academicJournals

Vol. 8(48), pp. 6178-6184, 12 December, 2013
DOI: 10.5897/AJAR12.646
ISSN 1991-637X ©2013 Academic Journals
http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

Full Length Research Paper

Variability and predictability of productive and body traits of Fulani ecotype chicken

Jesuyon, Oluwatosin M. A.* and Salako, Adebowale E.

Department of Animal Science, University of Ibadan, Oyo State, Nigeria.

Accepted 24 April, 2013

Improvement of the domestic chicken has dominated the effort of indigenous breeders in Nigeria in recent times. Three hundred and fifty-seven (357) Fulani ecotype chickens were surveyed and assessed for their phenotypic and productive characteristics in Osun State, Nigeria. Mature weight (kg), comb size, wattle size, breast length, breast width, leg length (all in cm); egg weight (gm), clutch size were examined and classified. A higher level of variability was revealed in comb size, wattle size, egg weight, and clutch size within the hen population of each local government; and in leg length within Orolu cocks and hens as shown by their coefficient of variation (CV), respectively. Strong and significant association was observed between mature weight and wattle size, mature weight and comb size, and between wattle size and comb size in the cocks; and between egg weight and egg clutch size in hens. Breast length and breast width were best predictors of each other while mature weight was best predicted by wattle size in cocks. Breast length was predicted by mature weight and leg length, breast width was predicted by mature weight and, mature weight was predicted by the combination of leg length, breast length and breast width in hens. All parameters were more accurately predicted in cocks than in hens. Statistical modelling revealed sexual dimorphism on all equations.

Key words: Body parameters, Fulani chicken, predictability, settlements, variability.

INTRODUCTION

Domestic chickens contribute highly to the socio-economic condition of Nigerians. A survey (Aphca news, 2006) reported the population of backyard poultry in Nigeria to be 84 million, which amounts to about 60% of the total poultry population in Nigeria.

These indigenous chickens are largely unimproved and uncharacterized. Their management, feeding and housing is simple free-range. There are three chicken ecotypes in Nigeria namely the Fulani, the Eastern and the Yoruba ecotypes. The Fulani ecotype is prevalent in the middle and northern parts of the country but there are pockets of this ecotype among the Fulani descendants in the rural settlements of Osun State. Various studies on growth (Ibe, 1993; Sola-Ojo and Ayorinde, 2009); egg traits, fertility and hatchability (Peters et al., 2004; Fayeye and Oketoyin, 2006) and phenotypic variations (Mancha et al., 2006; Ajayi and Agaviezor, 2009) have been reported for local chickens in Nigeria. But there is paucity of information on the physical characteristics of this chicken ecotype in Osun State, Nigeria. Furthermore, not much is known about their body characteristics, distribution and potential for improvement. Latshaw and Bishop (2001) submitted that for livestock, it is more common to estimate weight by measuring a part of the body trunk rather than an extremity.

Thus, Nwosu et al. (1985) observed in their biometrical study of the conformation of the native chicken in Nsukka that, there was very little variability in shank length among native chickens. Besides, not much study has been conducted into the variability that exists within the body parameters and between the various existing ecotypes. This study therefore was conducted to examine the ecological distribution, body parametric indices, variability and predictability of these biometric parameters

*Corresponding author. E-mail: dr.oluwatosinjesuyon@yahoo.com. Tel: +2348064310337.

in indigenous Fulani ecotype chicken in Osun State, Nigeria. Body traits measurement analyses are important for estimating the relative standard deviation of body parameters while regression analyses could reveal the predictability and the predictors of parameters of interest, thus characterizing each ecotype within and between sexes. The results from this study could be useful to all poultry researchers and breeders for further studies, inclusion in international data bank.

MATERIALS AND METHODS

This survey was conducted in five local Fulani settlements namely, Gaa Baba-Bayo, Gaa Abu, and Aba Aro in Ifon (Orolu Local Government Area, LGA); Gaa Koko, Ire (Ire Local Government Area, LGA) and Gaa Power-line Osogbo (Osogbo Local Government Area, LGA) of Osun State. These settlements are situated in the mid South-West region of Nigeria.

Three hundred and fifty-seven mature chickens in ratio 3 females to one male were assessed using the random sampling technique to pick famer-owners. The sampling size, n, was made large to compensate for the small population, N of this ecotype in the region. All birds were examined with the help of owner-farmers early in the mornings before they were released for scavenging. Body measurements taken were comb size, wattle size, breast length, breast width, leg length (all in cm), egg weight (gm), mature weight (kg) and number of eggs per clutch per hen (Clutch size).

Comb size was measured as length along the base, from the beak end to the end of the comb, wattle size was taken as length from the topmost part below the beak to the end of the wattle, breast length was measured as length from the tip of the breast at the sternum along the mid region to the end of the keel bone on the belly (Wikipedia.org, 2012), breast width was length was length across the breast over the tip of the sternum (pectus) from one edge of the wing to the other (Momoh and kershima, 2008), the Leg length was measured as length from the hip bone to the tarso-metatarsus joint (Semakula et al., 2011), egg weight of individual hens were taken and recorded individually for each hen, mature weight was taken as weight of birds that have roosted or layed eggs at least once while the clutch size was taken as number of eggs layed at a single stretch before the hens start to sit upon the eggs for brooding. Measurements were made with a cotton thread and the lengths measured were determined on a metric ruler. Egg weight was measured with a portable egg weighing scale while the weight of birds were determined with the outdoor 5 kg-capacity platform scale.

Data analysis was performed using ANOVA and descriptive procedure of the SPSS (Version 10.0 of 2001) software Pearson's correlation and stepwise regression analyses were done using the SAS (Version 8 for Windows of 1999) procedures (p = 0.05). Stepwise regression procedures was adopted for predicting each of comb size, breast length, breast width from mature weight as dependent parameter against all others as explanatory variables. All variables utilized in the model were those that met the 0.05 significance level for entry into the model.

RESULTS

Table 1 shows the mean of parameters studied and ecological distribution of the Fulani chickens surveyed among the three LGAs in Osun State, Nigeria. ANOVA ($p < 0.05$) shows that cocks differed from hens in all parameters measured. Among cocks, Ire sub-type had the longest breast (23.1 cm), the Orolu and Osogbo sub-types showed the widest breast (15.5 cm and 15.2%) while Osogbo cocks exhibited the longest legs (29.3 cm). Among hens, Osogbo sub-type had the longest breast (18.1 cm) and legs (13.2 cm); and a wider breast (14.2 cm). All settlements showed significant difference ($p \leq 0.05$) in egg weight: Orolu and Osogbo sub-types had the heaviest eggs (39.0 and 37.9 gm), followed by Ire (35.6 gm) sub-type, respectively. Mean mature weight was 2.29 and 1.44 kg for cocks and hens, respectively while Osogbo subtype cocks and hens displayed the heaviest mature weights of 2.40 and 1.50 kg, respectively. The hens revealed egg-clutch ranges of either 2 to 6 or 7 to 12 eggs per hen. Each L.G.A. had birds in both clutch ranges. Ire hens gave the highest prevalence of 4 to 6 egg clutch range of (62.5%) while Ifon hens submitted the highest record of 7 to 12 egg clutch range (55.6%).

Table 2 shows the CV of the various biometric parameters of the Fulani ecotype chicken. This table revealed low to medium level of variations within parameters within sex ranging from 0.006 to 0.476 and 0.025 to 0.376, respectively for cocks and hens. However, medium variability (0.476) was obtained in leg length among Orolu cocks, while a low level of variability was obtained in wattle size (0.314 to 0.376), comb size (0.300 to 0.334), egg clutch size (0.326 to 0.370) and egg clutch range (0.314 to 0.376) within each LGA ecological hen population. Whereas leg length (0.303) and egg weight (0.360) were comparatively variable among Orolu hens.

Table 3 shows the matrix of Pearson's phenotypic correlation coefficients between body and production parameters in both Fulani cock and hen populations, respectively in Osun State, Nigeria. Most pairs of parameters exhibited weak associations. Nevertheless, there were strong associations between wattle size and comb size (r = 0.91 and 0.32), wattle size and mature weight (r = 0.89 and 0.31) and, between breast length and breast width (r = -0.81 and 0.38). A highly positive association (r = 0.82) was obtained between egg weight and egg clutch size. These correlation coefficients were significant at 0.05 levels.

Table 4 reveals the stepwise regression equations for prediction of breast length, breast width, comb size and mature weight in both cocks and hens. The models were highly significant ($p < 0.05$) R^2 ranging from 0.66 to 0.82 in the cocks, to very low R^2 from 0.10 to 0.38 for all parameters predicted in the hens. All the equations regressed for cock parameters had higher intercepts or constants (47.5 vs. 12.98; 22.27 vs. 9.52; 2.23 vs. 1.05; 1.33 vs. 0.55) than those of same traits in the hens. This further demonstrated sexual dimorphism already observed between sexes of Fulani chicken in Osun and in the results. Thus, the stepwise model predicted all parameters better for cocks (R^2 = 0.66-0.82) than hens (R^2 = 0.10-0.38).

Table 1. Mean of body and productive parameters of Fulani ecotype chickens on free-range management in three selected Local Government Areas of Osun State, Nigeria

Parameter	Sex type	Mean (SE)	Ifon (SD)	Ire (SD)	Osogbo (SD)
Comb size,	Cocks	5.17(0.23)[a]	5.84 (1.01)	5.03 (0.00)	5.72(0.18)
Cm	Hens	1.65(0.09)[b]	1.48 (0.47)[b]	2.47 (0.18)[a]	1.41 (0.42)[b]
Wattle size,	Cocks	4.87(0.33)[a]	4.82 (1.40)	4.40 (1.03)	5.72 (0.18)
Cm	Hens	1.48(0.07)[b]	1.51 (0.50)	1.33 (0.43)	1.41 (0.42)
Breast,	Cocks	19.9(0.54)[a]	19.1 (1.10)[b]	23.1(0.64)[a]	19.1 (0.26)[b]
length cm	Hens	17.4 (0.24)[b]	17.3 (1.75)[b]	16.7 (0.74)[b]	18.1 (1.55)[a]
Breast,	Cocks	15.1 (0.24)[a]	15.5 (0.56)[a]	13.7 (0.44)[b]	15.2 (0.46)[a]
width cm	Hens	14.1 (0.23)[b]	14.6 (1.32)[a]	13.1 (1.86)[b]	13.7 (1.16)[b]
Leg length,	Cocks	21.0 (2.19)[a]	19.7 (9.38)[b]	19.4 (1.46)[b]	29.3 (0.18)[a]
Cm	Hens	12.1 (0.43)[b]	11.4 (3.45)[b]	13.1 (1.11)[a]	13.2 (0.34)[a]
No. of	Cocks	4.93 (0.07)[a]	4.89 (0.33)	5.00 (0.00)	5.00 (0.00)
Digits	Hens	4.02 (0.02)[b]	4.00 (0.00)	4.13 (0.35)	4.00 (0.00)
Mature	Cocks	2.29 (0.07)[a]	2.28 (0.31)	2.27 (0.31)	2.40 (0.14)
Weight, kg	Hens	1.44 (0.03)[b]	1.43 (0.19)	1.40 (0.21)	1.50 (0.14)
Egg weight, gm	Hens	38.2 (1.81)	39.0 (14.1)[a]	35.6 (8.63)[b]	37.9 (7.49)[a]
Mean of eggs /clutch/hen	Hens	6.93 (0.34)	7.33 (2.30)	6.25 (2.32)	6.33 (2.06)
Egg clutch Range	Range %	2-6 eggs 50	2-6 44.4	4-6 62.5	2-6 55.6
	Range %	7-12 eggs 50	7-12 55.6	9-12 37.5	7-10 44.4

[a, b] superscripts associated with Mean in each column and row indicate significant differences at $P < 0.05$; SE means Standard Error. SD means Standard Deviation.

DISCUSSION

The mean mature weight range values obtained within sex were close (2.28 to 2.40 and 1.40 to 1.50 kg) for cocks and hens, respectively. These figures were higher than 1.47 to 1.77 and 0.85 to 1.44kg reported by Nwosu et al. (1985) for Nsukka cocks and hens and 1.38 to 1.55 kg and 0.86 to 1.45 kg range for Owerri chickens, respectively. Results are also higher than Bayelsan (1.50 and 1.23 kg; Ajayi and Agaviezor, 2009); Tanzanian (1.95 and 1.35 kg; Goromela et al., 2009) and Central Mali (1.60 and 1.02 kg; Wison et al., 1987) cocks and hens. The egg weight was higher than 34.4 gm layed by Central Mali hens (Wison et al., 1987) while the clutch range of 7 to 12 was comparable to the mean clutch size of 12 reported by Tanzanian Village hens (Goromela et al., 2009) but ht mean clutch size was lower than 8.8 egg/hen layed by Malian hens (Wilson et al., 1987). This result showed that the Fulani chicken was heavier than other ecotypes in Nigeria. Results also showed that cocks were superior in weight to the hens in all body parameters thus demonstrating sexual dimorphism. This has been reported by Olawumi et al. (2008) and Gueye et al. (1998) for chickens. The heavier mature weight of the cocks was attributed to the ability of the males to secrete more quantity than females of sex hormones responsible for muscle development (Semakula et al., 2011).

This study showed low level of variability among Fulani Chickens and this seemed to be an adaptive feature to their natural environment. This suggested reasons for the slow progress in efforts to improve local chicken but this also directs efforts towards rapid improvement through crossbreeding with chicken possessing high level of variation in desired traits to bring about remarkable variations in their gene pool that will allow for selection. In this environment foundation selection favours Orolu cocks

Table 2. The coefficient of variation (CV) of body and productive parameters of Fulani ecotype chicken in three selected Local Government Areas of Osun State, Nigeria.

Parameters	COCKS				HENS			
	Total pop.	Orolu	Ire	Osogbo	Total pop.	Orolu	Ire	Osogbo
Wattle size	0.255	0.290	0.233	0.031	0.337	0.314	0.376	0.365
Comb size	0.160	0.198	0.000	0.031	0.323	0.334	0.319	0.300
Leg length	0.389	0.476	0.076	0.006	0.237	0.303	0.085	0.025
No of digits	0.054	0.068	0.000	0.000	0.038	0.000	0.086	0.000
Breast length	0.101	0.058	0.058	0.063	0.092	0.101	0.045	0.086
Breast width	0.060	0.036	0.032	0.030	0.106	0.090	0.143	0.084
Mature weight	0.120	0.135	0.135	0.059	0.129	0.134	0.153	0.094
Egg weight					0.314	0.360	0.242	0.198
Mean of eggs/clutch/hen					0.337	0.326	0.370	0.326
Egg clutch range					0.337	0.314	0.376	0.365

Total pop. means Total Population of Chicken by sex. OROLU, IRE and OSOGBO are the LGA of Settlements chosen for the survey.

Table 3. Pearson's correlation of body and production parameters in Fulani ecotype chickens on free-range management from selected Local Government Areas of Osun State, Nigeria.

	COCKS						
Parameters	Egg clutch	Egg weight	Wattle size	Comb size	Breast length	Breast width	Mature weight
Hens							
Egg weight	0.82**						
Wattle size	0.22	0.30		0.91**	0.06	-0.12	0.89*
Comb size	-0.03	0.08	0.32*		0.29	-0.32	0.83**
Breast length	0.16	0.06	0.36*	-0.06		-0.81**	0.21
Breast width	0.23	0.09	0.07	-0.16	0.38*		-0.13
Mature weight	0.16	0.20	0.31*	0.20	0.44**	0.40**	

Note: * means $P \leq 0.05$; ** means $P \leq 0.01$.

and hens as starting genetic material for improvement of the Fulani chicken because of their attributes in leg length, egg weight, number of eggs/clutch and the clutch range. Orolu cocks and hens were also found to be taller than chickens fro other LGAs. This result thus substantiated the observation of Nwosu et al. (1985) that there was little variability in shank length among native chickens, although this could be an adaptation for ranging the environment. Those traits that exhibited lower standard deviation values such as number of digits, breast length, breast width and mature weight were thought to be least sensitive to the environment and were expected to be highly genetically influenced traits. Therefore, they could be useful for characterization purpose in Fulani chicken. The values of the CV obtained in this study were lower than 4.11 to 16.93% published by Okon et al. (1997) for various body parameters of Lohmann brown broilers in the humid tropics.

The result on correlation signified a high level of association between body traits at mature live weight. These traits could be used to predict one another or select for correlated body traits. The highly significant association obtained between egg clutch size and egg weight may indicate that improvement in egg size could result in high and stable clutch size. Also, an improvement in breast length (r = 0.44) and breast width (r = 0.40) could have positive influence on the mature weight of the Fulani hen. The cocks could be developed as a meat type equivalent of the exotic broiler. However, the traits correlated in this study were different from those reported by Essien and Adeyemi (1999) where different traits were correlated with body weight. The coefficients of mature weight with other traits in this work were lower (0.16 to 0.44) than that (0.25 to 0.59 at 12 weeks and 0.48 to 0.62 at 9 weeks) reported by Okon et al. (1997) where they correlated body weight with body girth, body

Table 4. Stepwise regression equations for prediction of breast length, breast width, comb size and mature weight in Fulani ecotype chickens on free-range management from three selected Local Government Areas of Osun State, Nigeria.

Dependent parameter	Sex type	Model selection step	Explanatory body measurement	Intercept (a)	Independent b – values	Standard error of model	R^2	% model significance (*p*)
Breast length, cm	Cocks	1	BRW	47.531	-1.829	6.126	0.659	0.0004
	Hens	1	MWT	11.865	3.826	2.935	0.195	0.0027
		2	LL	12.975	-0.181	-	0.195	-
			MWT	-	4.569	2.964	0.096	0.0009
Breast width, cm	Cocks	1	BRL	22.269	-0.360	1.571	0.659	0.0005
	Hens	1	MWT	9.516	3.204	2.794	0.158	0.0076
Comb size, cm	Cocks	1	WS	2.225	0.605	0.492	0.820	0.0001
		2	WS	0.595	0.267	-	0.820	-
			BRL		0.101	1.025	0.060	0.0001
	Hens	1	WS	1.045	0.407	0.476	0.101	0.0358
Mature weight, kg	Cocks	1	WS	1.328	0.198	0.178	0.786	0.0001
	Hens	1	BRL	0.552	0.051	0.293	0.195	0.0027
		2	LL	0.141	0.023	-	0.195	-
			BRL	-	0.059	0.422	0.188	0.0004
		3	LL	-0.133	0.023	-	0.195	-
			BRL		0.047	-	0.124	-
			BRW		0.034	0.357	0.064	0.0001

Note: BRW = Breast Width (cm); BRL = Breast Length (cm); MWT = Mature Weight (kg); WS = Wattle Size (cm); LL = Leg Length (cm); *P* = model significance; R^2 = Co-efficient of multiple determination.

length, keel length, shank length and shank width. The focus of this study also differs from that of Ojedapo et al. (2008) where they studied the phenotypic correlation between internal and external egg qualities of a commercial layer strain in which they reported low indices (0.01 to 0.48) within and between egg internal and external quality traits; but Oleforuh et al. (2008) obtained higher coefficients (0.02 to 0.83) within egg internal and external quality traits at $p < 0.01$. The result from this study was comparable to the correlation indices (0.15 to 0.77) obtained between body weight and different egg traits in a commercial layer reported by Ayorinde et al. (1988), although they were generally lower than the correlated coefficients reported by Ajayi and Agaviezor (2009).

The stepwise regression model revealed that cock parameters were predicted in Step 1 of the procedure with higher R^2 of 0.66, 0.66, 0.82 and 0.79 for breast length, breast width, comb size and mature weight, respectively. All predictive equations for hen parameters had low R^2 (0.29, 0.16, 0.38 and 0.10), while optimum equations were obtained at the Step 2 of the stepwise procedure for hen parameters, with very low constants (12.98, 9.52, 0.60 and 0.14), respectively.

These equations also indicated that the best predictors of mature weight were wattle size and leg length and breast length in cocks and hens. Breast width was best predicted by breast length in cocks and mature weight in hens. Breast length was optimally predicted by breast width in males, and jointly by leg length and mature weight in females. It was believed that biological components of the measured parameters have contributed to their predictability.

Similarly, the high model significance ($p < 0.05$) of the all equations indicated their adequacy for predictive purposes. The R^2 range obtained from the cock equations (0.66 to 0.82) were higher and closer compared with the wide range (0.16 to 0.95) obtained by Oni et al. (2001a) from parabolic – exponential, and gamma type functions of Wood and McNally (2001), while the R^2 from the hen population were lower than that of cocks but close in range (0.10 to 0.38, $p < 0.05$). This signified that the stepwise model fits the cock better than hen data (Oni et al., 2001b). The R^2 of 0.98 that was obtained by Essien and Adeyemi (1999) from the predictive equations of body weight on age in Lohmann brown and Annak broilers was higher than that obtained ($R^2 = 0.79$) from the regression of mature weight on wattle size in cocks in this study. The R^2 of 0.347 to 0.575 obtained from stepwise regressions by Okon et al. (1997) were intermediate between that of the cocks and the hens in this study. The R^2 from the hen population in this study were lower but closer in range than that (0.11 to 0.86) reported by Abdulrazaq et al. (2010).

Conclusion

The low level of variability observed among Fulani chicken population in Osun implied that a high level of adaptability to the natural environment existed within this ecotype. This study also revealed a lower level of variability within traits compared to exotic broiler strains probably due to high level of inbreeding within the local free-range population. The R^2 also indicated the adequacy of the stepwise model for predicting breast length, breast width, comb size and mature weight better in cocks than in hens. The higher R^2 and constant in male equations suggested a basic difference in the biological mechanism for growth between cocks and hens.

REFERENCES

Abdulrazaq OR, Joseph UI, Ibrahim DK (2010). Regression models for estimating breast, thigh and fat weight and yield of broilers from non invasive body measurements. Agriculture and Biology Journal of North America. ScienceHuβ, Retrieved on July 20, 2012 from http://www.scihub.org/ABJNA. ISSN Print: 2151-7517, ISSN Online: 2151-7525.

Ajayi FO, Agaviezor BO (2009). Phenotypic characteristics of indigenous chicken in Selected Local Government Areas in Bayelsa state, Nigeria. In: Proceeding of the third Nigerian International Poultry Summit. 22-26 February 2009. Abeokuta, Nigeria. Ola, SI; Fafiolu, AO and Fatufe, AA (eds), pp. 75-78.

Aphca News (2006). Bird flu advances in Nigeria. Retrieved in March2008 from http://www.aphca .org/news/news records/news2006/22Feb06 AL.html.

Ayorinde KL, Toye AA, Aruleba, TP (1988). Association between body weight and some egg traits in a strain of commercial layer. Nig. J. Anim. Prod. 15:119-125.

Essien AI, Adeyemi JA (1999). Comparative growth characteristics of two broiler strains raised in the wet humid tropics. Trop. J. Anim. Sci. 1(2):1-8.

Fayeye TR, Oketoyin AB (2006). Characterization of the Fulani-ecotype chicken for Thermoregulatory feather gene. Livestock Research for rural development. 18. Article #3 Retrieved in March 2010 from http://www.cipav.org.co.lrrd 18/3/faye18045.

Goromela EH, 'Kwakkel FP, 'Verstigen MWA, Katule, AM and 'Sendalo, DSC (2009). Feeding System and Management of Village poultry in Tanzania. In: Proceedings of the 3rd Nigeria International Poultry Summit. 22-26 February 2009. Abeokuta, Nigeria, pp. 193.198.

Gueye EF, Ndiaye A, Branckaert DR (1998). Prediction of Body weight on the basis of body measurements in mature indigenous chickens in Senegal. Livestock Research for Rural Development . 10(3). Retrieved on July 20, 2012 from http://www.lrrd.org/lrrd 10/3/sene103.htm.

Ibe SN (1993). Growth performance of normal, frizzle and naked neck chickens in a Tropical Environment. Nig. J. Anim. Prod. 20:25-31.

Latshaw JD, Bishop BL (2001). Estimating Body Weight and Body Composition of Chickens by Using Noninvasive Measurements. Poult. Sci. J. 80(7):868-873. Retrieved in July 2012 from http://ps.fass.org/content/80/7/868.full.pdf.

Mancha YP, Mbap ST, Abdul SD (2006). Phenotypic characterization of local Chickens in the Northern Region of Jos plateau. Trop. J. Anim. Sci. 9(12):47-55.

Nwosu CC, Gowen F, Obioha FC, Akpan IA, Onuora GI (1985). A Biometrical study of the Conformation of the native chicken. Nig. J. Anim. Prod. 12(2):141-146.

Ojedapo LO, Adedeji TA, Olayemi TB (2008). Phenotypic correlation between internal and external egg quality traits of a commercial layer strain. In: Proceedings of the 33rd Annual Conference of Nigerian Society for Animal Production, pp. 31-33.

Okon B, Ogar IB, Mgbere OO (1997). Interrelationship of live body measurements of broiler chickens in a humid tropical environment. Nig. J. Anim. Prod. 24(1):7-12.

Olawumi OO, Salako AE, Afuwape AA (2008). Morphometric differentiation and assessment of function of the Fulani and young ecotype indigenous chickens of Nigeria. Intl. J. Morphol. 26(4):975-980.

Oleforuh VU, Okoleh AI, Adeolu AI, Nwosu CC (2008). Egg quality traits of the Nigerian Light local chicken ecotypes. In: P croceedings of the 33rd Annual Conference of Nigerian Society for Animal Production, pp. 1-2.

Oni OO, Dim NI, Abubakah BY, Asiribo OE (2001a). Egg production curve of Rhode Island Red Chickens. Nig. J. Anim. Prod. 28(1):78-83.

Oni OO, Abubakah BY, Dim NI, Asiribo OE, Adeyinka IA (2001b). Predictive ability of egg production models. Nig. J. Anim. Prod. 28(1):84-88.

Peters SO, Omidiji EA, Ikeobi CON, Ozoje MO, Adebambo OA (2004). Effects of Naked neck and frizzled genes on egg traits, fertility and hatchability in local chicken. Proceeding. Annual conference of Animal Science Association of Nigeria (ASAN), September 13-16, 2004. Ebonyi State University, Abakaliki, pp. 262-264.

Semakula J. Lusembo P, Kugonza DR, Mutetikka D, Ssennyonjo J, Mwesigwa M (2011). Estimation of live body weight using zoometrical measurements for improved marketing of indigenous chicken in the Lake Victoria basin of Uganda. Livestock Research for Rural Development. 23(8). Retrieved on July 21, 2012 from http://www.lrrd.org/lrrd23/8/sema23170htm.

Sola-Ojo FE, Ayorinde KL (2009). Characterization of growth potential of the Fulani ecotype chicken. In: Proceedings of the Third Nigerian International Poultry Summit. 22-26 February 2009, Abeokuta,

Nigeria, pp. 79-83.
SAS/STAT (1999). Statistical Analytical Systems Computer software. Version 8 for windows. SAS Institute Incorporated, N C, USA.
Statistical Package for Social Sciences (SPSS). (2001). Version 10.0. SPSS Incorporated. Illinois. USA.
Wikimedia commons (2012). Retrieved in July 2012 from http://commons.wikimedia.org/wiki/file:squelette_oiseau.svg
Wilson RT, Traore A, Kuit HG, Slingerland M (1987). Livestock production in Central Mali: reproductive, growth and mortality of domestic fowl under traditional management. Tropical Animal health and production. 19(4):229-236. In: Animal breeding Abstract (1988). 56(1).