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Statistical Modeling of Body Weight and Body Linear Measurements of the French Broiler Guinea Fowl in the Humid Tropics of Nigeria

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Abstract

This study was conducted to determine the relationship between body weight and body linear parameters of the French broiler guinea fowl (FBGF) raised in the humid tropics of Nigeria, and to establish an equation for predicting body weight of the FBGF using body linear parameters. A total of 86 FBGFs were used for the study. The birds were managed intensively for 38 weeks before measurements were taken on the birds. Body weight was taken using a sensitive digital weighing scale. Body biometrics-shank length, thigh length, keel length, chest circumference, body length and wing length were measured using a flexible measuring tape. Data were subjected to statistical package for analysis. The correlations between body weight and body linear measurements were determined using Pearson's product moment correlation coefficient (r). Data were also subjected to simple and multiple regression analysis. Correlations between body weight and body linear measurements were positive and significant ($P<0.01$). The values for coefficient of determination (R^2) ranged from 0.2% to 19.5% with shank length showing the highest R^2 value. This implies that shank length could be the best predictor of body weight of the French broiler guinea fowl. The predictive equations showed that there was a significant ($P<0.01$) relationship between body weight and body linear measurements. R^2 values observed in this study shows that the predictive equations could be used to predict body weight accurately using the simple regression model.

Keywords: Body weight; Body linear parameters; Statistical modeling

Introduction

Most of the developing countries are found in the tropics and are experiencing rapid urbanization [1]. The dominant issues to address are food security and nutrition, combating rural poverty to enhance rates and patterns of agricultural growth can contribute to economic development and environmental protection [1]. Most of the malnutrition seen in the world is as a result of relying too heavily on a few staple foods [2]. It is however difficult to obtain such variety but meat can complement most diets especially those dependent on a limited selection of plant foods. Contributions from sustainable increase in livestock and poultry production will therefore be desired in order to meet the demands of the human population for quality protein supply. It has been estimated that it will be necessary to increase meat production by 80 percent between 2000 and 2030 [3].

Rural poultry production over the years had centered on local chickens [4]. The local chicken contributes immensely to protein availability for rural communities, being the major source of meat than other protein providing products [5]. Rural poultry production had also support crop agriculture when sales of chickens are made to support rural farmers' revenue input to crop production or as a cushion when revenues expected from crop production are not feasible [6]. Rural farming communities of over 90 percent in developing countries reared local chickens on free range production systems [4]. This system of rural poultry production is not only affordable to the rural farming communities, but had also fitted into cultural and socio-economic lives of farming communities in the developing nations [7].

As important as the rural poultry production is in developing nations, value chain intervention and value addition strategies had not been introduced to the rural farming communities for adoption to improve revenue for the rural farming communities [8]. In view of these, the rural poultry production had not been able to provide its maximal support to rural farming communities [8]. Disease epidemics, unimproved housing and poor nutrition have over the years being a challenge limiting full utilization of the potential of the rural poultry sector in developing countries [9]. Aside value chain and value addition interventions, diversifying rural poultry production by introduction of unconventional poultry breeds like the French broiler guinea fowl will also provide improved support for the rural poultry production sub-sector.

Apart from body weight, a number of conformity traits are known to be good indicators of body growth and market value of guinea fowls [10]. Poultry breeders have tried to establish the relationship that exists between body weight and body linear measurements such as shank length, thigh length, keel length, body length, chest circumference and wing length. The relationships between these traits provide useful information on the performance and carcass value of the animals [11]. The relationship between body weight and body linear measurements is important for selection in breeding programs for genetic improvement of the breed [12]. The use of body linear measurements to predict body weight of different species of animals have been attempted by various researchers [13-15], however, there is little information on the prediction of body weight of poultry using body linear measurements [16].

The objectives of this study were to determine the relationships between body weight and body linear measurements of the French broiler guinea fowl raised in the humid tropics of Nigeria and to model

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the relationship between body weight and body linear measurements of the French broiler guinea fowl.

Materials and Methods

Location of study

This study was carried out in Makurdi, Benue State, Nigeria. Makurdi lies on latitude 7°30' 22" N and longitude 9°21' 22"E with a climate typical of the tropical zone, Makurdi has two distinct seasons. The wet season; which ranges from April to October and the dry season which ranges from November to March with an annual rainfall range from 508 mm to 1016 mm. The annual temperature ranges from 22.8°C to 40°C with annual relative humidity range of 47% to 87%.

Experimental design, birds and their management

The experimental design used was the randomized complete block design (RCBD). About 86 French broiler guinea fowl keets at 5 weeks of age were transferred to the rearing pen measuring 5 m×5 m dwarf walled with wire mesh, aluminum roofing sheet and cemented floor and wood shaving was used as litter material at a 2 cm depth. The birds were given anti stress (Vitalite®) on arrival through drinking water. They were fed commercial grower diet containing 18% crude protein while feed and water were provided ad libitum. The French broiler guinea fowls were dewormed at 32 weeks to control endo-parasites, cleaning of feeding and watering equipment's were carried out daily while litter materials were changed routinely.

Experimental procedure

Body weight measurement: Body weight of the individual birds was measured by placing the guinea fowl on a digital sensitive scale and taken weight in grams.

Body linear measurements: The Shank length, thigh length, keel length, chest circumference, body length and wing length were measured using a flexible measuring tape graduated in centimeters. Shank length was measured by taking the distance between the foot pad and hock joint. Thigh length was measured by measuring the distance between the hock joint and the tidio-fibula-fumoral joint. Keel length was measured by taking the distance between the anterior and posterior ends of the Keel. Chest circumference was taken by measuring the circumference of the body around the breast region. Body length was taken by measuring the distance between the phygostle and the last posterior vertebrate. Wing length was taken by measuring the distance between the tips of the phallenges to the scapula joint.

Data collection and analysis: Data were collected on thirty eight weeks old French broiler guinea fowls. Descriptive statistics was employed to measure the mean and standard error using Minitab 18. The relationship between body weight and body linear measurements was determined using Pearson's product moment correlation (r). Linear regression of body linear parameters on body weight was also performed using the following simple and multiple linear regression equations.

$$Y=B+\beta_1 X_1 \quad (1)$$

Simple regression equation

Where;

Y=dependent variable (Body weight).

B=the intercept

X1=independent variable

Y=Dependent variable (Body weight).

$$B=B+\beta_1 X_1+\beta_2 X_2 \ldots \beta_k X_k \quad (2)$$

Multiple regression equation

Where;

Y=the intercept

B_s=the slope

Xs=independent variables (SL, TL, KL, CC, BL, WL).

Results

Average body weight and body linear parameters

The mean values of body weight and body linear parameters are presented on Table 1. Body linear parameters ranged from 7.76 ± 0.53 cm to 23.53 ± 2.14 cm with shank length showing the least and body length shows the highest measurement.

Correlations between body weight and body linear measurements of the French broiler guinea fowl

The correlations between body weight and body linear measurements of the French broiler guinea fowls are presented on Table 2. Body weight and body linear measurements had (P<0.01) associations.

Prediction equation relating to body weight and body linear parameters

Prediction equation relating to body weight and body linear parameters is presented on Table 3. Body weight had significant (P<0.01) associations with body linear parameters. The values of the coefficient of determination (R^2) ranged from 0.2% to 19.4%.

Discussion

Body weight and body linear parameter

The mean value for body weight observed in this study was higher than the values 1.23 g, 1.13 g and 1.28 g for pearl grey, peal grey pied and white guinea fowls in Ghana reported by Brown et al. [17]. This could be that the French broiler guinea fowl is an improved strain compared to pearl grey, peal grey pied and white guinea fowls. Mean shank length observed in this study was also higher than the value reported by Kasperska et al. [18] but lower than the range of 8.88 ± 3.1 cm to 9.31 ± 4.7 cm reported by Panyoka et al. [19] for domestic and wild helmeted guinea fowl of Kenya. Brown et al. [17] also reported higher values for local guinea fowl in Ghana. Differences observed in this study could be attributed to differences in breeds, levels of improvement, environmental factors and management practices

Parameter (cm)	Mean ± SE	CV
BW (g)	1318.2 ± 5.87	10.74
SL (cm)	7.76 ± 0.53	6.86
TL (cm)	13.2 ± 1.01	7.66
KL (cm)	15.03 ± 5.90	39.7
CC (cm)	27.38 ± 3.03	11.3
BL (cm)	23.53 ± 2.14	9.11
WL (cm)	19.22 ± 1.52	7.88

BW: Body Weight; SL: Shank Length; TL: Thigh Length; KL: Keel Length; CC: Chest Circumference; BL: Body Length; WL: Wing Length; SE: Standard Error; CV: Coefficient of Variation; cm: Centimeter.

Table 1: Mean values of body linear parameters of the broiler guinea fowl.

Parameter	BW	SL	TL	KL	CC	BL	WL
BW (g)	-						
SL (cm)	0.437**	-					
TL (cm)	0.397**	0.507**	-				
KL (cm)	0.044**	0.124**	0.081**	-			
CC (cm)	0.409**	0.443**	0.360**	0.092**	-		
BL (cm)	0.390**	0.433**	0.277**	0.096**	0.435**	-	
WL (cm)	0.374**	0.573**	0.643**	0.102**	0.400**	0.411**	-
**(P<0.01) Level of Significance.							

Table 2: Correlation between body weight and body linear measurement of the French broiler Guinea fowl.

Parameter	Predictive equation	SE	R^2 (%)
SL	Y = 412+112SL	0.02	19.5
TL	Y=572+55.6 TL	0.06	16.4
KL	Y=1292+106KL	0.27	0.2
CC	Y=801+18.6CC	0.14	16.6
BL	Y=707+25.5BL	2.15	15.5
WL	Y=629+35.3WL	1.52	14.8

R^2: Coefficient of Determination; SE: Standard Error; SL: Shank Length; TL: Thigh Length; KL: Keel Length; CC: Chest Circumference; BL: Body Length; WL: Wing Length.

Table 3: Predictive equations and strength of prediction for body weight of the French broiler Guinea fowl.

employed. Mean thigh length value observed in this study was higher than the value of 11.57 ± 0.01 reported by Ogah [20] for indigenous guinea fowl of Nigeria. This could be that the French broiler guinea fowl is an improved strain compared to the indigenous guinea fowl of Nigeria. Mean keel length in this study was higher than the value of 11.57 ± 0.10cm reported by Ogah [20] and Brown et al. [17] for pearl grey, peal grey pied and white guinea fowls in Ghana. This could also be that the French broiler guinea fowl is an improved strain with broader body linear parts compared to the indigenous guinea fowl of Nigeria. Mean chest circumference reported in this study was higher than the mean value (26.85 cm) reported by Brown et al. [17] for local guinea fowl in Ghana. This could be because of the superior genome of the French broiler guinea fowl. Mean wing length and body length reported in this study were lower than the values reported by Panyoka et al. [19] for guinea fowls in Kenya. This could be as a result of uncontrolled mating system and breeding objectives which must have led to loss in hybrid vigor.

Correlations between body weight and body linear measurements

Body weight and body linear measurements had positive association in this study. That is, there existed a positive correlation between body weight and body linear parameters. This is in agreement with reports by Ukwu et al. [10] who reported high and positive correlation between body weight and body linear measurements in the Nigerian chicken, the report of Momoh and Kenshima [16] using Nigerian local chicken also agrees with the result of this study. Findings in this study indicated that shank length and chest circumference had the strongest correlations with body weight as compared to other body linear parameters. This corroborates with the results of Ojo et al. [21] who investigated the relationship between body weight and linear body measurements in Japanese quails. This implies that an improvement in shank length and chest circumference will lead to a corresponding improvement in body weight. The observed effect may be due to pleiotropic effect and gene linkage effects between the two traits of the French broiler guinea fowl. Selection for body weight gain could be achieving selection for shank length and chest circumference.

Prediction of body weight using body linear parameters

The significant and positive associations among body weight and body linear parameters, indicated by the prediction equations showed that, the predictive equations could be used to predict body weight with high accuracy. The highest coefficient of determination of shank length indicated that it has the highest accuracy to predict body weight compared to the other body linear measurements. R^2 values in this study were lower than those reported by Ukwu et al. [10] and Momoh and Kenshima [16] for Nigerian local chicken. This could be due to the effects of breeds determining body parts dimensions, environments and management systems employed.

Conclusion and Recommendation

Conclusion

The results of this study indicated that there were strong and positive correlations between body weight and body linear parameters. The study also indicated that body weight can be predicted using body linear parameters. Shank length had the highest capacity and accuracy to predict body weight compared to the other body linear measurements. This was followed by chest circumference. This relationship could be used in selection programs for genetic improvement of body weight gain in the populations of the French broiler guinea fowl raised in Nigeria. Thus, breeding program designed for genetic improvement of body weight gain in the populations of the broiler guinea fowl can apply selection to shank length and chest circumference as selection criteria.

Recommendation

From the results of the study, the following recommendations were drawn.

The strong relationship between body weight and body linear measurement can be exploited for genetic improvement of body weight gain of the broiler guinea fowl strains. Selection for body weight gain can be achieved by selection for shank length to explore the correlated association between these traits.

References

1. Ball A (2003) Why Tropical Countries are Underdeveloped. National Bureau of Economic Research, US.

2. Avornyo FK, Salifu S, Panyan EK, Al Hassan IB, Ahlagbe M, et al. (2016)

Characteristics of guinea fowl production systems in northern Ghana. A baseline case Study of 20 districts in northern Ghana. Livest Res Rural Development 28.

3. FAO (2011) Draft Guidelines on Phenotypic Characterization of Animal Genetic Resources. Commission on genetic resources for food and Agriculture, 31th regular session, 18-22 July 2011, Rome.
4. Padhi MK (2016) Importance of Indigenous Breeds of Chicken for Rural Economy and their Improvements for Higher Production Performance. Scientifica.
5. Garba J, Yarl AY, Haruna M, Ibrahim S (2013) Traditional poultry production: The role of women in Kaura-Namoda local government area, Zamfara State, Nigeria. African J Agr Res 8: 3415-3421.
6. Nhemachena C (2014) Economic impacts of climate change on agriculture and implications for food security in Zimbabwe. Afri J Agri Res 9: 1001-1007.
7. Wong JT, Alters RG (2017) Small-scale poultry and food security in resource-poor settings.
8. Virendra K, Wamkhede KG, Gena V (2015) Role of Cooperatives in Improving Livelihood of Farmers on Sustainable Basis. American J Educ Res 3: 1259-1266.
9. Bell JG (2009) Factors limiting production efficiency and profitability from smallholder poultry production. World Poutl Sci J 65: 207-210.
10. Ukwu HO, Okoro VMO, Nosine RJ (2014) Statistical Modeling of Body Weight and Linear Body Measurements in Nigerian Indigenous Chicken. J Agri Vet Sc 7: 27-31.
11. Lukuyu MN, Gibson JP, Savage DB, Duncan AJ, Mujibi FDN, et al. (2016) Use of body linear measurements to estimate liveweight of crossbred dairy cattle in smallholder farms in Kenya. Springerplus 5: 63.
12. Ige AO (2013) Relationship between Body Weight and Growth Traits of Crossbred Fulani Ecotype Chicken Derived Savannah Zone of Nigeria. Int Jour Applied Agri Agricultural Res 9: 157-166.
13. Attah S, Okubanjo AO, Omojola AB, Adeshinwa AO (2004) Body and carcass linear measurements of goats slaughtered at different weights. Livest Res Rural Development 16.
14. Sowande SO, Sobola OS (2008) Body measurements of West African dwarf sheep as parameters for estimation of live weight. Trop Anim Health Prod 40: 433-439.
15. Goe MR (2007) Use of heart girth to predict body weight of working oxen in the Ethiopian highlands. Livest Prod Sci 69: 187-195.
16. Momoh OM, Kenshima DE (2008) Linear Body Measurements as Predictors of Body Weight in Nigerian Local Chickens. ASSET: Int J 8: 206-212.
17. Brown MM, Alenyorge BA, Teye GA, Roessler R (2017) Phenotypic diversity, major genes and production potentials of local chickens and guinea Fowls in Tamale, northern Ghana. Asian-Australas J Anim Sci 30: 1372-1381.
18. Kasperska D, Korytkowska H, Kokoszynski D (2011) Effects of age and sex on body weight and body dimensions on pearl grey guinea fowl (*Numida meleagris L.*). Acta Sci Pol Zootechnica 10: 39-44.
19. Panyoka PM, Imboma T, Karuki DW, Makanda M, Oyier PA, et al. (2016) Phenotypic Characterization of Domestic and Wild Guinea Fowls of Kenya. Livest Res Development 28.
20. Ogah M (2013) Variability in Body Shape Characters in an Indigenous Guinea Fowl (*Numida meleagris L.*). Slovak J Anim Sci 46: 110-114.
21. Ojo V, Fayeye TR, Ayorindeamd KL, Olojede H (2014) Relationship between Body Weight and Linear Body Measurements in Japanese Quail. J Sc Res 6: 175-183.