Biometric measurements of body and internal organ traits of indigenous chickens on free range in South-Eastern NigeriaV. M. O¹. Okoro, G. E.¹ Ejioogu, I. C.¹ Okoli, G. A.¹ Anyanwu, C. T¹. Ezeokeke and C. L.² Okoro¹ Department of Animal Science and Technology, Federal University of Technology, Owerri.² Department of Agriculture, Owerri Municipal Council, Owerri. **Abstract**

A biometric study of the body conformation and internal organs of the indigenous chickens on free range in rural areas of Imo State in South-Eastern Nigeria was conducted using 5 Local Government Areas. It was observed that the predominant plumage colours were black (51.25%) and brown (36.25%) for the hens while the cocks were predominantly black (30.36%) and red (25.01%). The dressed colour of the birds was majorly yellow and white comprising of (70.68%) and (29.32%) for the hens and (77.75%) and (22.25%) for the cocks, respectively. Shank colour was black (95.4%) and white (4.65%) for the hens, while the cocks were (54.24%) black and (46.76%) white respectively. The mean shank length, neck length and back length of 6.725±0.09 cm, 11.11±0.20 cm and 17.77±0.29 cm were estimated for the hens, while the cocks had mean shank length, neck length and back length of 7.79±0.13 cm, 11.35±0.30 cm and 18.29±0.44 cm, respectively. The mean body weights of the hens and cocks were 868.48±21.18 g, and 1032±57.84 g, respectively with cocks being significantly ($P<0.05$) higher in body weight and back length than hens. The mean biometric and internal organ measures of chickens per Local Government Area (LGA) were also investigated with no significant ($P>0.05$) differences among chickens in the five LGAs except for weight of proventriculus and full intestine. Regression equations for the prediction of body weight using the biometric and internal organ measurements were obtained under two functional forms (linear and semi-log) which showed a weak coefficient of determination (R^2) ranging between 7.5 to 24.3% for biometric measurements, and a strong coefficient of determination (R^2) ranging between 21.4 to 98.89% for internal organs. There was no significant correlation coefficient (r) between the biometric measurements taken, but strong and significant correlation (r) was shown between internal organs and body weight. Therefore, indigenous chickens of South-Eastern Nigeria exhibit wide variability among phenotypes in terms of physical appearance, biometric measurement and internal organ characteristics. More so, the internal organs can be predicted more effectively than biometric measurements by the body weight, using regression models of the two functional forms; and significant indirect selection can be made to improve internal organs like gizzard weight using the bodyweight, due to significant correlation coefficient established.

Keywords: - biometric, internal organs, prediction equation, indigenous chicken, extensive, South -Eastern Nigeria.

Introduction

Poultry has been known to contribute about 10% of the total national meat production in Nigeria (FLD, 1983). Akinwumi *et al* (1979) showed that out of the 133 million

poultry raised in Nigeria, the local fowls constituted 123 million while 10 million were of the exotic breeds.

In Nigerian villages, local chickens are commonly reared under extensive system

of management which involves roaming and scavenging for their own food. There is no organized housing or the provision of drugs and vaccination. Thus, the local breed of chickens as reported by Awolola (1986) is allowed to scavenge for food with less management attention. Akinokun and Dettmers (1977) emphasized that the exposure of these chickens to harsh weather conditions affected their performance as a result of short environmental variations in form of weather and management associated with individual hatches.

The need to ascertain the productivity of the local chickens reared in their natural habitat and their possible contribution to the national meat supply and industry is ongoing. However, earlier work done by Hill and Modebe (1961), Oluyemi and Oyenuga (1971), Akinokun and Dettmers (1977), and Nwosu (1979) showed that improved management and feeding improved the productivity of eggs and meat of the local chickens of Nigeria.

Characterization and documentation of the various growth and reproductive traits of the indigenous chicken in their natural environment (not in improved management and feeding) is necessary for the improvement of their productivity. Studies on the characterization of the productivity of the indigenous chicken and conformational characteristics will give rise to their improved breeding and selection since most consumers in Nigeria still prefer them to exotic chicken due mainly to their tasty meat. Feather cover, body positions and conformation vary among regions and countries. Differences in body conformation are particularly

manifested in cockerels (Tadelle, 2003). The physical characteristics like colours of eggs, skin, comb, eyes, earlobes, shanks and plumage and body conformation (i. e. overall shape and appearance) of the indigenous chicken are necessary for their classification. This will facilitate genotype categorization and conservation for the national poultry industry. Dessie *et al.*, (2011) recommended that characterization works use a common set of descriptions developed by international institutions with proven poultry experience so that results across countries and regions can be accurately compared. There is little work done in the documentation of the biometric and internal organ characteristics of the indigenous chicken of South Eastern Nigeria reared on free range. In addition, there is dearth of information on the interrelationships between the internal organs and biometric measurements of indigenous chicken of South Eastern Nigeria. The objective of this study therefore, is to document and provide information on the biometric and internal organ characteristics of indigenous chicken reared on free range, as well as identify relationships between live weights, biometric and internal organ measurements, using prediction equations and correlation coefficients in the indigenous chicken of South Eastern Nigeria.

Materials and Methods

Over 45 farmers were identified as indigenous chicken farmers in 5 local government Areas of Imo State which include Owerri West, Owerri North,

Mbaitoli, Okigwe and Ikeduru Local Government Areas. About 9 farmers were identified per local government. Appointments were booked between the researchers and the co-operating farmers who had evidence of keeping indigenous chickens. On any day of appointment, chickens were restrained by the farmers and weighed with sensitive weighing balance according to the age of the chicken, as reported by the farmer. The lengths of the neck, shank and back were determined using metric tape. Observations of the colours of the plumage and beak were made and number of toes counted. Records were taken from one hundred and seventy-nine indigenous (179) hens and one hundred and twenty-eight (128) indigenous cocks, comprising of 35, 33, 28, 36 and 45 hens and 26, 32, 22, 18 and 30 cocks for Owerri North, Owerri West, Mbaitoli, Okigwe, and Ikeduru LGAs, respectively. A total of 30 chickens were slaughtered for the evaluation of their internal organs and carcass characteristics. The slaughtered samples were made up of 6 chickens per LGA, with equal number of cocks and hens.

Data Analysis:

The mean, percentages, coefficient of variation, Standard Error of Means and Standard deviations were estimated using Proc. Means Procedure of SAS (2001). The relationship between the body weight and the biometrical measurements (shank length, neck length and back length) of the body conformation was established using the Proc Reg. Procedure of SAS (2001) using two functional forms (linear and semi-log) under the multiple regression

models in the equation below:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + e_{ij} \quad \dots \quad (1)$$

Where

Y = the dependent variable (weight of the chicken)

b_0 = constant (intercept)

b_1 = coefficient of slope of X_1 (independent variable; shank length)

b_2 = coefficient of slope of X_2 (independent variable; neck length)

b_3 = coefficient of slope of X_3 (independent variable; back length)

e_{ij} = the residual or error term.

The relationship between the internal organs and the live weight of the chickens was also established using the Multiple Regression model in equation above according to the Proc. Reg. Procedure of SAS (2001) where

b_0 = constant (intercept)

b_1 = coefficient of slope of X_4 (weight of 1cm intestine taken from the vent up to 1cm)

b_2 = coefficient of slope of X_5 (weight of gizzard)

b_3 = coefficient of slope of X_6 (weight of heart)

b_4 = coefficient of slope of X_7 (weight of Spleen)

b_5 = coefficient of slope of X_8 (weight of Liver)

b_6 = coefficient of slope of X_9 (weight of Proventriculus)

b_7 = coefficient of slope of X_{10} (weight of full intestine)

e_{ij} = the residual or error term.

Biomtric measurements of body and internal organ traits of indigenous chickens on free range

Table 1: Percentage Plumage, beak, shank and dressed body colour of Indigenous Chicken of South -Eastern Nigeria.

Sex	Part of Chicken	Percentage colours						Number of Toes
		Black %	Brown %	White %	Orange %	Red %	Yellow (%)	
Hen	Plumage	51.25	36.25	11.25	1.25	-	-	4.00
	Beak	52.25	45.25	2.50	-	-	-	
	Dressed body	-	-	29.32	-	-	70.68	
	Shank	95.4	-	4.65	-	-	-	
Cock	Plumage	30.36	19.63	17.86	7.14	25.01	-	4.00
	Beak	46.25	50.25	3.50	-	-	-	
	Dressed body	-	-	22.25	-	-	77.75	
	Shank	54.24	-	46.76	-	-	-	

Results and Discussion

The major phenotypic characteristics of the indigenous chicken – plumage colour, beak colour, shank colour, dressed body colour and number of toes of the indigenous chicken of South Eastern Nigeria is shown in Table 1. The predominant plumage colours were black and brown for the hens, while the cocks were predominantly black, red and brown coloured. Nwosu *et al.* (1985) had already reported black, red and brown as the commonest colours in indigenous chicken of Nigeria. This red coloured plumage points to the fact that Indigenous chicken of South Eastern

Nigeria has its ancestry to the Red Jungle fowl, which is widely accepted by geneticists to be the common ancestor of domestic chickens (Crawford, 1990; Horst, 1991). The beak colour appeared to be blackish in most hens (52.25%), while the cocks were mainly brown beak coloured (50.25%). Dressed body colour appeared to be predominantly yellowish (77.75% and 70.68%) in cocks and hens respectively. The shank colour was mainly black and white (54.24% and 46.76%) in cocks and (95.4% and 4.65%) in hens respectively. Fletcher *et al.* (1977) suggested that higher light intensity could account for

Table 2: Mean body conformation (Biometric measurements) of indigenous chickens due to sex

Sex	Variables	Parameters			
		X ₁ (cm)	X ₂ (cm)	X ₃ (cm)	Y (g)
Hen	Mean	6.73	11.11	17.77 ^b	868.48 ^b
	SEM	0.09	0.20	0.29	21.18
	SD	0.78	1.81	2.56	188.28
	CV (%)	11.64	16.27	14.43	21.68
Cocks	Mean	7.79	11.35	18.29 ^a	1032.00 ^a
	SEM	0.13	0.30	0.44	57.84
	SD	0.69	1.61	2.35	305.99
	CV (%)	8.90	14.14	12.79	29.65

^{ab} = means on the same column with different alphabets are significantly different (P<0.05)

X₁ = Length of shank (cm)

X₂ = Length of neck (cm)

X₃ = Length of back (cm)

Y = body weight (g)

pigmentation in free range chicken. This could be the reason for the yellow dressed colour and black shank colour of the indigenous chicken which may not be unconnected with consumption of xanthophylls containing materials especially the green leaves and increased light intensity. Most of these divergent phenotypic appearances can also be due to diverse human needs in the form of selective breeding. This phenotypic appraisal contrasts most selected layer and meat type lines of poultry used in commercial production which appears either as black, brown or white plumage coloured for layers and only white for broiler lines. Dessie *et al.*, (2011) reported that there is also remarkable variation in the performance of indigenous chicken within and among breeds which is due to high phenotypic and genetic diversity. This variation is an important genetic attribute of the indigenous chicken, whereby selection

can act to improve their phenotype.

Table 2 shows the mean biometric measurements of indigenous chicken with respect to sex. The body measurements include lengths of shank, neck, back and body weight represented by X_1 , X_2 , X_3 and Y , respectively. There was no significant ($P>0.05$) sex effect on X_1 and X_2 , while X_3 and Y showed significant difference ($P<0.05$) between the two sexes, with males being higher than females. The coefficient of variation (CV) was higher ($P>0.05$) for X_1 , X_2 and X_3 in hens than in cocks, while only in Y is the CV higher ($P>0.05$) in cocks. This implies that there is wide variation for the values of X_1 , X_2 and X_3 in hens than in cocks, while cocks had a wider variation for Y . The significantly higher values of X_3 and Y in cocks than female can be attributed to sexual dimorphism expressed in most avian and mammalian species (Ikeobi *et al.*, 1995).

Table 3 shows the mean body conformation

Table 3: Mean body conformation (Biometric measurements) and visceral organs of indigenous chickens according to LGA of origin

Parameters	LGA					SEM	SD	CV (%)
	Owerri North	Owerri West	Mbaitol	Okigwe	Ikeduru			
X_1 (cm)	6.83	6.67	6.73	5.965	6.95	0.14	1.32	40.52
X_2 (cm)	11.25	12.15	10.75	11.28	10.29	0.43	1.92	50.27
X_3 (cm)	18.28	17.52	16.85	17.77	17.12	0.60	2.55	56.43
Y (g)	872.48	894.52	895.39	926.75	855.49	25.33	202.28	45.50
X_4 (g)	0.66	0.74	0.69	0.73	0.51	0.03	0.45	50.24
X_5 (g)	3.79	2.72	3.53	2.56	4.13	0.11	0.33	39.40
X_6 (g)	0.59	0.47	0.53	0.47	0.59	0.06	0.55	42.20
X_7 (g)	0.20	0.16	0.18	0.19	0.22	0.03	0.50	52.20
X_8 (g)	2.89	1.77	2.97	2.13	2.90	0.12	0.35	45.60
X_9 (g)	0.63 ^a	0.45 ^b	0.78 ^a	0.49 ^b	0.73 ^a	0.04	0.52	48.40
X_{10} (g)	11.16 ^a	7.79 ^b	10.64 ^a	8.45 ^b	9.60 ^{ab}	0.45	1.80	40.55

^{ab} = means on the same row with different superscripts are significantly different ($P<0.05$)

Table 4: Relationship between live weight and body conformation of indigenous chicken

Equation Number	R ² (%)	Prediction equations under two functional forms	Level of Sig.
1.	22.4	$Y = -347.91 + 115.89X_1 + 1.1778X_2 + 23.86X_3$.	**
2.	24.3	$Y = -1980.32 + 802.71\text{Ln}X_1 - 3.50\text{Ln}X_2 + 465.32\text{Ln}X_3$.	**
3.	13.02	$Y = 86.79X_1 + 284.80$.	**
4.	1.59	$Y = 79X_2 + 779.69$.	**
5.	2.14	$Y = 10.75X_3 + 677.47$.	**
6.	14.12	$Y = 597.70\text{Ln}X_1 - 265.85$.	**
7.	1.15	$Y = 86.56\text{Ln}X_2 + 661.21$.	**
8.	2.43	$Y = 210.58\text{Ln}X_3 + 264.87$.	**

** = P<0.01

X₁ = Length of shank (cm)

X₂ = Length of neck (cm)

X₃ = Length of back (cm)

Y = body weight (g)

Ln = Natural log

and visceral organs of indigenous chicken according to the LGAs of origin. Out of the 5 LGAs sampled for this study, there was no significant difference between them for the 9 parameters tested, except weight of proventriculus and weight of full intestine which were significantly different (P<0.05) among the LGAs. Birds from Owerri North, Mbaitoli and Ikeduru were significantly higher in weight of proventriculus than those from Owerri West and Okigwe LGAs while Owerri North, Mbaitoli and Ikeduru were higher in weight of full intestine than those from Owerri West and Okigwe LGAs. These differences in weight of proventriculus and full intestine which is also a between- and within- breed variation is commonly reported wherever evaluation schemes were implemented in the indigenous chicken (Dessie *et al.*, 2011). This is further assuaged by the very high CV (%) reported which ranged from 39.40 to

56.43% among the 9 parameters measured. Table 4 shows the relationship between the live weight and body measurements of indigenous chickens using two functional forms of multi-linear and Semi- log regression with their coefficient of determination (R²) values stated in percentages. Subsequently, linear regression equations of each of the four body parameters on live weight; with their R² values were presented. The two functional forms represented by equations 1 and 2 for Multi-linear equation and Semi-log equations respectively have R² values of 22.4 and 24.3 each, while the simple linear regression of each parameter on live weight had the R² values lying between 1.15 – 14.12% implying that all the coefficient of determination for the two functional forms and linear regressions were low. Although the regression equations are all significant (P<0.01), the low coefficient of variation implies that relationship between the live weight and body measurements is not strong, hence using the equations for prediction will not give a reliable and strong prediction. This finding is completely discordant with most prediction studies

Table 5: Relationship between live weight and internal organs of indigenous chicken

Equation Number	R ² (%)	Prediction equations under two functional forms Sig.	Level of
1.	98.89	$Y = -591.17 + 1.463X_4 + 3.361X_5 + 190.97X_6 + 2.737X_7 + 1.126X_8 + 41.216X_9$	***
2.	97.83	$Y = 2044.59 - 40.05\text{Ln}X_4 + 46.60\text{Ln}X_5 + 1447.20\text{Ln}X_6 - 117.82\text{Ln}X_7 - 62.51\text{Ln}X_8 + 518.27X_9$	***
3.	63.50	$Y = 9.75X_4 + 110.65.$	**
4.	54.52	$Y = 36.47X_5 - 130.92.$	**
5.	2.14	$Y = 250.24X_6 - 331.51.$	**
6.	65.54	$Y = 438.82X_7 + 272.82.$	**
7.	50.06	$Y = 37.28X_8 + 130.02.$	**
8.	60.39	$Y = 235.46X_9 - 412.57.$	**
9.	65.95	$Y = 950.71\text{Ln}X_4 - 3209.58.$	**
10.	58.00	$Y = 1408.72\text{Ln}X_5 - 3829.05.$	**
11.	95.39	$Y = 1531.43^*\text{Ln}X_6 - 1508.78.$	**
12.	67.60	$Y = 1017.50\text{Ln}X_7 + 504.10.$	**
13.	55.34	$Y = 956.837\text{Ln}X_8 - 1949.293.$	**
14.	63.04	$Y = 1635.907^*\text{Ln}X_9 - 1910.142.$	**

** = P<0.01, *** = P<0.001

X₄ = weight of 1cm intestine/full intestineX₅ = weight of gizzardX₆ = weight of heartX₇ = weight of SpleenX₈ = weight of LiverX₉ = weight of Proventriculus

Ln = Natural log.

(Fahmy *et al.*, 1968; Bhadula *et al.*, 1979; Peters *et al.*, 2006). Peters *et al.* (2006) reported a very high and significant R² values in the prediction of live weight from linear body measurement in crossbred chicken using linear and non-linear functional forms. Searle *et al.* (1989) also reported that body weight could be predicted from all body measurement with linear and exponential functions. This could be due to the very high variability identified between- and within- breed and environment of the individuals as well as the extensive system of management applied in the rearing of the birds.

Table 5 shows the relationship between the

live weight and internal organs of the indigenous chicken. Both the multi-linear and semi-log functional forms showed a positive regression coefficient except the semi-log function which showed a negative regression coefficient for weights of intestine (X₄), spleen (X₇), and liver (X₈). The coefficient of determination for the two functional forms ranged from 2.14 to 98.89% with very high level of significance (P<0.001). The multi-linear regression equation had the highest R² value of 98.89% while the simple linear regression for X₆ (weight of heart) had the least R² value (2.14). This result indicates that there is a strong and significant relationship between the internal organs and live weight of indigenous chicken reared extensively. Weight of spleen (X₇) best described the live weight having the highest R² value, under the simple linear functional form, while the linear semi-log form had weight of heart (X₆) best describing the live weight

Table 6: Pearsons Correlation coefficients for relationships between biometric and internal organ measurements of Indigenous chicken

	X1 (cm)	X2 (cm)	X3 (cm)	Y (g)	X4 (g)	X5 (g)	X6(g)	X7 (g)	X8 (g)	X9(g)	X10(g)
X1 (cm)	1.00	-0.332	0.133	-0.415	-0.326	0.383	0.542	0.059	0.267	0.406	0.403
		0.551	0.802	0.413	0.528	0.453	0.267	0.912	0.609	0.424	0.428
X2 (cm)		1.00	0.286	0.331	0.715	-0.598	-0.655	-0.710	-0.722	-0.793	-0.552
			0.583	0.522	0.111	0.210	0.166	0.114	0.105	0.060	0.256
X3 (cm)			1.00	0.417	0.424	-0.448	-0.078	-0.185	-0.406	-0.559	-0.001
				0.411	0.403	0.372	0.883	0.725	0.424	0.248	0.998
Y (g)				1.00	0.843	-0.923	-0.807	-0.655	-0.673	-0.603	-0.435
					<u>0.035</u>	<u>0.009</u>	<u>0.053</u>	0.189	0.143	0.201	0.388
X4 (g)					1.00	-0.882	-0.811	-0.901	-0.715	-0.683	-0.390
						<u>0.02</u>	<u>0.05</u>	<u>0.014</u>	0.110	0.135	0.444
X5 (g)						1.00	0.917	0.765	0.903	0.833	0.688
							0.01	0.076	<u>0.014</u>	<u>0.04</u>	0.131
X6(g)							1.00	0.776	0.861	0.752	0.804
								0.07	<u>0.028</u>	<u>0.085</u>	<u>0.05</u>
X7 (g)								1.00	0.696	0.547	0.434
									0.125	0.261	0.389
X8 (g)									1.00	0.934	0.872
										<u>0.006</u>	<u>0.024</u>
X9(g)										1.00	0.775
											<u>0.07</u>
X10(g)											1.00

X_1 = Length of shank (cm) X_5 = weight of gizzard
 X_2 = Length of neck (cm) X_6 = weight of heart
 X_3 = Length of back (cm) X_7 = weight of Spleen
 Y = body weight (g) X_8 = weight of Liver
 X_4 = weight of 1cm intestine. X_9 = weight of Proventriculus
 X_{10} = weight of full intestine.

going by the very high R^2 value (95.39%) reported.

Table 6 shows the correlation coefficients for the relationships between biometric and internal organ measurements in indigenous chicken. The Table shows that above each row is the correlation coefficient while below the row is the level of significance for the coefficient. The significant relationships include weight of 1cm intestine (X_4) and body weight (Y), weight of gizzard (X_5) and Y , weight of heart (X_6) and Y , X_5 and X_4 , X_6 and X_4 , weight of spleen (X_7) and X_4 , weight of liver (X_8) and X_5 , weight of proventriculus (X_9) and X_5 , X_8 and X_6 , X_9 and X_6 , weight of full intestine (X_{10}) and X_6 , X_9 and X_8 , X_{10} and X_8 , X_{10} and

X_9 . Each of these significant coefficient of correlation (underlined in Table 6) have a high correlation coefficient ranging from -0.882 to 0.934. The following variables X_5 and Y , X_6 and Y , X_5 and X_4 , X_6 and X_4 , X_7 and X_4 were negatively correlated which indicated an inverse relationship while the following variables X_8 and X_5 , X_9 and X_5 , X_8 and X_6 , X_9 and X_6 , X_{10} and X_6 , X_9 and X_8 , X_{10} and X_8 , X_{10} and X_9 were positively correlated thereby implying a direct relationship with each other. This finding implies that for the negative correlation coefficient, there is an inverse relationship between the two variables, while for the positive coefficient; there is a direct relationship between the two variables.

Conclusion

This study has revealed the phenotypic characteristics, biometric and internal organ measurements of the indigenous chicken of South-Eastern Nigeria in terms of sex and location. The phenotypic characteristics have shown wide variability in terms of plumage, shank, dressed body and beak colours of the chickens. The attempt to develop a prediction equation for live weight using the biometric and internal organ measurements has shown a very weak relationship between biometric measurements and live weight, indicating that an increase in the growth trait of any component will not correspondingly increase body weight, while that between internal organs and live weight demonstrated a very strong relationship, implying that internal organs have a direct relationship with live weight in indigenous chicken of South Eastern Nigeria. The correlation study showed a significant and high relationship between the body weight and some internal organs. This further buttresses the regression analysis results which established a strong and significant relationship between internal organs and live weight. This implies that the internal organs can be predicted significantly using the body weight, while a meaningful indirect selection can be achieved by improving the internal organs using the body weight; due to significant correlation established between the two.

References

- Akinokun, O. and Dettmers, A. 1977. Comparison of Ife breed of indigenous chicken of Nigeria with the Exotic strain II. Body weight and sexual maturity. A paper presented at the 4th Annual Conference of Nigerian Society of Animal Production. University of Ife, March 1977. Pp 17-23.
- Akinwumi, J. A., Adegeye, A. J., Ikpi, A. E. and Olayide, S. O. 1979. Economic analysis of the Nigerian Poultry Industry. Federal Livestock Department (FLD), Lagos.
- Awolola, M. D. 1986. A case study on adoption of recommended practices in poultry keeping. A Poultry Association of Nigerian Magazine; 1986 Pp 57-58, Maiden Issue.
- Bhadula, S. K., Bhat, P. N. and Garg, R. C. 1979. Prediction of body weight from body measurements in sheep. *Indian Journal of Animal Science*, 49, 775-777.
- Crawford, R. D. 1990. Origin and history of poultry species, in: Crawford, R. D. (Ed). *Poultry Breeding and Genetics* (Elsevier, Amsterdam) Pp 23–26.
- Dessie, T., Taye, T., Dana, N., Ayalew, W., and Hanotte, O. 2011. Current state of knowledge on phenotypic characteristics of indigenous chicken in the tropics. *World's Poultry Science Journal*, 67: 507–516.
- Fahmy M. H., Salah, E. and Galal, E. 1968. A study of weight and body dimensions of lambs and the predictions of weights using some linear dimensions. *Tropical Agriculture*, 45: 33-38
- FLD 1983. Annual Report. Federal

- Livestock Department, Lagos 1983. Pp 4–6.
- Fletcher, D. H., Janky, D. M., Voitle, R. A. and Harms, R. H. 1977.** Improved indigenous hen evolved by selective breeding. *Poultry Science* 56, 953-957.
- Hill, D. H. and Modebe, A. N. A. 1961.** Poultry Production at University College, Ibadan 1950-58. Tech. Bull No. 2, Faculty of Agriculture, University College, Ibadan, Nigeria.
- Horst, P. 1991.** Native fowl as reservoir for genomes and major genes with direct and indirect effects on the adaptability and their potential for tropically oriented breeding plans: A review. *Animal Research and Development* 33: 63-79.
- Ikeobi, C. O. N., Peters, S. O. and Ebozoje, M. O. 1995.** Sexual dimorphism in two strains of broiler chicken. *Nigerian Journal of Genetics*, 10: 16-22.
- Nwosu, C. C. 1979.** Characteristics of the Local chicken of Nigeria and its potential for egg and meat production. In proceedings of the 1st National Seminar on Poultry Production held at ABU, Zaria. Dec. 11 – 13 1979. Pp 23-26.
- Nwosu, C. C., Gowen, F., Obioha, F. C., Akpan, I. A. and Onuora, G. I. 1985.** A biometrical study of the conformation of the native chicken. *Nigerian Journal of Animal Production*, 12 (2), 12-17.
- Oluyemi, J. A. and Oyenuga, V. A. 1971.** A preliminary evaluation of the Nigerian Indigenous fowls as table birds. In proceedings of Agricultural Society of Nigeria, July, 1971. 8: 5–8.
- Peters, S. O., Adeleke, M. A., Ozoje, M. O., Adebambo, O. A. and Ikeobi, C. O. N. 2006.** Bio-prediction of live weight from linear body measurement traits among pure and crossbred chicken. *Nigerian Poultry Science Journal* 4: 1–6.
- SAS 2001.** SAS users guide. Statistics released version 9.0. Statistical Analysis System Institute, Inc. Cary, N.C.
- Searle, T. W., McGraham, N. and Donnelly, J. R. 1989.** Changes of skeletal dimensions during growth in sheep: the effect of nutrition. *Journal of Agricultural Science (Cambridge)* 10 (2): 112-117.
- Tadelle, D. 2003.** Phenotypic and genetic characterization of local chicken ecotypes of Ethiopia. *PhD Thesis*, Humboldt University, Germany, 209 pp.

Received: 12th July, 2012

Accepted: 22nd November, 2012