The correlations between body weight and linear body measurements in three strains of broiler chickens reared in monsoon zone in Nigeria

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Abstract

Body weight and linear body measurements in poultry, particularly in broiler chickens, are paramount for optimizing growth performance, health, and overall productivity, and there is a lack of comprehensive data regarding the correlations between body weight and linear measurements in broiler strains specific to this region. This study aims to fill that gap and provide a foundation for future research and practical applications. This study examined the genetic link between linear body measurements of three broiler chicken strains in Nigeria's monsoon zone. Data was gathered from 80 each of Arbor Acres, Cobb 500 plus, and Ross 308 strains broiler chicks. The characteristics measured included body weight (BWT), body length (BDL), wingspan (WS), thigh length (THL), shank length (SHL), and breast girth (BRTG). The data obtained were analyzed using the SPSS (Ver.23) process. Significant (P<0.05) differences were obtained in the body weight and linear metrics across broiler strains from day 1 to 56 days. Broiler strains significantly (P<0.05) affected broiler chickens' body weight and linear metrics attributes. Ross strain outperformed the Abor Acres and Cobb 500 Plus recording a body weight of 3.17kg, standard deviation of 0.537, and linear metrics including body length of 37.07cm, wingspan of 27.80cm, thigh length of 15.53cm, shank length of 9.90cm, breast girth 40.27cm). The coefficient of correlation between correlation, using bodyweight linear body measures the body weight and linear body measurements indicated positive and very significant (Arbor Acres = 0.56 - 0.79, Cobb 500 Plus = 0.41-0.82, and Ross 308 = 0.41-0.92). Thus, the Ross 308 strain had the best body weight and linear body measurement attributes, and it is therefore recommended to chicken entrepreneurs and researchers in the monsoon region of Nigeria for increased productivity and selection purposes.

Keywords: Correlations, growth performance, monsoon climate, Linear Body Measurements, strains

Les corrélations entre le poids corporel et les mesures corporelles linéaires chez trois souches de poulets à griller élevés dans la zone de mousson au Nigeria

Résumé

Le poids corporel et les mesures corporelles linéaires chez la volaille, en particulier chez les poulets à griller, sont essentiels pour optimiser la performance de croissance, la santé et la productivité globale. Cependant, il y a un manque de données complètes concernant les corrélations entre le poids corporel et les mesures linéaires chez les souches de poulets de chair spécifiques à cette région. Cette étude vise à combler cette lacune et à fournir une base pour de futures recherches et applications pratiques. Cette étude a examiné le lien génétique entre les mesures corporelles linéaires de trois souches de poulets à griller dans la zone de mousson du Nigeria. Des données ont été collectées auprès de 80 poussins de chaque souche :

Arbor Acres, Cobb 500 Plus et Ross 308. Les caractéristiques mesurées incluaient le poids corporel (PC), la longueur du corps (LC), l'envergure (E), la longueur de la cuisse (LC), la longueur du tibia (LT) et le tour de poitrine (TP). Les données obtenues ont été analysées à l'aide du logiciel SPSS (Ver. 23). Des différences significatives (P<0.05) ont été observées dans le poids corporel et les métriques linéaires entre les souches de poulets à griller du jour 1 au jour 56. Les souches de poulets à griller ont significativement (P<0.05) influencé le poids corporel et les caractéristiques métriques linéaires des poulets de chair. La souche Ross a surpassé les Arbor Acres et Cobb 500 Plus, enregistrant un poids corporel de 3.17 kg, un écart type de 0.537, et des métriques linéaires comprenant une longueur du corps de 37.07 cm, une envergure de 27.80 cm, une longueur de cuisse de 15.53 cm, une longueur de tibia de 9.90 cm et un tour de poitrine de 40.27 cm. Le coefficient de corrélation entre le poids corporel et les mesures corporelles linéaires a montré une corrélation positive et très significative (Arbor Acres = 0.56 - 0.79, Cobb 500 Plus = 0.41-0.82, et Ross 308 = 0.41-0.92). Ainsi, la souche Ross 308 présente les meilleures caractéristiques de poids corporel et de mesures corporelles linéaires, et elle est donc recommandée aux entrepreneurs avicoles et aux chercheurs dans la région de mousson du Nigeria pour augmenter la productivité et les objectifs de sélection.

Mots-clés : Corrélations, performance de croissance, climat de mousson, mesures corporelles linéaires, souches.

Introduction

Poultry farming accounts for 6-8% of Nigeria's GDP, with approximately 42% of the population participating in poultry farming directly or indirectly (Wuyep, 2018). These chickens are white and were bred to be huge and healthy, more breast meat for the consumer market. Broiler chicken breeds improve quickly and provide good protein and calorie value. (Maharjan *et al.,*2021, Ade *et al.,*2023). Growth is an important trait of animals, characterized by any change in body size per unit of time and defined by genotype and environment (Roff, 1996). Bodyweight and body conformation are the two most significant variables for development in domestic chickens (Akporhuarho and Omoikhoje, 2017). The processes influencing chicken growth control are too complex to be dealt with solely by univariate analysis because all associated variables are biologically connected because of gene pleiotropy and locus linkage (Rosario *et al*., 2003; Udeh and Ogbu, 2011). Salako (2006) suggests that aside from weight measurements, bodily measurements define a single individual or group more completely than the traditional weighing and grade method. When live weights are obtained alongside these parameters, these body measurements have been used for the estimation of weights repeatedly. Body proportions were used for determining breed, origin, and relationship via head measurements (Itty *et al*.,1997), in addition to size. For instance, EAAP and FAO have used wither height as the key indicator in West African dwarf goat, (Wilson, 1995). More recently, alternative body characteristics and indices computed from diverse combinations of conventional and non-conventional body metrics are not only superior guides to weights but are also employed as indications of type and function in domesticated animals (Mason, 1996, Salako, 2006).

The Monsoon region experiences heavy rainfall, which affects temperature and humidity levels, and this can lead to higher moisture levels in the environment, impacting poultry health and management practices (Zhao *et al.,* 2005). The climate is generally cooler and more humid compared to the hot, arid northern zones, influencing the types of poultry breeds that thrive

(Ade *et al.,* 2024). The breeds suited for the Monsoon region may differ due to local climatic conditions (Marambe *et al*.,2015). Humidity may favor specific breeds that are more resilient to such environments compared to those preferred in drier areas (Hoffmann, 2013). The humid environment can promote the prevalence of certain diseases, necessitating different management strategies compared to other regions. For instance, the risk of respiratory diseases may be higher, requiring vigilant biosecurity measures (Duchenne and Neetoo 2021).

The study was thus conducted to assess interactions between body weight and body measurements in three broiler strains of chickens reared in Nigeria's monsoon zone.

Materials and Methods

Description of the Experimental Site:

The investigation was conducted at the Poultry Section, Department of Animal Science and Production, Dennis Osadebay University, Asaba. Dennis Osadebay University, Asaba is situated between Latitude**:** 6.1850° N and Longitude: 6.7365° E. Experiences an average annual rainfall ranging between 1,500 and 2,000 mm (April-October) with a daytime temperature ranging from 25 to 30 °C (Asaba Metrological sub-station, 2024).

Managing experimental birds

The study used 240 broiler chicks obtained from a reputable hatchery, with 80 each of Arbor Acres (AAS), Cobb 500 Plus (CPS), and Ross 308 (RS). The actual data collection was done with 80 broilers per strain, whereas 10 chicks were provided to account for mortality. At day old, the chicks were housed in deep litter pens separately. From day 1- day 28 of age, they were offered *ad libitum* a standard broiler starting diet, followed by a standard feed broiler finishing diet from 28 to 56 days. Three birds were also regularly supplied with clean drinking water, and the broiler chicks received all the required vaccinations.

Parameters measured

The birds' body weights (BDWT) were measured weekly from 1-56 days of age. Linear body measurements, such as body length (BDL), wingspan (WSP), thigh length (THL), shank length (SHL), and breast girth (BRTG), were taken weekly with a flexible tailoring tape, as reported by Monsi (1992) and Udeh *et al.* (2011).

Data analysis

Descriptive statistics of SPSS (Ver.23) were used to obtain the means and standard errors of body weight and linear body measurements for each broiler strain. The effect of broiler strains on the parameters was tested using a one-way analysis of variance (ANOVA) in a completely randomized technique. For each broiler strain, a correlation matrix was generated based on body measurements.

A statistical model employed for analysis was

$y_{ij} = u + x_i + e_{ij}$

In this equation,

y_{ij} = represents the observation made on the jth individual in the ith group in broiler chicken strains (e.g., body weight, length).

u = Indicates the overall population mean estimate.

x_i = effect of the ith treatments (I = 1, 2, 3).

e_{ji} = Denotes the random error associated with each measurement.

Results

Table 1 illustrates the effect of strain on live body weight and linear body measurement in Arbor Acres (AAS), Cobb 500 Plus (CPS), and Ross 308 (RS) broiler chickens. At 56 days of age, live body weight has grown significantly ($P < 0.05$) with strain, with Cobb 500 plus and Ross 308 attaining 3.07 ± 0.6kg and 3.17 ± 0.8kg, respectively, surpassing Arbor Acres's 2.90 ± 0.02kg. Arbor Acres outperformed Cobb 500 Plus

(31.73 ± 0.55, 25.70 ± 0.01) and Ross 308 (3.17 ± 0.8, 29.86 ± 1.15) strains ($p<0.05$) in body length (34.07 ± 0.95) and wingspan length (27.57 ± 0.23). Arbor Acres and Cobb 500 plus strains had considerably greater thigh lengths (15.57 ± 1.43 and 15.53 ± 1.39) compared to Ross 308, which had the shortest (13.53 ± 1.21cm). Cobb 500 Plus has a higher shank length (9.87 ± 0.50) than Arbor Acres (8.83 ± 0.55), while Ross 308 had the lowest (7.90 ± 0.50) compared to other strains ($p<0.05$). The Ross 308 strain has a higher breast girth (40.27 ± 0.33) than the Arbor Acres and Cobb 500 plus strains, which had values of 38.27 ± 0.38 and 38.27 ± 0.38, respectively.

Table 2 shows the correlation matrix in terms of body weight and measures in the three broiler chicken strains. Arbor Acres, Cobb 500 Plus, and Ross strains had correlation matrix values of -0.57-0.81, -0.52-0.82, and -0.41 - 0.92, respectively. The interaction with body weight in most body measurements was positive and non-significant ($p>0.05$) in the three broiler strains. Arbor Acres broilers showed highly significant ($p<0.01$) positive relationships with shank length, wingspan (0.79), breast girth, and body length (0.63). Cobb 500 plus revealed notable ($p<0.05$) relationships between wingspan and body length (0.41), thigh length and wingspan (0.71), and breast girth and shank length (0.75). In the Ross strain, there were substantial positive associations ($p<0.05$) between thigh length and breast girth (0.74), and breast girth shank length (0.71).

Table 1. Effect of broiler strain body weight (kg) and linear body measures (cm) in three broiler chicken strains at 1-56 days old

Traits	No. Observed	AAS	CPS	RS	SD (AAS)	SD (CPS)	SD (RS)
Body weight (kg)	80	2.90± 0.02^{b}	3.07 ± 0.6^{b}	3.17 ± 0.8^{a}	0.179	0.537	7.155
Body length (cm)	80	36.73 ± 0.55^{a}	31.86 ± 1.15^{c}	37.07 ± 0.95^{a}	4.919	10.29	10.28
Wingspan (cm)	80	24.57 ± 0.13^{c}	25.70 ± 0.01^{b}	27.80 ± 0.28^{a}	1.163	0.089	2.504
Thigh length (cm)	80	13.57 ± 1.43^{b}	15 .53 ± 1.39^{a}	15.53 ± 1.21^{a}	12.79	12.43	10.82
Shank length (cm)	80	8.83 ± 0.55^{b}	7.87 ± 0.50^{c}	9.90 ± 0.50^{a}	4.919	4.472	4.472
Breast girth (cm)	80	38.27 ± 0.38^{b}	38.27 ± 0.38^{b}	40.27 ± 0.33^{a}	3.399	3.399	2.952

a,b,c, means on the same row with different superscripts are significantly ($p<0.05$) different. No. of observed—number of data observed; SD—standard deviation; Arbor Acres (AAS); Cobb 500 Plus (CPS); and Ross 308 (RS) broiler chickens.

Table 2. The coefficient of correlation matrix among body weight and body measured in Arbor Acres, Cobb 500, and Ross 308 broiler chickens at 1-56 days of age

Arbor Acres					
Body wt	BDL	WS	THL	SHL	BRTG
BDL	1.00				
WS	0.69	1.00			
THL	0.56	0.74	1.00		

SHL	-0.69	-0.76	0.73*	1.00	
BRTG	0.63**	0.79**	-0.78	0.64	1.00

Cobb 500 plus					
Body wt	BDL	WS	THL	SHL	BRTG
BDL	1.00				
WS	0.41*	1.00			
THL	0.62	0.71*	1.00		
SHL	0.66	0.74	0.82	1.00	
BRTG	0.52	0.62	0.73	0.75	1.00

ROSS 308					
Body wt	BDL	WS	THL	SHL	BRTG
BDL	1.00				
WS	0.92	1.00			
THL	0.45	0.62	1.00		
SHL	-0.74	-0.41	-0.70**	1.00	
BRTG	0.71	0.67	0.74	-0.71	1.00

*Correlation is significant at the (P<0.05) **Correlation is significant at the (P<0.01). Body wt= Body weight; BDL= Body length; WS= Wing length; THL= Thigh-length; SHL=Shank length; BRTG= Breast girth.

Discussion

Arbor Acres, Cobb 500 Plus, and Ross 308 obtained live body weights of 2.90kg, 3.07kg, and 3.17kg, respectively, at 56 days of age, these differences may differ in their growth rates and feed conversion efficiency, leading to variations in body weight at the same age, (Tavarez and Solis 2016, Zudidhof *et al.,* 2014), and the result of these findings is in agreement with the report of (Akporhuaho, 2017), which said that broiler chickens attain a market weight of 3073.08.00-2084.63g at 1-10 weeks, and the findings are consistent with previous results reported by Obasi *et al.,* (2023), who reported an average body weight is 3100.00g for Ross broilers at 56 days of age.

This study also supports the findings of (Udeh and Ogbu, 2011), who discovered substantial strain bodily distinctions lengths across Arbor Acres (32.79cm), Marshall (31.30cm), and Ross (37.12 cm) strains at 56 days of age, and this could be attributed to the distinct genetic backgrounds that influence growth patterns, body conformation broiler strains (El-Gendy 2009). Growth is a crucial trait of animals, defined as any change in body size per unit of time that is regulated based on genotype and environment (Roff, 1996).

Correlation is one of the most frequent and effective statistical methods for determining the degree of association between two variables (Ige *et al.,* 2015; Abdel-Lattif, 2019). The correlation coefficients discovered in this study show that Ross 308 has a strong positive correlation between body weight and wingspan (0.92), indicating that as the birds grow heavier, they also grow wider, a trait that may be selectively bred. In contrast, Arbor Acres has a more varied correlation structure, suggesting that body weight may not correlate as strongly with linear

measurements in this strain. The highest coefficients of correlation obtained between SHL and BDL, BRTG, and SHL in this investigation were consistent with the values published by Akporhuaho (2017). According to (Maiwashe *et al.,* 2002; Ige *et al.,* 2015), substantial to high correlation values between growth traits show that the two pairs of growth traits are driven by a comparable set of genes, and the selection of one is likely to increase the other, resulting in substantial genetic gain.

Conclusion

The study highlights important differences in growth and body measurements among Arbor Acres, Cobb 500 Plus, and Ross 308 broiler strains. Cobb 500 Plus and Ross 308 performed in live weight, while Arbor Acres showed superior body length and wingspan. These findings aid strain selection for optimal growth, improve meat quality, and inform targeted breeding programs. Understanding the correlations in growth traits allows for tailored feeding and management practices, ultimately enhancing production efficiency and profitability in the region's poultry industry.

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