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RELATIONSHIPS BETWEEN BODY WEIGHTS AND MORPHOMETRIC TRAITS OF INDIGENOUS NORMAL FEATHERED CHICKENS

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ABSTRACT

A study was carried out to ascertain the relationships between body weights and body morphometric traits of indigenous normal feathered chickens including chest girth (CG), body length (BL), thigh length (THL), shank length (SL), Shank circumference (SC), wing length (WL) and keel length (KL) of indigenous normal feathered chicken progenies. One hundred and thirtyeight (138) birds comprising of Ninety-six (96) males and Fourty two (42) females generated from the foundation stock were used for the experiment. Data were analysed with the help of SAS (Version 9.1) for correlation and regression analysis. The relationships among growth traits were positive, high and significant (P<0.01) in both sexes. Highest correlations between BW and CG (0.897) and between BW and THL (0.843) were observed in both males and females, respectively. Prediction equations obtained for both sexes indicated that coefficient of determination (R^2) is high in the models. CG and SC (0.80) were the best linear body measurements that predicted BW in males and SL (0.63) was the best predictor in females. The study concluded that body weights could be predicted using body morphometric traits with high degree of accuracy.

Keywords: Body weight, Normal feathered Chicken, Correlation, Morphometric Traits, Regression equation

INTRODUCTION

Nigeria is endowed with vast number of poultry species. It has a heterogenous chicken population of about 175 million and over 60% of the total are indigenous chicken (Fayeye, 2011) and mainly located in rural areas. Some merits of indigenous chicken include hardiness, adaptation to harsh weather conditions, ability to live on minimal resources regarding feed, medication and shelter (Ajayi, 2010). These birds especially at the level of family, provides high quality protein and resources (Gueye, 2003). Based on plumage colour, the chickens are classified into normal feathered, naked neck and frizzled feathered (Udoh *et al*., 2012). The normal feathered are the most predominant and possess straight feathers covering the entire skin. They are subdivided into various ecotypes by size and locations (Olawunmi *et al*., 2008). They scavenge for food and produce eggs all the year round.

According to Fayeye *et al*. (2014), growth is a dynamic and complex physiological process that starts instantly after a zygote is formed up to the time of maturity. Body weight and body measurements are relevant factors considered by poultry breeders/farmers (Adeniji and Ayorinde, 1990). Body weight is a parameter normally used for assessment of growth in livestock, however, other growth traits related to body morphometric which includes chest girth, body length and shank length (Ige, 2013; Yunusa and Adeoti, 2014) could also serve as growth indicators.

The relationships existing among growth traits provides critical information regarding the productivity and performance of the birds. Similarly, Adeniyi and Ayorinde (1990) observed that relationships existing between body weights and body measurements also reflect on performance of the chickens. Most of the body measurements basically indicates the length of the long bone in an animal recorded consecutively for a number of time (Oke *et al*. (2004). The study was therefore undertaken to assess the relationships between body weights and body morphometric of indigenous normal feathered chickens and use the information for body weight prediction.

MATERIALS AND METHODS

Study Area

The experiment was carried out at the Poultry Production Unit (PPU) Potiskum, Yobe State. Potiskum is located between latitudes 11^0 03’ and 11^0 30’ N, longitudes 11^0 50’ and 11^0 51’ E at an altitude of 427 m above sea level having an average rainfall of 700mm/annum (Bunmi *et al*., 2016).

Experimental Birds and Their Management

Sixty matured and healthy indigenous normal feathered chickens comprising of fifty females and ten males of breeding age were used as foundation stock to generate offsprings for the experiment. The birds were purchased from households and village markets. Each batch of chickens bought was quarantined for two weeks and fed layers’ mash containing 18% CP and 2650 ME/kg. Before the birds arrived, pens were thoroughly cleaned, disinfected and sawdust were applied. The drinkers and feeders were also washed and cleaned.

The parental stock was divided in to ten breeding groups; each group comprising of six birds at 1:5 mating ratio. Laying boxes for natural incubation were used. Feed and water were available throughout the experiment. Chicks hatched were identified and brooded together. Commercial diets were fed (chick mash 0-8 weeks, grower crumble 9-19 weeks and layer pellets at 20 weeks on ward) containing 20, 16 and 18% CP with 2780, 2600 and 2650 ME/kg respectively. Vaccination of the birds against common disease in the place was carried out and all routine management were strongly adhered.

Data Collection

Data were collected on Body weight (BW) and body measurements which includes body length (BL), Chest girth (CG), Shank length (SL), Shank circumference (SC), Keel length (KL), Wing length (WL) and Thigh length (THL) for each bird among 66 cocks and 57 hens from at 24 weeks of age. Digital weighing balance and tape rule were used for taken body weights and body measurements of the birds, respectively, as described by (Adeleke *et al*., 2011).

Statistical Analysis

Estimation of Pearson's correlation coefficients between body weights and body morphometrics were done with help of SAS (Version 9.1). Regression of body weights on body morphometric traits were estimated using the same statistical package. The correlation and regression equations are as follows;

$$r = \frac{\sum X_i \, Y_i}{\sqrt{\Sigma X^2 i \; \Sigma Y^2 i}}$$

a + bX + e (1) Simple regression model

$a + b_i X_i + b_2 X_2 \ldots + b_k X_{k} + e_2$ (2) Multiple regression model

RESULTS AND DISCUSSION

Table 1 shows the Pearson correlation coefficients for body weights and body morphometric traits in male and female chickens. There were very high significant positive correlations ($P < 0.01$) between body weight and chest girth, body length, thigh length, shank length, shank circumference, wing length and keel length in both sexes. Similar trends ($P < 0.01$) were recorded among the traits studied in both sexes. The higher values of correlations observed in indigenous chickens indicate that body weight and linear body measurements are under similar physiological and genetic mechanism. This also reveals adaptability of breed to favourable environmental condition of the study area and hence selection of these traits will lead to increment in selection response. The findings in this study is in conformity with Oleforuh-Okoleh *et al*. (2017) who also reported a high correlation between body weight and shank length in indigenous normal feathered (0.62 to 0.94) where as in the naked neck genotype it was between body weight and body length (0.73 to 0.94), respectively. In a related study, Adeleke *et al*. (2011) recorded phenotypic correlation of 0.15 to 0.92 between body weight and breast girth at day old and 20 weeks of age in Nigerian local chickens. The results of this study corroborates the findings of Adeyinka *et al*. (2006) who reported high phenotypic correlation estimates among body measurements of broiler chickens. Also, Haunshi *et al*. (2012) also observed high and positive phenotypic relationships between body weight and shank length of local chickens. This implies that the aforementioned traits could be important for selection. The findings of this study indicated that selection for any of these morphometric traits will directly lead to the improvement in body weights of local chicken which is tantamount to the findings of Tabassum *et al*. (2014).

Table 1: Pearson correlation between body weight and morphometric traits of indigenous normal feathered chickens

	BW	CG	BL	THL	SL	SC	WL	KL
BW		0.897**	0.711**	0.762**	0.857**	0.895**	0.504**	0.770**
CG	0.706**		0.760**	0.793**	0.882**	0.891**	0.645**	0.797**
BL	0.567**	0.746**		0.711**	0.756**	0.891**	0.587**	0.652**
THL	0.648**	0.698**	0.843**		0.722**	0.748**	0.649**	0.689**
SL	0.793**	0.793**	0.732**	0.820**		0.887**	0.670**	0.827**
SC	0.755**	0.736**	0.692**	0.762**	0.791**		0.536**	0.759**
WL	0.594**	0.733**	0.731**	0.794**	0.795**	0.679**		0.672**
KL	0.607**	0.747**	0.829**	0.823**	0.777**	0.742**	0.763**	

**= $P<0.01$, upper diagonal=male, lower diagonal= female, BW= Body weight, CG= Chest girth, BL= Body length, THL= Thigh length, SL= Shank length, SC=Shank circumference, WL= Wing length, KL= Keel length

Table 2 shows the regression equations for body weight prediction in indigenous chickens. Based on Coefficient of determination (R^2) values in males, chest girth and shank circumference (0.80) were the best body linear parameters that predicted body weight followed shank length (0.74), keel length (0.59), thigh length (0.58), body length (0.51) and wing length (0.25), respectively. Addition of multiple linear body parameters to predict body weight has increased the prediction accuracy to (0.87). On the other hand, in females, shank length was the best body linear parameter that predicted body weight with highest accuracy (0.63), followed by shank circumference (0.57), chest girth (0.50), thigh length (0.42), keel length (0.37), wing length (0.35) and body length (0.32) in decreasing order. The introduction of multiple linear body parameters in body weight prediction has yielded higher prediction accuracy (0.70) than any single linear body measurement among females. Higher value for the prediction accuracy implies a better variance that the dependent variable is explained by independent variable. This study reveals that chest girth, shank length and shank circumference could be used to predict body weight with greater precision. These results are related to the findings of Dahloum *et al*. (2016) who observed positive and high association between body weights and linear body traits, indicated that chest girth and shank length as the best predictors of body weight indigenous chicken of Sri lanka. In another results, Liyange *et al*. (2015) observed a high and positive relationships among body weight and morphometric traits, while chest girth and shank length were relatively the best predictors of body weight. In a related study, Abdel-latiff (2019) reported chest girth (R^2 =0.62) and shank length (R^2 =0.65) in white leghorn and chest girth (R^2 =0.45) and shank length (R^2 =0.54) in Coshin chickens had better prediction of body weight. Also, Ige *et al*. (2006) observed that accumulation of muscle in chest and thigh region create a positive and strong association among chest girth or shank length with body weight. In another study, Ukwu *et al*. (2014) recorded high R^2 values in wing length (0.66), thigh length (0.70) and body length (0.79), respectively in indigenous chicken of Nigeria. The high R^2 obtained in this study showed that these traits could be utilized for body weight prediction with good efficiency.

Table 2: Body weight prediction using morphometric traits of indigenous normal feathered chickens

Predictor	**Equation**	**R^2**
Males		
CG	BW= -2260.96 + 143.66CG	0.80
BL	BW= -523.13 + 58.35BL	0.51
THL	BW= -1693.56 + 155.99THL	0.58
SHL	BW= -2134.14 + 332.22SL	0.74
SC	BW= -1718.02 + 627.90SC	0.80
WL	BW= -1306.40 + 137.07WL	0.25
KL	BW= -4421.12 + 420.45KL	0.59
CG, BL, THL, SL, SC, WL, KL	BW= -2347.59 + 60.90CG + 4.56BL + 27.85 THL + 59.65SL + 211.37SC – 56.74WL + 66.23KL	**0.87**
Females		
CG	BW= -1480.85 + 109.92CG	0.50
BL	BW= -531.25 + 55.19BL	0.32
THL	BW= -511.24 + 86.11THL	0.42
SL	BW= -2134.14 + 239.95SL	0.63
SC	BW= -2022.14 + 689.19SC	0.57
WL	BW= -1067.64 + 116.19WL	0.35
KL	BW= -281.45 + 281.45KL	0.37
CG, BL, THL, SL, SC, WL, KL	BW= -1552.02 + 35.49CG -11.41BL + 6.07 THL + 173.57SL + 320.44SC – 27.42WL – 47.19KL	**0.70**

R^2= Coefficient of determination, BW= Body weight, CG= Chest girth, BL= Body length, THL=Thigh length, SL= Shank length, SC=Shank circumference, WL= Wing length, KL= Keel length

Table 3 shows the stepwise regression equations of body weights on morphometric traits of indigenous normal feathered chickens. In males, CG alone accounted for 80.4% of the variability of BW. The addition of SC rose part of the explained variance to 84.9%. Also, addition of WL and KL increases the variability at 85.4% and 86.2% of BW in the model. Further inclusion of THL and SL also increases variability of BW at 86.8% and 87.8% in the model with greater precision. In females, SL solely accounted for 60.9%, inclusion of SC and WL increases the variability of BW at 66.1% and 68.4%, respectively. Regression coefficient of determination increases in both sexes. The findings of this study indicated that body weight of indigenous normal feathered chickens can be predicted from morphometric traits with a high degree of accuracy which is in concomitant with the result of Ige *et al.* (2014) and Lamido *et al*. (2022).

Table 3: Regression of body weights on body morphometric traits of indigenous normal feathered chickens

Step	Predictor(s)	Regression equation	R^2
Males			
1	CG	BW= -2261 + 143CG	0.804
2	CG, SC	BW= -2178 + 77.3CG + 326SC	0.849
3	CG, SC, WL	BW= -1938 + 90.0CG + 314SC -27WL	0.854
4	CG, SC, WL, KL	BW= -2509 + 80.9CG + 281SC – 39WL + 88KL	0.862
5	CG, SC, WL, KL, THL	BW= -2522 + 72CG + 2257SC – 49WL + 87KL + 28THL	0.868
6	CG, SC, WL, KL, THL, SL	BW= -2393 + 64CG + 193SC – 57WL + 65KL + 32THL + 73SL	0.873
Females			
1	SL	BW= -1315 + 243SL	0.609
2	SL, SC	BW= -1918 + 152SL + 337SC	0.661
3	SL, SC, WL	BW= -1121 + 187SL + 405SC -110WL	0.684

R^2= Coefficient of determination, BW= Body weight, CG= Chest girth, BL= Body length, THL=Thigh length, SL= Shank length, SC=Shank circumference, WL= Wing length, KL= Keel length

CONCLUSION

This study showed that body weights is highly associated with body measurements. This implies a high chance of arriving at correlated response when selection is applied on a single trait of the normal feathered chickens. Body weight can be predicted using morphometric traits especially chest girth, shank length and shank circumference. Therefore, rural farmers in markets or scientists under field conditions can easily use this tool to predict body weight. The findings of this study will greatly assist in indigenous chicken selection programmes.

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