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Phenotypic variations in local chickens: Influence of strain and sex on morphometric traits

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ABSTRACT: This study evaluated the influence of strain and sex on the phenotypic traits of local chickens. A total of 150 chickens were used, comprising 50 chickens each from three strains (Frizzle, Naked Neck and Normal-feathered), with an equal distribution of 25 males and 25 females per strain. The phenotypic traits measured included body weight (BW), body length (BL), shank length (SHL), chest circumference (CC), wing span (WS) and drumstick length (DS). The data collected were analysed using the Statistical Analysis System (SAS), and significance was determined at $p < 0.05$. The results revealed significant differences among the strains, with Normal-feathered chickens exhibiting superior growth performance in most traits, followed by Naked Neck and Frizzle strains. Males generally had higher values than females in all measured traits, demonstrating sexual dimorphism. Correlation analysis showed strong positive relationships among several traits, particularly between BW and BL (r=0.617**), BW and SHL (r=0.638**) and DS and SHL (r=0.702**), indicating that selection for one trait could enhance others. These findings provide crucial insights for genetic selection and breeding programmes aimed at improving the productivity and adaptability of indigenous chickens. The superior performance of the Normal-feathered and Naked Neck strains suggests their potential for commercial and rural poultry production. Further research should explore molecular markers linked to these traits to optimize breeding strategies for sustainable poultry development.

Keywords: Chicken, correlation, phenotypic traits, sex, strains.

INTRODUCTION

Local chicken production plays a vital role in rural livelihoods, food security and economic sustainability, particularly in developing countries (Adebambo *et al*., 2024). Indigenous chickens exhibit significant genetic diversity, which influences their phenotypic traits, adaptability and productivity (Ogbuehi *et al*., 2021). Understanding the effects of strain and sex on phenotypic characteristics is crucial for optimizing breeding programmes and improving poultry performance (Oladapo *et al*., 2024). Strain variation is a key determinant of growth performance, morphological traits and adaptability in local chickens. Studies have shown that different strains, such as Frizzle, Naked Neck and Normal-feathered chickens, exhibit distinct phenotypic traits due to genetic and environmental interactions (Adebambo *et al*., 2010; Kanasuah *et al*., 2025). Normal-feathered chickens tend to have superior body weight, body length, and overall size compared to Frizzle and Naked Neck strains (Yacouba *et al*., 2022). These differences influence their productivity, market value and resilience to environmental stressors (Khare and Khare, 2017). Sexual dimorphism also significantly affects growth traits, with males generally exhibiting higher body weight, longer shank length and greater chest circumference than females (Assefa and Melesse, 2018; Adekoya *et al*., 2013). This variation is attributed to hormonal differences and genetic factors that influence growth rates and feed efficiency (Egena *et al*., 2014). Understanding these variations aids in selection programmes aimed at enhancing meat and egg production in indigenous poultry systems (Dana *et al*., 2011). This study aimed to assess the influence of strain and sex on the phenotypic traits of local chickens, contributing to

improved breeding strategies and genetic conservation efforts.

MATERIALS AND METHODS

Study area

This study was conducted in a poultry research facility at the University of Calabar, located in Cross River State, Nigeria. Calabar lies within the tropical rainforest zone (latitude 4°57′N and longitude 8°19′E) and experiences high ambient temperatures and relative humidity throughout the year, with an annual rainfall of approximately 2,500 mm and temperatures ranging between 25 and 32°C (Okon *et al*., 2025). The region is characterized by a humid climate that influences poultry production by affecting feed intake, growth performance, and thermoregulatory responses (Halima, 2007). The environment was selected to assess the adaptability and phenotypic traits of different local chicken strains under similar management conditions.

Experimental animals and management

A total of 150 local chickens were used for the study, comprising three strains: Frizzle, Naked Neck and Normal-feathered. Each strain consisted of 50 birds, with an equal representation of both sexes (25 males and 25 females). The chickens were sourced from local breeders and raised under semi-intensive management conditions, which are suitable for maintaining genetic diversity while allowing birds to exhibit natural behaviours (Ojo, 2010). They were provided with commercial poultry feed and clean drinking water *ad libitum*. Routine vaccination and biosecurity measures were implemented to ensure optimal health status (Okon *et al*., 2025).

Data collection

Phenotypic traits, including body weight (BW), body length (BL), shank length (SHL), chest circumference (CC), wing span (WS) and drumstick length (DS), were measured using standard procedures. Body weight was recorded using a digital weighing scale, while linear body measurements were taken with a measuring tape and recorded in centimeters.

Statistical analysis

Data were analysed using the Statistical Analysis System (SAS) software. Descriptive statistics were computed, and analysis of variance (ANOVA) was performed to determine the influence of strain and sex on the phenotypic traits. Mean comparisons were conducted using Duncan's Multiple Range Test at a 5% significance level. Additionally, correlation analysis was performed to assess relationships between phenotypic traits across all chicken strains.

RESULTS AND DISCUSSION

Table 1 presents the influence of different strains of local chickens: Frizzle, Naked neck and Normal-feathered on various phenotypic traits, including body weight (BW), body length (BL), shank length (SHL), chest circumference (CC), wing span (WS) and drumstick length (DS). The results indicated significant variations ($p<0.05$) across the strains for all measured parameters. The Normal-feathered and Naked neck strains recorded significantly higher body weights (1.17 and 1.14 kg, respectively) compared to the Frizzle strain (0.94 kg). These findings align with previous research, which suggests that frizzle feathering is associated with reduced growth performance due to inefficient thermoregulation and higher metabolic rates (Adedeji *et al*., 2008; Kanasuah *et al*., 2025). Similar studies by Abdulraheem *et al.* (2024) have shown that naked-neck chickens tend to have higher body weights due to their superior feed conversion efficiency and adaptability to hot climates. The body length was significantly higher in Normal-feathered (27.57 cm) and Naked neck (27.50 cm) strains compared to the Frizzle strain (25.75 cm). This result is in agreement with the work of Azimu *et al*. (2018), who reported that frizzle-feathered chickens often exhibit shorter body lengths due to genetic predisposition affecting skeletal growth. Further research by Isidahomen *et al*. (2012) emphasized that naked-neck chickens tend to have longer body structures, which contribute to better carcass yield. The shank length varied significantly among the strains, with the Normal-feathered strain recording the highest (8.25 cm), followed by Naked neck (8.06 cm) and Frizzle (7.19 cm). Studies by Adebambo *et al*. (2024) and Dana *et al*. (2011) confirmed that longer shank lengths in Normal-feathered chickens enhance their mobility and scavenging ability, which are crucial for adaptability in extensive production systems. The Normal-feathered strain had a significantly higher chest circumference (27.58 cm) than both Naked neck (25.57 cm) and Frizzle (26.10 cm). Chest circumference is an essential parameter for meat yield, and these findings are supported by Ogbuehi *et al*. (2021), who reported that normal-feathered chickens tend to have better breast muscle development compared to frizzled and naked-neck variants. The Normal-feathered strain exhibited the highest wing span (37.95 cm), followed by Naked neck (34.42 cm) and Frizzle (31.93 cm). This observation aligned with reports by Assefa and Melesse (2018), which indicated that wing span correlates with flight ability and overall body frame. Additionally, Faruque *et al*. (2010) found that wing span is a crucial indicator of fitness and

Table 1. Influence of strains on the phenotypic traits of local chickens.

Parameters	Frizzle	Naked neck	Normal-feathered	P-value
BW (kg)	0.94[b]	1.14[a]	1.17[a]	0.03
BL (cm)	25.75[b]	27.50[a]	27.57[a]	0.02
SHL (cm)	7.19[b]	8.06[a]	8.25[a]	0.01
CC (cm)	26.10[b]	25.57[b]	27.58[a]	0.02
WS (cm)	31.93[c]	34.42[b]	37.95[a]	0.04
DS (cm)	11.58[b]	13.23[a]	13.68[a]	0.01

[abc]Means on the same row having different superscripts are significantly different ($p<0.05$), BW = body weight, BL = body length, SHL = shank length, CC = chest circumference, WS = wing span, DS = drum stick.

Table 2. Influence of sex (male) on the phenotypic traits of local chicken.

Parameters	Frizzle	Naked	Normal-feathered	P-value
BW (kg)	1.13	1.19	1.29	0.53
BL (cm)	26.50[b]	28.87[a]	28.99[a]	0.01
SHL (cm)	7.73[b]	8.56[a]	8.87[a]	0.03
CC (cm)	27.83	27.30	27.23	2.63
WS (cm)	32.40[b]	36.60[a]	37.30[a]	0.04
DS (cm)	12.21[b]	14.03[a]	14.47[a]	0.03

[ab]Means on the same row having different superscripst are significantly different ($p<0.05$), BW = body weight, BL = body length, SHL = shank length, CC = chest circumference, WS = wing span, DS = drum stick.

survivability in free-range systems. The Normal-feathered and Naked neck strains had significantly longer drumsticks (13.68 cm and 13.23 cm, respectively) compared to the Frizzle strain (11.58 cm). Similarly, findings by Dessie and Ogle (2001) suggested that drumstick length is influenced by genetic and environmental factors, with the frizzle trait potentially limiting leg development due to metabolic constraints.

Table 2 presents the influence of male sex on the phenotypic traits of different strains of local chickens, namely Frizzle, Naked neck and Normal-feathered. The parameters assessed include body weight (BW), body length (BL), shank length (SHL), chest circumference (CC), wing span (WS) and drumstick length (DS). Significant differences ($p<0.05$) were observed for body length, shank length, wing span and drumstick length among the strains, while body weight and chest circumference were not significantly ($p>0.05$) different. The Normal-feathered strain had the highest body weight (1.29 kg), followed by the Naked neck strain (1.19 kg) and the Frizzle strain (1.13 kg), though the difference was not statistically significant ($p=0.53$). This aligns with previous studies that found that normal-feathered chickens tend to have superior growth performance due to their genetic predisposition for better feed conversion efficiency and meat yield (Ogbuehi *et al*., 2021; Kanasuah *et al*., 2025). Studies by Azimu *et al*. (2018) suggest that frizzle-feathered chickens may experience metabolic challenges that limit weight gain compared to their normal-feathered and naked-neck counterparts. The body length of the Naked neck (28.87 cm) and Normal-feathered (28.99 cm) strains was significantly higher than that of the Frizzle strain (26.50 cm) ($p=0.01$). This agreed with the findings of Isidahomen *et al*. (2012), who reported that naked-neck chickens generally exhibit longer skeletal structures that contribute to increased body size and better meat production. Similarly, Abdulraheem et al. (2024) reported that normal-feathered chickens show enhanced skeletal development, making them preferable for meat production. Shank length was significantly longer in Normal-feathered (8.87 cm) and Naked neck (8.56 cm) strains than in the Frizzle strain (7.73 cm) ($p=0.03$). Longer shanks in these strains may be linked to superior skeletal growth and increased foraging ability, as reported by Dana *et al*. (2011). Similar results were reported by Assefa and Melesse (2018), indicating that longer shanks provide a survival advantage in extensive systems, where scavenging ability is critical. Unlike other traits, chest circumference did not show any significant difference among the three strains ($p=2.63$), with values ranging from 27.23 cm (Normal-feathered) to 27.83 cm (Frizzle). This finding aligned with Ogbuehi *et al*. (2021), who noted that chest circumference may not be significantly influenced by strain in local chickens due to variations in muscle distribution patterns. Adebambo *et al*. (2024) also highlighted that chest circumference may be more affected by environmental factors and feed availability than by genetic factors. Wing span was significantly higher in the Normal-feathered (37.30 cm) and Naked neck (36.60 cm) strains than in the Frizzle strain (32.40 cm) ($p=0.04$).

Table 3. Influence of sex (female) on the phenotypic traits of local chicken.

Parameters	Frizzle	Naked	Normal-feathered	P-value
BW (kg)	0.75[b]	1.10[a]	1.05[a]	0.04
BL (cm)	25.00[b]	26.13[a]	26.15[a]	0.05
SHL (cm)	6.64[b]	7.57[a]	7.63[a]	0.04
CC (cm)	24.37[b]	23.83[b]	27.93[a]	0.01
WS (cm)	31.47[b]	32.23[b]	38.60[a]	0.04
DS (cm)	10.90[b]	12.43[a]	12.89[a]	0.03

[ab]Means on the same row having different superscripts are significantly different (p<0.05), BW = body weight, BL = body length, SHL = shank length, CC = chest circumference, WS = wing span, DS = drum stick.

Previous studies (Faruque *et al*., 2010; Azimu *et al*., 2018) indicated that larger wing spans correlate with better flight capability and adaptability in extensive production systems. Additionally, Dessie and Ogle (2001) suggested that wing span may be a genetic indicator of overall skeletal robustness in chickens. The Normal-feathered (14.47 cm) and Naked neck (14.03 cm) strains had significantly longer drumstick lengths than the Frizzle strain (12.21 cm) (p=0.03). This is in agreement with the findings of Ogbuehi *et al*. (2021), who reported that normal-feathered and naked-neck chickens exhibit better muscle development in the lower limbs, which contributes to increased meat yield. According to Adekoya *et al*. (2013), drumstick length is a crucial trait for selecting birds with high meat-producing potential.

Table 3 presents the influence of sex (female) on the phenotypic traits of local chickens based on three genotypes: Frizzle, Naked Neck, and Normal-feathered. The statistical significance is assessed using p-values, with differences considered significant at p<0.05. The parameters evaluated include body weight (BW), body length (BL), shank length (SHL), chest circumference (CC), wing span (WS) and drumstick length (DS). The body weight of Naked Neck (1.10 kg) and Normal-feathered (1.05 kg) chickens was significantly higher than that of Frizzle chickens (0.75 kg) (p=0.04). This result is in agreement with previous studies, which indicated that Naked Neck and Normal-feathered chickens generally exhibit superior growth performance compared to Frizzle chickens (Oladapo *et al*., 2024). The genetic advantage of Naked Neck chickens in terms of heat tolerance may contribute to their higher body weight (Dessie and Ogle, 2001). Furthermore, reports by Udoh (2014) confirmed that Naked Neck birds exhibit better feed conversion efficiency compared to their Frizzle counterparts. The body length of Naked Neck (26.13 cm) and Normal-feathered chickens (26.15 cm) was significantly higher than that of Frizzle chickens (25.00 cm) (p=0.05). Studies by Ige (2013) and Adebambo *et al*. (2010) supported these findings, suggesting that body length is a critical determinant of overall growth and adaptability in local chicken breeds. The shorter body length in Frizzle chickens may be attributed to their genetic makeup, which prioritizes heat dissipation over body mass development (Song *et al*., 2024). The shank length was significantly shorter in Frizzle chickens (6.64 cm) compared to Naked Neck (7.57 cm) and Normal-feathered (7.63 cm) chickens (p=0.04). Similar findings were reported by Lamido *et al*. (2024), who emphasized that shank length is positively correlated with overall body size and weight. The superior shank length of Naked Neck and Normal-feathered chickens may be an adaptation for better mobility and foraging efficiency, as reported by Kanasuah *et al*. (2025). A significant difference was obtained in chest circumference (p= 0.01), with Normal-feathered chickens (27.93 cm) having the highest value, followed by Frizzle (24.37 cm) and Naked Neck (23.83 cm). Chest circumference is an essential trait for meat yield, and these results aligned with the reports of Ogbuehi et al. (2021), who found that Normal-feathered chickens generally exhibit higher muscle deposition. However, the lower chest circumference in Naked Neck chickens may be offset by their higher body weight, indicating that meat distribution varies among different genotypes (Udoh, 2014). Wing span was significantly higher in Normal-feathered chickens (38.60 cm) compared to Naked Neck (32.23 cm) and Frizzle (31.47 cm) chickens (p=0.04). This finding corroborates the results of Okpeku *et al*. (2019), who noted that Normal-feathered chickens tend to have a broader wing structure, which may enhance flight capability and thermoregulation. Frizzle chickens, known for their curled feathers, typically exhibit a reduced wing span, likely impacting their flight and mobility (Kanasuah *et al*., 2025). Drumstick length was significantly lower in Frizzle chickens (10.90 cm) compared to Naked Neck (12.43 cm) and Normal-feathered (12.89 cm) chickens (p=0.03). This observation aligned with the findings of Dessie and Ogle (2001), who reported that drumstick length is a critical factor influencing meat yield, particularly in indigenous chicken breeds. The genetic advantage of Naked Neck and Normal-feathered chickens may explain their superior drumstick development (Salisu *et al*., 2018).

The pooled correlation of phenotypic traits of local chickens presented in Table 4 highlights the relationships among various phenotypic traits in local chicken breeds. Correlation coefficients measure the strength and direction of associations between traits, with values closer to 1 indicating strong positive correlations and those near zero

Table 4. Pooled correlation of phenotypic traits of local chickens.

	BW	BL	SHL	CC	WS	DS
BW	1.000					
BL	0.617**	1.000				
SHL	0.638**	0.673**	1.000			
CC	0.561*	0.455*	0.431*	1.000		
WS	0.347	0.417*	0.439*	0.387	1.000	
DS	0.571*	0.606**	0.702**	0.432*	0.616**	1.000

BW = body weight, BL = body length, SHL = shank length, CC = chest circumference, WS = wing span, DS = drum stick * = (p<0.05), ** = (p<0.01).

suggesting weak or no correlation.BW exhibited significant positive correlations with BL (r = 0.617, p<0.01), SHL (r = 0.638, p<0.01), CC (r = 0.561, p<0.05), and DS (r = 0.571, p<0.05). These findings suggest that increases in body weight are associated with proportional increases in body length, shank length, chest circumference and drumstick size. Similar trends have been reported in previous studies (Adebambo *et al*., 2024), which found that larger body weight in indigenous chicken breeds is often accompanied by improved structural traits, making them more suitable for meat production. BL showed strong positive correlations with SHL (r = 0.673, p<0.01) and DS (r = 0.606, p<0.01), indicating that longer chickens tend to have longer shanks and drumsticks. This aligned with the findings of Abdulraheem et al. (2024), who reported that selection for longer body frames in local chickens resulted in improved limb development, which may enhance their adaptability and mobility in free-range systems. SHL had significant correlations with BW (r = 0.638, p<0.01), BL (r = 0.673, p<0.01), DS (r = 0.702, p<0.01), WS (r = 0.439, p<0.05), and CC (r = 0.431, p<0.05). The strong association between SHL and DS supported the argument that leg development is crucial in local chicken breeds for improved scavenging ability and structural integrity (Yacouba *et al*., 2022; Sanda *et al*., 2022). Furthermore, the correlation with WS suggests that limb length may also influence wing extension and flight capability.CC was positively correlated with BW (r = 0.561, p<0.05), BL (r = 0.455, p<0.05), SHL (r = 0.431, p<0.05), and DS (r = 0.432, p<0.05). These correlations indicate that birds with a broader chest tend to be heavier and longer-bodied, a characteristic often associated with meat-producing strains (Evanno *et al*., 2005; Azimu *et al*., 2018).WS had moderate correlations with BL (r = 0.417, p<0.05), SHL (r = 0.439, p<0.05), and DS (r = 0.616, p<0.01), suggesting that birds with larger wingspans tend to have longer bodies and stronger limbs. These findings are consistent with the studies of Faruque *et al*. (2010), who reported that wing span is an important trait in assessing flight capability and adaptation to free-range environments.DS exhibited strong correlations with BW (r = 0.571, p<0.05), BL (r = 0.606, p<0.01), SHL (r = 0.702, p<0.01), and WS (r = 0.616, p<0.01). The strong association with SHL confirmed that drumstick development is directly linked to overall leg structure, which influences movement and foraging efficiency (Egena *et al*., 2014; Ogbuehi *et al*., 2021).

Conclusion

The findings of this study highlighted significant influences of strain and sex on the phenotypic traits of local chickens. Normal-feathered chickens exhibited superior performance in terms of the phenotypic traits, followed by naked neck and frizzle-feathered strains. Males generally had higher values for body weight, body length, shank length and drumstick size, emphasizing sexual dimorphism in local chicken populations. The pooled correlation analysis revealed strong positive associations among key growth traits, suggesting that selection for one trait can indirectly enhance others. These results provide critical insights for breeding programmes aimed at improving productivity, adaptability and resilience of indigenous chickens in tropical environments. Future research should explore genetic markers associated with these traits to optimize selection and breeding strategies for sustainable poultry production.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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