Nigerian J. Anim. Sci. 2016 (2):289 - 296

Effect of Genotype and Age on Some Morphometric, Body Linear Measurements and Semen Traits in Nigerian Indigenous Chickens

Olutunmogun[1], A.K., Orunmuyi[2], M., Kabir, M.[3] and Musa, A.A.[4]

[1]National Animal Production Research Institute, Ahmadu Bello University, Zaria, Nigeria
[2]Department of Animal Production and Health, Federal University Oye - Ekiti, Nigeria
[3]Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria
[4]Department of Animal Production, Kogi State University, Anyigba, Nigeria

Corresponding author: olutunmogunkayode@yahoo.com

Target Audience: Animal breeders/ scientists, Poultry farmers

Abstract

A population of 231 roosters of the Nigerian indigenous chickens of normal feathered frizzle feathered and naked neck genotypes was evaluated for the effect of genotype and age on some morphometric body linear measurements and semen characteristics of three Nigerian chicken genotypes. 20 roosters from each genotype were evaluated for semen characteristics at 24, 28 and 32 weeks of age in relation to body weights and linear body measurements at those ages. Data were obtained and analyzed for body weights, body linear measurements and for the semen characteristics. The analyzed data showed that all the body parameters were significantly (P<0.05) affected both by age and genotypes except wattle width (WW) comb length (CL) and comb height (CH) at 24 weeks of age. Semen characteristics revealed that both age and genotype had significant (P<0.05) effects though semen colour and pH were not significantly (P>0.05) affected at 24 and 28 weeks respectively with superiority in most of the trait in the normal feathered genotype. Correlation estimates showed most traits not significantly (P>0.05) correlated. It is concluded that some level of genetic variations exist in body weight, linear measurements and semen traits in roosters of three genotypes used in this study and they can be used for breeding and artificial insemination purposes for genetic improvement.

Key words: Age, genotypes, indigenous chickens

Description of Problem

The assessment of semen quality characteristics of poultry birds gives an excellent indicator of their reproductive potential and has been reported to be a major determinant of fertility and subsequent hatchability of eggs (1). The cardinal point to be successful in poultry breeding therefore depends not only on basic efficient management of the breeder flock but also on reproductive characteristics of breeders,

testicular and reproductive tract growth in the males or ovary and oviduct performance in the females (**2**). Economic traits of body measurements and morphometric traits correlate with semen quality therefore enhancing fertility in breeder males (**3**). The ornaments that have been compared to sperm quality in birds include tail attractiveness in peafowl and combs and wattles in chicken (4, 5 and 6). Of these ornamental traits, comb and wattle have clearly been identified as good indicators of semen quality in male birds (7).The non-ornaments which are correlated with semen quality in male chickens: body weight, shank length (SL) and keel length (KL) (6). Observations have been made that significant genotype differences affected body size and semen characteristics of cocks, except the pH value (**3**). Therefore the objective of this study was to evaluate the effect of genotype and age between genetic traits of linear body measurements, morphometric and semen traits of the Nigerian indigenous chickens.

Materials and Methods

Description of Experimental Site

The study was carried out at the Poultry Unit of the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria. The study is located in the Northern Guinea Savannah of Nigeria which lies between latitude 11º 09' 06" N and longitude 7º 38' 35" E (8). The climate is relatively dry with an annual rainfall of 1100mm from late April to mid October. The temperature varies from 26° to 35°C depending on the seasons while the relative humidity during the hamattan period, hot and wet seasons are 21,37 and 77% respectively (9).

Experimental Birds, Design and Management

The roosters used for the study were obtained from the mating programme of three genotypes of the Nigerian indigenous chickens. 231 roosters were used for the evaluation of body weights and linear body measurements (101 normal feathered, 56 frizzle feathered and 74 naked necks) while 20 roosters from each genotypes was then used to evaluate the semen quality characteristics. The birds were allocated different pens according to genotypes and subjected to the same managerial conditions. The roosters were fed standard breeder mash with metabolizable energy (ME) of 2520.08kcal/kg with crude protein (CP) of 18.05% and crude fiber of 5.74. Feed and water were provided *ad libitum*.

Measurements of body weight, breast girth and shank length

Individual body weight (g), breast girth (cm), and shank length (cm) were recorded from chickens of the three genotypes at 24, 28 and 32 weeks of age which were tagged individually. The body weights were measured using the Camry top loading sensitive scale with sensitivity of 0.1g. A flexible measuring tape was used to measure the breast girth and shank length at the anatomical reference points as described by (10, 7).

Secondary Sexual Traits

Individual secondary sexual traits of comb length (CL), comb height (CH), wattle length (WL) and wattle width

(WW) were measured. The CL and WL were measured as the maximum horizontal distance between the front and the rear of the comb or wattle. Also, CH was measured as the maximum vertical distance from the highest peak of the comb to the base. WW was taken as the maximum vertical distance from base of the wattle to the distal end. Measurements (cm) were recorded as described by (11).

Physical Semen Characteristics

Semen samples were collected from individual roosters at 24, 28 and 32 weeks of age using the massage method squeezing the copulatory organs (12) to obtain semen to study genotype, age and body weight effects on the physical semen characteristics. During and after collection, temperature of samples was maintained at 38° to 40°C in a water bath flask until sperm concentrations were accessed. Collection was done once on each of the roosters at the three ages. Semen samples were examined for the following characteristics: ejaculate volume was determined to the nearest 0.1ml from the graduated collection tube, semen colour was scored (creamy = 1, milk = 2 and consistency =3), motility score (from 0 to 100%), percentages of live sperm was determined from individual raw semen smeared on glass sides with eosin nigrosin stain, sperm concentration were obtain using the Neubauer Haemocytometer while semen pH was obtained by means of chemo craft pH paper.

Statistical Analyses

Data collected were subjected to Analysis of Variance (ANOVA) of **(13)**. Means separation was by Duncan Multiple Range Test (DMRT) of SAS. Model for investigating the effect of genotype and age on body weight, linear body measurements and semen characteristics of the roosters is as shown below:

$$\mathbf{Y_{ijk} = \mu + G_i + A_j + e_{ijk}}$$

Where;

Y_{ijk} = observation on the i^{th} genotype at the j^{th} age, μ = overall population mean, G_i = fixed effect of the i^{th} genotype (i=3: Normal feather, Frizzle, Naked neck), A_j = fixed effect of age (j=3: 24, 28, 32) and e_{ijk} = random error.

Results and Discussion

Body weight, body linear measurements and secondary sexual characters as affected by genotype and age

The values obtained for body weight, breast girth and shank length with the secondary sexual characters of the three genotypes of the Nigerian indigenous roosters from 24 – 32 weeks of age are presented in Table 1. The result showed that all the traits were significantly ($P<0.05$) different at the ages apart from wattle width, comb height and comb lengths at 24 weeks of age which were not significant ($P<0.05$). The progressive increase in body weight is in accordance to the report of (3) that a general linear increment exist with increasing age in local strains of indigenous cocks (El- Salam and Mandarah cocks) with increment in age. However, the values for body weight and morphometric traits in this study were lower than the values reported by (11) in Norfa cocks and (7) in Bandarah cocks.

These differences could be attributed to genotype/strain types and environments which play major effect in the genetic make up.

Table 1: Least square means (±SE) of some body measurements of three genotypes of Nigerian chickens

		Genotype			
Age(weeks)	**Traits**	**Normal**	**Frizzle**	**Naked neck**	**LOS**
24	BW	1167.80±32.1^{a}	1096.74±45.39^{b}	1111.89±35.79^{b}	*
	BG	25.15±0.28^{b}	22.76±0.39^{c}	26.48±0.31^{a}	*
	SL	9.78±0.15^{ab}	9.57±0.21^{b}	10.13±0.16^{a}	*
	WL	2.53±0.04^{a}	2.53±0.06^{a}	2.36±0.05^{b}	*
	WW	2.56±0.03	2.56±0.04	2.56±0.04	NS
	CL	3.72±0.04	3.69±0.06	3.60±0.04	NS
	CH	6.21±0.06	6.27±0.08	6.08±0.06	NS
28	BW	1227.80±32.1^{a}	1146.74±45.39^{b}	1164.89±35.79^{b}	*
	BG	25.65±0.28^{b}	23.16±0.39^{c}	26.93±0.31^{a}	*
	SL	10.03±0.15^{ab}	9.78±0.21^{b}	10.34±0.16^{a}	*
	WL	2.93±0.04^{a}	2.83±0.06^{a}	2.66±0.05^{b}	*
	WW	5.76±0.03^{a}	5.56±0.04^{b}	5.66±0.04^{b}	*
	CL	6.11±0.04^{a}	6.11±0.06^{a}	5.90±0.04^{ab}	*
	CH	9.51±0.06^{a}	9.47±0.08^{ab}	9.28±0.06^{b}	*
32	BW	1285.8±32.1^{a}	1206.74±45.39^{b}	1222.89±35.79^{ab}	*
	BG	26.44±0.28^{b}	23.96±0.39^{c}	27.73±0.31^{a}	*
	SL	10.33±0.15^{ab}	10.03±0.21^{b}	10.64±0.16^{a}	*
	WL	3.13±0.04^{a}	3.03±0.06^{a}	2.86±0.05^{b}	*
	WW	6.27±0.03^{a}	6.06±0.04^{b}	6.16±0.04^{b}	*
	CL	6.72±0.04^{a}	6.59±0.06^{ab}	6.50±0.04^{b}	*
	CH	10.31±0.06^{a}	10.26±0.08^{ab}	10.09±0.06^{b}	*

^{abc} =Means having different superscript along rows for a given trait differ signific antly (P<0.05), BW=Body weight, BG= Breast girth, SL=Shank length, WL=Wattle length, WW=Wattle width, CL=Comb length, CH=Comb height, LOS = Level of significance

Semen characteristics as affected by genotype and age

Table 2 shows the genotype and age effect on the semen characteristics. The result showed that significant (P<0.05) differences were obtained for most of the traits apart from semen colour at 24 weeks and pH at 28 weeks of age which were not significant (P>0.05). Semen volume had fluctuations in quantity as age increased for normal and frizzle but was consistent for the naked neck. Also, motility dropped for the normal and frizzle but increased for the naked neck genotype. Concentration and pH reduced as age increased with the value of pH moving towards the acidic direction leading to a reduction in the semen concentration. Though much have not being done in comparing age amongst these genotypes however, the result of this study on semen volume between the three genotypes were similar to those of (14) who recorded values of 0.27ml, 0.24ml and 0.22ml for naked neck, frizzle and normal feather roosters respectively. Although this result is at variance with that of (15) who used similar genotypes but had a range of 0.39 to 0.59ml of semen volume.

Furthermore, this study is not in agreement with those of (16) who recorded a much higher values for normal feather (0.83ml) and frizzle feather (1.10 ml) and a lower value for naked neck (0.18ml). These differences may possibly be attributed to age and environmental factors (17). The colour of the semen of the roosters was creamy white in most of the samples which could be as a result of the natural tendencies of the roosters and the level of sperm concentration (18). The semen motility, pH, semen concentration as well as live cell recorded in this study were higher than those reported by (16) and (14) in respect of age.

Table 2: Least square means (±SE) for semen characteristics in the three genotypes of Nigerian chickens

		Genotype			
Age	**Semen variables**	**Normal**	**Frizzle**	**Naked neck**	**LOS**
24	Volume(ml)	0.12 ± 0.03^{b}	0.24 ± 0.03^{a}	0.12 ± 0.03^{b}	*
	Colour	Creamy	Creamy	Creamy	NS
	Motility (%)	85.71 ± 9.54^{ab}	90.0 ± 7.98^{a}	79.88 ± 8.93^{b}	*
	pH	7.43 ± 0.2^{a}	7.20 ± 0.17^{a}	6.88 ± 0.2^{b}	*
	Conc($x10^{9}$/m)	6.42 ± 11.38^{b}	7.02 ± 9.52^{a}	5.73 ± 10.65^{c}	*
	Live sperm (%)	54.3 ± 11.11^{c}	75.0 ± 9.2^{b}	85.0 ± 10.39^{a}	*
28	Volume(ml)	0.32 ± 0.05^{a}	0.17 ± 0.0^{b}	0.18 ± 0.05^{b}	*
	Colour	Creamy	Milky	Milky	*
	Motility (%)	91.8 ± 5.75^{a}	83.3 ± 7.4^{b}	81.0 ± 5.75^{b}	*
	pH	7.20±0.18	7.00±0.23	7.20±0.18	NS
	Conc($x10^{9}$/ml)	5.27 ± 12.26^{a}	4.13 ± 15.8^{b}	4.30 ± 12.26^{b}	*
	Live sperm (%)	78.0 ± 10.47^{a}	60.0 ± 13.52^{b}	80.0 ± 10.47^{a}	*
32	Volume (ml)	0.18 ± 0.04^{a}	0.08 ± 0.04^{b}	0.22 ± 0.04^{a}	*
	Colour	Creamy	Creamy	Milky	*
	Motility (%)	74.60 ± 5.20^{b}	62.60 ± 5.82^{c}	90.00 ± 5.20^{a}	*
	pH	6.60 ± 0.28^{b}	6.60 ± 0.28^{b}	7.00 ± 0.32^{a}	*
	Conc($x10^{9}$/ml)	4.31 ± 12.24^{a}	4.31 ± 12.24^{a}	3.80 ± 13.68^{b}	*
	Live sperm (%)	73.0 ± 16.75^{a}	57.0 ± 16.75^{c}	67.50 ± 18.73^{b}	*

^{abc} = Means with different superscript within the same row for a trait differ significantly ($P<0.05$), Conc.=Concentration, LOS = Level of significance

Pearson correlation for bodyweight, body linear traits and semen traits at different ages

Table 3 shows the phenotypic Pearson correlations (r) between the body linear measurements and semen characteristics at the three ages. Relationships between body weight and most of the body measurements and semen traits were high, positive and non significant ($P>0.05$) at the three age groups. However, some positive correlations exit between some of the traits at the three different age groups. At 24 weeks of age, correlations values between traits were: CL and WL (r=0.52), CH and CL (r=0.85) and concentration and motility (r=0.61). At 28 weeks, the correlations values between traits were: BW and BG

(r=0.51), BW and SL (r=0.75) and concentration and motility (r=0.83). While at 32 weeks, correlation values were: BW and BG (r=0.58), BW and SL (r=0.61), volume and BG (r=0.50) and live cells and pH (r=0.87). The positive relationship between body weight and most of the body measurements showed that body weight can be predicted from body linear measurements and agrees with the observation of (19). Most of the positive relationship had very strong association between the traits considered and agrees with the report of (20) and (21) who reported similar results. (3) reported that body weight had influence on semen quality trait like volume, concentration and motility but not pH in two local strains of chickens and that the heavier weight bird had advantage of high concentration but the motility was to the advantage of the lighter weight group which was similar to report of this study. (20, 22) have reported relationships between body linear measurements and semen traits in layer types of cock which were similar to the findings of this study.

Table 3: Phenotypic Pearson correlation for body weight, linear measurement and semen characteristics

Traits	BW	BG	SL	WL	WW	CL	CH	Vol	Col	Mot	pH	Conc
AGE						**24 WEEKS**						
BW												
BG	0.34											
SL	0.21	-0.02										
WL	0.35	-0.03	-0.09									
WW	-0.13	0.11	-0.09	0.34								
CL	0.22	-0.21	-0.08	0.52*	0.47							
CH	0.30	-0.28	-0.03	0.54*	0.33	0.85***						
Vol	0.05	-0.17	-0.34	0.17	-0.04	0.03	0.10					
Col	-0.29	-0.65	0.005	0.24	-0.09	0.27	0.35	0.03				
Mot	0.09	-0.13	-0.29	0.43	0.24	0.01	0.04	0.27	-0.06			
pH	0.11	-0.36	0.11	0.16	-0.15	0.15	0.18	-0.29	0.31	-0.24		
Conc	0.04	0.19	-0.15	0.39	0.18	0.10	0.03	0.008	-0.06	0.61**	-0.13	
Live	-0.23	0.24	-0.21	-0.28	0.04	-0.23	-0.33	-0.29	0.23	0.16	-0.29	0.18
						28 WEEKS						
BW												
BG	0.51**											
SL	0.75***	0.68**										
WL	-0.08	-0.37	-0.24									
WW	-0.13	-0.21	-0.19	0.79***								
CL	-0.18	-0.41	-0.12	0.64**	0.64**							
CH	-0.14	-0.36	-0.27	0.81***	0.81***	0.81***						
Vol	-0.08	-0.38	0.16	0.09	0.41	0.46	0.38					
Col	0.16	0.51*	0.28	-0.82	-0.66	-0.65	-0.79	-0.44				
Mot	-0.08	-0.35	0.03	0.35	-0.08	0.12	0.24	0.69*	-0.42			
pH	-0.08	0.28	0.04	-0.18	0.08	-0.06	-0.11	-0.27	0.55*	-0.63		
Conc	0.25	-0.17	0.36	0.33	0.005	-0.14	0.2	0.57*	-0.35	0.83***	-0.43	
Live	0.16	0.26	0.21	0.11	-0.23	-0.33	-0.03	0.41	0.04	0.59*	-0.28	0.35
						32 WEEKS						
BW												
BG	0.58**											
SL	0.61**	0.34										
WL	0.12	0.04	0.0009									
WW	-0.09	0.27	-0.17	0.68**								
CL	0.001	-0.12	0.01	0.14	0.09							
CH	-0.14	-0.34	0.09	0.33	0.22	0.53*						
Vol	-0.11	0.50*	-0.08	-0.18	0.35	0.27	-0.15					
Col	-0.11	0.32	0.34	-0.46	-0.31	-0.27	-0.36	0.32				
Mot	0.09	0.45	-0.06	-0.21	0.16	0.21	-0.21	0.65**	0.23			
pH	0.07	0.36	0.03	-0.16	0.07	0.19	-0.12	0.53*	0.28	0.95***		
Conc	0.1	-0.35	0.09	0.47	0.23	0.25	0.29	-0.42	-0.74	-0.26	-0.23	
Live	0.13	0.42	-0.19	0.05	0.29	0.2	-0.19	0.47	-0.01	0.92***	0.87***	-0.1

*Significant (P<0.05) **Significant (P< 0.01) *** Highly significant (P<0.001) BW=Body weight, BG= Breast girt h, SL=Shank length, WL=Wattle length, WW=Wattle width, CL=Comb length, CH=Comb height, Vol. =Semen volume, Col.=Colour, Mot.=Motility, Conc.=Concentration, Live sperm

Conclusion and Application

1. Regarding to body weight and body linear measurements, the normal feathered genotype performed better when compared to the two other genotypes.
2. The semen quality characteristics of the normal feather proved to be genetically better then the other two genotypes.
3. Traits with positive and significant correlations can be selected as markers to improve the reproductive performance of the male local chicken genotypes.

References

1. Peters, S.O., Omidiji, E.A., Ikeobi, C.O.N., Ozoje, M.O. and Adebambo, O.A. (2004). Effect of naked neck and hatchability in local chicken. In: Self sufficiency of animal protein in Nigeria. In: *Proceedings of the 29th Annual Conference of Animal Science Association of Nigeria, 29: 262-264.*
2. Ratana, C. (2001). Effects of mating ratio, cock number in the flock and breeder age on fertility in Thai native chicken flock. *Kasetsart Journal (Nat. Sci.)*, 35: 122 – 131.
3. Abd El Ghany, F.A., Alm El Dein, A.K., Soliman, M.M., Rezaa, A.M. and El Sodany, S.M. (2011). Relationship between some body measurements and fertility in males of two local strains of chicken. *Egyptian Poultry Science,* 31(2): 331-349.
4. Pizzari, T., Jensen, P. and Cornwallis, C.K. (2004). A novel test of the phenotype-linked fertility hypothesis reveals independent components of fertility. *Proc. R. Sco. Land, 271: 51- 58.*
5. Bilcik, B. and Estevez, I. (2005). *I*mpact of male competition and morphological traits on mating strategies and reproductive success in broiler breeders. *Applied Animal Behavior Science, 92: 307-323.*
6. Galal, A. (2007). Predicting semen attributes of naked neck and normally feathered male chickens from live performance traits. *International Journal of Poultry Science, 6(1): 36-42.*
7. El-Sahn, A.A. (2007b). Use of phenotypic traits to predict cocks fertility: The ornamental and non-ornamental traits. *Egyptian Poultry Science, 27: 1085–1097.*
8. Ovimaps, (2012). Ovilocation map; ovi earth imaginery. Dated July, 2012.
9. Akpa, G.N., Ifut, J.O. and Mohammed, F. (2002). Indigenous management of dystocia in ruminant livestock of Northern guinea savannah of Nigeria. *Journal of Animal Production, 29: 264-270.*
10. El-Sahn, A.A. (2007a). Use of phenotypic traits to predict cocks fertility: The secondary sexual traits and the skeletal conformation. *Egyptian Poultry Science, 27: 521–536.*
11. Gabriel, G.M., Kalamah, M.A., El-

Fiky, A.A. and Ali, F.A. (2009). Some factors affecting semen quality traits in Norfa 347 cocks. *Egyptian Poultry Science, 29(11): 677-693.*

12. Burrows, W.H. and Quinn, J.P. (1937). The collection of spermatozoa from the domestics fowl and turkey. *Poultry Science, 16: 19-24.*
13. SAS. (2002). Statistical Analysis System, Computer Software, Version 9: Statistics SAS Institute Inc. Cary, Northern Carolina 27513, USA.
14. Machebe, N.S. and Ezekwe, A.G. (2006). Ejaculate characteristics of three genotypes of local cocks in the humid tropics. *Journal of Agriculture Food, Environment and Extension,* 3(2): 33-37.
15. Isidahomen, C.E. (2015). Semen characteristics of three genotypes of indigenous cocks in the humid environment of Nigeria. In: *Proceedings of the 40th Annual conference of the Nigerian Society for Animal Production,* 40: 8-10.
16. Ajayi, F.O., Agaviezor, B.O. and Ajuogu, P.K. (2011). Semen characteristics of three strains of local cocks in the humid tropical environment of Nigeria. *International Journal of Animal and Veterinary Advances,* 3(3): 125-127.
17. Ezekwe, A.G. and Machebe, N.S. (2004). Ejaculate characteristics of two strains of local cocks (Naked-Neck and Frizzle) in Nigeria. In: *Proceedings of the 29th Annual Conference of the Nigeria Society for Animal Production,* 29: 92–95.
18. Etches, R.J. (1998). *Reproductions in Poultry*. CAB International Wallingford.
19. Ajayi, F.O., Ejiofor, O. and Ironkwe, M.O. (2008). Estimation of body weight from body measurements in two commercial meat type chickens. *Global Journal of Agricultural Science,* 7(1): 57 – 59.
20. Udeh, I. (2012). Use of factor scores for determining the relationship between body measurements and semen traits of cocks. *Open Journal of Animal Science,* 2(1): 41-44.
21. Yakubu, A., Kuje, D. and Okpeku, M. (2009). Principal components as measures of size and shape in Nigerian indigenous chickens. *Thai Journal of Agricultural Science,* 42(3): 167-176.
22. Udeh, I., Ugwu, S.O.C. and Ogagifo, N.L. (2011). Predicting semen traits of local and exotic cocks using linear body measurements. *Asian Journal of Animal Science,* 5 : 268-276. DOI:10.3923/ajas.2011.268.276.