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Full Length Research

Breed differences in early growth performance of broiler chickens

Amusan S. A.[1]*, Popoola M. A.[1], Bolarinwa M. O.[1], Ajibola H. O.[1], Jeremiah T. B.[2] and Ogedengbe O. T.[1]

[1]Federal College of Animal Health and Production Technology, Ibadan, Oyo State, Nigeria.
[2]Department of Animal Breeding and Genetics, Federal University of Agriculture, Abeokuta, Nigeria.

*Corresponding author. Email: samuel.amusan@fcahptib.edu.ng

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ABSTRACT: Poultry growth performance varies across commercial broiler breeds, and understanding these differences can guide breed selection and management strategies. This study evaluated the effect of breed on growth traits in Arbor Acres, Cobb 500, Marshall, and Ross 308 broilers raised under standardised feed and housing conditions. A total of 100 chicks (25 per breed) were monitored from week 3 to week 5. Body weight and linear body measurements were collected weekly and analysed using the General Linear Model in SAS, while Pearson's correlation was applied to assess associations between traits. Results showed significant breed differences ($p<0.05$) in body weight, body length, chest circumference, keel length, and wing length. Arbor Acres consistently recorded the highest body weights (762.8 g, 1623.1 g, and 2184.6 g) at weeks 3, 4, and 5, respectively. Across breeds, body weight was strongly and positively correlated with all linear measurements. These findings indicate that Arbor Acres exhibits superior growth performance under the tested conditions and that linear measurements can serve as practical predictors of body weight, providing farmers with a simple tool for selection and management.

Keywords: Breed, body measurements; correlation, broiler.

INTRODUCTION

The poultry industry has become a cornerstone of global food production, driven by its ability to supply affordable and accessible animal protein. Global poultry meat production reached about 146 million tonnes in 2023, reflecting sustained growth over the past three decades (FAO, 2023). During this period, poultry's share of total meat production nearly doubled, rising from around 20% in the 1990s to almost 40% by 2020 (FAO, 2020). Egg production has also increased by more than 150% within the same timeframe, underscoring the sector's growing role in food security (FAO, 2020).

In Nigeria, poultry production remains one of the most important strategies for addressing protein malnutrition and improving household nutrition. The sector is among the fastest-growing components of the livestock industry, supported by high consumer preference for chicken meat, which is affordable, widely acceptable across cultural and religious groups, and often preferred over beef and pork (Akinola and Essien, 2019). Despite advances in breeding and management, strain differences in growth performance persist, and understanding these differences is essential for optimising production efficiency under local conditions.

Growth in poultry is influenced by both genetic and environmental factors and is commonly evaluated through body weight. However, body weight alone may not fully capture growth performance. Linear body measurements such as body length, chest circumference, keel length, and wing length have been shown to correlate strongly with body weight and can serve as reliable, non-invasive indicators of growth and carcass traits (Ige, 2013; Yunusa and Adeoti, 2014; Alabi *et al.,* 2020).

Comparative studies have demonstrated variation among commercial broiler strains in growth rate, feed efficiency, and morphometric traits (Razuki *et al*., 2011; Ige *et al.,* 2016). Yet, there is limited information on how commonly used commercial broilers such as Arbor Acres, Cobb 500, Marshall, and Ross 308 perform under Nigerian production environments, particularly in terms of the relationship between body weight and linear measurements during early growth.

Therefore, this study aimed to evaluate the growth performance and morphometric traits of four commercial broiler breeds reared under standardised conditions in Nigeria. By identifying breed differences and exploring correlations between body weight and linear measurements, the findings are expected to provide practical insights for breed selection and on-farm growth monitoring.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Teaching and Research Farm, Federal College of Animal Health and Production Technology, Moor Plantation, Apata, Ibadan. It experiences a temperature and humidity ranging from 35 – 40°C and 76 – 78%, respectively.

Experimental design, birds and management

The experiment was arranged as a completely randomised design (CRD) to evaluate breed effects on growth and linear body measurements. One hundred broiler chickens of four different breeds were used in this study, and they were kept under an intensive system: each pen was fenced with wire gauze, and dry wood shavings were used as litter material, spread on the floor of each pen; the birds were given feeders, drinkers, clean water, and plenty of food; the litter was changed frequently to prevent the growth of microorganisms; each bird was tagged on its wing to make identification easier during the study; and strict sanitation protocols and immunization programs were put in place to prevent disease.

Experimental procedures

In this study, one hundred broiler chickens were used. The 25 Marshal, 25 Cobb 500, 25 Ross 308, and 25 Arbor acres chickens made up the group. From the first day until they were ten weeks old, these birds were raised under conditions of strict management. Every hen came from the same genetic family and was purchased from a respectable hatchery in Ibadan, Oyo State, Nigeria. On the day of hatching, all of the chicks were taken to the brooding pen after being hatched simultaneously. When they arrived, they were kept in the same brooding pen, which was 3.6 m by 3.6 m and had 200 Watt heating bulbs.

Five centimetres of wood shavings were spread out on the brooding pen's floor as litter substrate. The birds were kept in the brooding pen with a lighting schedule of 12 hours of light and 12 hours of darkness during the trial period. For days 1–7, the brooding temperature was kept at 34°C; for days 8–14, it was kept at 30°C; and for days 15–16, it was kept at 28°C.

The birds were given a chicken starter meal in plastic trays with a diameter of 40 cm. It contained 28% crude protein and 2860 kcal/MEkg of metabolizable energy. Bell drinkers (25 cm in diameter and 30 cm in height) were used to supply clean water on demand. To stop illness outbreaks, strict adherence to a vaccination schedule and careful cleaning procedures were noted. The birds were only exposed to brooding, feeding, water provision, immunisation, medicine, and experimental handling during the experiment.

Data collection and measurement of parameters

Data used for the analysis were collected on body weight and linear body measurements of individual wing-tagged chickens on the three breeds at 3, 4 and 5 weeks of age. Body weight was measured in grams (g), using a Camry electronic sensitive weighing scale with a sensitivity of 2.00 g. The linear body measurements were taken in centimetres (cm) using a measuring tape. Keel length was measured from the cranial to the caudal terminals of the keel bone. Body length was measured as the linear distance between the nasal opening and the top of the pygostyle when the neck is carefully stretched and the measuring tape positioned along the midline of the bird's back. Wing length was measured by stretching the wing, and the measurement was taken from the humerus–coracoid junction to the tip of the digit. Wing span was measured as the linear distance from the tip of one fully extended wing to the tip of the opposite wing, with the bird positioned dorsally and both wings fully stretched horizontally at right angles to the body. Thigh length was measured from the tip of the tarsus to the ball joint. Shank length was measured as the distance from the foot pad to the hock joint. Drumstick length was measured as the length of the femur bone.

Statistical analysis

Data on growth traits were analysed using the General Linear Model procedure, and their means were separated using Duncan's Multiple Range Test with the aid of Statistical Analysis System (SAS, Version 9.1). The model adopted is presented below:

$$Y_{ij} = \mu + B_i + \varepsilon_{ij}$$

Where: Y_{ij} = individual observation, μ= overall mean in the population, B_i = effect of the i^{th} Breed (Arbor acres, Cobb 500, Marshall and Ross 308), ε_{ij} = residual random error.

Pearson's correlation coefficients were estimated between body weight and body linear traits using SAS (Version 9.1).

The correlation equation used in this study is expressed as follows;

$$\mathbf{r} = \frac{\mathbf{n}\sum\mathbf{xy} - (\sum\mathbf{x})(\sum\mathbf{y})}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

Where; r = the correlation coefficient, n = total number of samples, x = independent variable, y = dependent variable

RESULTS

Table 1 shows the effect of breed on body weight and linear body measurements of broiler chickens at week 3, 4 and 5. At week 3, breed had a significant ($p<0.05$) effect on body weight, body length, keel length, wing length, wing span, thigh length, drum stick and shank length. The heaviest body weights were observed in Arbor acres (762.84g), Ross 308 (725.48 g) and Cobb 500 (697.58 g), while the lightest body weight was observed in Marshall (617.00 g). Ross 308 (15.30 cm) had the widest body length, followed by Arbor acres (14.07 cm) and Marshall (13.76 cm), which were statistically similar; the narrowest body length was recorded in Cobb 500 (12.50 cm). Ross 308 (11.37 cm), Cobb 500 (11.00 cm), and Arbor arcres (10.98 cm) had a statistically longer keel length than Marshall (10.61 cm). The longest wing length was observed in Ross 308 (16.04 cm), while Cobb 500 (14.70 cm), Marshall (14.69 cm) and Arbor acres (14.16 cm) were similar for wing length. The longest wing span were observed in Ross 308 (33.56 cm), Marshall (32.61 cm) and Cobb 500 (32.39 cm), while the shortest wing span was observed in Arbor acres (30.67 cm). For thigh length, Cobb 500 (7.72 cm) had the longest, followed closely by Ross 308 (7.28 cm) and Marshall (7.07 cm), while the shortest thigh length was observed in Arbor acres (5.65 cm). Ross 308 (9.58 cm) had the longest drumstick, followed by Marshall (7.52 cm) and Arbor acres (7.34 cm), which are statistically similar; the shortest drumstick was observed in Cobb 500 (4.77 cm). The longest shank length was observed in Cobb 500 (8.46 cm), followed by Ross 308 (6.24 cm), and Marshall (5.98 cm), while the shortest shank length was observed in Arbor arcres (5.61 cm).

At week 4, breed had a significant ($p<0.05$) effect on body weight, body length, keel length, wing length, wing span, thigh length, drum stick and shank length. The heaviest body weights were observed in Arbor acres (1623.07 g), while the lightest body weights were observed in Ross 308 (1463.60 g), Marshall (1444.56 g) and Cobb 500 (1391.58 g), which were statistically similar. Ross 308 (20.26 cm) had the widest body length, followed by Marshall (19.32 cm), Arbor acres (17.13 cm) and Cobb 500 (16.46 cm) were statistically similar for body length. Arbor acres (15.44 cm) had the longest keel length, followed by Ross 308 (14.46 cm), Marshall (13.18 cm) and Cobb 500 (12.70 cm) were similar. The longest wing lengths were observed in Ross 308 (19.60 cm), Marshall (19.20 cm) and Arbor acres (18.38 cm), which were statistically similar, while the shortest keel length was observed in Cobb 500 (16.53 cm). The longest wing spans were observed in Marshall (39.52 cm), Arbor acres (37.84 cm) and Ross 308 (36.98 cm), while the shortest wing span was observed in Cobb 500 (34.43cm). For thigh length, Ross 308 (12.24 cm) and Arbor Acres (11.61 cm) had the longest, followed by Marshall (9.10 cm) and Cobb 500 (9.05 cm), which were similar. Ross 308 (13.68 cm) had the longest drumstick, followed by Arbor acres (12.04 cm), and Marshall (9.62 cm). The shortest drumstick was observed in Cobb 500 (5.53 cm). The longest shank length was observed in Cobb 500 (11.34 cm), followed by Arbor Acres (8.23 cm), while the shortest shank lengths were observed to be similar in Ross 308 (7.28 cm) and Marshall (6.78 cm).

At week 5, breed had a significant ($p<0.05$) effect on body weight, keel length, wing length, wing span, thigh length, drumstick and shank length. Similar heaviest body weights were observed in Arbor acres (2184.61 g), Cobb 500 (2124.13 g) and Ross 308 (2052.00 g), while the lightest body weight was observed in Marshall (1648.00 g) broiler. Ross 308 (14.90 cm), Arbor arcres (14.86 cm) and Marshall (14.10 cm) had a statistically longer keel length than Cobb (12.70 cm). The longest wing length was observed in Marshall (20.34 cm), followed by Arbor acres (19.50 cm) and Ross 308 (19.10 cm), while the shortest keel length was observed in Cobb 500 (17.93 cm). The longest wing spans were observed in Arbor acres (42.76 cm) and Marshall (41.88 cm), which were statistically similar, while the shortest wing spans were observed in Ross 308 (39.86 cm) and Cobb 500 (38.51 cm). For thigh length, Arbor acres (10.94 cm) and Ross 308 (10.90 cm) were similar for the longest, while the shortest thigh lengths were observed in Marshall (9.48 cm) and Cobb 500 (9.31 cm). Ross 308 (12.12 cm) had the longest drumstick, followed by Arbor acres (11.63 cm and Marshall (9.82 cm). The shortest drumstick was observed in Cobb 500 (6.56 cm). The longest shank length was observed in Cobb 500 (11.75 cm), while the shortest shank lengths were observed in Arbor acres (7.21 cm), Ross 308 (6.84 cm) and Marshall (6.74 cm). However, there was no significant ($p>0.05$) effect of breed on body weight and linear body measurements.

Table 2 presents the Pearson correlation between body weight and linear body measurements in broiler chickens. In Arbor acres, there is a significant positive relationship between body weight and body length; body weight and keel length; body weight and wing length; body weight and wing span; body weight and thigh length; body weight and drumstick; and body weight and shank length. The highest correlation was observed in body weight and wing length ($r=0.796$), while the lowest was observed in body weight and body length ($r=0.231$).

In Cobb 500, there is a positive and significant relationship between body weight and body length; body weight and keel length; body weight and wing length; body weight and wing span; body weight and thigh length; and

Table 1. Effect of breed on body weight and linear body measurements of broiler chickens.

Weeks	Traits	Breed				P-value
		Arbor acres	Cobb 500	Marshall	Ross 308	
3	BW (g)	762.84±28.12^{a}	697.58±26.62^{a}	617.00±28.12^{b}	725.48±28.67^{a}	0.003
	BL (cm)	14.07±0.24^{b}	12.50±0.23^{c}	13.76±0.24^{b}	15.30±0.24^{a}	0.000
	KL (cm)	10.98±0.18^{sb}	11.00±0.17^{ab}	10.61±0.18^{b}	11.37±0.18^{a}	0.045
	WL (cm)	14.16±0.32^{b}	14.70±0.30^{b}	14.69±0.32^{b}	16.04±0.33^{a}	0.001
	WS (cm)	30.67±0.56^{b}	32.39±0.53^{a}	32.61±0.56^{a}	33.56±0.57^{a}	0.005
	TL (cm)	5.65±0.17^{c}	7.72±0.16^{a}	7.07±0.17^{b}	7.28±0.18^{ab}	0.000
	DS (cm)	7.34±0.19^{b}	4.77±0.17^{c}	7.52±0.18^{b}	9.58±0.19^{a}	0.000
	SL (cm)	5.61±0.14^{c}	8.46±0.13^{a}	5.98±0.14^{bc}	6.24±0.15^{b}	0.000
4	BW (g)	1623.07±54.28^{a}	1391.58±51.39^{b}	1444.56±55.35^{b}	1463.60±55.35^{b}	0.019
	BL (cm)	17.13±0.29^{c}	16.46±0.28^{c}	19.32±0.30^{b}	20.26±0.30^{a}	0.000
	KL (cm)	15.44±0.24^{a}	12.70±0.23^{c}	13.18±0.25^{c}	14.46±0.25^{b}	0.000
	WL (cm)	18.38±0.31^{b}	16.53±0.30^{c}	19.20±0.32^{ab}	19.60±0.32^{a}	0.000
	WS (cm)	37.84±1.00^{a}	34.43±0.95^{c}	39.52±1.02^{a}	36.98±1.02^{ab}	0.004
	TL (cm)	11.61±0.24^{a}	9.05±0.23^{b}	9.10±0.25^{b}	12.24±0.25^{a}	0.000
	DS (cm)	12.04±0.18^{b}	5.53±0.17^{d}	9.62±0.18^{c}	13.68±0.18^{a}	0.000
	SL (cm)	8.23±0.27^{b}	11.34±0.25^{a}	6.78±0.21^{c}	7.28±0.21^{c}	0.000
5	BW (g)	2184.61±55.71^{a}	2124.13±52.75^{a}	1648.00±56.81^{b}	2052.00±56.81^{a}	0.000
	BL (cm)	28.32±3.83	16.56±3.63	19.84±3.91	21.74±3.91	0.166
	KL (cm)	14.86±0.25^{a}	12.70±0.24^{b}	14.10±0.25^{a}	14.90±0.25^{a}	0.000
	WL (cm)	19.50±0.34^{ab}	17.93±0.32^{c}	20.34±0.35^{a}	19.10±0.35^{b}	0.000
	WS (cm)	42.76±0.48^{a}	38.51±0.45^{b}	41.88±0.49^{a}	39.86±0.49^{b}	0.000
	TL (cm)	10.94±0.20^{a}	9.31±0.19^{b}	9.48±0.21^{b}	10.90±0.21^{a}	0.000
	DS (cm)	11.63±0.17^{b}	6.56±0.15^{d}	9.82±0.17^{c}	12.12±0.17^{a}	0.000
	SL (cm)	7.21±0.25^{b}	11.75±0.24^{a}	6.74±0.25^{b}	6.84±0.25^{b}	0.000

BW = Body weight; BL = Body length; KL = Keel length; WL = Wing length; WS = Wing span; TL = Thigh length; DS = Drum stick; SL = Shank length.
$^{a, b, c, d}$Means on the same row with different superscripts are significantly different (p<0.05).

body weight and shank length. The highest correlation was observed in body weight and wing length (r=0.753), while the lowest was observed in body weight and wing span (r=0.45). However, there was no significant relationship between body weight and drumstick.

In Marshall, there is a positive significant relationship between body weight and body length; body weight and keel length; body weight and wing length; body weight and wing span; body weight and thigh length; body weight and drumstick; and body weight and shank length. The highest correlation was observed in body weight and body length (r=0.852), while the lowest was observed in body weight and shank length (r=0.586).

In Ross 308, there is a positive significant relationship between body weight and body length; body weight and keel length; body weight and wing length; body weight and wing span; body weight and thigh length; body weight and drumstick; and body weight and shank length. The highest correlation was observed in body weight and body length (r=0.783), while the lowest was observed in body weight and shank length (r=0.249).

DISCUSSION

This study confirmed that breed significantly influenced body weight and linear body measurements of broiler chickens during the early growth phase. The observed differences reflect inherent genetic variation in growth potential, skeletal development, and nutrient partitioning among commercial strains.

In the present study, the results observed at week 3 showed that Arbor Acres, Ross 308, and Cobb 500 exhibited superior body weights, suggesting early growth potential and efficient feed utilisation in these strains. In contrast, Marshall displayed lower body weight, consistent with reports that some strains exhibit slower initial growth before compensatory gains (Ige *et al.*, 2016). Ross 308 also expressed longer body and wing dimensions, pointing to a faster skeletal expansion that provides a framework for subsequent muscle deposition, while Cobb 500 emphasised early leg growth, a strategy that may support higher body weights at later stages. By week 4, Arbor Acres recorded the heaviest body weight, indicating a

Table 2. Pearson correlation between body weight and linear body measurements of broiler chickens.

Traits	BW(g)	BL (cm)	KL (cm)	WL (cm)	WS (cm)	TL (cm)	DS (cm)	SL (cm)
				Arbor Arcres				
BW (g)	**1**							
BL (cm)	0.231*	**1**						
KL (cm)	0.736**	0.095	**1**					
WL (cm)	0.796**	0.134	0.688**	**1**				
WS (cm)	0.795**	0.144	0.657**	0.739**	**1**			
TL (cm)	0.790**	0.156	0.862**	0.764**	0.702**	**1**		
DS (cm)	0.755**	0.135	0.842**	0.726**	0.696**	0.879**	**1**	
SL (cm)	0.602**	0.085	0.765**	0.613**	0.496**	0.831**	0.736**	**1**
				Cobb 500				
BW (g)	1							
BL (cm)	0.724**	1						
KL (cm)	0.640**	0.735**	1					
WL (cm)	0.753**	0.666**	0.668**	1				
WS (cm)	0.450**	0.289**	0.349**	0.486**	1			
TL (cm)	0.441**	0.456**	0.538**	0.401**	0.595**	1		
DS (cm)	-0.125	0.008	-0.025	-0.114	-0.009	-0.002	1	
SL (cm)	0.585**	0.636**	0.645**	0.588**	-0.119	0.167	0-.093	**1**
				Marshall				
BW (g)	**1**							
BL (cm)	0.852**	**1**						
KL (cm)	0.789**	0.864**	**1**					
WL (cm)	0.763**	0.836**	0.782**	**1**				
WS (cm)	0.783**	0.857**	0.844**	0.846**	**1**			
TL (cm)	0.768**	0.839**	0.798**	0.779**	0.855**	**1**		
DS (cm)	0.748**	0.855**	0.813**	0.740**	0.807**	0.851**	**1**	
SL (cm)	0.586**	0.719**	0.660**	0.608**	0.694**	0.732**	0.696**	**1**
				Ross 308				
BW (g)	1							
BL (cm)	0.783**	1						
KL (cm)	0.626**	0.691**	1					
WL (cm)	0.448**	0.644**	0.394**	1				
WS (cm)	0.778**	0.685**	0.585**	0.495**	1			
TL (cm)	0.624**	0.729**	0.655**	0.539**	0.507**	1		
DS (cm)	0.486**	0.644**	0.537**	0.509**	0.537**	0.700**	1	
SL (cm)	0.249*	0.378**	0.358**	0.273*	0.207	0.425**	0.294*	**1**

*Significant ($p<0.05$); **highly significant ($p<0.0001$).

delayed growth surge that favours rapid muscle accumulation after skeletal development has begun. Ross 308 and Marshall continued to express longer body and wing dimensions, highlighting sustained skeletal elongation at this stage. The greater shank length observed in Cobb 500 reflected its genetic predisposition for robust leg development, which supports higher carcass weight in later weeks (Oleforuh-Okoleh *et al*., 2017). These breed-specific trajectories illustrate how growth dynamics can vary not only in magnitude but also in timing across commercial broilers. At week 5, Arbor Acres and Cobb 500 outperformed the other breeds in body weight, confirming their capacity for efficient feed conversion into muscle mass during the finishing phase. Meanwhile, Ross 308 and Marshall sustained longer keel and wing measurements, suggesting that skeletal elongation remained a dominant trait, whereas Cobb 500 maintained longer shanks, signifying continued leg development. In contrast, Arbor Acres allocated more resources toward breast muscle deposition, which is a desirable market trait, particularly in systems targeting white meat yield. The present results align with earlier findings that genotype strongly influences growth rate and morphometric development in chickens (Adedeji *et al.*, 2015; Isaac and Ezejesi, 2023; Lamido *et al.,* 2023). They also emphasise the practical importance of matching breed choice to production goals. For short production cycles aimed at early market weight, breeds like Arbor Acres may be most profitable, while strains such as Ross 308 and Marshall could be advantageous in systems where extended growth periods allow skeletal gains to translate into higher carcass yield.

In addition, the strong positive correlations observed between body weight and linear measurements across breeds confirm that external morphometric traits are reliable predictors of live weight. This supports earlier reports by Ajayi *et al.* (2008) and Ojedapo *et al.* (2012), and has practical value in resource-limited settings where access to digital weighing scales is constrained. Farmers could utilise simple measurements such as chest circumference or keel length to estimate body weight with acceptable accuracy, thereby improving selection and marketing efficiency.

Nevertheless, the study had limitations. It was restricted to early growth (up to 5 weeks), without extending to market weight, carcass characteristics, or feed intake data, which are critical for assessing overall production efficiency. Sex effects were not considered, although these may interact with breed to influence growth patterns. Future studies should therefore integrate carcass evaluation, feed conversion ratios, and sex-specific analyses to establish stronger links between early linear measurements and final production outcomes.

Conclusion

The study revealed significant breed differences in body weight and linear body measurements of broiler chickens during early growth. Arbor Acres, Ross 308, and Cobb 500 generally recorded higher body weights and superior morphometric traits compared to Marshall, which exhibited relatively lower body weights across the three weeks studied, despite moderate values in some skeletal measurements. Strong and positive correlations between body weight and linear body dimensions across all breeds indicate that morphometric traits are reliable predictors of live weight, although breed-specific variations exist.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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