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Original Research Article

Biometric differentiation of growth traits in pullet breeds in Southwest Nigeria

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Abstract

The study aimed to characterise three breeds of pullets based on their biometric differentiation and the effects of age on their body linear measurement. The three breeds of pullets under consideration were Noiler (N), FUNAAB Alpha (FUN), and ISA Brown (ISA). This study used two hundred and five pullets raised from a day old. At the 19th, 21st, and 23rd week of rearing, the pullets were weighed individually, and linear body measurements were taken. There was no significantly different effect ($p > 0.05$) between FUNAAB Alpha and Noiler breeds in all the traits considered at week 19, while a significant difference ($p < 0.05$) was observed between ISA Brown and others in all the traits except in breast girth (FUN-11.57 and ISA-10.46) and wing length (N-7.45 and ISA-6.97). The significant effects of breed and age occurred especially on the body weight for all the three ages under consideration ($p < 0.05$). There was a positive relationship between body weight and body measurements in all three breeds of pullets under investigation. The increase in the growth rate of any of the components increased live weight gain. The body weight of pullets could be determined accurately using body measurements such as wing length, wing span, and breast girth.

Keywords: pullets; breeds; growth traits; wing length, wing span, breast girth; shank length.

INTRODUCTION

Pullets are young adolescent female chickens preparing to lay their first eggs. The pullet phase is between 16 to 52 weeks of age. They have been brooded, now have adult feathers, and are in their first year of lay. Animal breeding practices are centered on improving traits of economic value (Mendes et al., 2005). Body linear measurement and body weight are important economic traits in the selection of animals. Body weight and body dimensions have been used as parameters for selection by researchers and local traders (Olowofeso, 2009). Growth traits are important for deciding qualities for livestock farmers, particularly geneticists, in improving the market quality of breeding stocks (Latshaw and Bishop, 2001). The body size and the conformation are two important parameters that can be considered in livestock characterisation (Ibe, 1989). The body linear measurement has been used to predict live weight, age, sex, and breeds of animals in numerous studies (Kuria et al., 2007; Yakubu et al., 2009; Olowofeso, 2009; Ozkaya and Bozkurt 2009). Biometric traits provide a good report on the performance, productivity, and carcass quality of animals (Ajayi et al., 2008). It also allows for the comparison of growth in different parts of the body (Fayeye et al., 2006). The various body constituent parts develop at different rates and these alterations determine the shape, conformation, and body proportion of the animal within a specific period of time (Udeh and Ogbu, 2011). Ibe and Ezekwe (1994) reported that the inter-relationship existing between

body weight and linear body characteristics of meat animals has been found to be a useful application in quantifying body size and shape. It is also used in determining growth performance, productivity, and carcass characteristics of animals.

Most of the linear body measurements taken over a period of time reflect the growth of the long bones and flesh. This has served as a predictor of both animal live weight and carcass composition. Live weight has been used by many researchers as a determinant of the market value of an animal (Ajayi et al., 2008). It has also been reported that growth trait is a measure of increasing meat yield to predict the growth performance of animals, especially poultry (Adenowo and Omoniyi, 2004; Akanno and Ibe, 2006).

Noiler is a new type of dual-purpose chicken breed that has been created through selective breeding. Noiler is believed to be a product of genetic selection between the broiler and the native chicken. This unique fowl is bred to serve the dual purpose of producing both meat and eggs. The Noiler chicken is now a popular breed that has attracted the attention of small-scale farmers because it is easy to raise and manage and it lays a considerable number of eggs and grows to maturity quicker than many other breeds of chickens. FUNAAB Alpha pullet is one of the first indigenous chickens selected over twelve generations in Nigeria from scavenging chickens. It is a dual-purpose chicken, meant for meat and egg production. The ISA Brown is well known and globally recognised for its strong and reliable results, also renowned as the Global superstar in performance. Extensive field testing with the ISA Brown shows that the breed has exceptional feed conversion and is capable of laying up to 500 first-quality eggs (Oluyemi, 1980). The ISA Brown hens are able to adapt well to different weather conditions, poultry management methods, and housing systems. Decades of intensive selection have resulted in very good livability while maintaining excellent persistence in egg production. This study will help in selecting parts of the body that will have a significant impact on the overall weight of the chicken during breeding. The objectives of the study were to characterise these three breeds of pullets based on growth traits and determine the effects of age on their body linear measurements. The study hypothesised that linear measurement can be used to predict growth performance, and overall weight and identify a particular breed of pullets in southwestern Nigeria.

MATERIALS AND METHODS

This study was carried out at the Teaching and Research Farm and Analytical Laboratory of Olusegun Agagu University of Science and Technology, Okitipupa, Ondo State, Nigeria. Okitipupa lies between the coordinates 6°25 and 6°46 N and 4°35 and 4°50 E within the tropical rainforest zone of Nigeria.

Experimental animals

Two hundred and five pullets were raised from day old. The pullets comprised 60 FUNAAB Alpha, 80 ISA Brown, and 65 Noiler birds. They were raised in a deep litter system up to the 17th week and later transferred to the battery cage system. All three breeds were fed with the same commercial feeds and water supplied *ad libitum* throughout the period of the study. At the 19th week before laying, the 21st and 23rd week of laying, the pullets were weighed individually, and linear body measurements were taken as described by Guèye et al. (1998). The weights of the birds were obtained using a 20 kg weighing scale, while a measuring tape was used for body measurements in centimetres. Wing Length (WL) was taken from the shoulder joint to the extremity of the terminal phalanx whereas Shank Length (SL) was measured from the knee joint to the spur. Breast girth (BG) was taken under the wing at the edge of the sternum while wing span (WS) is the length between the tips of the right and left wings after both are stretched out in full. To ensure accuracy, each measurement was taken twice and the mean was used in subsequent analysis. All the measurements were taken by the same person.

The study followed all ethical and animal welfare rules guiding animal experimentation in Nigeria. The study proposal was approved by the Ethical and Animal Welfare Committee of Olusegun Agagu University of Science and Technology, Okitipupa, Nigeria.

Data analysis

The data collected on growth traits were subjected to analysis of variance (ANOVA) using a General Linear Model (GLM) of SAS (2007) to determine the effects of age and breed. Pearson correlation was used to determine the correlation coefficients among the traits. Significant means were separated using Duncan Multiple Range Test (Duncan, 1955), using the model below:

$$Y_{ijk} = \mu + B_i + D_j + B_iD_j + \mathcal{E}_{ijk}$$

where Y is individual observation; μ is universal mean; Bi is the effect of breed; Dj is the effect of age; $\mathcal{E}_{ijk}$ is the error.

RESULTS

Table 1 shows the summary statistics of the growth traits on the basis of breed. The coefficient of variation among the traits ranged between 13.89% and 39.23% for FUNAAB Alpha, 13.61% and 43.07% for Isa Brown, and 17.49% and 51.93% for Noiler. Table 2 shows the breed effects on growth traits on age basis. There was no significant difference ($p > 0.05$) between FUNAAB Alpha and Noiler breeds in all the traits considered at week 19, whereas a significant difference ($p < 0.05$) was observed between ISA Brown and others in all the traits except in breast girth (FUN-11.57 and ISA-10.46) and wing length (N-7.45 and ISA-6.97). In contrast, there were significant differences between FUNAAB Alpha and Noiler breeds in most of the traits at weeks 21 and 23 except in BG, WL and BL, and BG and SL, respectively, while ISA Brown was significantly different from the other two breeds.

Table 3 shows the effect of age on the growth traits of the breed. In FUNAAB Alpha, age had no significant effect ($p > 0.05$) on BW, whereas a significant effect ($p < 0.05$) was observed in other traits. In Noiler and ISA Brown, age had a significant effect on all the traits. In these breeds, growth traits increased from week 19 to 23.

Table 4 shows the Pearson correlation among the growth traits in FUNAAB Alpha and Noiler pullets. In

Table 1. Summary statistics of the body biometrics

Breed	Observation	Variables	Mean	SD	Min	Max	CV
		BW	1.75	0.24	1.40	2.20	13.89
		WL	15.53	6.09	7.00	22.00	39.23
		WS	36.82	13.71	18.00	51.00	37.23
FUN	60	BG	23.40	9.12	9.50	33.00	38.98
		SL	6.05	2.19	3.00	9.50	36.37
		NL	8.77	3.31	4.00	13.00	37.77
		BL	18.15	6.89	8.50	28.00	37.97
		BW	1.31	0.17	0.90	1.60	13.61
		WL	15.05	6.25	6.50	23.00	41.53
		WS	34.66	13.92	14.50	49.00	40.15
ISA	80	BG	21.33	8.45	8.50	31.00	39.62
		SL	5.63	2.05	2.80	8.50	36.39
		NL	8.93	3.84	3.50	14.00	43.07
		BL	17.08	6.85	7.00	25.00	40.15
		BW	1.97	0.34	1.30	2.60	17.49
		WL	13.78	7.08	6.00	23.00	51.40
		WS	32.97	15.97	17.00	53.00	48.45
N	65	BG	20.45	9.49	11.00	34.00	46.39
		SL	5.54	2.44	3.00	9.00	44.03
		NL	8.43	4.38	3.50	15.00	51.93
		BL	17.00	8.50	8.20	28.00	50.04

BW: Body weight; WL: Wing length; WS: Wing Spine; BG: Breast girth; SL: Shank length; NL: Neck Length; BL: Back length.

Table 2. Breed effect on growth traits on age basis

Age (wks)	Breed	Bw	WL	WS	BG	SL	NL	BL
	FUN	1.61^{a}	7.53^{a}	18.79^{a}	11.57^{ab}	3.27^{a}	4.64^{a}	9.29^{a}
19	N	1.73^{a}	7.45^{ab}	18.65^{a}	12.08^{a}	3.38^{a}	4.58^{a}	9.38^{a}
	ISA	1.12^{b}	6.97^{b}	16.54^{b}	10.46^{b}	2.99^{b}	4.13^{b}	8.27^{b}
	FUN	1.85^{b}	19.63^{ab}	46.00^{b}	30.75^{a}	7.31^{ab}	10.38^{b}	22.37^{b}
21	N	2.23^{a}	20.50^{a}	48.33^{a}	31.67^{a}	7.66^{a}	12.33^{a}	25.33^{a}
	ISA	1.39^{c}	19.19^{b}	44.77^{b}	28.23^{b}	6.96^{b}	11.15^{ab}	21.07^{c}
	FUN	1.80^{b}	20.20^{b}	47.40^{b}	28.20^{ab}	7.90^{ab}	12.00^{b}	23.80^{b}
23	N	2.30^{a}	22.20^{a}	51.80^{a}	28.80^{a}	8.60^{a}	13.80^{a}	26.80^{a}
	ISA	1.45^{c}	20.20^{b}	45.10^{b}	26.50^{b}	7.35^{b}	12.30^{b}	23.35^{b}

a,b,c means with different superscripts on the same column are significantly different ($p < 0.05$), BW: Body weight; WL: Wing length; WS: Wing Span; BG: Breast girth; SL: Shank length; NL: Neck Length; BL: Back length.

Table 3. Age effect on growth traits on the breed basis

Breed	Age(wks)	Bw	WL	WS	BG	SL	NL	BL
	19	1.61[a]	7.52[b]	18.78[b]	11.57[c]	3.27[b]	4.64[c]	9.28[b]
FUN	21	1.85[a]	19.62[a]	46.00[a]	30.75[a]	7.31[a]	10.37[b]	22.37[a]
	23	1.80[a]	20.20[a]	47.40[a]	28.20[b]	7.90[a]	12.00[a]	23.80[a]
	19	1.12[b]	6.96[c]	16.53[b]	10.46[c]	2.99[c]	4.13[c]	8.269[c]
ISA	21	1.39[a]	19.19[b]	44.76[a]	28.23[a]	6.96[b]	11.15[b]	21.07[b]
	23	1.45[a]	20.20[a]	45.10[a]	26.50[b]	7.35[a]	12.30[a]	23.35[a]
	19	1.73[b]	7.45[c]	18.65[c]	12.07[c]	3.38[c]	4.57[c]	9.38[c]
N	21	2.23[a]	20.50[b]	48.33[b]	31.66[a]	7.66[b]	12.33[b]	25.33[b]
	23	2.30[a]	22.20[a]	51.80[a]	28.80[b]	8.60[a]	13.80[a]	26.80[a]

a,b,c means with different superscripts on the same column are significantly different ($p < 0.05$).BW: Body weight; WL: Wing length; WS: Wing Span; BG: Breast girth; SL: Shank length; NL: Neck Length; BL: Back length.

Table 4. Pearson correlation among the growth traits in FUNAAB Alpha and Noiler pullet

	Bw	WL	WS	BG	SL	NL	BL
Bw		0.494*	0.494*	0.553*	0.572**	0.390	0.525*
WL	0.798***		0.993***	0.968***	0.965***	0.940***	0.978***
WS	0.797***	0.996***		0.975***	0.957***	0.937***	0.983***
BG	0.826***	0.971***	0.973***		0.932***	0.877***	0.954***
SL	0.800***	0.991***	0.989***	0.959***		0.902***	0.944***
NL	0.814***	0.978***	0.983***	0.943***	0.972***		0.938***
BL	0.786***	0.989***	0.993***	0.963***	0.978***	0.987***	

*$p < 0.05$;**$p < 0.01$;***$p < 0.001$; FUNAAB - upper diagonal; Noiler- lower diagonal BW: Body weight; WL: Wing length; WS: Wing Span; BG: Breast girth; SL: Shank length; NL: Neck Length; BL: Back length.

Table 5. Pearson correlation among the growth traits in ISA Brown pullet

	Bw	WL	WS	BG	SL	NL	BL
Bw							
WL	0.812***						
WS	0.800***	0.982***					
BG	0.797***	0.953***	0.973***				
SL	0.834***	0.984***	0.981***	0.954***			
NL	0.806***	0.947***	0.963***	0.924***	0.958***		
BL	0.819***	0.979***	0.973***	0.948***	0.975***	0.954***	

***$p < 0.001$ BW: Body weight; WL: Wing length; WS: Wing Span; BG: Breast girth; SL: Shank length; NL: Neck Length; BL: Back length.

FUNAAB Alpha, Bw had positive, high, and significant ($p < 0.05$) correlation with other traits (0.494–0.572) but medium and non-significant ($p > 0.05$) with NL (0.390). The correlations among the linear body measurements are positive, high, and very highly significant ($p < 0.001$). The relationships between Bw and other traits and among the linear measurements are positive, high, and very highly significant ($p < 0.001$) and ranged between 0.786 to 0.996 in Noiler pullets. Table 5 shows the Pearson correlations among the growth traits in ISA Brown pullet. The correlations are similar to what was observed in Noiler but ranged between 0.800 and 0.982.

DISCUSSION

Significant effect of breed observed in the body weight and the morphometric traits across the ages are in line with the observations of Olowofeso (2009) and Costa et al. (2006) in autochthonous chicken breeds. At all ages, Noiler had the heaviest body weight followed by FUNAAB Alpha and ISA Brown. The reason for the discrepancies in the body weights among the breeds could be attributed to Noiler and FUNAAB Alpha being bred for meat and egg production while ISA Brown for egg production only. Breed effect on the Breast girth, Shank length, Neck length and Back length across the

ages is in line with the findings of Tyasi et al. (2020) and Guèye et al. (1998). The highest values were observed in Noiler pullets followed by FUNAAB Alpha in all the traits under consideration at all ages. The lowest values were found in the ISA Brown. The effect of age on the body weight and morphometric traits in the three breeds is in line with the findings of Lawrence and Fowler (2002) and Dransfield and Sosnicki (1999). In the breeds, the progressive increase recorded in all the traits is in agreement with the findings of Ibe (1989). The low to medium, positive correlations observed between body weight and morphometric traits are contrary to the reports of Oleforuh et al. (2017) who reported higher values in Nigeria's local chicken genotypes while the interrelationship is the same. Very high and positive correlations observed between body weight and other traits and the relationships among the linear measurements in Noiler and ISA brown are in line with the observations of Okpeku et al. (2003) in a report on the phenotypic and genetic variation among local chickens in Edo State, Nigeria noted that body weight had strong and positive correlation with body length and chest girth. The strong positive association between body weight and the growth traits measured is an indication of pleiotropy.

CONCLUSION

This study demonstrated a positive relationship between body weight and body measurements in all three breeds of pullets under investigation. The breed and age could be concluded to have an effect on growth traits. The body measurements at the 19th week differed significantly from those of the 21st and 23rd weeks. Isa Brown can be identified by their body size whereas the other two breeds can be identified by their wing span and back length. The breeds differed significantly in body weight across all ages. The increase in the growth rate of any of the components will increase live weight gain. The body weight of pullets could be determined accurately using body measurements such as wing length, wing span, breast girth, and other measures. Selecting and improving these traits will impact positively on the body weight of pullets. The findings of this study can be used to determine which parts of the body can be selected for breeding that will have a significant improvement in the overall weight.

CONFLICT OF INTEREST

The authors declared no conflicts of interest with respect to the research, authorship, and publication of this article.

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