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Prediction of live body weight in exotic turkey (*Meleagris gallopavo*) using linear body measurements in South-West Nigeria

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1 ABSTRACT

The objective of this study was to predict the live body weight of exotic turkey using linear body measurement. Data on linear body measurements collected from one- hundred and two (102) exotic turkeys at the age of six month were used to predict the live body weight of the turkey and determine the effect of sex on the variables. Sex had a significant effect ($p<0.05$) on virtually all the variables in favour of the male except on body weight and thigh length. The body weight, shank length, thigh length, body length, wing length, wing span and breast girth for males were 8.84 kg, 9.97 cm, 23.40 cm, 76.27 cm, 35.87 cm, 80.27 cm and 60.20 cm respectively, while the corresponding values for female were 8.16 kg, 8.31 cm, 22.29 cm, 68.47 cm, 32.93 cm, 73.65 cm and 57.24 cm. The correlation coefficients between body weight and the linear measurements in the two sexes were positive and mostly significant in male. It ranged between 0.471 and 0.859 in male and 0.031 and 0.539 in female. Coefficient of determination was highest (0.481) in breast girth and followed by body length (0.399) in simple linear regression. The coefficient of determination among the multiple regression models ranged between 0.409 and 0.671. Live body weight of six month old exotic turkey could be predicted using simple and multiple linear regressions.

2 INTRODUCTION

There is a consensus amongst researchers working with different livestock and poultry species that morphometric characteristics could serve as predictors of body weight and carcass parameters. Different studies have exploited correlations of morphometric measurements with body weight and carcass parameters to develop techniques for estimating body weight and carcass parameters in different livestock and poultry species, where weighing scales may not be available. (Adeoye, *et al.,* 2017 and Adeoye, et al 2018)The estimation of body weight using morphometric measurements becomes very useful in smallholder livestock and poultry producers who rarely keep birth records. Measurements of various morphometric traits are of value in estimating body weight and carcass parameters in livestock and poultry production and because of the relative ease in measurements they can be used as an indirect method of predicting body weight (Adeoye, *et al.,* 2018).These will provide good information on performance and productivity of livestock and poultry. The use of morphometric measurements to predict body weight or carcass parameters would overcome many of the problems associated with visual assessment or evaluation. Body weight has a direct relation to the production and profitability of any livestock enterprise. It has

been reported by Nwosu et al (1985) that body weight is the best parameter for making management, health and production and marketing decisions. As a result of this, there is need to develop objective means for describing and evaluating body weight and conformation characteristics especially in smallholder livestock and poultry production sector where measuring scales are unavailable. Morphometric characteristics have been a recurring interest to livestock production either to supplement body weight as a measure of productivity or as predictors of some less visible characteristics (Supriyantono *et al.,* 2012). Body weight measurement is used mostly to evaluate body development in livestock and poultry production ((De Brito Ferreira *et al.,* 2000), but it is not easily measured in the field. Several studies have shown that body weight has a direct relationship with morphometric characteristics and carcass parameters in cattle (Tennant *et al.,* 2002; Bozkurt, 2006; Alphonsus *et al.,* 2010; Milla *et al.,* 2012), in goats (Nsoso *et al.,* 2004; Otoikhain *et al.,* 2008; Mahieu *et al.,* 2011), in sheep (Baffour-Awuah *et al.,* 2000; Sowande and Sobola, 2008, in pigs (Brannaman 1984), in rabbits (Pinna *et al.,* 2004;Chineke 2005), in poultry (Ige *et al.,* 2006;Ogah, 2011;) and fish (Cherif *et al.,* 2008 ;Yakubu *et al.,* 2012; Adeoye *et al.,*2016). The objectives of this study were to determine the best regression equation that predict the live body weight of exotic turkey at sixth month of age and to determine the correlation coefficients between the body weight and the linear measurements.

3 MATERIALS AND METHODS

The experiment was carried out at Turkey unit of Teaching and Research Farm of Ondo State University of Science and Technology, Okitipupa. Ondo State. Okitipupa is located between latitude 6°53' N and longitude 4°53' E (Worldatlas.com). The area lies within the rain forest zone of Nigeria.

3.1 Experimental Animals: One- hundred and two (102) day old turkeys (poults) bought from a reputable hatchery in Ibadan were reared at the Turkey Unit of Teaching and Research Farm of Ondo State University of Science and Technology, Okitipupa. The management system was intensive whereby the turkeys were fed with commercial feed and water supplied *adlibitum* in deep litter housing till six months of age.

3.2 Data collection: At sixth month of age the weights of the birds were obtained using a 20 kg weighing scale, while a measuring tape was used for body measurements in centimetre. Wing Length (WL) was taken from the shoulder joint to the extremity of terminal phalanx while Shank Length (SL) was measured from the hock joint to the spur. Thigh Length (TL) was taken as the distance between the hock joint and the pelvic joint. Body Length (BL) is the length between the tip of the *rostrum maxillare* (beak) and that of the *cauda* (tail, without feathers). Breast girth (BG) was taken under the wing at the edge of the sternum while wing span (WS) is length between tips of right and left wings after both are stretched out in full. To ensure accuracy, each measurement was taken twice and the mean was used in subsequent analysis. All the measurements were taken by the same person

3.3 Data Analysis: The data collected were subjected to analysis of variance to determine the summary statistics and sex effect on the growth traits using SAS (2003). Pearson correlation was used to determine the correlation coefficients among the traits on sex basis. Stepwise multiple regression analysis was used by including the different linear measurements individually and collectively, to identify the best predictor variables for estimating the body weight. Body weight and regression equation were compared based on coefficient of determination. The simple regression model used is as follows:

Y = a + biXi + E
Where: Y = body weight
a = constant
bi = regression coefficient of the ith independent variable,
Xi = the value of the independent variable
E = error term
Xi = X1 + - - - - + X6 (X1 = body length, X2 = breast girth, X3 = thigh length, X4 = shank length, X5 = wing span, X6 = wing length)

4 RESULTS

Table 1 shows the summary statistics of the body weight and linear body measurements of male and female exotic turkey. The body weight, shank length, thigh length, body length, wing length, wing span and breast girth for female were 8.16, 8.31, 22.29, 68.47 32.93, 73.65 and 57.24 respectively, while the corresponding values for male were 8.84, 9.97, 23.40, 76.27, 35.87, 80.27 and 60.20. The effect of sex on the variables was significant ($p<0.05$) except on body weight and thigh length. Though the body weight and thigh length were higher in male (8.84 and 23.40) and lower values observed in female (8.16 and 22.29).

Table 1: Summary statistics of body weight and linear body measurements of male and female turkeys

Sex	Observations	Variables	Means	Std. Dev	N	CV
Female	61	Bwt	8.16	1.27	61	15.62
		SL	8.31	0.74	61	8.89
		TL	22.29	2.22	61	9.97
		BL	68.47	3.40	61	4.97
		WL	32.93	2.46	61	7.46
		WS	73.65	4.18	61	5.67
		BG	57.24	4.25	61	7.43
MALE	41	BWT	8.84	2.44	41	27.60
		SL	9.97	1.47	41	14.74
		TL	23.40	5.18	41	22.14
		BL	76.27	8.14	41	10.67
		WL	35.87	3.64	41	10.16
		WS	80.27	8.15	41	10.6
		BG	60.20	5.14	41	8.54

Bwt-body weight, Sl-shank length, Tl-thigh length; Bl-body length; Wl-wing length; Ws-wing span; Bg-breast girth

Table 2: Effect of sex on the body weight and linear body measurements of exotic turkey

VARIABLES	MALE	FEMALE	OVERALL
Body weight (kg)	8.84±0.63a	8.16±0.22a	8.37±0.25
Shank length (cm)	9.97±0.38a	8.31±0.13b	8.81±0.18
Thigh length (cm)	23.40±1.33a	22.29±0.38a	22.63±0.48
Body length (cm)	76.27±2.10a	68.47±0.58b	70.86±0.91
Wing length (cm)	35.87±0.94a	32.93±0.42b	33.83±0.45
Wing span (cm)	80.27±2.10a	73.65±0.72b	75.67±0.91
Breast girth (cm)	60.20±1.33a	57.24±0.73b	58.14±0.67

a, b means with different superscript in the same row are significantly different ($p<0.05$)

Table 3 shows the correlation coefficients between body weight and linear body measurements. The upper diagonal is for male while the lower diagonal is for female. The

coefficients were all positive for both sexes except in female where the coefficient between body weight and shank length was negative (-0.031). Among the males the correlation coefficients ranged between 0.447 and 0.859 while in the females it ranged between -0.031 and 0.539. Regression analyses equations are shown in Table 4. When one variable was included in the regression model breast girth (0.481) had the highest coefficient of determination, followed by body length(0.399) while in a multiple regression of two variables breast girt and thigh length (0.616) had the highest followed by breast girth and body length (0.599). As the number of variables increased the coefficient of determination increased. In a contrary trend, the higher the coefficient of determination the lower the residual mean square observed.

Table 3: Correlation coefficient between body weight and linear body measurement in male and female exotic turkey

	BWT	SL	TL	BL	WL	WS	BG
BWT	1.000	0.471	0.662**	0.772**	0.447	0.479	0.859***
SL	-0.031	1.000	0.668*	0.786**	0.773**	0.868***	0.204
TL	0.158	0.386*	1.000	0.712**	0.589*	0.591*	0.509
BL	0.432*	0.489**	0.549**	1.000	0.719**	0.792**	0.630*
WL	0.048	0.280	0.489**	0.239	1.000	0.833***	0.108
WS	0.305	0.439**	0.530**	0.579**	0.514**	1.000	0.223
BG	0.539**	-0.072	-0.226	0.147	-0.053	0.177	1.000

Bwt-body weight, Sl-shank length, Tl-thigh length; Bl-body length; Wl-wing length; Ws-wing span; Bg-breast girth

Table 4: Regression analyses for predicting live weight from morphometric traits in Nigerian local turkey

	Intercept		regression	coefficient						
Prediction equations	**a**	**b1**	**b2**	**b3**	**b4**	**b5**	**b6**	**MSE**	**R2**	**P value**
Y = a+b1BG	-6.389	0.254						1.251	0.481	
Y= a+b2BL	-3.738		0.171					1.346	0.399	
Y= a+b3TL	2.629			0.254				1.504	0.250	
Y= a+b4WS	-0.649				0.119			1.557	0.197	
Y= a+b5SL	4.420					0.448		1.639	0.109	
Y= a+b6WL	2.566						0.172	1.649	0.099	
Y=a+b1BG+ b2BL	-9.932	0.186	0.106					1.111	0.599	
Y = a+b1BG+ b3TL	-9.095	0.226		0.191				1.087	0.616	
Y = a+b1BG+ b4WS	-9.932	0.225			0.069			1.191	0.540	
Y = a+b1BG+ b5SL	-7.670	0.239				0.245		1.227	0.512	
Y = a+b1BG+ b6WL	-9.787	0.242					0.120	1.206	0.528	
Y= a+b2BL+ b3TL	-3.652		0.142	0.087				1.339	0.418	
Y= a+b2BL+ b4WS	-2.948		0.203		-0.041			1.350	0.409	
Y= a+ b1BG +b2BL+ b3TL	-10.189	0.197	0.058	0.130				1.067	0.639	
Y= a+ b1BG b2BL + b3TL+ b4WS+ b5SL+ b6WL	-10.555	0.176	0.127	0.136	0.007	-0.424	-0.005	1.054	0.671	

Sl-shank length, Tl-thigh length; Bl-body length; Wl-wing length; Ws-wing span; Bg-breast girth

Table 5 shows the actual body weight and the predicted weights. The best predictors were the models that give the asterisk body weight. This implies that live body weight can be predicted by both simple and multiple regressions.

Table 5: Actual body weight and predicted body weight of exotic turkey at six month of age

Actual weight (kg)	Predicted weight (kg)
8.37	8.38
8.37	8.38
8.37	8.38
8.37	8.36
8.37	8.37*
8.37	8.39
8.37	8.39
8.37	8.37*
8.37	8.37*
8.37	8.38
8.37	8.34
8.37	8.38
8.37	8.33
8.37	8.31
8.37	8.37*

5 DISCUSSION

The significant effect of sex observed in most of the variables considered and the non-significant effect in the body weight were in line with the observation of Adeoye *et al.,* (2017). The non-significant effect of sex observed in the live body weight and thigh length of the exotic turkey in this study is contrary to the report of Djebbi *et al.,* (2014) who reported significant difference in the body weight and thigh length of male and female local turkey in Tunisia. Similar report was also given by Ogah, (2011) for Nigerian Indigenous turkey. The values in the male were higher than the values observed in the female in all the variables which is an indication of sexual dimorphism. In the male, the correlations between the body weight and other growth traits ranged between medium to high, positive and significant ($p<0.01$; $p<0.001$) except with shank length and wing span that were not significant. The positive correlation between the body weight and other variables indicate plieotropy which means that body weight can be predicted by any of the variables. Similar trend was also observed in the female. The positive and high correlations observed among the growth traits in the male and female are in line with the reports of Djebbi *et al.,* (2014) and Ogah (2011). As the coefficient of determination increased in each regression model residual mean square increased. This observation is in consonance with the finding of Sam, *et al.* (2016) and Alade, *et al.* (2008). In regression model with one variable, body length had the highest coefficient of determination (0.584) which means that 58.4% change in body weight could be attributed to change in body length. This in line with the report of Ewuola (2014) who reported highest coefficient of determination for body length in duck. Higher coefficient of determinations observed in this study among multiple regression models shows that the actual weight is better predicted by multiple models. This is in line with the observation of Sam, *et al.* (2016). In conclusion, the live body weight in exotic turkey could be better predicted by simple model and multiple regression models.

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