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LINEAR BODY MEASUREMENTS AS PREDICTORS OF BODY WEIGHT IN NIGERIAN LOCAL CHICKENS

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ABSTRACT

Data on body weight (BW) and body measurements [linear body length (BL), chest circumference (CC), crus (CS), femur (FR), tarsometatarsus (TM)] were individually collected from 300 mature local chickens at three markets in Makurdi Local Government Area (LGA) of Benue State between February and June 2005. The objective of the study was to establish relationships between body weight and body measurements in local chickens and apply the data to predict body weight from body measurements. Data collected were subjected to least squares analysis using the generalized linear procedure. They were also subjected to regression and correlation analyses. Results indicated that males showed higher values for BW and body measurements (P< 0.05} than the females. The correlation coefficients (r) between BW and CC (r = 0.62 for males and r = 0.74 for females) and BW and BL (r = 0.72 for males and r = 0.68 for females) were strong, positive and significant (P< 0.001). BW had a linear relationship with both CC (R^2 =0.52 and 0.62) and BL (R^2 = 0.47 and 0.13) for males and females, respectively. Thus CC and BL are the body measurements that are most appropriate for the prediction of body weight in local chickens.

Keywords: Local chicken, Body weight, Body measurements, Prediction.

INTRODUCTION

The local chickens in Nigeria have for long been neglected in spite of the fact that they supplement a great deal of daily protein requirements both in the urban cities and rural areas. In terms of numbers, the local chickens constitute about 92% of the total poultry population in Nigeria (Akinwumi *et al*., 1979). Despite the importance of the local chickens to the Nigerian economy, their production systems remained traditional and their marketing system is quite informal and poorly developed.

Body weight is an important attribute of farm animals as it forms the basis for not only assessing growth and feed efficiency but also in making economic decisions. It has been reported by Nwosu *et al*. (1985a) that live weight is the best parameter for making management, health and production and marketing decisions. Body weight is also regarded as a function of framework or size of the animal and its condition. Variation in body weight within a flock can be attributed to genetic variation and environmental factors that impinge on individuals (Ayorinde and Oke, 1995).

The relationship existing among linear body traits provides useful information on the performance, productivity and carcass characteristics of animals. Most of the linear measurements reflect primarily the length of the long bones of the animal and when taken sequentially over a period of time, they generally indicate the way in which the animal body is changing shape and have been used as predictors of live weight and carcass composition (Oke *et al.,* 2004). Relationships between body weight and linear body measurements are important not only in predicting body weight but also useful in genetic improvement strategies.

In an organized livestock marketing system, weight ought to be taken to determine the market prices of animals. This requires the use of weighing scales which, quite often may not be available to the rural livestock and poultry farmers/traders. There are other indirect methods of assessing body weights in animals without recourse to the use of weighting scales. An example is the use of body measurements to predict body weight. A lot of works have been done in this regard in larger animals, particularly cattle, sheep and goats (Nwosu *et al*., 1985a; Attah *et al.,* 2004; Sowande and Sobola, 2007; Goe, 2007). In poultry, Oke *et al.* (2004) related body weight with some egg production traits in the guinea fowl while Teguia *et al.* (2008) reported significant associations between body weight and some body characteristics in the African muscovy ducks. Several characterization works on the Nigerian local chicken had reported on their body weights and linear body measurements (Nwosu *et al.*, 1985b; Nwosu, 1990) but few had attempted to predict body weight of the local chicken from linear body measurements.

The objective of this study was, therefore, to examine the relationship between body weight and linear body measurements in local chickens in Makurdi Local Government Area of Benue State so as to develop an equation for predicting body weight from linear body measurements.

MATERIALS AND METHODS

This study was carried out in Makurdi and its environs. Makurdi which is the capital of Benue State and also the Headquarters of Makurdi LGA is situated within longitude 8^{o} 37^{1}E and latitude 7^{o} 41^{1}N with an altitude of 97m above the sea level. It falls within the sub humid climate with mean annual rainfall of 2000mm and temperature of 32.5^{o}C

The study was carried out between February and June 2005. The data on body weight and linear body measurements were individually collected from 300 local chickens (116 males and 184 females) at three markets, namely Fidi, Northbank and Modern markets. The birds in these markets were brought for sales by rural farmers who raised them under scavenging systems. Individual body weight was taken using a 20kg capacity kitchen scale while the body measurements were taken using a measuring tape and in accordance with the procedures described by Salomon (1996). The body measurements included body length (BL), chest circumference (CC), crus (CS), femur (FR) and tarso-metatarsus (TM). These were measured as follows:

BL: Length between the (the lower end) of the Rostrum maxillae (beak) and that of the caudal tail (without feathers). The bird's body was completely drawn throughout its length.

CC: Circumference of the chest was taken at the tip of the pectus (hid breast).

FR: length between the mid region of the coax (hip bone) and that of the Genu (knee).

CS: length between the mid region of the Genu and that of the Regio tarsalis.

TM: length between the mid region of the Regio tarsalis and the outset of the Digitalus pedis IV.

Statistical Analysis

The data on body weight and linear body measurements were analysed using the General Linear Model procedure of SAS (1998). The statistical model used was:

$Y_{ij} = \mu + S_i + e_{ij}$

where, Y_{ij} = estimated value for the body weight or linear body measurement, μ = population mean, S_i = fixed effect of sex and e_{ij} = residual error.

Pearson correlation coefficients were estimated between BW and all body measurements. Data were also subjected to simple and multiple regression analyses.

RESULTS AND DISCUSSION

The mean ± SEM values of BW and body measurements according to sex of mature Nigerian local chickens as obtained from market sheds are presented in Table1.The males showed higher values for BW and body measurements ($P < 0.05$) than the females. This is expected since males are heavier than females. Similar observations had been made in indigenous chickens by Missohou *et al.* (1997) and Ngou Ngoupayou (1990). Hassan and Adamu (1997) also observed higher values for these parameters in indigenous male pigeons when compared with the females.

Although information on the age of the birds brought to the markets could not be obtained because neither the indigenous chicken keepers nor traders were aware of the ages, the average body weight of the sampled birds indicated that they were about 6 months of age because Nwosu (1977) reported similar values for the Nigerian local chickens at this age under extensive system of management.

There were large variations in linear body measurements of the local chickens especially in body length and chest circumference as indicated by their respective SEM. The implication here is that there exists opportunities for selection for BL and CC in local chickens. If these traits are positively correlated to any economic trait in chicken, selection for them would lead to improvement in the economic traits.

Table 2 shows the Pearson's correlation coefficients between body weight and body measurements for both males (above diagonals) and females (below diagonals).The correlation coefficients between the BW and body measurements were both positive and significant ($P<0.001$) in the males. In the females, BW was only positively and significantly ($P<0.001$) correlated to BL and CC, with FR, CS and TM demonstrating non significant ($P>0.05$) correlation with BW. Gueye *et al.* (1998) reported a similar observation in indigenous Senegalese chickens. In both sexes highest correlations of BW were found with BL (r = 0.72 and 0.68 for males and females, respectively) and CC (r = 0.62 and 0.74 for males and females, respectively) in comparison with other body measurements. This agrees with the report of Hassan and

Adamu (1997) that body length as well as chest width were strongly and significantly correlated to body weight in indigenous pigeons. In the African muscovy duck, Teguia *et al.* (2008) reported highest correlation coefficients of body weight with wing length and thoracic perimeter in both male and female.

The prediction equations consisting of body measurement values based on both linear and multiple regressions are presented in Table 3. Live body weight had a simple linear relationship with both BL (R^2 = 0.47 and 0.13) and CC (R^2 = 0.52 and 0.62) for male and female, respectively. When BL and CC were combined in a multiple regression, R^2 in both male and female increased to 0.67 and 0.68, respectively. In both sexes the high R^2 values of the multiple regression equations when compared with the simple linear regression equations showed that multiple regression technique was better in predicting BW from body measurements than simple linear regression technique. For instance, when multiple regression technique based on BL and CC were used instead of linear regression, there were improvements of about 43 to 29% in R^2 values for males and about 423 to 10% in R^2 values for females. When other body measurements were included in the prediction equations no substantial improvements in R^2 values were observed. BL and CC gave higher R^2 value than the other body measurements, hence only the prediction equations involving BL and CC are presented.

CONCLUSION

This study which was designed to predict body weight from body measurements of mature Nigerian local chickens have demonstrated the feasibility of estimating body weight of mature local chicken from body measurements. Thus, using only a measuring tape, it is possible to estimate the body weight of these chickens. BL and CC are the most suitable body measurements for this purpose. The prediction formulae provided in this study can assist both the trader and the buyer to have an accurate, easy, cheap and rapid means of obtaining body weight of mature Nigerian local chicken without recourse to a weighing or spring balance measurements.

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Table 1: Mean ± SEM Body weight and body measurements of local chicken from sheds in Makurdi L.G.A., Benue State

Parameter	Male	Female
Body weight (kg)	1.36 ± 0.24a	1.06 ± 0.21b
Body measurement (cm):		
Body length	44.80 ± 2.74a	40.73 ± 2.40b
Chest circumference	26.33 ± 2.11a	24.65 ± 1.85b
Crus	9.51 ± 0.97a	8.9 ± 0.70b
Femur	21.67 ± 1.34a	19.29 ± 1.36b
Tarso metatarsus	7.21 ± 0.76a	6.6 ± 0.71b

a,b = Mean with different superscript on the same row are significantly different (P < 0.05).

Table 2: Correlation coefficients between body weight (BW) and body measurements[a] in Nigerian local chicken

	BW	BL	CC	F	C	TM
BW	-	0.72***	0.62***	0.59***	0.35***	0.51***
BL	0.68***	-	0.48***	0.66***	0.72***	0.67***
CC	0.74***	0.23*	-	0.24*	0.17ns	0.25**
F	0.10ns	0.47***	0.13ns	-	0.68***	0.59***
C	0.21ns	0.48***	0.02ns	0.53***	-	0.71***
TM	0.13ns	0.59***	0.01ns	0.42***	0.60***	-

a = The above diagonal coefficients are for males while below diagonal are for females.
* = (P <0.05) ** = (P < 0.01) *** = (P < 0.001) ns = (non significant) (P > 0.05)

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Table 3: Prediction of body weight (BW, g) from body length (BL, cm) or/and chest circumference (CC, cm)

Sex	Regression equation	R2	Significance
Male	BW = -1045 + 74.1 BL	0.47	***
Male	BW = -897 + 80.3 CC	0.52	***
Male	BW = -2124 + 46.4 BL + 59.1 CC	0.67	***
Female	BW = -357 + 38.6 BL	0.13	**
Female	BW = -1227 + 90.5 CC	0.62	***
Female	BW = -1752 + 17.0 BL + 85.9 CC	0.62	***

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