Yolk Weight (mm), YI = Yolk Index, AW = Albumen Weight (mm), AI = Albumen Index, δ^2_B = Variance between birds, δ^2_W= Variance within birds, R = Repeatability, SE = Standard Error.

Increasing in accuracy based on repeated record will be compare with selection single record as described by Lush (1945)

$$\left(\frac{k}{1+(k-1)R}\right)^{0.5}$$

Where, K= the number of record per bird
R= repeatability.

RESULTS

Table 1 shows the repeatability estimate of the external egg quality traits in quail birds. The repeatability estimates of these external traits for 1, 2, 3, 4, 5, 6 weeks laying periods were high. Egg weight (EW) values ranged from 0.76 to 0.87, Egg length (EL) values ranged from 0.94 to 0.99, Shell thickness (ST) varies from 0. 60 to 0.80, Egg breadth (EB) values ranged from 0.52 to 0.80 and haugh unit (HU) values varies from 0.71 to 0.85. Generally the estimate of repeatability values ranged from 75 – 100% for the variables measured traits. Repeatability of Egg weight, Egg length, Shell thickness and Egg breadth and Haugh unit increased linearly with the laying age.

The repeatability estimate of the internal egg quality trait in quail birds were shown in Table 2. The repeatability estimate of these internal egg traits for 1, 2, 3, 4, 5 and 6 weeks laying period were also high. Yolk weight (YW) values ranged from 0.70 to 0.84, Yolk index (YI) from 0.72 to 0.82, Albumen weight (AW) from 0.82 to 0.92 and Albumen index (AI) from 0.68 to 0.85. Generally the estimated repeatability values for internal egg quality trait ranged from 0.70 to 0.92 for the parameter measured. Repeatability of Yolk weight, Yolk index, Albumen weight increased also as the age of the bird's increases except for Albumen index (AI) (R^2= 50%).

Table 3 reveals the variance components and repeatability of egg traits quality in quail birds at week 1, 2, 3, 4, 5, and 6 laying period. The value for δ^2_B(Variance component due to difference among individual bird) ranged from 0.0002 to 0.050 for all variables. The δ^2_W (Error variance component within flock) varied from 0.0142 to 1.0049. The repeatability estimates for the variables were also high ranging 0.85 to 0.97.

DISCUSSION

The pattern of variation in both external and internal egg quality trait for repeatability estimate for quail were in line with the findings of Akpa *et al.* (2008). These researchers reported high repeatability estimates for egg quality trait in Japanese quail. The high repeatability estimate varying from 0.50 to 0.99 of the measured parameters in this present study were in agreement with the work of Sooncharen and Edwards (1989) with the exception of shell membrane thickness at 12 weeks, which was low at 0.33. The application of high repeatability is that fewer records will be required to characterize the inherent transmitting ability of individuals. These led to some savings in the cost of collecting additional data. These observations on the present study were grossly not in line with findings of many authors like Chineke (1999), Ansah *et al.* (1985), Bennerwitz *et al.*(2007) and Ojedapo *et al.* (2007). All these authors observed values that were generally low for repeatability estimate. This may due to the attributed influence of environmental and age related factors (Falconer, 1989) and due to different species of poultry involved. These authors report were on pullets or layers and not on quail birds.

The linear increase of Egg weight, Egg length, Shell thickness, Egg breadth, Haugh unit, Yolk weight, Yolk index, Albumen weight and Albumen index values reveals an indication that repeatability estimate increases as all the variables increases. This also implies that there would be an age at which repeatability in these traits is optimum

and at this optimum repeatability age that the prediction of most probable transmitting ability on individuals for the traits under consideration for selection purpose is best done.

Conclusion

The results from this present study reveals the repeatability estimates of egg quality traits in quails were high and the repeatability of the traits increased as the laying period progressed, thus indicating progressive maternal influence on these traits with advance in age and a fewer records were needed in characterizes the ability of the quail.

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