



COMPARATIVE EVALUATION OF MORPHOMETRIC TRAITS AND THEIR ASSOCIATION WITH SEX AND BODY WEIGHT IN THREE INDIGENOUS CHICKEN ECOTYPES OF NORTH-CENTRAL NIGERIA

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ABSTRACT

The future improvement of indigenous chicken production systems largely depends on the availability and effective utilization of their genetic variability. The relationship between body weight and morphometric traits is important in planning breeding. Therefore, this study evaluated morphometric traits and their relationships with body weight and sex in three indigenous chicken ecotypes from Nasarawa, Benue, and Plateau States, Nigeria. A total of 120 mature chickens, comprising 40 birds each from the Fulani, Kwalla, and Tiv ecotypes aged 18–24 weeks, were used. The birds were managed under a semi-intensive system. Body weight was measured weekly using a weighing balance. Linear body measurements including breast girth, body length, shank length, wing length, and keel length were obtained using a measuring tape (cm), while comb length, wattle length, beak length, comb height, spur thickness, wattle width and height, and ocular dimensions were measured using a digital vernier caliper. Data were subjected to analysis of variance and correlation analyses. Significant ($P < 0.05$) differences in body weight were observed among the ecotypes. The Kwalla ecotype had the highest mean body weight (1.50 kg), followed by the Tiv (1.38 kg) and Fulani (1.25 kg) ecotypes. Sex had a highly significant effect ($P < 0.05$) on body weight. Several morphometric traits, including beak length, comb height, wattle length, ocular length, and spur thickness, differed significantly ($P < 0.05$) across ecotypes and sexes. In the Fulani ecotype, body weight showed strong positive correlations ($P < 0.01$) with keel length ($r = 0.73$), spur thickness ($r = 0.53$), breast girth ($r = 0.48$), body length ($r = 0.39$), and shank length. In the Kwalla ecotype, only spur thickness was significantly correlated with body weight, while body length ($r = 0.55$) showed a positive association in the Tiv ecotype. These findings suggest that selection based on positively correlated morphometric traits could enhance body weight. The Kwalla ecotype demonstrates strong potential for meat production and should be prioritized in genetic improvement programs.

Keywords: Morphometric, Ecotypes Indigenous, Kwalla Chicken

INTRODUCTION

The demand for indigenous chickens is increasing as exotic and hybrid breeds often fail to perform optimally under rural village conditions, thereby creating a gap between poultry demand and supply (Islam *et al.*, 2015). Indigenous chickens have gained widespread acceptance among rural, peri-urban, and urban populations due to their adaptability, preferred taste, and higher market value compared to commercial broiler strains. Across sub-Saharan Africa, local poultry populations exhibit considerable variability in body size, conformation, plumage colour, and other phenotypic characteristics. These populations are commonly classified into ecotypes; however, according to FAO (1999) recommendations, they cannot be distinctly identified based solely on phenotypic or functional traits (Bogale, 2008). The Tiv chicken ecotype constitutes an important component of Nigeria's poultry genetic resources, particularly in Benue State, where it is predominantly reared under traditional family-based free-range systems within the derived Southern Guinea savannah zone (Alemu, 2022). This ecotype is believed to possess diverse adaptive and productive traits which, if properly characterized, could serve as a foundation for selection and genetic improvement strategies in rural poultry production systems (Gwaza *et al.*, 2013). Previous studies have shown that sex significantly influences growth performance traits in Tiv indigenous chickens, with the exception of initial body weight (Ugbo *et al.*, 2025). The sustainability and future improvement of indigenous chicken production systems largely depend on the availability and effective utilization of their genetic variability (Benítez, 2002). However, there is limited information on growth performance and morphometric traits, as well as their

relationship with body weight, particularly in the Kwalla chicken ecotype. Therefore, this study aimed to compare morphometric traits and evaluate their relationships with body weight and sex among three indigenous chicken ecotypes in North-Central Nigeria.

MATERIALS AND METHODS

Location of the Study

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm of Federal University of Lafia Nasarawa State, Nigeria. Lafia is located on latitude 8.4939°N North and Longitude East 8.5153°E altitude 290–300m above sea level with a mean temperature of 340°C, humidity of 40–86%, average day light of 9–12hrs and a rainfall between 1500mm to 1800mm.

Experimental Birds

A total of 120 mature indigenous chickens were used for this study, comprising 40 birds from each of the Fulani, Kwalla, and Tiv ecotypes. Within each ecotype, 25 were hens and 15 were cocks, aged between 18 and 24 weeks, with an average age of 21 weeks. The foundation stocks were sourced from different farming communities: Daudu and Yelwata in Benue State for the Tiv ecotype; Adudu, Awe, Akurba, and Akwanga in Nasarawa State for the Fulani ecotype; and Namu and Kwagallak in Qua'an Pan Local Government Area of Plateau State for the Kwalla ecotype.

All birds were managed under a semi-intensive production system. They were allowed to scavenge freely during the day within the farm environment, including areas around cattle pens, where they accessed natural feed resources. In addition to scavenging, the birds were occasionally supplemented with

a commercially prepared grower diet containing approximately 18% crude protein and 2800 kcal/kg metabolizable energy, provided either in the morning or evening. The birds were housed under a deep litter system, which provided shelter and protection, particularly during the night. Standard management practices, including routine cleaning and provision of clean water, were maintained throughout the study period.

Body Metric Measurement

At 18 weeks of age, the birds were individually identified using wing tags, and additional identification was provided using labeled paper tape as a backup. Body weight was measured weekly using a digital weighing balance. Linear body measurements were taken following standard procedures. Body length was measured as the distance from the first cervical vertebra to the pygostyle. Shank length was measured as the distance from the footpad to the hock joint. Wing length was measured from the shoulder joint along the dorsal midline to the tip of the wing. Keel length was determined as the length of the keel bone using a measuring tape. Breast girth was measured as the circumference around the breast region of the body using a measuring tape, as described by Molenaar *et al.* (2008). All measurements were recorded in centimeters (cm) and taken with the birds in a relaxed and upright position to ensure accuracy and consistency.

Comparative Morphological Traits Measurement

Comb length was measured using a digital vernier caliper as the distance from the base to the tip of the comb. Wattle length was measured as the distance from the point of attachment below the beak to the distal end of the wattle. Spur thickness (diameter) was measured using a vernier caliper and recorded in millimeters (mm). Wattle width was measured as the distance across the widest part of the wattle, while wattle height was measured from the base to the apex of the wattle. Beak length was measured as the distance from the base of the beak at the feather line (rietal region) to the tip of the maxilla. Ocular length (OCL) was measured as the distance between the medial and lateral canthus of the eye, while ocular width (OCW) was measured as the distance across the eye socket from the proximal to the distal margins. All measurements were taken using a digital vernier caliper, following the procedures described by Atansuyi *et al.* (2017).

Ethical Approval

This research received ethical approval and clearance from the Research Ethics Committee of the Directorate of Research and Creative Thought, Federal University of Lafia, with approval number: FUL/DIRECT/ECC/2025/LS:0001.

Statistical Analysis

Body conformation, morphological traits and body weights data were analyzed using analysis of variance (Proc ANOVA), and the significant differences among the means were tested using Tukey's test. Association between body weight and body conformation and metric traits were tested using correlation analysis. The SAS software (Version 9.4) was used for these purposes.

RESULTS AND DISCUSSION

Comparative Conformation Traits of three ecotype of indigenous Chickens

There was a significant difference ($P < 0.05$) in body weight at 19 weeks of age among the three ecotypes studied. The Fulani chicken had an average body weight of 1.25 kg, while the Tiv ecotype averaged 1.38 kg, slightly higher than the Fulani (Table 1). However, the previously unreported Kwalla chicken had the highest average weight of 1.50 kg, exceeding both the Fulani and Tiv ecotypes. Nigerian indigenous chickens are generally classified as heavy or light ecotypes based on body weight and size (Dauda *et al.*, 2020). The heavy ecotype, with mature body weights ranging from 0.9 to 2.5 kg, is commonly found in the Guinea Savannah, Sahel Savannah, and some montane regions. In contrast, the light ecotype, with adult body weights between 0.68 and 1.5 kg, occurs predominantly in mangrove, swamp, rainforest, and derived savannah agro-ecological zones. This classification is consistent with the present study, where the Kwalla chicken from the montane area of Plateau State weighed more than both the Fulani and Tiv ecotypes. Keel and body lengths did not differ significantly ($P > 0.05$) among the ecotypes studied. However, breast girth varied significantly, as did neck length, with the Tiv ecotype showing the longest average neck length (18.4 cm) compared to 15.4 cm and 15.2 cm for the Fulani and Kwalla ecotypes, respectively. Similarly, wing and shank lengths differed significantly, with the Kwalla ecotype exhibiting the highest average values for both traits relative to the Fulani and Tiv ecotypes. These findings are consistent with previous studies. Ukwu *et al.* (2017) reported body weight (1.76 kg), shank length (10.31 cm), wing length (16.36 cm), body girth (35.21 cm), and toe length in Tiv local chickens. Deeve *et al.* (2013) reported body length of 38.93 cm, shank length of 12.72 cm, and body weight of 1.31 kg in Tiv local chickens under free-range conditions. Genetic diversity analyses of the Tiv and Fulani ecotypes also indicated considerable genomic variability between the two populations (Gambo *et al.*, 2020).

Table 1: Comparative Conformation Traits of Three Ecotype of Indigenous Chickens in Southern Guinea Savannah of Nigeria

Ecotype	Body weight (kg)	Keel length(cm)	Breast girth(cm)	Body Length(cm)	Neck Length (cm)	Wing Length(cm)	Shank Lenth(cm)
Fulani	1.25±0.05 ^b	15.3±0.62 ^a	28.0±0.65 ^a	22.8±0.71 ^a	15.4±0.63 ^b	19.8±0.75 ^{ab}	9.00±0.33 ^b
Kwalla	1.50±0.04 ^a	14.4±0.24 ^a	28.7±0.78 ^{ab}	24.1±0.84 ^a	15.2±0.27 ^b	20.3±0.49 ^a	12.2±0.23 ^a
TIV	1.38±0.04 ^{ab}	15.1±1.41 ^a	25.9±0.73 ^b	21.8±1.05 ^a	18.4±1.40 ^a	17.4±1.15 ^b	10.5±1.07 ^b

^{a b c}Means bearing different superscripts in a column differ significantly at $P < 0.05$

Comparative Morphological Traits of Three Ecotype of Indigenous Chickens

Beak length, comb height, wattle length, ocular length, and spur thickness differed significantly ($P < 0.05$) among the ecotypes studied (Table 2). Similarly, Osaiyiwu *et al.* (2009) reported a beak length of 28.2 mm in Fulani ecotype chickens

at 12 weeks of age. In contrast, comb length, wattle height, and ocular width did not differ significantly ($P > 0.05$) among the ecotypes. Previous studies have also documented variations in morphological traits among indigenous chicken populations. For instance, Gwaza *et al.* (2013) reported differences in body dimensions including body length, tail

width, body height, comb height, shank length, thigh length, tail length, wattle length, and body width among Tiv local chicken populations. Morphological measurements are useful for assessing population structure, as they increase the

consistency of individuals within a population and enhance the separation of individuals between populations (Deeve *et al.*, 2013).

Table 2: Comparative Morphological Traits of Three Ecotype of Indigenous Chickens in Southern Guinea Savannah of Nigeria

Ecotype	Beak Length(mm)	Comb Length(mm)	Comb Height(mm)	Wattle Length(mm)	Wattle Height(mm)	Ocular Length(mm)	Ocular Width(mm)	Spur Thickness (mm)
Fulani	27.9±0.96 _a	27.2±2.77 ^a	10.6±1.58 _b	19.7±1.19 ^a _b	12.7±1.29 _a	11.1±0.24 ^a _b	8.23±0.24 _a	3.82±0.43 ^b
Kwalla	23.7±0.49 _{ab}	39.9±6.02 ^a	24.3±0.60 _a	18.4±0.57 ^b	9.42±0.64 _a	10.2±0.24 ^b	8.41±0.16 _a	4.45±0.19 ^{ab}
TIV	25.3±1.18 _b	39.4±5.69 ^a	15.6±2.77 _b	25.4±4.14 ^a	8.93±0.97 _a	11.8±0.51 ^a	8.86±0.37 _a	6.01±0.99 ^a

^{a b c}Means bearing different superscripts in a column differ significantly at P<0.05

Effect of Sex on Body Weight and Comparative Conformation Traits of Three Ecotype of Indigenous Chickens

The effect of sex on body weight was highly significant in both the three ecotypes studied. The male weigh heavier than the female both the ecotypes. The female kwalla chicken weigh higher than both the Fulani and Tiv ecotypes. Though, the Female Tiv chicken weigh more than the Fulani ecotype. Similar to what was obtained in the present study Bassey *et al.*, (2022) reported that Males consistently had higher weights (1,728.49 g) than their female counterparts (1,518.18g) at 20 weeks old. It is generally understood that male and female chickens can exhibit different growth patterns due to biological differences. Males often grow faster than females during the early stages of development (Lamido *et al.*, 2023).

Keel length did not differ between sex except for Kwalla ecotype which the male had longer keel length than female. Breast girth differs significantly among sex in Fulani and

Kwalla chicken except Tiv ecotype. Body length differs significantly among sex in Fulani and Kwalla chicken except Tiv ecotype. Neck length did not differ significantly among sex except for the Tiv ecotype which differ significantly between male and female chicken. Wing length did not differ significantly among sex except for the Tiv ecotype which differ significantly between male and female chicken. There is no significant different in shank length between male and female chicken in all the three ecotypes studied. Ukwu *et al.*, (2017) reported that Local chickens in North central Nigeria, irrespective of sex, were significantly (P<0.05) better than local chickens in South eastern Nigeria in terms of body weight, shank length, wing length and toe length. However, body girth of local chickens in Southeast and North central Nigeria did not significantly differ (P>0.05). Ugbo *et al.*, (2025) revealed that sex had significant (P<0.05) effect on several growth parameters such as final body weight (FBW), average weight gain (AWG) and growth rate (GR) with male having better growth performance.

Table 3: Effect of Sex on Body Weight and Comparative Conformation Traits of Three Ecotype of Indigenous Chickens in Southern Guinea Savannah of Nigeria

Ecotype by Sex	Body weight (kg)	Keel length(cm)	Breast girth(cm)	Body Length(cm)	Neck Length(cm)	Wing Length(cm)	Shank Length (cm)
Fulani							
Male	1.46±0.03 ^a	16.2±0.25 ^a	31.1±0.61 ^a	25.2±0.55 ^a	15.5±0.41 ^a	22.1±0.69 ^a	10.0±0.48 ^a
Female	1.14±0.06 ^b	14.7±0.96 ^a	26.2±0.55 ^b	21.4±0.89 ^b	15.3±0.98 ^a	18.5±0.97 ^b	8.38±0.36 ^a
Tiv							
Male	1.46±0.04 ^a	17.4±0.80 ^a	26.0±1.46 ^a	22.2±1.82 ^a	20.4±2.15 ^a	17.0±0.87 ^a	11.8±2.08 ^a
Female	1.30±0.05 ^b	12.8±0.80 ^a	25.8±0.54 ^a	21.4±1.24 ^a	16.4±1.50 ^b	17.9±0.87 ^a	9.2±0.20 ^a
Kwalla							
Male	1.62±0.05 ^a	15.0±0.01 ^a	31.0±0.94 ^a	26.8±0.48 ^a	15.6±0.50 ^a	18.6±0.67 ^a	12.1±0.20 ^a
Female	1.41±0.03 ^b	14.0±0.36 ^b	26.8±0.30 ^b	22.0±0.57 ^b	15.0±0.25 ^a	20.1±0.74 ^a	12.3±0.42 ^a

^{a b c}Means bearing different superscripts in a column differ significantly at P<0.05

Effect of Sex on Comparative Morphological Traits of Three Ecotype of Indigenous Chickens

Beak length differed significantly between sexes in all ecotypes, with males generally having longer beaks than females, except in the Kwalla ecotype, where females exhibited longer beaks than males. Comb length was significantly greater in males than females across all ecotypes studied (Table 4). Comb width did not differ significantly between sexes, except in the Fulani ecotype. Wattle length differed significantly between sexes only in the Fulani ecotype. Male Fulani chickens exhibited superior comb size, wing length, shank length, and breast breadth compared to

females of the same ecotype. They also had higher live weight, shank length, and thigh, with the coefficient of variation for body weight in males (19.6%) being markedly higher than in females (8.2%). The prominence of male combs relative to females has been reported previously (Olawunmi *et al.*, 2008). Wattle width differed significantly between sexes in both Fulani and Kwalla ecotypes, but not in the Tiv ecotype. Ocular length differed significantly between sexes in the Kwalla ecotype, but not in Fulani or Tiv chickens. However, ocular width and spur thickness did not differ significantly between sexes in any of the three ecotypes studied.

Table 4: Effect of Sex on Comparative Morphological Traits of Three Ecotype of Indigenous Chickens in Southern Guinea Savannah of Nigeria

Ecotype by Sex	Beak Length(mm)	Comb Length(mm)	Comb Width(mm)	Wattle Length(mm)	Wattle Width(mm)	Ocular Length(mm)	Ocular Width(mm)	Spur Thickness (mm)
Fulani								
Male	31.4±0.96 ^a	44.0±3.24 ^a	23.6±2.28 ^a	19.7±1.73 ^a	18.6±2.16 ^a	11.5±0.34 ^a	8.4±0.46 ^a	4.25±0.55 ^a
Female	25.9±0.74 ^b	20.0±1.02 ^b	7.0±1.10 ^b	17.9±1.30 ^b	9.93±0.64 ^b	10.5±0.25 ^a	8.1±0.30 ^a	3.60±0.58 ^a
TIV								
Male	27.5±1.83 ^a	52.3±6.02 ^a	24.3±2.30 ^a	25.7±5.06 ^a	9.3±1.09 ^a	12.0±0.92 ^a	9.17±0.30 ^a	7.88±1.43 ^a
Female	23.2±0.86 ^b	26.5±7.55 ^b	10.4±2.30 ^a	24.0±0.01 ^a	7.0±0.01 ^a	11.7±0.56 ^a	8.62±0.65 ^a	4.14±0.80 ^a
Kwalla								
Male	22.5±0.68 ^b	60.7±0.92 ^a	23.4±1.12 ^a	20.6±0.88 ^a	9.00±1.0 ^a	10.8±0.21 ^a	8.74±0.28 ^a	5.00±0.17 ^a
Female	24.6±0.42 ^a	22.6±0.52 ^b	25.1±0.45 ^a	18.2±0.85 ^a	9.75±0.94 ^b	9.83±0.30 ^b	8.15±0.10 ^a	4.00±0.15 ^a

^{a b c}Means bearing different superscripts in a column differ significantly at P<0.05

Relationship between Body Weight and Body Linear Measurement in Three indigenous Ecotype Chickens in Southern Guinea Savannah of Nigeria

Table 5 presents the coefficients of genetic correlation between body weight and various growth traits. In the Fulani ecotype, highly significant positive correlations were observed between body weight and spur thickness ($r = 0.53$), keel length ($r = 0.73$), breast girth ($r = 0.48$), body length ($r = 0.39$), and shank length ($r = 0.69$). Consistent with these findings, Yunusa and Adeoti (2014) reported that body length and breast girth had the highest direct effects on body weight in Fulani cocks. Similarly, Ige (2013) observed significant correlations between body weight and body girth, body length, wing length, keel length, beak length, and shank length in Fulani crossbred chickens.

In the Kwalla ecotype, a highly significant positive correlation was found only between body weight and spur

thickness ($r = 0.74$). Positive but non-significant correlations were observed between body weight and keel length ($r = 0.79$), breast girth ($r = 0.61$), and body length ($r = 0.60$), whereas shank length was negatively associated with body weight ($r = -0.37$) (Table 5). To date, no previous studies have reported genetic correlations for the Kwalla ecotype. However, path analysis by Egena et al. (2014) indicated that body length exerted the greatest direct effect on body weight in both male (path coefficient = 0.417) and female (0.428) chickens.

For the Tiv ecotype, positive but non-significant correlations were observed between body weight and spur thickness ($r = 0.41$), keel length ($r = 0.27$), body length ($r = 0.55$), and shank length ($r = 0.12$). Conversely, breast girth showed a small negative, non-significant correlation with body weight ($r = -0.042$) (Table 5).

Table 5: Relationship between Body Weight and Body Linear Measurement in Three Indigenous Ecotype Chickens in Southern Guinea Savannah of Nigeria

Ecotype/Parameter	Body weight	Spur Thickness	Keel length	Breast girth	Body length	Shank length
Fulani						
Body weight	1.00	0.53**	0.73**	0.48*	0.39*	0.69**
Kwalla						
Body weight	1.00	0.74*	0.79 ^{ns}	0.61 ^{ns}	0.60 ^{ns}	-0.37 ^{ns}
Tiv						
Body weight	1.00	0.41 ^{ns}	0.27 ^{ns}	-0.042 ^{ns}	0.55 ^{ns}	0.12 ^{ns}

Correlation coefficients with superscript (ns) are not significant ($p > 0.05$)

CONCLUSION

The present study demonstrated that body weight, body conformation, and morphological traits differ significantly among the three indigenous chicken ecotypes studied. The Kwalla chicken, originating from Plateau State, exhibited the highest body weight compared to the Fulani and Tiv ecotypes at 21 weeks of age. In the Fulani ecotype, body weight showed significant positive correlations with spur thickness, keel length, breast girth, body length, and shank length. In contrast, only spur thickness was significantly and positively correlated with body weight in the Kwalla ecotype. In the Tiv ecotype, none of the measured traits showed a significant association with body weight, although body length exhibited a strong positive but non-significant correlation. These findings suggest that genetic improvement programs can achieve meaningful gains by selecting traits that are positively and significantly associated with body weight. Furthermore, the Kwalla chicken demonstrates considerable potential as a meat-producing ecotype due to its superior body weight relative to the Fulani and Tiv ecotypes. Therefore, further studies focusing on the growth performance, carcass

characteristics, and genetic potential of the Kwalla ecotype are recommended to fully exploit its contribution to indigenous poultry production in North-Central Nigeria.

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