Advances in Life Science and Technology
ISSN 2224-7181 (Paper) ISSN 2225-062X (Online)
Vol.41, 2016

Prediction equations and inter-relationships among selected growth traits of an indigenous turkey birds in derived savanna zone of Nigeria

*Amao, S.R[1]. and Ojedapo, L.O[2].

[1]Department of Agricultural Education (Animal Sci. Division; Animal Breeding and Genetics unit), School of Vocational and Technical Education, P.M.B.1010, Emmanuel Alayande College of Education. Oyo .Oyo State. Nigeria.

[2]Department of Animal Nutrition and Biotechnology, P.M.B 4000. Ladoke Akintola University of Technology. Ogbomoso. Oyo State. Nigeria.

Abstract
This experiment was conducted to predict the growth pattern of a local stain of turkey three regression models at different ages. A total of 150 poults were used for the study which lasted for 12 weeks. Measurements of body length (Shank length) and thigh length (Thigh Length) were regressed against body weight using linear, quadratic and cubic functions. The coefficient of determination (R^2) noted ranged from 50.32% to 78.24% for the three functions. Cubic function had the highest R^2 values for the body measurements, followed by quadratic function while linear function had the least R^2 value across the four age groups. The highest (78.24%) was observed at the 12^{th} week. Best accuracy of prediction was noticed with breast girth, keel length and shank length in all the age groups. From the results observed in this study, body weight of turkeys can be predicted from any of the body length, breast girth, keel length and shank length with best accuracy of prediction obtained with cubic function and breast girth, keel length and shank length as the regressor.
Keywords: Prediction equation, turkey birds, linear, quadratic, cubic equation, growth traits

1. Introduction

Body weight, a function of skeletal size, fleshing and condition (Tierce and Nordskog, 1985), is simply a measure of overall body growth which itself is the sum total of increases in size of different structural body components. In chicken, the breast and legs are the major structural components of the body. They constitute the major muscle masses and are of great economic importance. Harmonious development of these two components is desirable for the production of broilers with good body conformation (Ibe and Nwakalor, 1987). Kabir *et al.,* (2006) reported that the relationship between body weight and shank length, a parameter of leg development, has important bearing on table quality of chickens.

A number of non linear models have been used to describe growth curves in chickens: (Grossman *et al.,* 1985) applied the logistic function to chickens data, although its symmetrical form does not correspond to the growth pattern of chickens (Kniezetora *et al*., 1991). The regression equations have been established to estimate body weight from body measurements (Singh and Minshrd, 2004). The usefulness of these regression models was to allow a fact evaluation of the body weight of an animal and in selection criteria (Amao *et al*., 2012; Ojedapo *et al.,* 2010).

Regression coefficient may have the wrong sign (+) or an implausible magnitude. Accordingly, the partial regression coefficients are unstable and unreliable (Hair Jr *et al.*, 1992; Pimentel *et al*., 2007). Prediction of marketable weight of birds at an early stage of life taking breast angel as a predictor at early stage can assist in selection of broilers at an early stage (Amao, *et al.,* 2010), therefore saving both on feed and managerial resources. Linear equation is commonly used method to assess body weight at different ages (Raji *et al.,* 2009). The prediction with quadratic regression was better in comparison with the linear relationship. Thus, reported also by Semakula *et al.,* (2011) that reveals correlation coefficients between body weight and other measurements were high and positive and prediction using quadratic regression was the most reliable compared to the simple linear regression and polynomial. Ojedapo *et al.,* (2012) and Yakubu *et al*., (2009) had reported a cubic function predicted body weight and other body components more accurately than quadratic and linear functions. Therefore the aim of this present study was to Prediction equations and inter-relationships among selected growth traits of an indigenous turkey birds in derived savanna zone of Nigeria.

2. Materials and Methods

2.1 Experimental Site

The experiment was carried out at the poultry research and production unit of the teaching and research farm Ladoke Akintola University of Technology Ogbomoso. Ogbomoso is situated in the derived savanna zone of Nigeria lies within latitude 8° 15' and longitude 4° 15' The area has an annual rainfall of 1247m with altitude between 200-600m above the sea level while the annual temperature is about 27°C (Ojedapo and Amao, 2014).

2.2 Experimental Birds and Management

A total of l50 of day- old poults of local breed of turkey were obtained from a reputable farm in Ibadan, Oyo State. The brooder house was partitioned into three (3) pen each pen measured 1.2m x 0.6m x l.lm. Each pen was disinfected with a suitable disinfectant to prevent infection before the arrival of the poults. As a precautionary method, the local strain was differently identify by placing the separate partitioned pen in brooder house with a floor covered with wood shaving which were kept dry always and replaced when soiled or dampened when need arises vaccine and medicament were also administer to the birds base on the drawn vaccination program and disease condition.

2.3 Feed and Feeding

The birds were fed with the same feed from day old to eight 8 weeks old under the same feeding regime, with a standard broiler starter ration containing 28% crude protein and 2700kcal/kgME from day old to eight weeks of age, followed by a commercial grower mash diet containing 18- 20% crude protein and 3000kcal/kgME from 8 weeks to the end of the experiment at 15 weeks. The birds were fed and watered *ad-libitum* under the same condition throughout the experimental period.

2.4 Data Collection

Parameter was collected or determine from 150 birds on a weekly basis and the following measurements were taken namely, body weight, body length, shank length, thigh length and keel length by the procedure of Ojedapo *et al*., (2012).

2.5 Statistical Analysis

Data obtain was subjected to analysis of variance using the general linear model (GLM) of SAS (2003). Regression model equation which are listed below 1.linear 2.quadratic and 3.cubic equation are use in predicting growth pattern of indigenous turkeys, and is evaluated using the step wise variable selection procedure. Here is one of the generalize prediction model

$$Y = a + \sum_{1=k}^{k} b_1 x_1 + e_1$$

Where Y = dependent growth trait
a = intercept
b_1 = partial regression coefficient
x_1 = independent growth trait
ei = random error (iind o.δ^2) identically independently
normal distributed with zero mean and constraint variable

The equation to be used are listed below

Y_1 = a + bx---------- (linear)
Y_2 = a + bx + cx ---------- (quadratic)
Y_3 = a + b x + c x^2 + dx^3--------- (cubic)

When Y_1 Y_2 and Y_3 are dependent variable (body weight), while x represent the independent variables, b is regression coefficient and c in y_1 represent the same function associated with independent variable and is normally called the intercept represent the estimate of independent variable when the independent variable is zero. Furthermore, c and d represent constant function in Y_2 and Y_3 respectively.

3 Results

Table 1 shows the estimate of parameters in linear, quadratic, and cubic functions fitted for body weight and other body measurement relationship at 3rd week. The relationship between body weights and other body measurements, body length, breast girth, keel length, shank length and thigh length were best described by cubic model. The coefficient of determination (R^2) varied from 60.24 to 65.32%, 67.23 to 68.62%, 50.32 to 52.24%, 54.33 to 58.33%, 50.34 to 58.32% for, BL, BG, KL, SL and TL respectively. Table 2 shows the estimate of parameters in linear, quadratic, and cubic functions fitted for body weight and other body measurement relationship at 3rd week. The relationship between body weights and other body measurements, body length, breast girth, keel length, shank length and thigh length were best described by cubic model. The coefficient of

determination (R^2) varied from 62.32 to 62.48%, 68.93 to 69.35%, 54.48 to 56.34%, 53.88 to 54.72%, 52.47 to 60.34% for, BL, BG, KL, SL and TL respectively.

Table 3 shows the estimate of parameters in linear, quadratic, and cubic functions fitted for body weight and other body measurement relationship at 3rd week. The relationship between body weights and other body measurements, body length, breast girth, keel length, shank length and thigh length were best described by cubic model. The coefficient of determination (R^2) varied from 65.48 to 69.52%, 70.48 to 73.47%, 72.62 to 75.47%, 73.32 to 76.34%, 60.47to 65.88% for BL, BG, KL, SL and TL respectively. Table 4 shows the estimate of parameters in linear, quadratic, and cubic functions fitted for body weight and other body measurement relationship at 3rd week. The relationship between body weights and other body measurements, body length, breast girth, keel length, shank length and thigh length were best described by cubic model. The coefficient of determination (R^2) varied from 68.05 to 70.48%, 70.48 to 74.88%, 74.47 to 78.49%, 75.33 to 78.24%, 68. 47 to 68.88% for BL, BG, KL, SL and TL respectively.

4 Discussion

The present study for R^2 for the fitted functions at 3rd, 9th and 12th week of age obtained were similar to the values reported by Amao *et al*., (2011), R^2 ranged from 82% - 92%. However, the R^2 obtained in this study was lower than R^2 values reported by Ojedapo *et al.,* (2012) and Adeleke *et al.,* (2004). The differences between R^2 obtained in this study and that of earlier researchers might be attributed to differences in type of species and types of functions used. Adeleke *et al.,* (2004) used exponential and double-log functions. Exponential function was not appropriate in this study because Nigeria local turkeys cannot experience exponential growth in the first 12 weeks of life. Cubic functions had the highest R^2 values for all the body measurements while linear function had the least R^2 value across the four age groups. However, the present study was also in corroborated with the findings of Durosaro *et al*., (2013) on the estimation of body weight of Nigeria local turkey from zoometrical measurements 4, 8, and 12 weeks of age.

Coefficient of determination is the percentage of variations in the value of dependent variable that can be explained by variations in the value of the independent variable (Mason *et al.,* 1983; Congelosi *et al*., 1983). The magnitude of the coefficient of determination for each body measurements in turkeys obtained in this study corroborated the findings of Adeniji and Ayorinde (1990) that body weight of birds can easily be predicted from any given value of the body measurement in the cob broiler strain using linear and stepwise regression equations. However, this present magnitude of the coefficient of determination was also in accordance with the study of Oluwatosin (2007) who noted similar variable among selected growth traits in cockerels. Best accuracy of prediction was obtained with breast girth, keel length and shank length in all the four age groups and this is in agreement with the findings of Adeleke *et al*., (2004) and Ojedapo *et al.,* (2012) for laying birds, Raji *et al*., (2009) and Sandip (2010) for ducks, Yakubu *et al*., (2009) and Amao *et al*., (2011) for broiler chickens.

5. Conclusion

This present study indicated that variability exist in the functions, coefficient of determination and body linear measurement. Prediction of the body weight and other linear measurement were best described by cubic function with Breast girth, keel length and shank length took the lead. Based on the results from the current study, it can be recommended that researchers should used cubic functions for prediction and other prediction methods aparts from cubic function should be research on to know their potential for future prediction.

Reference

Adeleke, M.A., Ozoje, M.O., Oluwafunmilayo, A., Debambo, Peter, S.O. & Bamgbose, A.M. (2004). "Estimation
of body weight from linear body measurements among crossbred egg-type chickens". *Proceedings of the 29th Annual Conference of the Genetics Society of Nigeria.* University of Agricultural, Abeokuta Pp 88-91.

Adeniji, F.O. & Ayorinde, K.L. (1990). "Prediction of body weight of broilers at different ages from same linear body measurements". *Nigerian Journal of Animal Science,* **17**:41-47.

Amao, S. R., Ojedapo, L. O. & Sosina, A. O. (2010). "Effect of strains on some growth traits of meat type chickens
reared in derived savanna environment of Nigeria". *Journal of Agriculture and Veterinary Sciences,* **2**:56-64.

Amao, S.R, Ojedapo, L.O, Oyewumi, S.O. & Amen, S.A (2011). "Estimate of body weight from linear body

measurement in Wadi Ross meat type chicken in derived savannah zone of Nigeria". *Proceeding of the 16th Annual Conference of the Animal Science Association of Nigeria*. Pp 9-12.

Amao, S.R., Ojedapo, L.O., Oyewumi, S.O & Olatunde, A.K. (2012). "Body Conformation characteristics of Marshall strain of commercial broiler chickens reared in derived savanna environment of Nigeria". 37th *Annual Conference of the Nigerian Society for Animal Production (NSAP)-* March, 18th –21st, 2011. 37:1-3.

Blasko, A. & Gomez, E. (1993). "A note on growth curve of rabbit lines selected on growth rate or litter size". *Animal Production,* **57**:332-334
.
Congetosi, V.E,, Taylor, P.E. & Rice, P.F (1983). "Basic statistics. A Real World Approach", 3rd edition st Paul: West publishing co.pp 315-336.

Durosaro, S.O, Oyetade, M.S., Ilori, B.M, Adenaike, A.S, Olowofe O., Wheto M., Amusan, S.A, Osho, S.O. & Ozoje M.O (2013). "Estimation of body weight of Nigeria Local turkey from zoometrical measurements 4, 8, and 12
weeks of age". *Global Journal of Science Frontier Research Biotechnology and Genetics*, **13** (1): 1-4.

Grossman, M., Bohren, B. B. & Anderson, V. L. (1985). "Logistic growth of chicken: a comparison of techniques to
estimate parameters". *J. Heredity,* **76**:397-399.

Hair Jr, J. E., Anderson, R. E., Tatham, R. L. & Black, W. C. (1992). "Multivariate data analysis". 3rd Edition, Macmillan Publishing Company, New York pp 544.

Hassan, A. & Groma, A. (1992). "Body weight measurement relationship in Nigerian Red Sokoto goats". In: Rey,
B; Lebbie, S. H. B. and Reynolds, L. (eds); Small ruminant Research and Development in Africa. *Proc. of the first
Biennial Conference of the African Small Ruminant Research Network ILLRAD,* Nairobi, Kenya. 492-497.

Ibe, S. N. & Nwakalor, L. N. (1987). "Growth pattern and conformation in broilers; Influence of Genotype and Management on Isometry of growth". *Poultry Science,* **66**:1247-1251.

Tierce, J. U. & Nordskog, J. F. (1985). "Performance of layer-type chickens as related to body conformation and composition 1. A static analysis of shank length and body weight at 20 weeks of age". *Poultry Science,* 64:605-609.

Kabir, M., Oni O. O., Akpa, G. N. & Adeyinka, T. A. (2006). "Heritability estimates and the interrelationships of body weight and shank length in Rhode Island Red and white chicken". *Pakistan Journal of biological Science,* **9**(15); 2892-2896

Knizetora, H., Hyanek, J., Knize, B. & Robicek, J (1991). "Analysis of growth curves in fowl I. chickens Broiler"
Poultry Science., **32**:1027-1038.

Mason, R.O., Lind, D.A. & Marchal, W.G. (1983), "Statistics: An introduction", New York Harcowt Brace Janovick, Pp 338-383

Ojedapo, L. O., Adedeji, T. A., Ameen, S. A. & Amao, S. R. (2010). "Interrelationship between body weight and other body linear measurement in Anak strain of commercial broiler". *Proceedings of 15th Annual Conference of Animal Science. Association of Nigeria* Uyo. Pp. 172-174.

Ojedapo, L. O; Amao, S. R., Ameen, S. A., Adedeji T. A., Ogundipe, R. I & Ige A. O. (2012). "Prediction of body
weight and other linear body measurements of two commercial layer strain chickens". *Asian Journal of Animal Sciences,* **6**(1): 13-22.

Ojedapo, L.O. & Amao, S.R. (2014). "Sexual dimorphism on carcass characteristics of japanese quail (*Coturnix coturnix japonica*) reared in derived savanna zone of Nigeria". *International Journal of Science, Environment and Technology,* **3** (1): 250- 257.

Oluwatosin, O. O. (2007). "Prediction equations and inter-relationships among selected growth traits in cockerels".
Africa Journal of Animal and Biomedical Sciences, **2**(1): 21-26.

Pinmentel, E. C. G., Quciroz, S. A., Carvalheiro, R & Fries, L. A. (2007). "Use of ridge regression for prediction of
early growth performance in crossbred calves". *Genetics Model. Biological.,* **30**:536-544.

Raji, A. O., Igwebuike, J. U. & Usman, M. T. (2009). "Zoometrical body measurement and their relation with live
weight in matured local Muscovy ducks in Borno State Nigeria". *Journal of Agricultural and Biological Science,*
4(3): 58-63.

Sandip, B. (2010). "Comparative efficiency of linear and some non-linear equations in predicting body weight of Male Duck at 21, 28, 35, 42, 49 and 56 days using breast angle at corresponding ages as a predictor". *Global Veterinaria,* **5**(2):65-71.

SAS (2003). "Statistical Analysis System". Version 9.2, carry North Carolina, SAS Institute Corporated.

Semakula, J., Lusembo, P., Kugonza, D. R., Mutetikka, D. Szennyonjo, J. & Mwesigwa, M (2011). "Estimation of
live body weight using zoonmetrical measurements for improved marketing of indigenous chicken in the Lake Victoria basin of Uganda". *Livestock Research for Rural Development,* **23**(8) 2011.

Singh, P. N. & Mishra, A. K. (2004). "Prediction of body weight using conformation traits in Barbari goats". *Indian Journal of Small Ruminant,* **10**(2): 173-178.

Yakubu, A., Idahor, K. O., & Agade, Y. I. (2009). "Using factor scores in multiple linear regression model for predicting the carcass weight of broiler chickens using body measurements". *Revista Udo Agricola,* **9**(4): 963-967.

Table 1: Estimate of parameters in linear, quadratic and Cubic functions fitted for body weight and other body measurement relationship of local turkey at 3rd week

Parameters	Functions	R^2	S.E	Sig
BL	$Y_1 = -234.71 + 32.22X$	60.24	2.14	**
	$Y_2 = 405.47 - 53.32X+2.2X^2$	62.62	0.82	***
	$Y_3 = 2006.04 - 281.81X+12.63X^2 + 0.28X^3$	65.32	0.34	***
BG	$Y_1 = -348.12 + 30.43X$	67.23	2.01	**
	$Y_2 = 294.84 - 40.34+1.68X^2$	68.62	0.62	***
	$Y_3 = 2006.50 - 30.32X+13.46X^2 + 0.21X^3$	68.32	0.33	***
KL	$Y_1 = -134.32 + 55.24X$	50.32	6.61	**
	$Y_2 = -74.45 + 38.42X 4.15X^2$	52.24	6.25	***
	$Y_3 = 2143.47 - 1420.07X -203.41X^2 - 0.61X^3$	52.11	5.20	***
SL	$Y_1 = -432.81 + 30.44X$	54.33	3.22	**
	$Y_2 = 307.88 - 34.4^2 X + 0.33X^2$	56.77	4.78	***
	$Y_3 = 1006.32 - 471.82X + 13.63 X^2 + 0.2X^3$	58.33	4.55	***
TL	$Y_1 = 349.32 + 23.49X$	50.34	4.78	**
	$Y_2 = 408.34 + 47.33X + 0.47X^2$	52.40	5.88	***
	$Y_3 = 1009.44 - 482.22X + 14.77X^2 + 0.47X^3$	58.32	6.89	***

*** P<0.001, **P<0.01, * P<0.05

Y_T, Y_2 and Y_3 Body weight (g) BL = Body Length (cm), BG = Breast Girth (cm), KL= Keel Length (cm), SL = Shank length (cm), TL = Thigh length (cm), R^2= Coefficient of Determination (%), S.E = Standard error, Sig = level of significance.

Table 2: Estimate of parameters in linear, quadratic and Cubic functions fitted for body weight and other body measurement relationship of local turkey at 6th week

Parameters	Functions	R^2	S.E	Sig
BL	$Y_1 = - 419.32 + 53.26X$	62.47	3.47	**
	$Y_2 = 735.38- 41.47X+2.47X^2$	62.32	3.88	**
	$Y_3 = 1925.74-834.17X+32.47X^2 + 0.79X^3$	62.48	2.79	***
BG	$Y_1 = - 1008.72+ 68.17X$	68.47	4.78	**
	$Y_2 = 453.47-37.48X+1.47X^2$	68.93	3.47	**
	$Y_3 = 1900.34-2103.48X+90.37X^2 - 0.37X^3$	69.35	4.88	***
KL	$Y_1 = 347.47+100.47X$	54.49	3.47	**
	$Y_2 =1347.47 - 347.23X + 31.48X^2$	54.48	4.88	**
	$Y_3 = 1037.20- 239.41X +327.33X^2- 12.47X^3$	56.34	4.00	***
SL	$Y_1 = - 482.85 + 25.38X$	55.47	5.78	**
	$Y_2 = 407.33 – 47.88X + 0.49X^2$	53.88	6.85	**
	$Y_3 = 1507.48 + 343.22X+15.70X^2+0.98X^3$	54.72	6.77	***
TL	$Y_1 = 399.47+48.33X$	52.47	7.32	**
	$Y_2 = 489.85+88.47X+1.32X^2$	54.33	8.44	**
	$Y_3 = 2001. 34-538.44X+18.33X^2+ 1.38X^3$	60.34	8.43	***

*** P<0.001, **P<0.01, * P<0.05

Y_1, Y_2 and Y_3 Body weight (g) BL = Body Length (cm), BG = Breast Girth (cm), KL= Keel Length (cm), SL = Shank length (cm), TL = Thigh length (cm), R^2= Coefficient of Determination (%), S.E = Standard error, Sig = level of significance.

Table 3: Estimate of parameters in linear, quadratic and Cubic functions fitted for body weight and other body measurement relationship at 9th week

Parameters	Function	R^2	S.E	Sig
BL	$Y_1 = - 623.41 - 56.02X$	65.48	3.47	**
	$Y_2 = 921 .62 - 57.00X+2.47X^2$	68.02	8.22	**
	$Y_3 = 1821.22 - 2100.24X+80.47X^2 + 0.35X^3$	69.52	7.34	***
BG	$Y_1 = - 1082.06 + 82.72X$	70.48	6.48	**
	$Y_2 = 532.02 - 42.04X+3.82X^2$	70.00	3.48	**
	$Y_3 = 12007.20-4123.47X+408.22- 9.47X^3$	73.47	4.47	***
KL	$Y_1 = 647.32+137.48X$	72.62	3.48	**
	$Y_2 = 1800.32 - 312.62 X 4.86X^2$	73.82	4.82	**
	$Y_3 = 1200.32 - 247.32X + 247.32X^2- 16.86X^3$	75.47	5.62	***
SL	$Y_1 = -329.20 + 127.87X$	73.32	4.33	**
	$Y_2 = 1200.62 – 45.25^2 X + 14.74X^2$	75.44	5.67	**
	$Y_3 = -7003.32 + 461.26X+347.48X^2- 18.32X^3$	76.34	6.66	***
TL	$Y_1 =347.83 + 128.48X$	60.47	7.32	**
	$Y_2 = 498.00 + 39.88X+1.48X^2$	62.33	6.32	**
	$Y_3 = 2080. 47 - 639.44X + 19.99X^2 + 2.48X^3$	65.88	4.32	***

*** P<0.001, **P<0.01, * P<0.05 Y_1, Y_2 and Y_3 Body weight (g) BL = Body Length (cm), BG = Breast Girth (cm), KL= Keel Length (cm), SL = Shank length (cm), TL = Thigh length (cm), R^2= Coefficient of Determination (%), S.E = Standard error, Sig = level of significance.

Table 4: Estimate of parameters in linear, quadratic and Cubic functions fitted for body weight and other body measurement relationship at 12th week

Parameters	Functions	R^2	S.E	Sig
BL	Y_1 = - 2473.47-237.04X	68.05	4.88	**
	Y_2 =12572 .48-658.47X+16.05X^2	69.78	10.24	**
	Y_3 = 2447.47+148.47X+15.68X^2 + 0.48X^3	70.48	11.47	***
BG	Y_1 = - 1243.48+135.34X	70.48	11.28	**
	Y_2 = 5347.34-479.89X+6.43X^2	72.48	10.47	**
	Y_3 = 8248.35-489.89X+14.47- 0.75X^3	74.88	10.82	***
KL	Y_1 = 1649.48+434.19X	74.47	12.47	**
	Y_2 =3432.67 - 483.78 X40.47X^2	76.35	13.48	**
	Y_3 = 16834.48-443.04X+487.90X^2- 3.47X^3	78.49	11.99	***
SL	Y_1 = -400.38 + 348.00X	75.33	11.32	**
	Y_2 = 1289.33 –34.38^2 X+10.32X^2	76.44	4.33	**
	Y_3 = -8009.00+532.02X+393.32X^2-10.47X^3	78.24	12.00	***
TL	Y_1 =438.44+135.49X	68.88	7.32	**
	Y_2 =539.38+80.88X+1.89X^2	68.47	6.48	**
	Y_3 = 2280. 88-748.33X+33.47X^2+3.88X^3	68.75	3.32	***

*** P<0.001, **P<0.01, * P<0.05
Y_1, Y_2 and Y_3 Body weight (g) BL = Body Length (cm), BG = Breast Girth (cm), KL= Keel Length (cm), SL = Shank length (cm), TL = Thigh length (cm), R^2= Coefficient of Determination (%), S.E = Standard error, Sig = level of significance.