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Repeatability estimates of body weight and shank length in Japanese quail *(Coturnix coturnix Japonica)*

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***Target Audience:** Animal breeders, animal geneticists, academia, researchers.*

Abstract

Weekly body weight and shank length records of 2,591 quails were used to estimate the repeatability of body weight and shank length in Japanese quail (Coturnix coturnix japonica). Variance components between individual quails, error variance among the quails and standard error were computed using Microsoft Excel computer package. The results showed that average body weight of quail ranged from 7.482g at hatching to 203.508g (Seventh week) while the shank length ranged from 1.424cm at hatch to 3.619cm (Seventh week). The result showed that Japanese quails had high repeatability estimate at all weeks of age for the body weight ranging from 0.929 to 0.989. Similarly, the repeatability of body weight gain ranged from 0.753 to 0.883. Also, the repeatability estimates for shank length at all weeks of age were also high ranging from 0.879 to 0.997. The repeatability estimates for shank length increment ranged from low estimate value of 0.0968 at the 2nd week of age to high value of 0.713 at the 7th week of age. In conclusion, the result showed that fewer records are required to characterize body weight and shank length growth performance potential of Japanese quail and that Japanese quails can be selected for these growth performance traits at early stages of their life.

***Keywords:** Japanese quail, Repeatability, Body weight, Shank Length.*

Description of Problem

Japanese quail *(Coturnix coturnix japonica)* is the smallest avian species being kept for meat and egg production and their sexual maturation is rapidly accomplished and turnover of generations is rapid (1). They produce about 250-270 eggs per year, resistant to most poultry diseases and represent a viable poultry enterprise for smallholder rural farmers (2). However, Japanese quail is a relatively novel poultry stock in Nigeria (3) and has not been widely kept like chickens, turkeys and guinea fowl. The merits of these birds over other popular poultry stocks in the tropical environment can be adequately utilized to improve the protein intake of Nigerians by incorporating appropriate genetic improvement methods for their growth performance traits. The genetic parameters such as repeatability for these traits could guide breeders in designing appropriate breeding plan for this poultry species.

Repeatability, as a genetic parameter, is an important concept derived from quantitative genetics theory that describes the degree to which variation within individuals contributes to total variation in a population and it measures the degree of association between records in the same animal for traits expressed more than once in an animal life (4). It can also be expressed as the ability of an animal to repeat current performance in successive records. Its usual genetic application has been to set an upper limit on heritability and it can be used to

indicate whether efforts to measure heritability are likely to be worthwhile (4). In order to establish a breeding program for quail, it is essential to estimate genetic parameters for the traits to be improved. The scale of the genetic parameters could show the amount of improvement by selection. Knowledge about genetic parameters such as repeatability can help the breeder to predict future performance of the birds that are meant for genetic evaluation studies. Some of the estimated genetic parameters for various traits of domestic Japanese quail were reported by several foreign researchers (5, 6 and 7). But scanty information is available on the genetic parameters of economic traits of Japanese quails in Nigeria. (8**).** The objective of this study, therefore, was to estimate repeatability of body weight and shank length of Japanese quails.

Materials and Method

The data used for this study were secondary data obtained from an experiment conducted at the Quail Unit of Centre Songhai, Port-Novo, Benin Republic. Body weight (BW) was measured from day old to seven weeks of age on weekly basis using a KERRO® electronic compact scale (model number BL50001) with accuracy 0.01g while Shank length (SL) was measured using a measuring tape n a weekly basis from day old to seven weeks of age.

Data collection

Body weight and shank length records of 2,591 birds were used for this study which consisted of 20,728 records for each trait considered. Weekly body weight gain was calculated as the difference between the weekly body weight recorded and the weekly body weight recorded in the preceding week. Similarly, the weekly shank length increment was calculated as the difference in the weekly shank length recorded and the shank length recorded in the preceding week.

Data Analysis

The data obtained were subjected to statistical analysis using the following model as described by (9) to generate the variance components.

$Y_{km} = \mu + \alpha_k + e_{km}$

Where:

Y_{km}= The m^{th}record of the k^{th} bird

μ = Overall mean

α_k = Effect of the k^{th} bird

e_{km} = Random error

The variance components due to difference between individual quails and within individual component of variance were generated using (10). The repeatability estimate was calculated using the following expression:

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

Where, R= Repeatability estimate; $\sigma^2{}_B$= variance component due to difference among individual quail; $\sigma^2{}_W$= Within individual component of variance (or error variance)

The standard error was calculated using the formula described by (9) as follows;

$$SE = \frac{\sqrt{2(1-R^2)(1+(K-1)R)^2}}{k(k-1)(n-1)}$$

Where SE= Standard error; k=Number of measurements; n= Number of birds; R= Repeatability.

Results

Means of body weight and shank length

The means of body weight, body weight gain, shank length and shank length increment as well as their standard error of the means at different ages from day old to the seventh week are presented in Table 1. The mean body weight ranged from 7.482g at day old (0 week) to 203.508g at the 7th week of age while the mean shank length ranged from 1.418 cm at day old (0 week) to 3.608 cm at the 7th week of age. The mean body weight and shank length increased progressively as the age of the

bird increased and therefore indicated a dependency of body weight and shank length on age and that there was a direct positive relationship between the age of the birds and the growth performance traits being considered.

The body weight gain ranged from 12.106g at the 1st week to a peak value of 36.092g at the 7th week of age. Similarly, the means of weekly shank length increment of Japanese quail ranged from minimum value of 0.198cm at the 6th week to a maximum value of 0.502cm at the 3rd week of age. The weekly body weight gain and shank length increment did not increase progressively with the age of the birds implying a non-linear relationship between the age of the birds and the gain in body weight and shank length increment of the birds.

Table 1: Means and standard errors of body weight and shank length of quails at different ages

Age (Weeks)	Body weight (g) ±SE	Shank length (cm) ±SE	Bodyweight gain (g)±SE	Shank length increment (cm) ±SE
0	7.482±0.0153	1.418 ±0.00177	-	-
1	19.588±0.063	1.775±0.00190	12.106 ±0.582	0.357 ±0.00161
2	39.759±0.116	2.173±0.00200	20.172 ±0.752	0.398 ±0.00185
3	74.958±0.157	2.675±0.00195	35.198 ±0.110	0.502 ±0.00195
4	101.745±0.171	2.989 ±0.00152	26.787 ±0.104	0.314±0.00141
5	133.869±0.157	3.206 ±0.00138	32.125 ±0.0912	0.217±0.000930
6	167.416±0.181	3.404 ±0.00144	33.547 ±0.915	0.198±0.000820
7	203.508±0.194	3.608 ±0.00141	36.092 ±0.114	0.204±0.000910

SE=standard error of the means

Repeatability of Body weight and shank length of Japanese quail

Repeatability estimates and estimated variance components of body weight and shank length of Japanese quails at weeks 1, 2, 3, 4, 5, 6 and 7 are presented in Tables 2 and 3 respectively. The repeatability estimates for body weight were high at all weeks of age ranging from 0.929 at 1st week to 0.989 at 7th week of age. For the shank length, all repeatability estimates were also very high and they ranged from 0.879 at 1st week to 0.997 at 6th week of age. The repeatability estimates for these growth performance traits increased progressively from the first week to the seventh week implying that Japanese quails have ability to repeat their outstanding performance and maintain ranking in successive records for body weight.

Table 2: Variance components and repeatability estimates for body weight in Japanese quail

Age (Weeks)	σ^2_B	σ^2_w	R	SE
1	73.27	5.55	0.929	0.0140
2	265.87	15.375	0.945	0.0107
3	871.08	27.5	0.969	0.00775
4	1532.40	37.153	0.976	0.0215
5	2434.7	41.58	0.983	0.00551
6	3589.44	47.82	0.987	0.00477
7	5051.00	54.00	0.989	0.00435

σ^2_B = Variance component due to difference among individual quails; σ^2_w = Error variance component within quails; R= Repeatability estimate; SE= Standard error

Table 3: Variance components and repeatability estimates for shank length in quail

Age (Weeks)	$\sigma^2{}_B$	$\sigma^2{}_w$	R	SE
1	0.0637	0.00877	0.879	0.0177
2	0.143	0.00930	0.934	0.0118
3	0.290	0.00945	0.968	0.00786
4	0.409	0.00874	0.979	0.00626
5	0.494	0.0082	0.982	0.0212
6	3.380	0.00780	0.997	0.00232
7	0.63	0.00745	0.988	0.00321

$\sigma^2{}_B$ = Variance component due to difference among individual quails; $\sigma^2{}_w$ = Error variance component within quails; R= Repeatability estimate; SE= Standard error

Repeatability of Body weight gain and shank length increment in Japanese quail

Repeatability estimates and estimated variance components of body weight gain of Japanese quails at weeks 2, 3, 4, 5, 6 and 7 are presented in Tables 3 and 4 respectively. All the values of repeatability for body weight gain were high at all weeks of age and they ranged from 0.753 at 2nd week to 0.883 at 3rd week of age. The repeatability estimates for shank length increment ranged from low value of 0.0968 at 2nd week to medium value of 0.458 at the 4th week and high values in later life. This indicated that Japanese quail can be selected at early stage of growth for body weight gain. Also, current performance exhibited at early stage of life has high propensity of being repeated in later life. It also showed that fewer records are required to estimate the body weight gain potential of these birds. However, the high repeatability estimate values from the 5th to 7th week of age indicate that Japanese quail should be selected for shank length increment from the 5th week of age to the 7th week of age so as to realize high expected selection response.

Table 4: Variance components and repeatability estimates for body weight gain in quail at different ages.

Age (Weeks)	$\sigma^2{}_B$	$\sigma^2{}_w$	R	SE
2	35.52	11.70	0.753	0.0228
3	137.35	18.25	0.883	0.0147
4	96.18	20.67	0.823	0.0158
5	86.79	20.85	0.806	0.0186
6	80.82	20.99	0.794	0.0154
7	80.07	22.84	0.778	0.0153

$\sigma^2{}_B$= Variance component due to difference among individual quails; $\sigma^2{}_w$ = Error variance component within quails; R= Repeatability estimate; SE= Standard error.

Table 5: Variance components and repeatability estimates for shank length increment in Japanese quail at different age.

Age (Weeks)	σ^2_B	σ^2_w	R	SE
2	0.000835	0.00778	0.0968	0.0205
3	0.00561	0.00847	0.398	0.0187
4	0.00645	0.00764	0.458	0.01693
5	0.0109	0.00656	0.625	0.01698
6	0.0131	0.00575	0.695	0.0164
7	0.0132	0.00530	0.713	0.0159

σ^2_B= Variance component due to difference among individual quails; σ^2_w = Error variance component within quails; R= Repeatability estimate; SE= Standard error.

Discussion

This present study on repeatability of body weight were in agreement with the report of (3) who reported high repeatability estimate for body weight and egg quality traits of Japanese quail at 12 and 28 weeks of age. They reported 0.92 for body weight at 12 weeks of age and 0.99 at 28 weeks of age. The high repeatability estimates were also consistent with the report of (11) who reported high repeatability estimate that ranged from 0.88 to 0.98 and also with the report of (12) who reported that Anak 2000 strain, Ross and Shavers strain of exotic broilers had a very high repeatability estimate for body weight that ranged from 0.98-0.99 for body weight at weeks 2, 4, and 6 which was close to the upper bound of repeatability value. Similarly, (12) reported repeatability estimate of shank length for Anak 2000 strain to be 0.50, 0.92 and 0.83 at 2, 4 and 6 weeks respectively, Ross strain to be 0.91, 0.94 and 0.92 at 2, 4 and 6 weeks. However, the values were in contrast to the low repeatability estimates of 0.332, 0.032, 0.451 and 0.384 reported by (13) at 2, 4, 6 and 8 weeks, respectively, for Marshal broilers. However, the results of this study were in contrast with the findings of (14) that reported lower values for shank length for local chickens at 4 weeks of age.

The results on the means of body weight and body weight gain showed an increase in the live body measurements as the birds matured, indicating a direct positive relationship between live body weight and age. High repeatability estimates obtained for body weight, body weight gain, and shank length showed that fewer records are required to estimate the potential of these birds for growth performance and to realize a high response to selection (4). Similarly, the high repeatability estimate obtained indicated large influence of additive genes on these growth performance traits (15). Japanese quails can also be selected for these growth performance traits at early stage. All repeatability estimates obtained for shank length increment of Japanese quail at early stage of growth (2-4 weeks) were low whereas all estimates obtained at later stages of growth (5-7 weeks) were high. The low repeatability estimates obtained for shank length increment from the 2nd to the 4th week of age showed that selection for shank length increment should be done from the 5th to 7th weeks of age so as to realize high response to selection and more records might be needed to evaluate the shank length increment potential of Japanese quails (4).

Conclusion and Applications

1. Results of the analysis showed that body weight, shank length and body weight gain had high repeatability estimates at all weeks of age while the repeatability estimates for shank length increment were low from 2nd to 4th week of age.

2. High repeatability estimates indicated high performance potential with higher accuracy and hence selection decisions can be initiated without recourse for further record. It also indicated that fewer records are needed to evaluate the body weight and shank length of Japanese quail. It was therefore recommended that Japanese quails can be selected for these growth performance traits at early stages of their growth.

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