PREDICTION OF BODY WEIGHT OF LOCAL AND EXOTIC TURKEY STRAINS FROM LINEAR BODY PARAMETERS USING LINEAR AND CUBID REGRESSION MODELS

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ABSTRACT
This study was carried out to predict the body weight of local and exotic turkey strains from linear body parameters using linear and cubic regression models. A total of One Hundred (100) 1-day-old turkey poults consisting of 75 local strains and 25 exotic turkey strain was used for the study. Each strain was replicated three (3) times with eight (8) birds per replicate. Prophylactic antibiotics and anticoccidial drugs were administered to the birds, fed feed and fresh water was given to them *ad-libitum*. The experiment lasted for twenty (20) weeks with the measurement of the linear body parameter and body weight of the birds collected bi-weekly. The data collected was subjected to linear and cubic regression models. And the result from the regressions equations demonstrated a positively relationship between body weight, linear body measurement component with age, showing that increase in the body weight and linear body parameters will increase as the birds increase in age. The result on linear regression showed high level of association at $p<0.05$ significant level and R^2 (%) in the parameters with the least value seen in local black body weight 54 (R^2%) and highest seen in thigh length of local black with (R^2%). In the cubic function, high level of significance was seen in all the parameters with the least value of 60 (R^2%) seen in the local black while the highest value of 97 (R^2%) was seen in the thigh length of local black and breast length of spotted. Based on the research results, body weight of turkeys can be predicted using linear regression and cubic models.
Keywords: Body weight, Prediction, Turkey, Strain, Model.

INTRODUCTION
Turkey belongs to the family of *meleagriddae* (order Gallifroms). The best known is the common turkey (*Melegris gallopavo*), a native game bird of North America and the other species is *Meleagris ocellata*, the ocellated turkey (Djebbi *et al.,* 2014). Presently in Nigeria, most of these breeds have been crossed with another breed, with the aim of having turkeys that will adapt to our environment. This has resulted into Nigerian local turkeys having multi-coloured plumage and sometimes appearing as pure black or white (Ngu *et al*, 2014). Currently, the poultry population in Nigeria is estimated at 104.3 million comprising of 72.4 million chickens, 11.8 million duck, 4.7 million guinea fowls, 15.2 million pigeons and 0.2 million turkeys (Agbonika *et al*., 2020). Accurate and proper assessment of body weight is difficult under field conditions (Atansuyi *et al*., 2017), as it is mostly estimated by visual appreciation, a method which is widely inaccurate (Chitra *et al*., 2012). Thus, reliable and easy-to-apply methods have been developed to estimate body weight on-farm where weighing scales are not usually available. Several authors have found strong association between body weight and linear body parts and have developed body weight prediction models (both linear and non-linear) using the linear body components (Lukuyu *et al*, 2016). The aim of this study was to determine if the accuracy of body weight prediction models from some linear measurement of local and exotic turkey strains can be improved using linear and cubic regression models. This could help in the selection and breeding strategies for improvement of the turkey strains in the future studies.

MATERIALS AND METHODS
The study was carried out at the Poultry Unit of Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State. A total of one hundred (100) 1-day-old turkey poults consisting of 25 each of Black, White and Spotted local strains and 25 exotic turkey strains were used for the study. The local strains of turkey were purchased from a reputable hatchery in Owerri while

the exotic turkey strains were purchased from a reputable farm in Ibadan. The birds were reared in an environmentally controlled brooder house for four (4) weeks, after which they were transferred to deep litter rearing pens. Each strain was replicated three (3) times with eight (8) birds per replicate. The floor of the pen was covered with woods having as the litter material and kept dry by replacing the wet litter with dry ones when necessary. Feed and fresh water was given *ad libitum*. Routine management operations such as washing of the water and feeding troughs were carried out on daily basis. The compositions of the experimental diets were pre-starter-27.78CP% and 2856.00kcal/kg, starter-23.84CP% and 2899.15kcal/kg, and grower-19.00CP% and 2941.85kcal/kg.
The following data were collected:
Body weight (BWT):-It was measured bi-weekly using a top loading 20kg CAMRY scale with as sensitivity of 10g.
Body length (BL), Breast girth (BG), Wing length (WL), Shank length (SL), Drum Stick Length (DS), Keel Length (KL), Thigh length (TL). All the linear parameters were measured using meter rule and tailor's tape calibrated in cm, except BWT, which was measured as earlier indicated.
Simple linear regression was carried out on body weight and each of the linear body parameters on age to determine the growth of the body and each of the component parts. Regression was also carried out on body weight and each of the linear body parameters on age using cubic function. The regression model is given as;
$Y_i = a + b_i X_i + e_i$
Where;
Y_i = Response (dependent) variable, e.g. BL, KL etc
a = Y- intercept
b_i = Slope
X_i = i^{th} independent variable, ie. BWT
e_i = Random error, assumed to be independently, identically and normally distributed with zero mean and constant variance [ii nd$(0,\sigma^2)$].
The cubic model is given as;
$Y = b_0 + b_1x + b_2x^2 + b_3x^3 + e_1$
Where:
Y = Response or dependent variables (eg BW, KL, BL etc)
X = Independent variables (Age)
b_0 = Intercept
b_1, b_2, b_3 = Regression coefficients
e_1 = Random error, assumed to be independently, identically and normally distributed with zero mean and constant variance [iind$(0,\sigma^2)$].

RESULTS AND DISCUSSION

The results of the prediction of body weight from linear body parameters of the turkey strains and their coefficients of determination (R^2) are presented in tables 1 and 2, using different regression (linear and cubic) models. Results showed that the regression coefficient had appositive value in the relationships between body weight and the zoometric traits. It is therefore likely that body weight and linear body parameters would increase with age. The relationship between body weight and body measurements with age were best described by cubic model. However, the coefficient of determination showed a wide variation in the relative contribution of body weight and linear body parameters to age (54% to 97 %,) in linear model and (60% - 98 %,) in cubic model. Very high coefficient of determination was obtained for BWT and linear body parameter in all the genetic groups. However, local black has the least R^2 value of 53% for BWT in the linear regression model and 60% in the cubic model. The value of R^2 obtained in this study was with in the R^2 values (73.91-97.91%) reported for similar traits by Adeleke *et al*. (2004), and the values (82 to 92%) reported by Amao *et al*. (2011), respectively.
The range of R^2 obtained in the prediction of keel length in all the genetic groups where within the 70% reported by Durosaro *et al*. (2013) for local turkey sat 12 weeks of age, which also suggest that keel length is a best indicator of weight in turkey at 12 weeks. This was also in agreement with the findings of Amao *et al*. (2011) who reported the best accuracy of prediction with keel length, Adeleke *et al*. (2004) reported that body weight can be predicted from keel length for cross bred egg-type

chickens and Adeniji and Ayorinde (1990) for Cobb broiler strain. R^2 for the regression of shank length on age was also high in all the genotype. This agreed further with the findings of Adeniji and Ayorinde (1990) that body weight of birds can be predicted from any given value of the morphometric measurements (body length, body girth, keel length, shank length, drum stick length and shank thickness).The highest R^2 value for the regression of body weight and linear body parameters on age suggest that age can be the best predictor of body weight and linear body parameters in all the genotypes.

Table1: Regression of Body Weight and Linear Body Parameters on Age of Local and Exotic Turkey Strain

Genotypes	Equation	R^2(%)	SEM	Significance
Local White	BWT=-675.735+187.212x	77	642.17	*
	BL=9.07+2.62x	96	3.45	*
	BRTWT=4.42+1.86x	97	2.16	*
	KL=1.40+0.71x	93	1.20	*
	SL=3.30+0.87x	86	2.19	*
	WL=5.18+1.29x	95	1.90	*
	THL=3.11+0.86x	95	1.17	*
Local Black	BWT=-754.73+212.70x	54	1235.36	*
	BL=9.47+2.73x	96	3.48	*
	BRTWT=2.67+2.06x	96	2.49	*
	KL=1.90+0.64x	95	0.95	*
	SL=3.15+0.95x	85	2.46	*
	WL=4.97+1.48x	95	2.03	*
	THL=2.67+0.96x	97	1.11	*
Spotted	BWT=-698.01+203.57x	80	627.73	*
	BL=9.52+2.77x	95	3.77	*
	BRTWT=3.56+2.03x	97	2.28	*
	KL=1.99+0.64x	93	1.09	*
	SL=3.51+0.92x	82	2.71	*
	WL=6.06+1.32x	85	3.48	*
	THL=2.60+0.95x	93	1.56	*
Exotic	BWT=-955.16+322.15x	93	548.36	*
	BL=14.82+2.85x	95	4.00	*
	BRTWT=6.93+2.27x	97	2.57	*
	KL=1.75+0.88x	94	1.37	*
	SL=3.24+1.34x	94	2.12	*
	WL=6.08+1.81x	95	2.71	*
	THL=4.39+0.95x	92	1.79	*

*Significant at $P<0.05$; R^2 = Coefficient of determination; S. E = Standard error of the estimate
BWT=body weight, BL = body length, BRTWT = Breast girth, KL = Keel Length, SL = Shank length, WL = Wing Length, THL = Thigh length

The high R^2 in the regression of body weight and linear body parameters on age in all the genotypes (except the regression of BWT on age in local black turkeys in linear regression model) suggest that age can be used to predict body weight and linear body parameters in these genotypes. High R^2 values of shank length, in the four genotypes was in agreement with the findings of Ukwu *et al*. (2014) who reported that shank length was the best predictor of body weight in Nigerian local chicken. Nosike (2015) reported R^2 value of 96% with shank length in black phenotype of turkey strain, which was higher than the 82% - 94% obtained with shank length in this study.
High R^2 value sand significance obtained from the regression equation in all the genotypes how that age is a very good predictor of body weight and body parameters in turkeys and should be used to

predict body weight and linear body traits in exotic and indigenous turkey genotypes without slaughtering. This will ensure that animals that reach market size and weight at a faster rate are selected and hence should be used by breeders in the selection of animals for use as breeding stock (Isaac *et al*, 2011).

Table 2: Prediction of Body Weight and Linear Body Measurements from Age using Cubic Function

Genotypes	Equation	R^2 (%)	SEM	Significance
Local White	$BWT=19.32+45.96–3.713x^2+0.57x^3$	89	440.37	*
	$BL=13.39+0.16x+0.29x^2–0.01x^3$	97	3.13	*
	$BRTWT=3.51+2.50x+-0.09x^2+0.00x^3$	97	2.11	*
	$KL=1.98+0.54x+0.01x^2+0.00x^3$	94	1.17	*
	$SL=0.69+2.20x–0.15x^2+0.00x^3$	88	2.19	*
	$WL=2.92+2.37x–0.11x^2+0.00x^3$	95	1.79	*
	$THL=3.93+0.50x+0.03x^2-0.00x^3$	96	1.15	*
Local Black	$BWT=300.17-1.53.71+24.18x^2-0.34x^3$	60	1156.42	*
	$BL=12.20+1.17x+0.18x^2–0.01x^3$	96	3.37	*
	$BRTWT=3.33+1.92x–0.00x^2+0.00x^3$	97	2.47	*
	$KL=2.21+0.46x+0.02x^2–0.00x^3$	95	0.95	*
	$SL=0.21+2.40x–0.15x^2+0.00x^3$	87	2.06	*
	$WL=2.06+3.07x–0.18x^2–0.01x^3$	96	1.82	*
	$THL=3.86+0.37x+0.06x^2–0.00x^3$	97	1.06	*
Spotted	$BWT=-54.45+11.07x+3.81x^2+0.30x^3$	90	456.99	*
	$BL=11.21+1.45x+0.18x^2–0.01x^3$	96	3.60	*
	$BRTWT=1.90+2.57x–0.03x^2+0.00x^3$	97	2.16	*
	$KL=1.71+0.74x–0.01x^2+0.00x^3$	93	1.09	*
	$SL=0.61+2.22x–0.13x^20.00x^3$	84	2.32	*
	$WL=1.88+3.24x–0.19x^2+0.01x^3$	87	3.27	*
	$THL=3.62+0.45x+0.05x^2–0.00x^3$	94	1.55	*
Exotic	$BWT=44.06–13.03x+20.79x^2-0.24x^3$	97	335.45	*
	$BL=9.04+4.76x–0.12x^2+0.00x^3$	97	3.08	*
	$BRTWT=2.33+4.61x–0.25x^2+0.01x^3$	98	2.19	*
	$KL=0.41+1.85x–0.13x^2+0.00x^3$	96	1.13	*
	$SL=1.06+2.17x–0.07x^2+0.00x^3$	95	2.12	*
	$WL=1.52+3.65x–0.16x^2+0.00x^3$	96	2.24	*
	$THL=2.68+1.41x–0.01x^2–0.00x^3$	94	1.52	*

*Significant at P<0.05; R2 = Coefficient of determination; S.E = Standard error of the estimate

The results from the regression equations demonstrated a positive relationship between body weight, linear body measurements components (body length, breast width, keel length, shank length, wing length and thigh length) with age, showing that increase in the body weight and linear body parameters will increase as the birds increase in age. This result also indicated that with local and exotic turkey strains, body weight and linear body parameters could easily be predicted by farmers from any given age without the use of sophisticated instrument.

CONCLUSION

The high significant (P<0.05) regression equation of body parameters on age showed that age is a good predictor of body weight and linear body parameters as the body weight and body measurements increase within creasing age in the four genotypes. The relationship between body weights and body measurements with age were best described by cubic mode l. However, the coefficient of determination shows a wide variation in the relative contribution of body weight and linear body parameters to age (54% to 97%, Table1) in linear regression model and (60% - 98%, Table2) in cubic model.

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