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Prediction of growth pattern of marshal chicken using three regression model

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ABSTRACT

This study aims to investigate the prediction of growth pattern of Marshall Chicken using regression model. A total of 300 day-old chick of birds comprised of males and females were procured from a reputable farm in Ibadan, Oyo state. On the day of arrival, the chicks were supplied with water and anti-stress plus antibiotics for a period of 5 days during brooding. The birds were raised under deep litter management system. The coefficient of determination (R) values in Marshall Strain, with keel length recording the highest value (94, 95 and 98) respectively in all the functions. The growth pattern using mathematical model or function in this research revealed that the leading key indicators (Standard error, determination coefficient and correlation of determination), suggest that Simple Linear Regression is more appropriate to describe growth pattern of Marshal strain compare to quadratic and cubic functions. All the linear body parameters have their R values above 50%, that is, they could be used to predict the body weights of the broiler strain, although the accuracy of prediction increase with an increase in the R value. In summary, amongst all the linear body parameters evaluated, the keel length had the highest R value in all the functions.

Keywords: Growth models, Simple Linear, Quadratic and Cubic Function, Marshall Chicken

1. INTRODUCTION

The contribution of poultry to animal protein supply in Nigeria cannot be overemphasized. FAO (2008) estimated that, the poultry population at 137,679,000 out of this number, 115,880,864 representing 84% is backyard poultry, while 21,798,079 representing 16% are exotic poultry. According to Ojedapo *et al.*, (2010), poultry contributed significantly as a key source of animal protein for human consumption in Nigeria, accounting for around 10% of total national livestock output. Poultry meat and eggs account for more than a third of animal proteins consumed (Permin and Pedersen, 2000). In many developing countries of the world including Nigeria, the broiler industry plays a major role in supplying the population with meat which is highly nutritious and popularly consumed (Ukwu, 2004). The broiler chicken in Nigeria had served as the major source of protein for the population. On the contrary, human population was believed to be

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increasing rapidly especially in the developing countries like Nigeria. In this regard, food production and supply are found to be lower than the rate at which population is growing especially in the developing countries. As such, breeders have done good job through continuous selection that helped to reduce the age at marketing in the last four decades; as a result, body weight of 1.5 kg in broilers which was possible at 12 weeks of age in the past can now be achieved at 6-7 weeks (Kabir *et al*., 2006). Genetically improved strains of poultry have been a major contribution to the success of the poultry industry, which is a major source of animal protein for human population in most countries of the world (McKay, 2009). Furthermore, Health, nutrition, and environmental management advances have all contributed to enhanced performance, although genetic improvement constitutes larger percentage of the changes. McKay is a character in the film McKay (2009). According to Havenstein *et al.,* (2003a,b), genetic modifications are responsible for at least 85 percent of the increase in performance. Yakubu and Salako (2009) hinted that from conception until maturity, growth is a complicated and dynamic physiological process. Growth in any organism is a result of the genetic quality and characteristics of the individual and genetic x environment interaction (Kor *et al*., 2006). Body components like as live weight and linear body measures can be used to assess cattle growth (Wolanski *et al.,* 2006; Saatci and Tilki, 2007). Poultry farmers require specific methods for selecting animals for breeding. Commercial breeders and producers have noticed that linear body measures, often known as conformation features, are essential criteria in determining body weight. As a result, breeders choose hens with desired proportions as well as desirable production attributes, notably body weight (Ojedapo *et al.,* 2010). According to Amao *et al.,* (2012), the vast majority of the linear body measures represent the animals' long bones. Chicken height, wing span, keel length, Shank length, breast width, body length, thigh length, and head circumference are examples of conformation features (Ojo *et al.,* 2010). There are other traits that are less significant nutritionally than conformation traits; these are called morphological traits otherwise called head measurements. They include comb length and height, ocular length and width, beak length, wattle length and width, ear lobes length and width. Yakubu and Salako (2009) reported that comb length, beak length, and neck length did not significantly influence body weight. The relationships between body weight and conformation traits have been found to have important implications in the production of broilers with desirable body conformation (Ibe and Nwakalor, 1987). The body weight and other variables are direct and favorable, according to Okon *et al.,* (1997). As such knowledge of this relationship would help breeders organize their program in order to achieve optimum combination of body weight and conformation for maximum economic returns (Adeniji and Ayorinde, 1990). The value of analyzing interrelationships and conformation qualities in poultry, according to Chambers and Fortin (1984), is in their use as predictors of characteristics such as body weight. Such applications could speed up the assessment of traits through the involvement of simple measurement tools like ruler or tape, as such simple linear measurements that can predict body weight without necessitating bird slaughter will be particularly desirable. However, two significant metrics for monitoring growth in domestic hens are body weight and body conformations. This study therefore investigated the prediction of growth pattern of Marshall Chicken using regression model.

2. MATERIALS AND METHODS

Experimental Site

The research was conducted at the Ladoke Akintola University of Technology's Poultry Unit, Teaching and Research Farm in Ogbomoso, Oyo State, Nigeria. Ogbomoso is located at latitude 8° 15' north of the equator and longitude 4° 15' east of the Greenwich Meridian. It is around 145 kilometers north-east of Ibadan, the state capital of Oyo. The altitude is between 300 and 600 meters above sea level (Ewetola, *et al.,* 2015).

Experimental Birds and Management

300 day-old chicks comprising of males and females were procured from a reputable farm in Ibadan, Oyo state. On the day of arrival, the chicks were supplied with water and anti-stress plus antibiotics during the duration of 5 days during brooding. The birds were raised under deep litter management system.

Experimental Site

Housing and management: The chicks were managed intensively and wood shavings was used as litter materials. At the age of 4 weeks, the birds were wing tagged according to genotype for easy identification.

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Experimental Feeding

The chicks were fed with broiler starter of 22-25% CP and 2900kcalME/kg from day one to 5weeks of age and broiler finisher of 20% CP and 3000kcalME/Kg for 6-12weeks supplied with good, clean, cool, fresh drinkable water *ad libitum.* All necessary vaccinations and medications were given at the appropriate time.

Data Collection

The data collection was based on the genotype. The initial body weight (BW) of the chicks was measured using a sensitive scale and other body linear measurements such as chest girth, shank length, keel lenght, wing length, thigh length. The traits were assessed using weekly basis using a tailor's measuring tape in centimeters for linear measurements and sensitive scale in grams for body weights from week 0 till week 12 of age as described below:

Body Weight (kg): This was measured for individual live birds

Chest Girth (cm): The diameter of the breast around the deepest part of the breast was measured.

Keel length (cm): It was measured as the sternum's length.

Shank Length (cm): The distance between the hock joint and the tars metatarsus was measured.

Thigh Length: The distance between the hock joint and the pelvic area was measured.

Wing Length: It was measured from the scapula joint to the wing's final digit.

Regression model:

Traits studied were body weight, chest girth, body length, shank length and keel length. Measurements of chest girth, keel length, body length and shank length were compared to their body weight using simple linear, Quadratic and Cubic regression analysis (SAS, 2003).

Model function:

- Linear $Y = a + bx$
- Quadratic $Y_2 = a + bx + cx^2$
- Cubic $Y_3 = a + bx + cx^2 + dx^3$

Y, Y_2 and Y_3 are dependent variables (body weights) while x represents the independent variables (chest girth, keel length, shank length and body length), b, c, d are the regression coefficients associated with independent variables and a is the intercept represents the estimate of dependent variable when the independent variable is zero.

Statistical Analysis

The data collected were analyze via a one-way analysis of variance (ANOVA) using the general linear model (GLM) procedure of SAS (2003).

Model;

$^{\gamma}ij = \mu + G_i + e_{ij}$

$^{\gamma}ij$=Individual Observation

U = Overall Mean

G_i = Effect of Genotype

e_{ij} = The error

3. RESULT

Table 1 shows the estimation of parameters in Marshall Strain. Coefficient of determination, correlation of determination in body length in all functions are similar and have the least values in BL (67, 68 and 69) respectively. Coefficient of determination (R^2) were highly significant $P< 0.05$ across all body parameters in simple linear function while other functions are non-significant. The resultant values obtained were (0.67, 0.76, 0.94, 0.75, 0.88, and 0.90) respectively for BL, CG, KL, SL, TL, WL. While chest girth and keel length are similar in values in simple linear and quadratic functions of BL (76, 75 and 94, 95) respectively.

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Table 1: Estimation of Parameters in Simple Linear, Quadratic and Cubic Function Fitted For Body Weight-Linear Body Measurements of Marshall Broiler Chicken

Traits	Function	R^2	R^2-Adjusted	R^2 %	S.E	LOS
Body Length	$Y = 11.71 + 0.00x$	0.67	0.67	67	0.20	***
	$Y_2 = 11.60 + 0.00x – 7.81x^2$	0.68	0.68	68	0.35	***
	$Y_3 = 11.63 + 0.00x + 1.06x^2 – 5.50x^3$	0.69	0.69	69	0.56	***
Chest girth	$Y = 12.78 + 0.00x$	0.76	0.76	76	0.25	***
	$Y_2 = 12.59 + 0.00x – 0.00x^2$	0.75	0.75	75	0.43	***
	$Y_3 = 12 .64 + 0.00x – 1.50x^2 – 7.77x^3$	0.87	0.87	87	0.50	***
Keel Length	$Y = 5.58 + 0.00x$	0.94	0.94	94	0.15	***
	$Y_2 = 5.50 + 0.00x – 5.27x^2$	0.95	0.95	95	0.26	***
	$Y_3 = 5.47+ 0.00x – 0.00x^2 + 5.39x^3$	0.98	0.98	98	0.41	***
Shank Length	$Y = 4.07 + 0.00x$	0.75	0.75	75	0.10	***
	$Y_2 = 3.96 +0.00x – 7.01x^2$	0.78	0.78	78	0.13	***
	$Y_3 = 4.06 – 0.00x + 0.00x^2 – 1.71x^3$	0.85	0.85	85	0.21	***
Thigh Length	$Y = 9.05 + 0.00x$	0.88	0.88	88	0.17	***
	$Y_2 = 8.91 + 0.00x – 9.28x^2$	0.90	0.90	90	0.26	***
	$Y_3 = 8.98 + 0.00x – 7.43x^2 -1.28x^3$	0.93	0.93	93	0.43	***
Wing Length	$Y = 10.70 + 0.00x$	0.90	0.90	90	0.21	***
	$Y_2 = 10.57 + 0.00x^2 -8.29x^3$	0.93	0.93	93	0.37	***
	$Y_3 = 10.68 + 0.00x + 0.00x^2 – 1.98x^3$	0.94	0.94	94	0.59	***

BL-Body length; CG- Chest girth; KL- Keel Length; SL-Shank length; TL- Thigh Length; WL-Wing length; NS- Non significant; SE-Standard error of estimate; LOS-Level of significance; ***Significant at $P< 0.05$

4. DISCUSSION

The value of R in this research was similar to the range (82.8 – 98.0%) reported by Nosike (2015) in local turkey varieties. All other linear body metrics in all strains investigated had a percent R value more than 50%, implying that any linear body parameter may be used to predict broiler body weight. The values of determination coefficient (R) in the Marshall Strain, with keel length having the greatest value (94, 95, and 98) in all functions. This implies that keel length could give the best accuracy of prediction in the assessment of body weight in broiler chicken. Another body parameter closer to high keel length values is Wing length 0.90, 0.93 and 0.94 respectively in simple linear, quadratic and cubic functions which also agreed with the result of Ojo *et al*., (2010) and Ogah (2011) who in separate studies reported that at 7–8 weeks, the maximum R value in wing length was found in several strains of age. Nosike (2015) also reported R value of 96% with wing length in the black turkey strain and could also give accurate prediction in the assessment of body weight in broiler chicken.

5. CONCLUSION

The growth pattern using mathematical model or function in this research showed that the leading key indicators (Standard error, coefficient of determination and correlation of determination), suggest that Simple Linear Regression is more appropriate to describe growth pattern of Marshal strain compare to quadratic and cubic function. All the linear body variables have their R values higher than 50%, that is, they may perhaps be used to make predictions on the body weights of the broiler strain, although the accuracy of prediction increase with an increase in the R value. In summary, among all of the linear body characteristics that have been examined, the keel length had the highest R value in all the functions.

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Conflicts of interests

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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