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Genotype effect on growth parameters and secondary sexual characteristics in three Nigerian cock genotypes and their genetic parameters

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Abstract

The study evaluated effects of genotype on body parameters and secondary sexual characteristics of three Nigerian indigenous cock genotypes (Naked neck(Na), Frizzled feathered(Fz) and Normal feathered(NF)) and their correlations with body weight. A total of 150 Nigerian indigenous cocks of 50 cocks per genotype at 16 weeks of age were studied. Body parameters were: Body weight(BW), breast girth(BG), keel length(KL) and secondary sexual characteristics: comb subjected to Analysis of Variance (ANOVA) of GLM of SAS Ver. 9.2 and means were separated with LSD at 5% probability. The result showed that genotype significantly (P<0.05) influenced growth parameters measured for 6 weeks. For BW, Fz (2.54±0.05Kg) and Na (2.52±0.07Kg) cock genotypes had a significant (P<0.05) higher means than NF (2.33±0.03 Kg). Na (34.00±0.37cm) and Fz (33.00±0.54cm) had higher Means for BG than NF cock genotypes. NF (11.69±0.48cm) had higher means for KL than Na (10.44±0.35cm). For secondary sexual characteristics: CL of NF (9.78±0.36cm) was the longest compared to Fz(5.57±0.56cm) and Na(2.14±0.06cm). SP for Fz(1. 67±0.l5cm) and NF(1.54±0.l5cm) were significantly p<0.5) longer than Na(1. 13±0.l5cm). BW and growth parameters showed a positive correlation range of very low to high (-0.04 – 0.82) with BW/BG (0.82) having the best relationship while BW/Spur (-0.04) came least. Correlation between BW and secondary sexual characteristics ranged between -0.04 and 0.54, with BW/Spur (0.54) being the best correlated parameters in this study. Conclusively, Fz and Na cock genotypes performed best in growth traits while NF genotype was best in secondary sexual characteristics.

Keywords: Body weight; Cock genotypes; correlations; Secondary sexual characteristics

1. Introduction

Indigenous chickens are widely distributed in the rural areas of tropical and sub-tropical countries. Indigenous chickens in Africa generally possess some genetic traits which make them hardy, adaptable to harsh environmental conditions and are able to adjust to fluctuations in feed availability [1, 2]. They are reared in free range low input system, backyard and semi-intensive husbandry system [3]. The daily feed ration of a chicken must be balanced which contain certain amounts of carbohydrates, proteins, fats, vitamins and minerals [4]. Hence, the flock is generally allowed to scavenge in the village to derive their essential nourishment from insects, grubs and carrions as well as picking up of any spillage from food preparation and processing, thus ensure that nothing is wasted [4]. Nigerian chicken breeds have been reported to have many advantageous gene complexes or gene marker; that could be harnessed in the development of meat or egg type chicken suitable for use in the tropics. These major genotypes are the naked neck, Frizzle and Normal Feathers [5].

The most important aim of keeping indigenous chicken is to conserve their genetic resources and maintain the genetic variation for future breeding purpose. It is also necessary that poultry breeding programs should include the local poultry, since they possess some distinctive tolerance to certain local diseases and adaptability to local climatic conditions [6] According to Ibe [7] the frizzled and Naked neck genes are tolerance to heat stress, disease resistance and increased productive capacity. Local chicken production which is still important in low income deficit in the tropics

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is an appropriate system to support the fast growing population with high quality protein requirement [8]. They are often dual purpose and are important to the rural and resource-limited households in Nigeria [9]. Moreover, in the context of Nigeria, local chicken production and management is easier than the broiler and pullet production, particularly in the coastal region where modern facilities including electricity supply are regularly available, and high frequency of coastal environment predisposed the exotic breeds of poultry to disease [10].

Growth is controlled by both genetic and non-genetic factors such as hormonal, environmental and nutritional factors. Thus involves dynamic physiological changes which initiates when the zygote is formed during fertilization and continues till maturity of the individual [11]. However, numerous studies have shown that growth traits relating to body morphometric measurements such as body length, shank length and chest girth can serve as good indicators of growth [12,13]. Body morphometric measurements could be used to describe body conformation and predict live weight, examine relationship among economic traits, evaluate breed and reproductive performance and study interactions between heredity and environment [14]. Both growth performance and body conformation traits in any livestock are considered as important parameters in assessing the potential of genetic improvement animal breeds. Improvement of the reproductive efficiency, variation, phenotypes and their associations form the basis for genetic improvement or animal breeding programs [15].

Local cocks are selected based on physical and secondary sexual characteristics that are associated with maturity in cockerels for example comb size, breast girth, keel length [16]. Shank and wattle length of all the three indigenous breeds were positively correlated [17] which demonstrated that indigenous cockerel's body weight and comb length of all the three indigenous breeds were positively correlated. Phenotypic traits (secondary sexual characteristics) such as comb and wattle length have been reported to be useful to predict the growth, fertility and sperm quality in broiler cockerels [18].

In view of this, an interest was developed to investigate on the effects of genotype on body parameters and secondary sexual characteristics as well as their correlations between body weights and secondary sexual characteristics in the three genotypes of Nigerian local cocks.

2. Materials and Methods

2.1. Experimental site and preparation of the site

The experiment was conducted in the poultry unit of the Teaching and Research farm of University of Uyo, Nigeria. It lies within latitude 4^0 32'N and 5^0 33'N, and longitudes $7^0$25'E and $8^0$25E with annual rainfall of between 2000 mm and 3200 mm from March to October. Annual temperature varies between 26^o C and 28^o C [19].

The experimental site was cleaned by washing with detergent, disinfected and fumigated a week before the arrival of the matured Cocks of 16 weeks of age. A rearing pen containing 3 hutches with 72 cells of 62cm x 80cm x 56cm each were constructed for the research. Beddings (wood shavings) were laid on the floor of each cell of the hutch for provision of heat to the birds. Adequate sanitary measures were kept; wood shavings were changed weekly. Feeding troughs, drinkers and other needed equipment for successful rearing of the birds were kept clean. The birds were kept under intensive management system.

2.2. Experimental birds Procurement and management

A total of seventy-two experimental mature cocks comprising of twenty-four cocks per genotype (Normal Feathered, Frizzled Feathers and Naked neck) of Nigerian indigenous cocks were used for the study. The cocks were obtained from local poultry breeders at 16 weeks of age. The cocks were quarantined for a period of one weeks in a dry, clean well ventilated pen. These cocks were weighed and placed in their individual cells. Fresh water and commercial feed (Finisher mash that contain 18% Crude Proteins and 3000 Kcal Metabolizable energy) were given to the cocks *ad libitum*.

2.3. Data collection

Body weight, keel length, breast girth and secondary sexual traits (Comb length and spur length) were measured forth-nightly for six weeks. Body weight was measured by using a digital scale calibrated at 0.01g. Comb length was measured using tailor's measuring tape as the distance between the tip of the comb and the base. The spur was measured using tape rule for the length from the base to the tip of the spur. Keel length was measured using tailor's tape as the length of the keel bone. The breast girth was measured using a tailor's measuring tape, as the circumference round the body's breast region.

2.4. Statistical Analysis

Data collected for all the body parameters were analyzed using General Linear Model of ANOVA in SAS Statistical Software Package ver. 9.2. Means were separated using Duncan's multiple Range Test [20] at probability of 5%. Phenotypic correlation was considered between body weight and secondary sexual characteristics through Pearson correlation technique.

Model:

$$Y_{ijk} = \mu + G_i + A_j + GA_{ij} + £ijk$$

Where:
Y_{ijk} = Observation of the i^{th} genotype on the k cocks
μ = Over all mean
G_i = Effect of the i^{th} cocks genotype (I = 1, 2, 3)
ϵ_{ijk} = Error due to individual observation

3. Result and Discussion

3.1. Effects of Genotype on body Parameters and secondary sexual characteristics of Nigerian indigenous cocks at different ages

The result showed that genotype significantly ($p<0.05$) influenced all the body traits of the 3 Nigerian indigenous cock genotypes measured, Table 1.

Mean BW of Indigenous FF cocks had mean values of 2.07±0.11 Kg followed by Na with 2.06±0.09 Kg and NF (1.89±0.02 Kg). However, FF (2.07±0.11 Kg), Na (2.06±0.09 cm) and NF (1.89±0.02 Kg) had significantly ($P>0.05$) similar values for BW at initial week.

Na had mean BG values of 30.58±0.59 cm, followed by FF cocks 32.10±0.43 cm and NF (29.75±0.62 cm). Similarly, FF with 32.10±0.43 cm was significantly ($p<0.05$) higher than NF with 29.75±0.62 cm but significantly ($P>0.05$) similar to Na cocks (30.58±0.59 cm) for BG at initial week. This study agrees with the reports of [21] which attributed such differences to genotype, age and nutrition.

NF cocks had mean KL of 11.18±0.44 cm, followed by FF with 10.38±0.35 cm and Na (9.88±0.35 cm). NF cocks had the highest mean value of 11.18±0.44 cm significantly ($P<0.05$) higher than Na (9.88±0.35 cm) but significantly ($P>0.05$) similar to FF (10.38±0.35 cm) at week 0. Hence this study agrees with the reports of [22] which established that differences existed between different Nigerian ecotypes from morphological point view. It also agrees with [21] which attributed this differences as due to strains, age and nutritional factors.

NF cocks had mean SP of 1. 53±0.l5 cm, followed by FF with 1.33±0.25 cm and Na (0.98±0.19 cm). NF cocks had the longest spur with the mean value of 1.53±0.15 cm significantly ($P<0.05$) longer than Na (0.98±0.19 cm) but significantly ($P>0.05$) similar to FF (1.33±0.25 cm) at initial. Hence, this study agrees with the reports of [22] which established that differences existed between different Nigerian ecotypes from morphological point view. Similarly, this study agrees with the reports of [21] which attributed this differences as due to strains, age and nutritional factors.

NF cocks had mean CL of 9.05±0.35 cm, followed by FF with 5.48±0.56 cm and Na (3.74±0.13 cm). NF cocks had the highest mean value of 9.05±0.35 cm for comb length significantly ($P<0.05$) higher than FF (5.48±0.56 cm) and Na (3.74±0.13 cm) while FF (5.48±0.56 cm) had CL significantly ($P<0.05$) longer than Na (3.74±0.13 cm) at initial (week 0). Hence, this study agrees with the reports of [21] which attributed this differences as due to strains, age and nutritional factors.

Table 1 Effects of Genotype on Body parameters and secondary sexual characteristics of Nigerian indigenous cocks (LSM±SE) (CM) at initial week (week 0)

Gen	N		Parameters			
		BW	BG	KL	SP	CL
Na	24	2.06±0.09[a]	32.10±0.43[a]	11.18±0.44[a]	1. 53±0.l5[a]	9.05±0.35[a]
NF	24	1.89±0.02[a]	29.75±0.62[a]	9.88±0.35 [b]	0.98±0.19[b]	3.74±0.13 [c]
FF	24	2.07±0.11a	30.58±0.42a	10.38±0.30ab	1.33±0.25 a	5.48±0.56 [b]

[a, b,] = Means along the same column with the same superscript are not significantly different (P>0.05) from each genotype. Gen = genotypes, N = numbers of observation, NF = Normal Feathered, Na= Naked neck, FF = Frizzle Feathered.

The results showed that genotype significantly (p<0.05) influenced all the body traits of the 3 cock genotypes measured at week 2, Table 2.

Mean BW of Indigenous FF cocks had mean values of 2.12±0.09 Kg followed by Na with 2.07±1.11 Kg and NF (1.90±0.03 Kg). However, FF (2.12±0.09 Kg) and Na (2.07±1.11Kg) had significantly (P<0.05) higher values than NF (1.90±0.03 Kg) for BW at week 2.

Mean BG of Na cock was 32.0±0.50 cm followed by FF cock with 31.33±0.64 cm and NF (30.00±0.59 cm) as the least. Similarly, Na cock (32.10±0.50 cm) and FF cocks (31.33±0.64 cm) were significantly (p>0.05) similar in mean values but statistically (p<0.05) higher than NF cocks (30.00±0.59 cm) for BG at week 2. Hence this study agrees with the reports of [22] which established that differences existed between different Nigerian ecotypes from morphological point of view.

NF cocks had mean values for KL (11.25±0.48 cm) followed by FF cocks with 10.48±0.30 cm and Na (l0.12±0.35cm) as the least for KL. NF cocks had the highest mean value of 11.25±0.48 cm significantly (P<0.05) higher than Na (l0.12±0.35 cm) but statistically (P>0.05) similar to FF (10.48±0.30 cm) at week2. Hence this study agrees with the reports of [21] which attributed this differences due to strains, age and nutritional factors.

NF cocks had mean SP of 1.55±0.l5 cm followed by FF cocks with 1.35±0.25 cm and Na cocks (0.99±0.16 cm). NF cocks had the highest mean value of 1.55±0.l5 cm significantly (P<0.05) higher than FF cocks with 1.35±0.25 cm and Na cocks (0.99±0.16 cm) but FF cocks (1.35±0.25 cm) was statistically (P>0.05) higher Na cocks (0.99±0.16 cm) at week 2. Hence this study agrees with the reports of [22] which established that differences existed between different Nigerian ecotypes from morphological point of view.

NF cocks had mean CL of 9.32±0.36 cm followed by FF cocks with 5.57±0.56 cm and Na cocks (1.80±0.11 cm). NF cocks had the highest mean value of 9.32±0.36 cm significantly (P<0.05) higher than FF cocks (5.57±0.56 cm) and Na cocks (1.74±0.13 cm) while FF (5.57±0.56 cm) had CL statistically (P<0.05) longer than Na cocks (1.80±0.11 cm) at week 1. Hence this study agrees with the reports of [21] (Peter *et al*., 2008) which attributed this differences as due to strains, age and nutritional factors.

Table 2 Effects of Genotype on Body parameters and secondary sexual characteristics (LSM±SE) (CM) of Nigerian indigenous cock at week two

Gen	N	BW	BG	KL	SP	CL
Na	24	2.12±0.09[a]	33.00±0.50[a]	11.25±0.48[a]	1.55±0.l5[a]	9.32±0.36[a]
NF	24	1.90±0.03[b]	30.00±0.59[b]	l0.12±0.35[b]	0.99±0.16[a]	1.80±0.11[c]
FF	24	2.07±1.11[a]	31.33±0.64[a]	10.48±0.30[ab]	1.35±0.25[a]	5.57±0.56[b]

[a, b,] = Means along the same column with the same superscript are not significantly different (P>0.05) from each genotype. Gen = genotypes, N = numbers of observation, NF = Normal Feathered, na= Naked neck, FF = Frizzle Feathered

The result showed that genotype significantly (p<0.05) influenced body parameters of the 3 cocks' genotypes of Nigerian chicken cock's measured at week 4, Table 3.

Mean BW of Indigenous Na cocks had mean values of 2.36±0.09 Kg, followed by FF with 2.30±0.11 Kg and NF (1.95±0.04 Kg). Na (2.36±0.09 Kg) and FF (2.30±0.11 Kg) had statistical (P>0.05) similar values for BW but significantly (P<0.05) higher values than NF (1.95±0.04 Kg) for BW at week 4.

Mean BG of NaFcock was 34.22±0.46 cm, followed by FF cock with 32.58±0.68 cm and Na (30.25±0.70 cm) as the least. Similarly, Na cock (34.22±0.46 cm) and FF cocks (32.58±0.68 cm) were significantly (p>0.05) similar in mean values but statistically (p<0.05) higher than NF cocks (30.25±0.70 cm) for BG at week 4. Hence this study agrees with the reports of [22] which established that differences existed between different Nigerian ecotypes from morphological point of view.

NF cocks had mean values of 11.46±0.48 cm, followed by FF cocks with 10.73±0.29 cm and Na (10.21±0.34 cm) as the least for KL. NF cocks had the highest mean value of 11.46±0.48 cm significantly (P<0.05) higher than Na (10.21±0.34 cm) but statistically (P>0.05) similar to FF (10.73±0.29 cm) at week 4. Hence this study agrees with the reports of [21] which attributed this differences due to strains, age and nutritional factors.

NF cocks had mean SP of 1.58±0.l5 cm followed by FF cocks with 1.57±0.20 cm and Na cocks (1.10±0.27 cm). The mean values obtain for SP at week 4 showed no significant (p>0.05) difference amongst the three genotypes measured in this study.

NF cocks had mean CL of 9.57±0.37 cm followed by FF cocks with 5.93±0.68 cm and Na cocks (1.91±0.07 cm). NF cocks had the highest mean value of 9.57±0.37 cm significantly (P<0.05) higher than FF cocks (5.93±0.68 cm) and Na cocks (1.91±0.07 cm) while FF (5.93±0.68 cm) had CL statistically (P<0.05) longer than Na cocks (1.91±0.07 cm) at week 4. Hence, this study agrees with the reports of [21] which attributed this differences as due to strains, age and nutritional factors. Similarly, this study agrees with the reports of [22] which established that differences existed between different Nigerian ecotypes from morphological point of view.

Table 3 Effects of Genotype on Body parameters and secondary sexual characteristics (LSM±SE) (CM) of Nigerian indigenous cock at week four

Gen	N	BW	BG	KL	SP	CL
Na	24	2.36±0.09a	34.22±0.46^{a}	11.46±0.48^{a}	1.58±0.l5^{a}	9.57±0.37^{a}
NF	24	1.95±0.04^{b}	30.25±0.70^{b}	10.21±0.34 ^{b}	1.10±0.27^{b}	1.91±0.07^{c}
FF	24	2.30±0.11^{a}	32.58±0.68^{a}	10.73±0.29^{ab}	1.57±0.20^{a}	5.93±0.68^{b}

$^{a, b,}$ = Means along the same column with the same superscript are not significantly different (P>0.05) from each genotype. Gen = genotypes, N = numbers of observation, NF = Normal Feathered, na= Naked neck, FF = Frizzle Feathered.

The result in Table 4 showed that genotype significantly (p<0.05) influenced body parameters of the 3 cocks' genotypes of Nigerian chicken cock's measured at week 6.

Mean BW of Indigenous FF cocks had mean values of 2.54±0.05 Kg followed by Na with 2.52±0.07 Kg and NF (2.33±0.031 Kg). Na (2.52±0.07 Kg) and FF (2.54±0.05 Kg) had significant (P>0.05) similar values for BW but significantly (P<0.05) higher values than NF (2.33±0.031 Kg) for BW at week 6.

Mean BG of FF cocks were 34.22±0.46 cm followed by Na cocks with 32.58±0.68 cm and NF (30.25±0.70 cm) as the least. Similarly, FF cocks (34.22±0.46 cm) and Na cocks (32.58±0.68 cm) were significantly (p>0.05) similar in mean values but significantly (p<0.05) higher than NF cocks (30.25±0.70 cm) for BG at week 6. Hence, this study agrees with the reports of [22] which established that differences existed between different Nigerian ecotypes from morphological point of view.

NF cocks had mean values of 11.69±0.48 cm followed by FF cocks with 10.93±0.30 cm and Na (10.44±0.35 cm) as the least for KL. NF cocks had the highest mean value of 11.69±0.48 cm significantly (P<0.05) higher than Na (10.44±0.35 cm) but statistically (P>0.05) similar to FF (10.93±0.30 cm) at week 6. Hence this study agrees with the reports of [21] which attributed this differences due to strains, age and nutritional factors.

NF cocks had mean SP of 1.59±0.l5 cm followed by FF cocks with 1.58±0.22 cm and Na cocks 1.12±0.21 cm). NF cocks had the highest mean value of 1.59±0.l5 cm significantly (P<0.05) higher than Na cocks (1.12±0.21 cm) but FF cocks (1.58±0.22 cm) was statistically (P>0.05) similar to FF cocks with 1.58±0.22 cm at week 6. Hence this study agrees with the reports

of [22] which established that differences existed between different Nigerian ecotypes from morphological point of view.

NF cocks had mean CL of 9.78±0.36 cm followed by FF cocks with 6.13±0.59 cm and Na cocks (2.14±0.06 cm). NF cocks had the highest mean value of 9.78±0.36 cm significantly (P<0.05) higher than Na cocks (2.14±0.06 cm) but statistically (P>0.05) similar to FF (6.13±0.59 cm) at week 3. Hence this study agrees with the reports of [22] which established that differences existed between different Nigerian ecotypes from morphological point of view.

Table 4 Effects of Genotype on Body parameters and secondary sexual characteristics (LSM±SE) (CM) of Nigerian indigenous cock at week six

Gen	N	BW	BG	KL	SP	CL
Na	24	2.52±0.07^{a}	34.00±0.37^{a}	11.69±0.48^{a}	1.59±0.l5^{a}	9.78±0.36^{a}
NF	24	2.33±0.031^{b}	31.38±0.56^{b}	10.44±0.35^{a}	1.12±0.21^{b}	2.14±0.06^{c}
FF	24	2.54±0.05^{a}	33.59±0.54^{a}	10.93±0.30^{ab}	1.58±0.22^{a}	6.13±0.59^{a}

$^{a, b,}$ = Means along the same column with the same superscript are not significantly different (P>0.05) from each genotype. Gen = genotypes, N = numbers of observation, NF = Normal Feathered, na= Naked neck, FF = Frizzle Feathered.

3.2. Phenotypic correlation between Body Weight and Secondary sexual characteristics on Normal Feathered Cocks at Week 4

The results on Table 5 revealed that NF cocks had low to high positive correlation between pairs of body weight and breast girth, keel length, spur with values 0.58, 0.16 and 0.75, respectively. NF cocks showed low to medium positive correlations among the pairs of the secondary sexual characteristics of breast girth and keel length, spur as 0.21 and 0.69, respectively. Keel length lowly correlated with spur positively (0.10).

Table 5 Phenotypic correlations between Body Weight and Secondary sexual characteristics of Normal Feathered Cocks at Week 4

	BW	CL	BG	KL
BW				
CL	0.42			
BG	0.58	0.03		
KL	0.16	0.05	0.69	
SP	0.75	0.45	0.21	0.10

BW= Body weight, CL= Comb length, BG=Breast, KL=Keel length, SP =Spur

3.3. Phenotypic correlations between Body Weight and Secondary sexual characteristics on Naked neck Cocks at Week 3

Table 6 Phenotypic correlations between Body Weight and Secondary sexual characteristics of Naked neck Cocks at Week 4

	BW	CL	BG	KL
BW				
CL	0.13			
BG	0.76	-0.5		
KL	0.37	0.45	0.83	
SP	0.08	0.07	0.76	0.14

BW= Body weight, CL= Comb length, BG=Breast, KL=Keel length, SP =Spur

As shown on table 6 Na cocks had low to high positive correlations between body weight and breast girth, keel length, and spur with values 0.79, 0.37 to 0.08, respectively. Na cocks had breast girth positively correlated with spur and keel length 0.76 and 0.83, respectively. Na cocks had Keel length positively correlated with spur 0.14 though low.

3.4. Phenotypic correlations between Body Weight and Secondary sexual characteristics of Frizzle feathered Cocks at Week 4

Frizzle feathered cocks had positive correlation with breast girth, keel length, and spur with 0.82, 0.61 and 0.54, respectively. Frizzle feathered cocks had breast girth positively correlated with keel length and spur 0.61 and 0.54, respectively. Frizzle feathered had keel length positively correlated with spur 0.63. However Frizzle feathered had a strong positive correlation between body weight and body secondary sexual characteristics at week 3, followed by Normal feathered, lastly by Naked neck Table 6. This is in line with report by various researchers; [23, 24, 25] which had similar observations among the Indigenous birds.

Table 7 Phenotypic correlations between Body Weight and Secondary sexual characteristics of Frizzle feathered Cocks at Week 4

	BW	**CL**	**BG**	**KL**
BW				
CL	0.28			
BG	0.82	0.03		
KL	0.61	0.55	0.63	
SP	0.54	0.60	0.64	0.63

BW= Body weight, CL= Comb length, BG=Breast, KL=Keel length, SP =Spur

3.5. Phenotypic correlation between Body Weight and Secondary sexual characteristics on Normal Feathered Cocks at Week 6

Normal feathered cocks' body weight had a positive correlation with breast girth and keel length, with values 0.27 and 0.50 but adversely correlated with spur with values -0.4 while the pairs of breast girth with keel length (0.82) positively correlated but adversely correlated with spur -0.15. Keel length positively correlated with spur 0.01 but very low.

Table 8 Phenotypic correlation between Body Weight and Secondary sexual characteristics on Normal Feathered Cocks at week 6.

	BW	**CL**	**BG**	**KL**
BW				
CL	0.39			
BG	0.27	0.13		
KL	0.50	0.52	0.83	
SP	-0.04	-0.03	-0.15	0.01

BW= Body weight, CL= Comb length, BG=Breast, KL=Keel length, SP =Spur

3.6. Phenotypic correlation between Body Weight and Secondary sexual characteristics on Naked neck Cocks at week 6.

Naked neck cocks' body weights had positive correlation with breast girth, spur, and keel length, with values 0.53, 0.02 and 0.59, respectively while breast girth lowly and positively correlated with keel length 0.19, but negatively correlated with spur -0.46. Keel length highly and positively correlated with spur 0.79.

Table 9 Phenotypic correlations between Body Weight and body secondary sexual characteristics of Naked neck Cocks at week 6

	BW	**CL**	**BG**	**KL**
BW				
CL	0.33			
BG	0.53	0.05		
KL	0.02	0.20	0.19	
SP	0.09	0.46	-0.46	0.79

BW= Body weight, CL= Comb length, BG=Breast, KL=Keel length, SP =Spur

3.7. Phenotypic correlations between Body Weight and Secondary sexual characteristics on Frizzled Feather Cocks at Week 6

Frizzled feathered cocks' body weights had positive correlation with breast girth, keel length, and spur with this values 0.72, 0.69 and 0.29. Frizzled feathered had breast girth positively correlated with spur and keel length 0.54 and 0.63. Frizzled feathered had keel length positively correlated with spur 0.59. However, Frizzle feathered had a strong positive correlation between body weight and Secondary sexual characteristics morphometric parameters in week 6, followed by Naked neck, lastly by Normal feathered. The three genotype had positive correlation which is in line with reports by various researchers: [22, 23, 24].

Table 10 Correlation between Body Weight and Morphometric Parameters on frizzle Feathered Cocks at week 5

	BW	**CL**	**BG**	**KL**
BW				
CL	0.28			
BG	0.52	0.45		
KL	0.79	0.54	0.63	
SP	0.29	0.44	0.54	0.59

BW= Body weight, CL= Comb length, BG=Breast, KL=Keel length, SP =Spur

4. Conclusion

Genotypes significantly ($P<0.05$) influenced body parameters and secondary sexual characteristics measured for 6 weeks in this study.

Fz and Na cock genotypes had the heaviest and widest body of all the Nigerian cock genotypes studied at all ages in this study.

NF cock genotype had the longest KL and in both secondary sexual characteristics (CL; Spur) measured at all ages in this study.

Body weight and growth traits had a positive correlation range of very low to high (-0.04 – 0.82) with BW/BG having the best relationship while BW/Spur was the least (-0.04) at all ages studied. But Correlation between BW and secondary characteristics ranged between -0.04 and 0.54, with 0.54 recorded for BW/spur as the best correlated parameters in this relationship studied.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no competing interests.

Statement of ethical approval

This research was carried out according to the ethical guidelines of the Institutional Animal Care and Use Committee (IACUC) of the International Livestock Research Institute as per the ethics application approval numbers 2014.15 and 2014.16.

Statement of informed consent

All authors have given approval / consent for the article to be submitted.

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