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Heritability and repeatability estimates of growth traits in FUNAAB Alpha and Noiler chicken genotypes

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Target Audience: *Poultry breeders, poultry farmers, commercial broiler producers*

Abstract

Genetic improvement of animals has greatly been encouraged as it has proved very efficient in improving productivity, health status and general management of animals. Hence, this research on heritability and repeatability of growth traits of FUNAAB Alpha and Noiler chickens. The study lasted for eighteen weeks and growth data were collected on weekly basis. Four hundred (400) day-old chicks, with 200 a piece for the two chicken genotypes were generated from parent stocks (5 cocks and 25 hens per genotype) with good pedigree data. Growth data were analysed using Generalized Linear Model of SAS and least significant difference (LSD) test was used to separate significant means. Computed variances and covariances of Generalized Linear Model of SAS were used to estimate heritability and repeatability of growth traits of interest. Noiler chicken genotype had a better body weight and linear body measurements from week ten to eighteen. Noiler male chickens were superior in all traits considered from week twelve to eighteen for genotype by sex interaction. Heritability and repeatability estimates were generally high in both chicken genotypes for all traits at the early stage while a decline was observed at the late stage. The highest heritability estimates for body weight observed at week seven in Noiler chicken and all linear body measurements (body circumference, breast girth, shank length, thigh length and wing length) observed at weeks 4, 12, 4, 2 and 4, respectively in FUNAAB Alpha is an indication that breeders can select for these traits at the aforementioned weeks.

Keywords: *Chicken, genotype, growth traits, heritability, repeatability*

Description of Problem

In Nigeria, indigenous poultry breeds development started in 1994 with initial characterisation of genetic resources sourced all over South-Western Nigeria. Data accumulated for a period of 16 years at the Federal University of Agriculture, Abeokuta (1, 2, 3, 4, 5, 6, 7, 8) suggested that indigenous poultry breed development is a feasible proposition and should be encouraged. Through crossbreeding and intensive selection over 10 generations, the FUNAAB-Alpha chickens were developed at the Poultry Breeding Unit of the Directorate of the University Farms, Federal University of Agriculture, Abeokuta, Ogun State in Nigeria for improved meat and egg production without compromising the adaptation to tropical climate and diseases.

There are two types of the FUNAAB Alpha chickens; the egg type and the meat type. The egg type is a dual-purpose which was developed through a rigorous, systematic selection and breeding of the Nigerian indigenous chicken without eroding their tropical adaptive features and disease-resistance traits. They are phenotypically the same in terms of plumage colours with normal feather, frizzle feather and naked neck Nigerian indigenous chickens (9). The average chick weight at hatch is between 30 and 35 g, age at first lay ranged between 18 and 21 weeks, average body weight at first lay is between 1200 g and 1800g, and weight of first egg at lay is between 35 – 40 g. The average egg lay per year ranges between 200 and 250 eggs. Meanwhile, the meat / broiler type is a two-way cross (50% indigenous and 50% exotic) between selected FUNAAB Alpha and the exotic broilers. The plumage colour varied from white to ash with average body weight of 35- 42 g at hatch. The average body weight at 18 weeks varied from 1200 to 1600 g (9), and 1800 g by (10) compared to an average weight of 1300 g of the unselected indigenous chickens.

On the other hand, the Noiler chicken is a dual-purpose breed of chicken developed in Nigeria by Amo Farm Sieberer Hatchery. It is a hybrid chicken produced after successfully crossing a male broiler with an exotic pullet (11). Unlike broiler chickens, Noiler chickens come in varying colours; black, white, yellowish, brown and grey patches. The chickens are fast-growing, consume more feed than other breeds but are good converters. Aside their fast-growth rate, they can survive on free-range and can thrive well on forage, kitchen waste, farm by-products to produce good quality meat and egg. Hence dual-purpose bird with following characteristics; Hardiness, high resistance to common diseases, heat tolerance, low input-feed cost, and produce tougher meat than broiler birds.

Apart from upgrading of indigenous chicken through crossbreeding, genetic improvement can also be achieved through selective breeding. In most species of livestock, vast changes in performance have occurred over recent decades. A major part of this change is genetic, produced by selection between and within populations (12). This method has been used to develop the high-yielding exotic breeds and hybrids (13). However, selection is dependent on the presence of sufficient genetic variation for a given trait in a population. The general improvement direction is described as a breeding objective that answers the question ‘where we want to go’ (14). Genetic improvement programmes are based on accurate estimates of variance components and genetic parameters for economically-important traits described in the breeding objective on which selection and mating decision are made (14).

Heritability is one of the major genetic parameters expresses the phenotypic value as a guide to the breeding value, or the degree of correspondence between phenotypic value and breeding values. Furthermore, heritability enters into almost every formular connected with breeding methods, and many practical decisions about procedure depends on its magnitude. Another important estimate is repeatability. (15) defined repeatability as the proportion of the total variance in multiple measurement of a trait that is due to differences among individuals. According to (16), Repeatability refers to the variability in repeated measurements in which some factors are considered constant.

Repeatability is of importance in the profitability of the poultry industry, the magnitude of repeatability estimates gives an indication of the extent to which selection applied at any stage will affect subsequent flock performance (17). However, this will help breeders to organise the optimum combination for maximum economic returns (18).

Materials and Methods

Experimental site

The research was conducted at the Poultry Breeding Unit of the Directorate of University Farms (DUFARMS), Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. Located on latitude 7°10’N and 3°2’E in Odeda Local Government Area, Ogun State, Nigeria (19). The vegetation represents a tropical climate region with an average rainfall of 1100 mm, a mean temperature of about 34°C and a yearly average relative humidity of 82% (20).

Experimental birds

The sample size for this experiment was

600 birds. Two hundred pure line day-old chicks comprising 100 each of two chicken genotypes (FUNAAB Alpha and Noiler) were procured from two reputable hatcheries (Abeokuta in Ogun State and Awe in Oyo State). Each genotype was housed in a separate deep litter pen at day-old and the birds were individually tagged for identification purpose. Brooding was done for three weeks and the duration of the experiment lasted for 18 weeks by adhering strictly to the standard management routine practices as described by (20).

Superior stocks based on body weight were selected from among the initial 200 chickens raised for 18 weeks. Five (5) cocks and twenty-five (25) hens each of FUNAAB Alpha and Noiler chickens were selected in ratio 1:5 to generate 200 chicks each of the chicken genotypes. The selected parent stocks were raised till 22 weeks to attain sexual maturity before artificial insemination was carried out.

Semen collection and artificial insemi-nation

The cocks were trained for semen collection for four weeks using abdominal massage technique (6) from the 19th to 22nd week. Semen collection was done thrice a week (every other day) and each hen was inseminated thrice a week throughout the period.

The semen collected from the cocks was artificially inseminated into the oviduct of the hen and fertile eggs were collected and labelled according to the chicken genotypes. Hatchable eggs were stored in a cool room of 20 to 25^{o}C and 80% relative humidity for five days to get an appreciable number of fertile eggs before being transferred to the hatchery. The eggs were set in the incubator and fertility was determined after candling on the 18th day. Selection of two hundred each of the chicken genotypes from the pool of eggs set was carried out to generate the chicks after 21 days of setting.

Management of chicks

Intensive system of management was adopted for the research while the pen houses were thoroughly disinfected before the arrival of day-old chicks, wood shavings were evenly spread on the floor and heat source was provided through high voltage bulbs and charcoal heated coal pots were provided as alternative source of heat for the chicks. Feeders and drinkers were made available in right number to prevent unnecessary competition among the flock. The generated chicks were raised for twelve weeks during which their productive performance was recorded and compared weekly.

Biosecurity measures

At the entrance of the poultry house, a foot bath was placed in order to prevent virulent pathogenic microbes. Biosecurity measures were ensured in the pens and there was restricted entry of visitors in the brooding house to prevent disease outbreak. Also, the litter was changed every week to prevent bad odour and wet litter which could lead to bacterial build-up within the pens. All these were ensured for proper hygiene.

Feed and feeding

The birds were fed *ad libitum* with a commercial broiler starter feed containing 23% crude protein and 2840 kcal/kg metabolisable energy (ME) from day-old to 6 weeks, and later fed with commercial feed containing 19% crude protein and 2875 kcal/kg ME from 6 to 18 weeks of age. The birds also had access to clean and cool drinking water *ad libitum*.

Data collection

The body weights of the birds were determined on weekly basis from week 1 to 18 with a sensitive scale (Camry IS09001 Dial Spring Scale) calibrated to 5 kg. Biometric data (body circumference, breast girth, shank length, thigh length and wing length) were measured weekly using a measuring tape as described by (21). The birds were sexed using the natural secondary characteristics at week 10.

Genetic parameter estimates

Genetic parameters (heritability and repeatability) were estimated from the following growth parameters (body weight, body circumference, breast girth, shank length, thigh length and wing span).

Growth performance evaluation

- Body weight (g): A sensitive scale was used to determine individual bird's weight.
- Body circumference (cm): The circumference of the bird's body was measured from the back to the chest region.
- Breast girth (cm): The measurement of the chest circumference around the deepest region (hind breast).
- Shank length (cm): length from the hock joint to the tarsometatarsus of any leg.
- Thigh length (cm): The thigh length was taken at the distance between the hock joint and the pelvic joint (22).
- Wing length (cm): This was measured from the distance between the tip of the phalanges and the coracoid-humerus joint.

Analysis of growth data

Growth data was subjected to a factorial experiment and analysed using the Generalized Linear Model of (23) and the model used is of the form:

$Y_{ijk} = \mu + G_i + S_j + (GS)_{ij} + \varepsilon_{ijk}$

where,

Y_{ijk} = Observation made on traits of interest (body weight, body circumference, breast girth, shank length, thigh length and wing length)

μ = Overall estimate of the population mean.

G_i = Fixed effect of the i^{th} genotype of chickens (i = FUNAAB Alpha, Noiler)

S_j = Fixed effect of the j^{th} sex of chickens (j = Male, Female)

$(GS)_{ij}$ = Fixed effect of the interaction between genotype and sex

ε_{ijk} = Random error associated with each measurement.

Least significant difference (LSD) test was used to separate the means to ascertain if there were significant differences among genotypes.

The Generalized Linear Model of SAS was used to estimate the variances and covariances of heritability and repeatability using the formulae below:

Heritability (h^2): This was calculated from sib analysis using the formular:

$$h^2 = \frac{2\delta_s^2 + 2\delta_D^2}{\delta_S^2 + \delta_D^2 + \delta_W^2} \quad (23).$$

Repeatability:

$$R = \frac{\sigma_b^{\ 2}}{\sigma_b^{\ 2} + \sigma_w^{\ 2}} \quad (23).$$

Results

The effect of genotype and sex on body weight and linear body measurements of the two chicken genotypes (FUNAAB Alpha and Noiler) at weeks 2, 4 and 6 are presented in Table 1. There is significant ($P<0.05$) effect on genotype and sex on the linear body measurement considered. The results revealed that Noiler chickens performed better when compared with FUNAAB Alpha chickens at weeks 2. Both chicken genotypes had good early start in life but Noiler was superior at week 2. The two chicken genotypes recorded progressive weights as they advance in age though, weeks 4 and 6 were not significantly ($p>0.05$) different. An increasing weight differential was observed for sex, as the males were significantly ($p<0.05$) superior to the female counterparts in terms of body weight by a difference of 7.56 g, 59.94 g and 64.26 g at weeks 2, 4 and 6 respectively.

Table 1: Effect of genotype and sex on the body weight and linear body measurements of two chicken genotypes at weeks 2, 4 and 6 (LSM±SE)

AGE (Week)	Genotype / Sex	BW (g)	BC (cm)	BG (cm)	SL (cm)	TL (cm)	WL (cm)
2	FUNAAB Alpha	155.05±2.14^{b}	15.81±0.11^{b}	9.25±0.06^{a}	4.75±0.04^{a}	7.84±0.06	9.68±0.06
	Noiler	161.08±2.40^{a}	16.90±0.11^{a}	8.17±0.06^{b}	4.55±0.04^{b}	7.94±0.06	9.77±0.06
	Sex						
	Female	154.43±2.34^{b}	16.27±0.13	8.62±0.09	4.62±0.04	7.83±0.07	9.74±0.07
	Male	161.99±2.44^{a}	16.44±0.14	8.80±0.09	4.68±0.04	7.96±0.07	9.74±0.07
4	FUNAAB Alpha	364.85±17.23	22.22±0.32	10.31±0.12^{ab}	5.88±0.05^{b}	10.59±0.10^{b}	13.26±0.19^{b}
	Noiler	355.20±17.23	21.43±0.32	10.64±0.12^{a}	6.31±0.05^{a}	11.26±0.10^{a}	13.85±0.19^{a}
	Sex						
	Female	331.23±20.36^{b}	21.28±0.38^{b}	10.47±0.14	5.95±0.05^{b}	10.77±0.11^{b}	13.13±0.22^{b}
	Male	391.17±21.18^{a}	22.41±0.39^{a}	10.47±0.14	6.25±0.06^{a}	11.09±0.11^{a}	14.02±0.23^{a}
6	FUNAAB Alpha	545.10±8.30	24.51±1.34	11.47±0.17^{b}	7.28±0.08	12.79±0.10^{b}	15.72±0.09^{b}
	Noiler	527.53±8.89	24.97±1.44	12.50±0.18^{a}	7.45±0.08	13.70±0.11^{a}	16.02±0.10^{a}
	Sex						
	Female	506.63±8.99^{b}	24.38±0.16^{b}	11.93±0.17	7.11±0.08^{b}	13.09±0.11	15.57±0.09^{b}
	Male	570.89±9.52^{a}	25.12±0.17^{a}	11.97±0.18	7.64±0.09^{a}	13.35±0.11	16.17±0.10^{a}

[a, b] Means on the same column for each parameter with different superscripts are significantly different ($p<0.05$)
BW = Body Weight, BC = Body Circumference, BG = Breast Girth, SL = Shank Length, TL = Thigh Length and WL = Wing Length

Linear body measurements result at week 2 revealed that, FUNAAB Alpha had higher ($p<0.05$) least squares means for breast girth and shank length when compared with Noiler chickens, while for body circumference, Noiler was significantly better. At week 4, Noiler significantly performed better than FUNAAB Alpha in all linear body measurements and replicated similar pattern of superiority in breast girth and thigh length at week 6. The result of sex showed that males were superior ($p<0.05$) to their female counterparts in all linear body measurements considered at weeks 2, 4 and 6.

Table 2 shows the least squares means for body weight as affected by genotype and sex of the two chicken genotypes at weeks 8, 10 and 12. It was observed that there was no significant ($p>0.05$) difference in the body weight of the two chicken genotypes at weeks 8 and 10 but Noiler was significantly ($p<0.05$) higher body weights than FUNAAB Alpha chickens at week 12 with an average mean difference of 72 g. The males of these genotypes were significantly superior to the female counterparts with respect to body weight at weeks 8, 10 and 12 by a difference of 123.38 g, 193.72 g and 243.77 g, respectively.

Table 2: Effect of genotype and sex on the body weight and linear body measurements of chickens at weeks 8, 10 and 12 (LSM±SE)

AGE (Week)	Genotype / Sex	BW (g)	BC (cm)	BG (cm)	SL (cm)	TL (cm)	WL (cm)
8	FUNAAB Alpha	840.39±12.71	28.83±0.19	11.75±0.22[b]	8.50±0.08[b]	15.18±0.16[b]	18.61±0.14[b]
	Noiler	871.46±13.60	29.32±0.21	14.06±0.24[a]	8.88±0.08[a]	15.99±0.17[a]	19.11±0.15[a]
	Sex						
	Female	796.73±13.34[b]	28.35±0.20[b]	12.66±0.26	8.41±0.07[b]	15.26±0.12[b]	18.40±0.11[b]
	Male	920.11±14.13[a]	29.86±0.21[a]	13.01±0.27	8.98±0.07[a]	15.89±0.12[a]	19.34±0.12[a]
10	FUNAAB Alpha	1156.08±17.41	32.84±0.19[a]	12.67±0.17[b]	9.49±0.08[a]	16.94±0.12[b]	20.35±0.13[a]
	Noiler	1179.78±18.64	31.43±0.21[b]	15.07±0.18[a]	8.29±0.09[b]	18.13±0.12[a]	18.89±0.14[b]
	Sex						
	Female	1075.85±18.39[b]	31.35±0.21[b]	13.45±0.20[b]	8.54±0.10[b]	17.17±0.13[b]	19.13±0.16[b]
	Male	1269.56±19.48[a]	33.12±0.22[a]	14.17±0.22[a]	9.36±0.10[a]	17.86±0.14[a]	20.27±0.17[a]
12	FUNAAB Alpha	1317.94±20.25[b]	35.24±0.25	13.29±0.13[b]	10.10±0.08[b]	18.49±0.14[b]	21.34±0.20
	Noiler	1389.33±21.68[a]	34.80±0.26	14.48±0.14[a]	10.89±0.08[a]	19.48±0.15[a]	21.58±0.21
	Sex						
	Female	1236.34±21.12[b]	34.11±0.27[b]	13.59±0.14[b]	9.91±0.08[b]	18.34±0.15[b]	20.28±0.21[b]
	Male	1480.11±22.37[a]	36.07±0.28[a]	14.13±0.14[a]	11.09±0.08[a]	19.64±0.16[a]	22.77±0.22[a]

[a, b] Means on the same column for each parameter with different superscripts are significantly different ($p<0.05$)
BW = Body Weight, BC = Body Circumference, BG = Breast Girth, SL = Shank Length, TL = Thigh Length and WL = Wing Length

The results of the linear body measurements considered showed significant ($p<0.05$) difference(s) in mean values based on genotype and sex effects. Noiler chicken genotype attained least squares means values that were significantly superior to FUNAAB Alpha in all the traits considered except body circumference at week 8.

At weeks 10, FUNAAB Alpha had a better ($p<0.05$) BC, SL and WL than Noiler chickens. For BG and TL, Noiler chicken performed better ($p<0.05$) at weeks 10 and 12 with BG and TL values that were significantly superior to FUNAAB Alpha chicken genotypes. The males were significantly superior to their female counterparts in all the linear body measurements considered at weeks 8, 10 and 12.

The results obtained at weeks 14, 16 and 18 for the two chicken genotypes are presented in Table 3. There were significant ($p<0.05$) differences in least squares means between the genotypes and sex. For body weight, both chicken genotype had mean values which increased progressively but with a difference of 39 g, 135 g and 184 g at weeks 14, 16 and 18 respectively in favour of Noiler genotype. Similar progressive pattern of superiority was observed for sex effect during these weeks with males being significantly ($p<0.05$) better than their female counterparts with a difference of 235 g, 322 g and 412 g at 14th, 16th and 18th week of age.

Significant ($p<0.05$) differences were also observed in the results of the linear body measurements considered between sex and genotype. Noiler chicken genotype attained least squares means that were significantly ($p<0.05$) superior to FUNAAB Alpha for all the traits considered except body weight at weeks 14. At weeks 16 and 18 Noiler chicken was also significantly ($p<0.05$) superior to FUNAAB Alpha for all the growth traits except for BC at week 16 and BG at week 18 where there were no significant ($p>0.05$) differences in the values obtained for the two genotypes. Predictably, sex effect showed that, males were better ($p<0.05$) when compared to their female counterparts in all the linear body measurements considered at the afore-mentioned weeks.

Table 3: Effect of genotype and sex on the body weight and linear body measurement of chickens at weeks 14, 16 and 18 (LSM±SE)

AGE (Week)	Genotype / Sex	BW (g)	BC (cm)	BG (cm)	SL (cm)	TL (cm)	WL (cm)
14	FUNAAB Alpha	1572.16±22.37	37.83±0.26[b]	13.26±0.08[b]	10.74±0.09[b]	19.10±0.15[b]	21.67±0.18[b]
	Noiler	1611.24±23.95	42.40±0.28[a]	13.61±0.09[a]	11.20±0.09[a]	20.19±0.16[a]	23.16±0.19[a]
	Sex						
	Female	1479.70±24.04[b]	38.75±0.35[b]	13.18±0.10[b]	10.23±0.07[b]	18.65±0.14[b]	21.36±0.20[b]
	Male	1714.56±25.47[a]	41.32±0.37[a]	13.70±0.10[a]	11.77±0.08[a]	20.67±0.14[a]	23.49±0.21[a]
16	FUNAAB Alpha	1729.71±25.65[b]	39.37±0.23	14.05±0.09[b]	10.86±0.10[b]	19.92±0.15[b]	22.49±0.17[b]
	Noiler	1864.61±27.46[a]	39.02±0.24	14.99±0.09[a]	11.67±0.11[a]	20.91±0.16[a]	24.07±0.19[a]
	Sex						
	Female	1640.89±27.04[b]	37.79±0.21[b]	14.26±0.10[b]	10.35±0.08[b]	18.94±0.12[b]	21.64±0.14[b]
	Male	1962.78±28.64[a]	40.80±0.22[a]	14.75±0.11[a]	12.24±0.09[a]	22.00±0.12[a]	25.00±0.15[a]
18	FUNAAB Alpha	1895.25±27.68[b]	41.75±0.31[b]	14.93±0.09	10.94±0.09[b]	19.93±0.15[b]	22.68±0.18[b]
	Noiler	2079.55±29.64[a]	43.74±0.34[a]	15.16±0.10	11.73±0.10[a]	20.46±0.16[a]	24.02±0.19[a]
	Sex						
	Female	1787.03±28.01[b]	41.25±0.36[b]	14.55±0.09[b]	10.44±0.08[b]	18.86±0.10[b]	21.72±0.15[b]
	Male	2199.00±29.67[a]	44.28±0.38[a]	15.59±0.10[a]	12.28±0.08[a]	21.66±0.11[a]	25.08±0.15[a]

[a, b] Means on the same column for each genotype with different superscripts are significantly different ($p<0.05$)
BW = Body Weight, BC = Body Circumference, BG = Breast Girth, SL = Shank Length, TL = Thigh Length and WL = Wing Length

Significant ($p<0.05$) differences were observed for genotype and sex interaction on all traits studied (BW, BC, BG, SL, TL and WL) except for thigh length and wing length at week 2 and body circumference at week 6 (Table 4). Noiler male and FUNAAB Alpha male chickens consistently recorded better performance for all the traits of interest from week 2 to 10. Noiler male and FUNAAB Alpha male chickens repeatedly recorded significantly ($p<0.05$) better body weights from week 2 to 10 when compared to the other two interactive groups.

The linear body measurements on the other hand displayed different pattern of superiority among the four interactive groups, for instance, Noiler male and female chickens were significantly ($p<0.05$) superior to FUNAAB Alpha male and female at week 2 for body circumference, while at week 4, 8 and 10 FUNAAB Alpha male and Noiler male were significantly superior to the other two categories. Results obtained for BG showed that FUNAAB Alpha male and female both had significantly ($p<0.05$) superior values to the other two categories at week 2 while at weeks 6, 8 and 10 Noiler male and female were significantly ($p<0.05$) superior to the other two categories.

Table 4: Effect of interaction between genotype and sex on body weight and linear body measurements of chickens at weeks 2, 4, 6, 8 and 10 (LSM±SE)

Genotype	Sex	Dependent variable	Age (Week)				
			2	4	6	8	10
FUNAAB Alpha	Female	BW (g)	151.37±3.01^{bc}	322.55±24.16^{bc}	514.90±11.21^{b}	777.25±16.56^{b}	1066.67±22.03^{b}
FUNAAB Alpha	Male		158.73±3.01^{ab}	407.16±24.16^{a}	575.29±11.21^{a}	903.53±16.56^{a}	1245.49±22.03^{a}
Noiler	Female		157.27±2.90^{ab}	339.27±23.26^{b}	498.20±11.33^{b}	816.60±16.72^{b}	1085.20±22.25^{b}
Noiler	Male		165.53±3.13^{a}	373.83±25.16^{ab}	565.13±12.82^{a}	941.79±18.93^{a}	1301.03±25.20^{a}
FUNAAB Alpha	Female	BC (cm)	15.74±0.16^{b}	21.49±0.45^{b}	23.96±1.91	27.96±0.26^{c}	31.85±0.26^{b}
FUNAAB Alpha	Male		15.88±0.16^{b}	22.95±0.45^{a}	25.06±1.91	29.71±0.26^{a}	33.83±0.26^{a}
Noiler	Female		16.76±0.15^{a}	21.08±0.43^{b}	24.80±1.93	28.74±0.26^{b}	30.84±0.26^{c}
Noiler	Male		17.05±0.16^{a}	21.83±0.47^{ab}	25.19±2.18	30.06±0.30^{a}	32.19±0.29^{b}
FUNAAB Alpha	Female	BG (cm)	9.24±0.10^{a}	10.32±0.17^{ab}	11.26±0.24^{b}	11.49±0.32^{c}	12.11±0.24^{c}
FUNAAB Alpha	Male		9.25±0.10^{a}	10.29±0.17^{ab}	11.68±0.24^{b}	12.00±0.32^{bc}	13.24±0.24^{b}
Noiler	Female		8.05±0.09^{b}	10.61±0.17^{ab}	12.61±0.24^{a}	13.85±0.32^{a}	14.82±0.24^{a}
Noiler	Male		8.30±0.10^{b}	10.67±0.18^{a}	12.36±0.27^{a}	14.33±0.36^{a}	15.38±0.27^{a}
FUNAAB Alpha	Female	SL (cm)	4.71±0.05^{a}	5.68±0.06^{c}	7.06±0.10^{d}	8.19±0.10^{d}	8.96±0.10^{b}
FUNAAB Alpha	Male		4.77±0.05^{a}	6.08±0.06^{b}	7.51±0.10^{b}	8.81±0.10^{b}	10.01±0.10^{a}
Noiler	Female		4.54±0.05^{b}	6.20±0.06^{b}	7.16±0.10^{bc}	8.63±0.10^{bc}	8.12±0.10^{d}
Noiler	Male		4.57±0.05^{b}	6.44±0.06^{a}	7.82±0.12^{a}	9.21±0.12^{a}	8.50±0.12^{c}
FUNAAB Alpha	Female	TL (cm)	7.77±0.09	10.58±0.13^{b}	12.59±0.14^{d}	14.77±0.22^{c}	16.74±0.16^{c}
FUNAAB Alpha	Male		7.91±0.09	10.61±0.13^{b}	13.00±0.14^{c}	15.58±0.22^{b}	17.15±0.16^{c}
Noiler	Female		7.87±0.08	10.95±0.13^{b}	13.61±0.15^{ab}	15.75±0.22^{ab}	17.62±0.16^{b}
Noiler	Male		8.02±0.09	11.61±0.14^{a}	13.81±0.16^{a}	16.31±0.25^{a}	18.78±0.18^{a}
FUNAAB Alpha	Female	WL (cm)	9.73±0.09	13.01±0.26^{b}	15.43±0.13^{c}	18.12±0.19^{c}	19.89±0.18^{b}
FUNAAB Alpha	Male		9.64±0.09	13.51±0.26^{b}	16.00±0.13^{b}	19.10±0.19^{b}	20.80±0.18^{a}
Noiler	Female		9.70±0.08	13.23±0.25^{b}	15.72±0.13^{b}	18.69±0.20^{b}	18.36±0.18^{c}
Noiler	Male		9.85±0.09	14.57±0.27^{a}	16.40±0.15^{a}	19.65±0.22^{a}	19.58±0.20^{b}

$^{a, b, c, d}$ Means on the same column with different superscripts are significantly different ($p<0.05$)
BW = Body Weight, BC = Body Circumference, BG = Breast Girth, SL = Shank Length, TL = Thigh Length and WL = Wing Length

FUNAAB Alpha male and female showed significantly superior SL at weeks 2 and 10 over their Noiler counterparts while at weeks 4, 6 and 8 Noiler male chickens had the best SL among the four interactive groups. Interaction between genotype and sex favoured Noiler males at weeks 4, 6, 8 and 10 when considering TL and WL while at week 10, FUNAAB Alpha male performed best.

Table 5 shows significant ($p<0.05$) genotype and sex interactive effect on all the economic traits of interest considered in this study from week 12 to 18. Noiler male chickens had the best body weight followed by FUNAAB Alpha male while FUNAAB Alpha female consistently recorded the least body weight among the four interactive groups from week 12 to 18.

Table 5: Effect of interaction between genotype and sex on body weight and linear body measurements of chickens at weeks 12, 14, 16 and 18 (LSM±SE)

Genotype	Sex	Dependent variable	Age (Week)			
			12	14	16	18
FUNAAB Alpha	Female	BW (g)	1204.51±24.98^{c}	1472.35±28.62^{c}	1606.47±30.71^{c}	1686.67±30.99^{d}
FUNAAB Alpha	Male		1431.37±24.96^{b}	1671.96±28.62^{b}	1852.94±30.71^{b}	2103.92±30.99^{b}
Noiler	Female		1268.80±25.22^{c}	1487.20±28.90^{c}	1676.00±31.02^{c}	1889.40±31.30^{c}
Noiler	Male		1543.85±28.56^{a}	1770.26±32.73^{a}	2106.41±35.12^{a}	2323.33±35.43^{a}
FUNAAB Alpha	Female	BC (cm)	34.23±0.33^{b}	36.81±0.33^{d}	38.09±0.27^{b}	39.93±0.41^{c}
FUNAAB Alpha	Male		36.25±0.33^{a}	38.85±0.33^{c}	40.65±0.27^{a}	43.57±0.41^{b}
Noiler	Female		34.00±0.34^{b}	40.73±0.33^{b}	37.48±0.27^{b}	42.60±0.41^{b}
Noiler	Male		35.83±0.38^{a}	44.54±0.37^{a}	41.00±0.31^{a}	45.21±0.46^{a}
FUNAAB Alpha	Female	BG (cm)	12.96±0.18^{d}	13.07±0.12^{c}	13.83±0.12^{d}	14.43±0.12^{c}
FUNAAB Alpha	Male		13.62±0.18^{c}	13.45±0.12^{b}	14.26±0.12^{c}	15.44±0.12^{b}
Noiler	Female		14.23±0.18^{b}	13.29±0.12^{bc}	14.69±0.12^{b}	14.67±0.12^{c}
Noiler	Male		14.81±0.20^{a}	14.03±0.14^{a}	15.38±0.13^{a}	15.78±0.14^{a}
FUNAAB Alpha	Female	SL (cm)	9.49±0.08^{d}	9.97±0.08^{d}	9.83±0.09^{d}	9.87±0.07^{d}
FUNAAB Alpha	Male		10.71±0.08^{b}	11.51±0.08^{b}	11.89±0.09^{b}	12.00±0.07^{b}
Noiler	Female		10.34±0.08^{c}	10.49±0.08^{c}	10.88±0.09^{c}	11.01±0.07^{c}
Noiler	Male		11.60±0.10^{a}	12.12±0.09^{a}	12.69±0.10^{a}	12.65±0.08^{a}
FUNAAB Alpha	Female	TL (cm)	17.83±0.18^{c}	18.02±0.18^{d}	18.35±0.12^{d}	18.40±0.14^{d}
FUNAAB Alpha	Male		19.15±0.18^{b}	20.18±0.18^{b}	21.48±0.12^{b}	21.45±0.14^{b}
Noiler	Female		18.85±0.18^{b}	19.30±0.18^{c}	19.53±0.13^{c}	19.32±0.14^{c}
Noiler	Male		20.28±0.20^{a}	21.32±0.20^{a}	22.68±0.14^{a}	21.92±0.16^{a}
FUNAAB Alpha	Female	WL (cm)	20.04±0.24^{b}	20.32±0.22^{d}	20.78±0.15^{d}	20.93±0.16^{d}
FUNAAB Alpha	Male		22.64±0.24^{a}	23.02±0.22^{b}	24.19±0.15^{b}	24.43±0.16^{b}
N						
N						

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$^{a, b, c, d}$ Means on the same column with different superscripts are significantly different (p<0.05)
BW = Body Weight, BC = Body Circumference, BG = Breast Girth, SL = Shank Length, TL = Thigh Length and WL = Wing Length

A significant (p<0.05) difference of 112.48 g, 98.03 g, 253.47 g and 219.41 g was observed between Noiler male and FUNAAB Alpha male chickens that was next in line in superior performance among the interactive groups at weeks 12, 14, 16 and 18 respectively.

A similar trend was observed in all the linear body measurements studied. For body circumference, Noiler male chickens performed best (p<0.05) among the four categories at weeks 14 and 18 while both FUNAAB Alpha male and Noiler male recorded the highest (p<0.05) body circumference at week 12 and 16. Noiler male chickens maintained a significantly (p<0.05) performance for breast girth, shank length and thigh length at weeks 12, 14, 16 and 18 while for wing length, FUNAAB Alpha male and

Noiler male chickens both had significantly ($p<0.05$) superior values to the other two counterparts (Noiler female and FUNAAB Alpha female) at week 12. At weeks 14, 16 and 18 Noiler male chickens had the highest wing length values which were significantly ($p<0.05$) superior to the other three categories.

Table 6: Heritability estimates of growth traits of FUNAAB Alpha and Noiler chicken genotypes from week 1 to 6

Genotype	Week	Trait					
		BW (g)	BC (cm)	BG (cm)	SL (cm)	TL (cm)	WL (cm)
FUNAAB Alpha	1	0.33	0.46	0.02	0.22	0.08	0.19
Noiler		0.45	0.65	0.50	0.25	0.63	0.19
FUNAAB Alpha	2	0.50	0.42	0.34	0.44	0.72	0.31
Noiler		0.50	0.43	0.40	0.47	0.51	0.51
FUNAAB Alpha	3	0.37	0.31	0.55	0.53	0.63	0.06
Noiler		0.48	0.48	0.40	0.46	0.59	0.40
FUNAAB Alpha	4	0.50	0.69	0.19	0.74	0.50	0.78
Noiler		0.16	0.44	0.46	0.14	0.54	0.44
FUNAAB Alpha	5	0.49	0.56	0.22	0.73	0.38	0.64
Noiler		0.39	0.38	0.63	0.56	0.32	0.30
FUNAAB Alpha	6	0.43	0.49	0.35	0.11	0.58	0.03
Noiler		0.42	0.54	0.49	0.20	0.57	0.12

BW = Body Weight, BC = Body Circumference, BG = Breast Girth, SL = Shank Length, TL = Thigh Length and WL = Wing Length

The estimates of heritability (h^2) from week 1 to 12 for the two chicken genotypes (FUNAAB Alpha and Noiler) are presented in Tables 6 and 7. The general overview of h^2 estimates across all traits studied ranged from very low (0.02 for breast girth at week one) to high (0.78 for wing length at week four) in FUNAAB Alpha while in Noiler chicken genotype, it ranged between (0.02 for wing length at week eleven) and (0.72 for thigh length at week eight).

Moderately high h^2 estimates were observed in the two chicken genotypes at the early stage of life (1 to 6 weeks) for body weight while at the late stage (7 to 12 weeks) the estimates ranged from low to moderate with the exception of week 7 (0.65) in Noiler and week 8 (0.55) in FUNAAB Alpha chickens. Higher h^2 estimates were recorded in FUNAAB Alpha from week four to six for body weight which were superior to their Noiler counterparts at those weeks. At the late stage, low h^2 estimate was observed for body weight from week 7 to 12 in FUNAAB Alpha chicken except at week 8 where a moderate h^2 estimate of 0.55 was recorded while in the Noiler chickens, the h^2 estimate for body weight was quite better from week 9 to 11 and it was highest at week 7 with an estimate of 0.65.

The h^2 estimates for body circumference displayed different patterns of classifications, in FUNAAB Alpha the estimate ranged from low to moderate with most of the weeks being low and the lowest was obtained at week 7 with h^2 estimate of 0.04 while for Noiler chicken genotype it ranged from low to high and the lowest was recorded at week 12 with a value of 0.15. Noiler chicken genotype recorded better h^2 estimates for body circumference in most weeks (1, 2, 3, 6, 7, 9, 10 and 11) with the highest value of 0.65 at week one while FUNAAB Alpha recorded better h^2 estimates at weeks 4, 5 and 12 with 0.69 as the highest at week 4.

In most of the weeks considered, Noiler chicken genotype had better h^2 estimates for breast girth with the highest value of 0.67 at week eleven while FUNAAB Alpha had better h^2 estimates only at weeks 3, 10 and 12. The highest h^2 estimates for breast girth from week one to twelve was observed in the FUNAAB Alpha chicken genotype at week twelve with an estimate of 0.69.

Table 7: Heritability estimates of growth traits of FUNAAB Alpha and Noiler chicken genotypes from week 7 to 12

Genotype	Week	Trait					
		BW (g)	BC (cm)	BG (cm)	SL (cm)	TL (cm)	WL (cm)
FUNAAB Alpha	1	0.15	0.23	0.31	0.26	0.53	0.21
Noiler		0.69	0.67	0.68	0.18	0.60	0.03
FUNAAB Alpha	2	0.60	0.54	0.66	0.48	0.85	0.97
Noiler		0.56	0.69	0.71	0.64	0.88	0.55
FUNAAB Alpha	3	0.77	0.62	0.74	0.94	0.75	0.21
Noiler		0.90	0.87	0.62	0.88	0.95	0.79
FUNAAB Alpha	4	0.58	0.77	0.33	0.86	0.48	0.85
Noiler		0.10	0.51	0.88	0.16	0.67	0.84
FUNAAB Alpha	5	0.45	0.65	0.60	0.84	0.44	0.80
Noiler		0.30	0.44	0.58	0.54	0.27	0.35
FUNAAB Alpha	6	0.30	0.45	0.56	0.05	0.73	0.05
Noiler		0.49	0.62	0.67	0.21	0.49	0.12

BW = Body Weight, BC = Body Circumference, BG = Breast Girth, SL = Shank Length, TL = Thigh Length and WL = Wing Length

Considering the h^2 estimates for shank length at the early stage of life, Noiler chicken genotype had better h^2 estimates at weeks 1, 2 and 6 with the highest estimate of 0.47 (moderate) at week two while FUNAAB Alpha recorded better h^2 estimates at weeks 3, 4 and 5 with 0.74 as the highest at week 4 which is also the highest for both chicken genotype from week 1 -12. Estimates for shank length at the late stage of production (7 - 12) showed that FUNAAB Alpha chicken genotype had better h^2 estimates at weeks 8 (0.20 though low), 11 (0.35 moderate) and 12 (0.49 moderate) while Noiler recorded better h^2 estimates at weeks 7 (0.61 high), 9 (0.51 high) and 10 (0.43 moderate).

A similar trend was observed for thigh length at various weeks, FUNAAB Alpha chicken genotype had better h^2 estimates at the early stage of life (2, 3, 5 and 6) with the highest value of 0.72 at week two while Noiler recorded better h^2 estimates at weeks 1 and 4 with 0.63 as the best estimate at week one. The trend in superiority changed at the later stage with Noiler chicken genotype having better h^2 estimates from week 7 to 12, except at week 10. Heritability estimates of 0.72 in FUNAAB Alpha at week 2 and Noiler at week 8 were the best h^2 estimate for thigh length from week 1 to 12.

The h^2 estimates for wing length ranged from low to high in the two chicken genotypes with the lowest estimate of 0.02 at week 11 in FUNAAB Alpha and 0.03 at week 6 in Noiler chicken while the highest estimates of 0.74 (week 4) and 0.55 (week 7) were observed in FUNAAB Alpha and Noiler chickens respectively. Noiler chicken genotype had better h^2 estimates at weeks 2, 3, 6 and 7 while FUNAAB Alpha chicken genotype recorded better estimates at weeks 4, 5, 8, 9, 10, 11 and 12.

Tables 8 and 9 shows the repeatability estimates of growth traits of FUNAAB Alpha and Noiler chicken genotypes from week 1 to 12 which ranged from low to high in body weight and all biometric traits. Noiler chicken genotype had high and better repeatability estimates for body weight at weeks 1, 3, 6, 7, 10 and 11 with 0.90 as the highest at week 3 while FUNAAB Alpha recorded high and better repeatability estimate at weeks 2, 4, 5, 8, 9 and 12 with 0.60 as the highest at week 2.

Table 8: Repeatability estimates of growth traits of FUNAAB Alpha and Noiler chicken genotypes from week 1 to 6

Genotype	Week	Trait					
		BW (g)	BC (cm)	BG (cm)	SL (cm)	TL (cm)	WL (cm)
FUNAAB Alpha	7	0.12	0.04	0.26	0.15	0.03	0.35
Noiler		0.65	0.63	0.61	0.61	0.53	0.55
FUNAAB Alpha	8	0.55	0.30	0.32	0.20	0.44	0.41
Noiler		0.22	0.30	0.58	0.12	0.72	0.33
FUNAAB Alpha	9	0.17	0.22	0.51	0.53	0.61	0.53
Noiler		0.25	0.46	0.49	0.51	0.67	0.05
FUNAAB Alpha	10	0.27	0.26	0.39	0.27	0.35	0.18
Noiler		0.40	0.54	0.34	0.43	0.22	0.05
FUNAAB Alpha	11	0.05	0.25	0.46	0.35	0.36	0.12
Noiler		0.48	0.64	0.67	0.32	0.43	0.02
FUNAAB Alpha	12	0.29	0.48	0.69	0.49	0.20	0.10
Noiler		0.29	0.15	0.16	0.39	0.35	0.07

BW = Body Weight, BC = Body Circumference, BG = Breast Girth, SL = Shank Length, TL = Thigh Length and WL = Wing Length

For body circumference, a different pattern of superiority was observed between the two chicken genotypes from week 1 to 12. Noiler chicken genotype recorded high and better repeatability estimates from week 1 to 12 except at weeks 4(0.77), 5(0.65) and 12(0.48) where FUNAAB Alpha was superior to Noiler chickens. The lowest (0.01) repeatability estimate was observed at week 11 in FUNAAB Alpha while the highest (0.87) was observed at week 3 in Noiler chickens. The repeatability estimates for breast girth ranged from low (0.02) to high (0.88) in Noiler chicken genotype with the highest estimate at week 4 while in FUNAAB Alpha it ranged from moderate (0.31) to high (0.86) with the highest estimate at week 9. Noiler chicken genotype had better estimates at weeks 1, 2, 4, 6, 7, 10 and 11 while better repeatability estimates were observed in FUNAAB Alpha at weeks 3, 5, 8, 9 and 12.

Repeatability estimates for shank length ranged from low (0.01, 0.07) to high (0.94, 0.88) from week 1 to 12 for FUNAAB Alpha and Noiler chicken genotypes respectively, the highest estimates were observed at week 3 in both genotypes while the lowest estimates were observed at weeks 7 and 8 for FUNAAB Alpha and Noiler respectively. Noiler chicken genotype had better estimates at the late stage of life (week 6 -11) when compared to FUNAAB Alpha while repeatability estimates recorded in FUNAAB Alpha at the early stage were better and very high (0.94) at week 3, (0.86) at week 4, and (0.84) at week 5.

Noiler chickens' thigh length was highest at week 3 with a repeatability estimate of 0.95. It recorded better repeatability estimates at the early stage (week 1 to 4) and at the late stage (week 7 to 11). Repeatability estimates were generally high at the early stage and declined at the late stage of the experiment in the two chicken genotypes. Similarly, for wing length, repeatability estimates were generally high at the early stage with 0.97 as the highest estimate at week 2 in FUNAAB Alpha. Wing length in both chicken genotypes recorded relatively low repeatability estimates from week 7 to 12. The lowest estimate of 0.01 was observed in Noiler chicken genotype at weeks 10 and 11.

Table 9. Repeatability estimates of growth traits of FUNAAB Alpha and Noiler chicken genotypes from week 7 to 12

Genotype	Week	Trait					
		BW (g)	BC (cm)	BG (cm)	SL (cm)	TL (cm)	WL (cm)
FUNAAB Alpha	7	0.33	0.47	0.33	0.01	0.07	NE
Noiler		0.58	0.54	0.73	0.27	0.39	0.36
FUNAAB Alpha	8	0.45	0.02	0.50	0.03	0.52	0.42
Noiler		0.28	0.40	0.28	0.07	0.60	0.32
FUNAAB Alpha	9	0.45	0.12	0.86	0.02	0.47	0.04
Noiler		0.14	0.24	0.53	0.56	0.58	0.08
FUNAAB Alpha	10	0.39	0.45	0.31	0.34	0.21	0.25
Noiler		0.47	0.47	0.49	0.85	0.24	0.01
FUNAAB Alpha	11	0.06	0.02	0.53	0.35	0.18	0.06
Noiler		0.40	0.40	0.80	0.49	0.31	0.01
FUNAAB Alpha	12	0.35	0.48	0.63	0.58	0.14	0.05
Noiler		0.12	0.16	0.02	NE	0.12	NE

BW = Body Weight, BC = Body Circumference, BG = Breast Girth, SL = Shank Length, TL Thigh Length and WL =Wing Length =

Discussion

Heritability plays a vital role in the formulation of breeding plans for animal and plant improvement. An important aspect of these plans is selection, that is, the choice of parents to produce the next generation, on which the improvement depends. For the selection to be effective, it is necessary that the members of the population on which the selection is practiced vary in their genetic make-up with regard to the character in question (body weight, body circumference, breast girth, shank length, thigh length and wing length). It is only the genetically determined variation which can be utilized for a permanent improvement of the production characteristics in the populations. The choice of relatives to use for the estimation of heritability depends on circumstances. In agreement to this statement, (5) observed that precision and bias are important points to be considered, the closer the relationship; the more precise is the estimate, which is a true reflection of this research, as sib analysis with sire and dam effect on progeny was used to estimate the heritability.

Differences obtained in the heritability estimate (h^2) for both genotypes are indicators of genetic influence on these parameters and all the growth traits of interest are heritable. High h^2 obtained for body weight and linear body measurements across different weeks in the chicken genotypes implies that high genetic influence could be attributed at those ages and the contribution of the environment is minimal, also it implies that selection based on individual performance alone may be advisable for those specific weeks while for the low heritability estimates, it means environment has a major contribution to the expression of the traits and genetic influence was minimal at those weeks. The implication of low to high h^2 values obtained in this work further confirms the fact that selection based on individual alone will yield substantial genetic gain for the high estimates and that offspring will perform better in the economic traits of interest than their parents (24). The high h^2 estimate could be as a result of additive gene dam effect that gave rise to high genetic variability and this could mean that individual selection will lead to high genetic gain. Generally, heritability and repeatability estimate of body weight and linear body measurement for both chicken genotypes were high at the early stage of production and low at the late stage of production. This is in agreement with the reports of (25); (26) and (27) that heritability estimates for body weight and growth-related traits in chickens exhibited a decreasing trend with increasing age. This could imply that selection for improvement of these traits by breeders will be best achieved at the early stage of life.

The low to high heritability (h^2) and repeatability (R) estimates obtained in the chicken genotypes from week one to twelve in this study cut across all levels of estimates reported by different scientists. (21) reported low h^2 estimates of their experimental birds while moderate to high h^2 estimates were reported for body weight at different ages in naked neck broiler chickens by (28) and (29). However, reports by (30); (31) showed moderate to high heritability estimates in growth and body conformation traits of crossbred resulting from modern broiler sire with dams from two unrelated highly-inbred lines and CARI Dhanraja broiler chicken strain. Similarly, (32) in his study; obtained an increasing trend in heritability estimates in chickens. With the fluctuating trend of h^2 estimates reported by various researchers, it further confirms the report of (33) that differences in h^2 estimates could be attributed to method of estimation, breed, environmental effects and sampling error due to sample size. Furthermore, changes in heritability estimates at varying ages could be an indication of different expression of growth-correlated genes at different ages in the chicken genotypes.

Heritability estimates for body weight, body circumference and breast girth from week 1 to 12 were within the range reported by (34) who made use of three broiler strains (Abor Acre, Marshall and Ross) and observed heritability estimates that ranged between 0.14 and 0.64 across all traits at 8 weeks, while the estimates of the shank length, thigh length and wing length were slightly higher. This could be due to differences in the duration of experiment and possibly the method of estimating the heritability. (34) estimated heritability of the three broiler strains using half-sibs method which made use of only the sire component on the sibs while in this study, parent-offspring regression-correlation analysis was used and this account for both the sire and dam components on the sibs.

Traits with high heritability has been passed well from parents to offspring, high heritability means rapid genetic progress between generation while low heritability suggest that it will require more generations to improve upon selected traits. Likewise, high repeatability estimates observed at some weeks in the traits considered implies that chicken genotypes understudied may have higher possibilities to repeat their present performance in the future especially at those weeks where high estimates were recorded and also fewer numbers of records are required to realize high expected response for selection as corroborated by (35).

Repeatability measures the similarities of successive records. The high estimates of repeatability observed in this study for most traits across all ages could imply duplication of performance in all the traits for those weeks and likewise for the low R estimates, which corroborate the definitions of repeatability by the following authors.

The highest repeatability estimates in body weight and other linear body measurements were observed from week 2 to 5 and 9 to 11. This means that selection for these traits with the highest (R) estimates is a guarantee of similar performance if proper management is ensured in future production. Repeatability as one of the tools of genetic parameter has assisted breeders in the selection of better breeds or strains, which has gone a long way in producing quick and rapid transformation in animal protein supply (36). The understanding of the principle of repeatability has continually helped breeders around the world to rightly select for traits of economic interest. This is buttressed by (17) who reported that, repeatability is of importance in the profitability of the poultry industry. The magnitude of repeatability estimates gives an indication of the extent to which selection applied at any stage will affect subsequent flock performance.

Conclusion and Applications

1. Noiler chicken genotype had a better body weight and linear body measurements (body circumference, breast girth, shank length, thigh length and wing length) from week ten to eighteen.
2. Sexual dimorphism favoured male birds in terms of body weight and linear body measurements from week one to eighteen.
3. In terms of genotype by sex interaction, Noiler male chickens were superior in all the traits considered from week twelve to eighteen.
4. FUNAAB Alpha chicken had the highest estimate of heritability in all the linear body measurements (body circumference, breast girth, shank length, thigh length and wing length) at weeks 4, 12, 4, 2 and 4, respectively.
5. Noiler chicken had the highest repeatability estimate for body weight, body circumference, breast girth and thigh length at weeks 3, 3, 4 and 3, respectively, while FUNAAB Alpha chicken had the highest repeatability estimate for shank length and wing length at weeks 3 and 2, respectively.

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