



## Research Article

# Comparative Growth Performance and Morphometric Characteristics of Funaab Alpha Chicken Strains (Normal Feather, Naked Neck, and Frizzle Feather) in A Semi-Arid Tropical Environment

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### ABSTRACT

This study investigated the comparative growth performance and morphometric characteristics of three strains of FUNAAB Alpha chickens: Normal Feather (NF), Naked Neck (Na), and Frizzle Feather (F), reared in a semi-arid Zone of Maiduguri. A total 90 day-old chicks were purchased at Federal University of Agriculture Abeokuta with three replicate per strain and 10 birds per replicate. Data on body weight and linear body measurements (body length, heart girth, wing length, shank length, thigh length, and neck length) were collected every two weeks from day-old to 12 weeks of age. Data generated were subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of SAS, differences among the strains and sexes were compared using Duncan Multiple Range Test (DMRT). The Naked Neck strain consistently exhibited significantly ( $P < 0.05$ ) higher body weight  $38.38 \pm 0.42$ - $2311.23 \pm 443.62$ g across all age groups compared to the Normal Feather  $32.67 \pm 0.45$ - $1620.00 \pm 91.17$ g and Frizzle Feather  $33.08 \pm 0.50$ - $1510.83 \pm 172.14$ g strains. Significant differences were also observed in various linear body measurements among the strains. Between sexes, males generally showed superior growth  $34.90 \pm 0.51$ - $2277.20 \pm 183.11$ g and larger dimensions compared to females  $33.16 \pm 0.68$ - $1138.40 \pm 21.29$ g. These findings highlight the genetic potential of the Naked Neck strain for improved growth performance in challenging tropical conditions, suggesting its suitability for enhanced poultry production in such regions.

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### INTRODUCTION

Poultry production plays a crucial role in global food security, particularly in developing countries where it provides a vital source of

protein and income for rural communities (Sonaiya 1990). In tropical and sub-tropical regions, indigenous chicken breeds are often preferred due to their adaptability to harsh

environmental conditions, disease resistance, and ability to thrive on low-input systems (Adeyanju, 2023). However, these local breeds typically exhibit slower growth rates and lower productivity compared to their exotic counterparts (Adebamboo *et al.*, 2018).

The FUNAAB Alpha chicken is an improved indigenous breed developed in Nigeria, aiming to combine the hardiness of local chickens with enhanced production traits (Adebamboo *et al.*, 2018). This breed comprises different strains, including Normal Feather, Naked Neck, and Frizzle Feather, each possessing unique phenotypic characteristics that may confer varying degrees of adaptability and productivity, especially in challenging climates (Oleforuh-Okoleh, 2023). The Naked Neck (Na) gene, for instance, reduces feather coverage, which is beneficial for heat dissipation in hot environments, potentially leading to improved growth and egg production (Fathi *et al.*, 2013; Hagan, 2010; Tixier-Boichard 2022). Similarly, the Frizzle Feather (F) gene, characterized by curled feathers, also contributes to thermoregulation by increasing insulation in cold and facilitating heat loss in hot conditions, although its primary benefit is often associated with heat tolerance it has lower body weight compared to the necked neck (Fathi *et al.*, 2013; Rajkumar *et al.*, 2010).

Understanding the comparative growth performance and morphometric characteristics of these FUNAAB Alpha strains is essential for optimizing their utilization in breeding programs and for sustainable poultry production in semi-arid regions like Borno State, Nigeria. Morphometric traits, such as body weight and linear body measurements, are important indicators of growth, development, and overall productivity in chickens (Fayeye *et al.*, 2006, Yakubu *et al.*, 2009; Lamido *et al.*, 2024). They are among important economic traits that are used for selection by local farmers and for research (Olowofeso, 2009). Similarly, livestock and poultry farmers and particularly geneticists used growth traits in improving the market quality of breeding stocks (Nwachukwu *et al.*, 2011). Body weight and its variation over time are affected by many processes and determined by various effects of genes depending on the age of individuals. Consequently, the genetic

evaluation for growth trait can be based on the live weights measured at different standard ages during the growth period (Rafat *et al.*, 2011). More over the performance of FUNAAB Alpha strains has not been evaluated in this environment. Hence this study was conducted to evaluate the growth performance and morphometric characteristics of Normal Feather, Naked Neck, and Frizzle Feather FUNAAB Alpha chicken strains from day-old to 12 weeks of age. The findings will contribute to a better understanding of the genetic potential of these strains and provide valuable information for poultry farmers and breeders in semi-arid tropical environments.

## **MATERIALS AND METHODS**

### **Study Area**

The experiment was conducted at Animal Science Teaching and Research farm of Kashim Ibrahim University Njimtilo, Maiduguri Borno State. The state falls within Latitudes 100 and 130 N, Longitudes 120 and 150 E. Maiduguri lie in the semi-arid zone of Nigeria. It is characterized by a short rainy season (3 to 4 months) with a long dry season period. Annual rainfall ranges from 500mm to 600mm while the ambient temperature reaches 40°C and above by April and May. The average elevation is approximately 354 meters above sea level (Shettima *et al.*, 2024)

### **Experimental Birds and Management**

A total of 90 day-old chicks of FUNAAB Alpha chickens, 40 hens and 50 cocks. Which comprises of three strain; Normal Feather (NF), Naked Neck (Na), and Frizzle Feather (F), 30 birds per strain (treatment) which were replicated thrice and 10 birds were used per replicate. The chicks were obtained from a reputable hatchery of Federal University of Agriculture Abeokuta. Upon arrival, the chicks were wing-banded for individual identification and randomly allocated to experimental pens (according to their strain). The birds were reared under an intensive management system in a well ventilated deep litter pens, with standard brooding practices implemented for the first four weeks. Chick mash diets that contain 20% CP and 12.4 MJ/kg and grower mash with 16% CP and 12.4 MJ/kg, including fresh water were provided ad libitum. Vaccination and routine

health management protocols were strictly followed throughout the experimental period.

#### Data Collection

Body weight (WT) was measured bi-weekly from day-old (week 0) until 12 weeks of age, using a digital scale (0.01g precision). Six linear body measurements were recorded bi-weekly in centimeters (cm) using a flexible measuring tape and a vernier caliper were appropriate (Younis and Cahaner, 1999). Measurements were taken twice and the mean was used to reduced error.

1. Body Length (BL): From the tip of the beak to the pygostyle.
2. Heart Girth (HG): Circumference of the chest behind the wings.
3. Wing Length (WL): From the shoulder joint to the tip of the longest primary feather.
4. Shank Length (SL): From the hock joint to the footpad.
5. Thigh Length (TL): From the hip joint to the hock joint.
6. Neck Length (NL): From the base of the skull to the shoulder joint.

#### Statistical Analysis

The experiment was carried out using Completely Randomize design. Data collected were subjected to analysis of variance (ANOVA) using SAS procedure. Means were compared using Duncan Multiple Range Test to determine the effects of strain and sex at a significance level of  $p < 0.05$ .

The model used is as follows:

$$Y_{ijkl} = \mu + G_i + H_j + S_k + E_{ijkl}$$

Where;  $Y_{ijkl}$  = observation on  $l^{\text{th}}$  individual of the  $j^{\text{th}}$  strain and the  $k^{\text{th}}$  sex

$\mu$  = the overall mean

$G_i$  = effect of the  $i^{\text{th}}$  individual

$H_j$  = effect of the  $j^{\text{th}}$  strain on growth performance ( $j= 3$ )

$S_k$  = effect of the  $k^{\text{th}}$  sex ( $k= 1$  and  $2$ )

$E_{ijkl}$  = all error terms assumed to be random normally distributed and independent with expectation equal to zero

#### Results

##### Effect of Strain on Body Weight and Linear Body Measurements

Table 1 details the effect of the three FUNAAB Alpha chicken strains on body weight and various linear body measurements across different age groups. A highly significant effect of strain ( $p < 0.05$ ) was observed on body weight throughout the experimental period from day-old to 12 weeks of age. The Naked Neck (Na) strain consistently demonstrated superior body weight, maintaining significantly higher values than both the Normal Feather (NF) and Frizzle Feather (F) strains at all measured ages. For instance, at day-old, Naked Neck chicks were already heavier ( $38.38 \pm 0.42\text{g}$ ) compared to Normal Feather ( $32.67 \pm 0.45\text{g}$ ) and Frizzle Feather ( $33.08 \pm 0.50\text{g}$ ). This trend continued, culminating in a substantial difference at 12 weeks, where Naked Neck birds averaged  $2311.23 \pm 443.62\text{g}$ , significantly surpassing Normal Feather  $1620.00 \pm 91.17\text{g}$  and Frizzle Feather  $1510.83 \pm 172.14\text{g}$  strains. Significant differences ( $p < 0.05$ ) were also evident in all linear body measurements among the strains. For Body Length, the Frizzle Feather strain exhibited significantly greater lengths at younger ages (2, 4, 6, 8, 10 weeks).

**Table 1:** Effect of Strain on Body Weight and Linear Body Measurements at Different Age of FUNAAB Alpha Chicken

Traits	Age	Normal Feather	Necked Neck	Frizzle Feather	LOS
<b>Body Weight (g)</b>	0	32.67±0.45 <sup>b</sup>	38.38±0.42 <sup>a</sup>	33.08±0.50 <sup>b</sup>	*
	2	191.67±7.05 <sup>b</sup>	272.31±22.28 <sup>a</sup>	204.17±5.14 <sup>b</sup>	*
	4	467.33±7.75 <sup>b</sup>	530.77±27.58 <sup>a</sup>	506.67±13.45 <sup>a</sup>	*
	6	621.00±23.94 <sup>c</sup>	1012.00±110.42 <sup>a</sup>	785.00±36.17 <sup>b</sup>	*
	8	1205.33±83.71 <sup>b</sup>	1708.46±258.34 <sup>a</sup>	1299.17±146.04 <sup>b</sup>	*
	10	1371.33±71.68 <sup>b</sup>	2162.69±354.93 <sup>a</sup>	1226.25±92.53 <sup>b</sup>	*
	12	1620.00±91.17 <sup>b</sup>	2311.23±443.62 <sup>a</sup>	1510.83±172.14 <sup>b</sup>	*
<b>Body Length (cm)</b>	2	7.87±0.28 <sup>b</sup>	7.77±0.28 <sup>b</sup>	10.17±0.67 <sup>a</sup>	*
	4	12.17±0.35 <sup>b</sup>	11.92±0.62 <sup>b</sup>	14.25±0.91 <sup>a</sup>	*
	6	14.20±0.35 <sup>b</sup>	15.00±0.70 <sup>b</sup>	19.25±1.31 <sup>a</sup>	*
	8	19.60±0.55 <sup>b</sup>	18.62±0.98 <sup>b</sup>	22.25±0.84 <sup>a</sup>	*
	10	25.93±1.08 <sup>b</sup>	27.77±2.50 <sup>b</sup>	30.25±2.43 <sup>a</sup>	*
	12	34.67±1.60 <sup>b</sup>	38.23±1.72 <sup>a</sup>	37.83±1.74 <sup>ab</sup>	*
<b>Heart Girth (cm)</b>	2	6.90±0.31 <sup>ab</sup>	6.54±0.42 <sup>b</sup>	7.50±0.54 <sup>a</sup>	*
	4	11.13±0.25 <sup>b</sup>	13.38±1.56 <sup>a</sup>	11.67±0.75 <sup>b</sup>	*
	6	15.57±0.49 <sup>b</sup>	19.46±3.04 <sup>a</sup>	17.25±1.57 <sup>ab</sup>	*
	8	21.17±1.13 <sup>b</sup>	20.69±1.99 <sup>b</sup>	26.75±1.02 <sup>a</sup>	*
	10	31.90±0.89 <sup>b</sup>	35.69±3.08 <sup>a</sup>	33.58±1.68 <sup>ab</sup>	*
	12	39.20±1.49 <sup>b</sup>	40.23±2.05 <sup>b</sup>	43.33±2.38 <sup>a</sup>	*
<b>Wing Length (cm)</b>	2	9.03±0.50 <sup>a</sup>	7.31±0.40 <sup>b</sup>	7.50±0.47 <sup>b</sup>	*
	4	15.20±0.95 <sup>a</sup>	11.15±0.99 <sup>b</sup>	10.75±0.68 <sup>b</sup>	*
	6	20.07±1.52 <sup>a</sup>	18.15±2.70 <sup>ab</sup>	17.17±2.19 <sup>b</sup>	*
	8	27.23±1.84 <sup>a</sup>	23.00±2.42 <sup>b</sup>	20.92±1.56 <sup>b</sup>	*
	10	28.63±1.51 <sup>ab</sup>	31.23±3.44 <sup>a</sup>	26.58±1.90 <sup>b</sup>	*
	12	33.97±1.34 <sup>ab</sup>	36.00±4.25 <sup>a</sup>	29.92±2.25 <sup>b</sup>	*
<b>Shank Length (cm)</b>	2	4.03±0.29 <sup>a</sup>	3.38±0.37 <sup>b</sup>	3.92±0.34 <sup>ab</sup>	*
	4	9.60±0.79 <sup>b</sup>	10.00±0.91 <sup>b</sup>	12.00±1.07 <sup>a</sup>	*
	6	13.13±0.96 <sup>b</sup>	17.38±2.65 <sup>a</sup>	14.75±1.08 <sup>b</sup>	*
	8	21.83±1.15 <sup>ab</sup>	25.00±2.58 <sup>a</sup>	21.00±1.87 <sup>b</sup>	*
	10	31.13±0.98 <sup>ab</sup>	34.85±2.72 <sup>a</sup>	30.08±2.62 <sup>b</sup>	*
	12	37.67±1.92 <sup>a</sup>	42.15±3.34 <sup>a</sup>	22.50±3.46 <sup>b</sup>	*
<b>Thigh Length (cm)</b>	2	5.83±0.25 <sup>b</sup>	8.31±1.27 <sup>a</sup>	5.83±0.41 <sup>b</sup>	*
	4	10.07±0.52 <sup>b</sup>	12.31±1.58 <sup>a</sup>	9.42±0.29 <sup>b</sup>	*
	6	11.60±0.61 <sup>b</sup>	14.31±1.05 <sup>a</sup>	10.83±0.21 <sup>b</sup>	*
	8	15.07±0.92 <sup>a</sup>	17.54±1.69 <sup>b</sup>	12.17±0.30 <sup>c</sup>	*
	10	22.10±1.88 <sup>a</sup>	21.15±2.73 <sup>a</sup>	13.33±0.38 <sup>b</sup>	*
	12	23.83±2.35 <sup>a</sup>	26.15±3.64 <sup>a</sup>	13.67±0.31 <sup>b</sup>	*
<b>Neck Length (cm)</b>	2	3.80±0.17 <sup>b</sup>	4.62±0.37 <sup>a</sup>	3.83±0.30 <sup>b</sup>	*
	4	9.13±0.60 <sup>a</sup>	7.69±0.31 <sup>b</sup>	6.58±0.19 <sup>b</sup>	*
	6	12.70±1.02 <sup>a</sup>	9.38±0.38 <sup>b</sup>	8.58±0.29 <sup>b</sup>	*
	8	13.40±0.84 <sup>a</sup>	12.15±0.72 <sup>a</sup>	10.17±0.27 <sup>b</sup>	*
	10	17.33±1.00 <sup>a</sup>	14.46±1.03 <sup>b</sup>	11.08±0.31 <sup>c</sup>	*
	12	23.13±1.93 <sup>a</sup>	16.62±1.59 <sup>b</sup>	11.58±0.26 <sup>c</sup>	*

<sup>a, b and c</sup>: Means within the same rows with different superscripts are significantly different at \* = P< 0.05.

However, by 12 weeks, the Naked Neck strain showed the highest body length (38.23 ± 1.72cm), although not significantly different from Frizzle Feather (37.83 ± 1.74cm), both being superior to Normal Feather (34.67 ± 1.60cm).

Heart Girth measurements revealed that Frizzle Feather birds had significantly larger heart girths at 2, 8, and 12 weeks. The Naked Neck strain showed significantly higher heart girth at 4 and 10 weeks, and was comparable to Frizzle Feather at 6 weeks. This indicates a fluctuating

pattern of development in chest circumference among the strains. For Wing Length, Normal Feather birds generally displayed greater lengths at earlier ages (2, 4, 6, 8 weeks). However, the Naked Neck strain took the lead at 10 and 12 weeks, showing significantly longer wings ( $31.23 \pm 3.44\text{cm}$  and  $36.00 \pm 4.25\text{cm}$ , respectively) compared to the other two strains at these later stages. Shank Length demonstrated a mixed pattern. Normal Feather birds had significantly longer shanks at 2 weeks. Frizzle Feather showed superior shank length at 4 weeks. The Naked Neck strain then exhibited significantly longer shanks at 6, 8, and 10 weeks, and maintained comparable length to Normal Feather at 12 weeks, both being significantly longer than Frizzle Feather at this age. Thigh Length was significantly higher in Naked Neck birds at 2, 4, 6, 10, and 12 weeks, consistently outperforming both Normal Feather and Frizzle Feather strains. Normal Feather birds showed superior thigh length at 8 weeks. This suggests a robust development of thigh musculature in the Naked Neck strain. Finally,

Neck Length was consistently and significantly higher in Normal Feather birds across most age points (4, 6, 8, 10, 12 weeks). The Naked Neck strain had the longest neck at 2 weeks, but subsequently, both Naked Neck and Frizzle Feather strains generally exhibited shorter neck lengths compared to the Normal Feather strain.

#### **Effect of Sex on Body Weight and Linear Body Measurements**

Table 2 illustrates the effect of sex on body weight and linear body measurements of FUNAAB Alpha chickens at different ages. Across all strains and age groups, male chickens consistently demonstrated significantly higher ( $p < 0.05$ ) body weight and larger linear body measurements compared to female chickens. For example, at 12 weeks, male birds had an average body weight of  $2277.20 \pm 183.11\text{g}$ , whereas females weighed  $1138.40 \pm 21.29\text{g}$ . Similar trends were observed for all linear body measurements, including body length, heart girth, wing length, shank length, thigh length, and neck length, where males consistently outperformed females.

**Table 2:** Effect of Sex on Body Weight and Linear Body Measurements at Different Age of FUNAAB Alpha Chicken

Traits	Age	Overall	Male	Female	LOS
<b>Body Weight (g)</b>	0	34.11±0.43	34.90±0.51 <sup>a</sup>	33.16±0.68 <sup>b</sup>	*
	2	213.46±7.88	233.00±13.11 <sup>a</sup>	190.00±4.04 <sup>b</sup>	*
	4	490.91±8.90	517.67±12.82 <sup>a</sup>	458.80±8.65 <sup>b</sup>	*
	6	749.20±36.60	843.20±58.48 <sup>a</sup>	636.40±26.49 <sup>b</sup>	*
	8	1344.73±85.38	1769.33±103.88 <sup>a</sup>	835.20±24.63 <sup>b</sup>	*
	10	1526.73±104.31	1951.00±151.96 <sup>a</sup>	1017.60±24.04 <sup>b</sup>	*
	12	1759.56±125.97	2277.20±183.11 <sup>a</sup>	1138.40±21.29 <sup>b</sup>	*
<b>Body Length (cm)</b>	2	8.35±0.25	9.33±0.34 <sup>a</sup>	7.16±0.21 <sup>b</sup>	*
	4	12.56±0.33	14.17±0.38 <sup>a</sup>	10.64±0.19 <sup>b</sup>	*
	6	15.49±0.46	17.33±0.61 <sup>a</sup>	13.28±0.38 <sup>b</sup>	*
	8	19.95±0.45	22.23±0.41 <sup>a</sup>	17.20±0.41 <sup>b</sup>	*
	10	27.31±0.99	33.13±0.79 <sup>a</sup>	20.32±0.50 <sup>b</sup>	*
	12	36.20±1.05	41.73±0.88 <sup>a</sup>	29.56±0.96 <sup>b</sup>	*
	<b>Heart Girth (cm)</b>	2	6.95±0.23	8.17±0.21 <sup>a</sup>	5.48±0.17 <sup>b</sup>
4		11.78±0.43	13.60±0.59 <sup>a</sup>	9.60±0.24 <sup>b</sup>	*
6		16.85±0.84	20.27±1.14 <sup>a</sup>	12.76±0.61 <sup>b</sup>	*
8		22.27±0.85	26.50±0.61 <sup>a</sup>	17.20±1.06 <sup>b</sup>	*
10		33.16±0.95	37.80±1.07 <sup>a</sup>	27.60±0.65 <sup>b</sup>	*
12		40.35±1.08	46.63±0.84 <sup>a</sup>	32.80±0.64 <sup>b</sup>	*
<b>Wing Length (cm)</b>		2	8.29±0.32	9.90±0.34 <sup>a</sup>	6.36±0.24 <sup>b</sup>
	4	13.27±0.65	16.53±0.75 <sup>a</sup>	9.36±0.28 <sup>b</sup>	*
	6	18.98±1.14	26.17±0.66 <sup>a</sup>	10.36±0.36 <sup>b</sup>	*
	8	24.85±1.24	31.47±1.14 <sup>a</sup>	16.92±0.96 <sup>b</sup>	*
	10	28.80±1.22	35.07±1.19 <sup>a</sup>	21.28±1.02 <sup>b</sup>	*
	12	33.56±1.33	40.40±1.38 <sup>a</sup>	25.36±0.94 <sup>b</sup>	*
	<b>Shank Length (cm)</b>	2	3.85±0.19	4.90±0.19 <sup>a</sup>	2.60±0.12 <sup>b</sup>
4		10.22±0.54	13.00±0.55 <sup>a</sup>	6.88±0.41 <sup>b</sup>	*
6		14.49±0.86	19.20±0.79 <sup>a</sup>	8.84±0.59 <sup>b</sup>	*
8		22.40±0.97	26.90±1.04 <sup>a</sup>	17.00±0.92 <sup>b</sup>	*
10		31.78±1.02	35.77±1.08 <sup>a</sup>	27.00±1.29 <sup>b</sup>	*
12		35.42±1.77	41.43±2.15 <sup>a</sup>	28.20±2.19 <sup>b</sup>	*
<b>Thigh Length (cm)</b>		2	6.42±0.36	7.50±0.56 <sup>a</sup>	5.12±0.25 <sup>b</sup>
	4	10.45±0.49	12.27±0.71 <sup>a</sup>	8.28±0.27 <sup>b</sup>	*
	6	12.07±0.45	13.77±0.63 <sup>a</sup>	10.04±0.30 <sup>b</sup>	*
	8	15.02±0.68	17.97±0.93 <sup>a</sup>	11.48±0.31 <sup>b</sup>	*
	10	19.96±1.29	26.07±1.67 <sup>a</sup>	12.64±0.33 <sup>b</sup>	*
	12	22.16±1.65	29.37±2.30 <sup>a</sup>	13.52±0.27 <sup>b</sup>	*
	<b>Neck Length (cm)</b>	2	4.00±0.15	4.27±0.18 <sup>a</sup>	3.68±0.23 <sup>b</sup>
4		8.24±0.36	9.93±0.46 <sup>a</sup>	6.20±0.17 <sup>b</sup>	*
6		11.02±0.62	13.93±0.78 <sup>a</sup>	7.52±0.27 <sup>b</sup>	*
8		12.40±0.52	14.73±0.70 <sup>a</sup>	9.60±0.18 <sup>b</sup>	*
10		15.29±0.69	18.73±0.82 <sup>a</sup>	11.16±0.22 <sup>b</sup>	*
12		19.07±1.28	25.50±1.57 <sup>a</sup>	11.36±0.19 <sup>b</sup>	*

<sup>a, b and c</sup>: Means within the same rows with different superscripts are significantly different at \* = P < 0.05.

## DISCUSSION

### Strain-Specific Growth Performance and Adaptability

The mean body weight of necked neck 2311.23±443.62g Normal Feather 1620.00±91.17g, and Frizzle Feather 1510.83±172.14g observed in this study at 12 weeks is higher than the value observed by Abdulraheem *et al.* (2020) 1655.73g in necked neck and 1250.21g Frizzle feathered indigenous chicken of Borno State at adult age. In the same vein, Ige *et al.* (2012) observed lower body weight of 1690g in necked neck and frizzle feather 1440kg chickens from southwest Nigeria. This confirms the FUNAAB Alpha chicken are improved indigenous breed as reported by Adebamboo. *et al.* (2018) that FUNAAB Alpha chicken is an improved indigenous breed developed in Nigeria, aiming to combine the hardiness of local chickens with enhanced production traits, it can be used to improve our indigenous chickens through crossbreeding.

The most striking findings of this study is the consistently superior growth performance of the Naked Neck (Na) 38.38±0.42-2311.23±443.62g strain across all age groups, as evidenced by significantly higher body weights recorded in the strain, compared to Normal Feather (NF) 32.67±0.45-1620.00±91.17g and Frizzle Feather (F) 33.08±0.50-1510.83±172.14g strains. The early advantage in body weight observed in Naked Neck chicks suggests an inherent genetic predisposition for faster growth, potentially linked to metabolic efficiency or early developmental vigor as suggested by (Ige *et al.*, 2012 and Abdulraheem *et al.*, 2020). Similarly, Rafat *et al.* (2011) stated that variation of body weight over time are caused by various effects of genes. This corroborate with the study of Abdulraheem *et al.* (2020) who recorded a higher weight of 1655.73g in necked neck and lower weight of 1250.21g Frizzle feathered indigenous chicken of Borno State. In the same vein, Ige *et al.* (2012) observed higher body weight 1.69 kg in necked neck and lower weight of 1.44kg in frizzle feathered chickens from southwest Nigeria. This is in line with the reports of (Galal, 2000; Hegan, 2010; Fathi *et al.*, 2013) all the authors observed higher body weight in necked neck compared to other strain and they suggest that the strain had a gene for fast growth compared to normal and frizzle feathered chickens. Hence it can be concluded that the necked neck had higher growth performance genetically compared to the

frizzle feathered and therefore, is recommended for farmers and breeders for improvement of our native chickens.

The lower body weight observed in normal feather may be due to hot ambient temperature of Maiduguri the data was taken during hot dry season (temperature of up to 40°C) which will often lead to reduced feed intake, impaired growth, and compromised welfare. Similar observation was made by (Abdulraheem *et al.*, 2020). On the other hand, the superior performance of the Naked Neck strain strongly positions it as a promising genetic resource for enhancing poultry productivity and resilience in hot environments due to its critical adaptation to high ambient temperatures of Maiduguri. This observation strongly corroborates previous researches of Galal, (2000); Hegan, (2010); Fathi *et al.* (2013). The authors suggested that the adaptive advantages of the naked neck gene in hot and semi-arid environments allows it bearer to perform better than other genotypes in a hot environment. In the same vein, Fathi *et al.* (2013); N'Dir (2007) stated that, reduced feather coverage, particularly on the neck and ventral regions of the necked neck strain enhances heat dissipation through non-evaporative cooling mechanisms, thereby reducing physiological stress and allowing for more efficient energy allocation towards growth rather than thermoregulation. Furthermore, Sola-Ojo and Ayorinde (2009) reiterated that, reduction in thermal load of the necked neck gene can allow the birds to maintain higher feed intake and divert more metabolic energy toward tissue accretion rather than thermoregulatory maintenance. Similarly, Rajkumar *et al.* (2011) reported that naked neck birds exhibit better immune responses and lower physiological stress under tropical conditions. The Frizzle Feather (F) strain also possesses a unique feather structure that aids in thermoregulation, its overall body weight gain was not as pronounced as that of the Naked Neck strain. The curled and sparse feathering of Frizzle chickens can facilitate heat loss by creating an air cushion that reduces heat flow from the body to the environment, and by increasing the effective surface area for heat exchange (Rajkumar *et al.* 2011). However, the degree of heat tolerance and its impact on growth performance can vary between different frizzled genotypes and environmental conditions. Our findings suggest that under the specific semi-arid conditions of Borno State, the Naked Neck gene confers a more significant advantage in terms of

overall growth rate compared to the Frizzle gene, its inherent ability to cope with heat stress translates into better growth rates, which can significantly contribute to food security and improve the livelihoods of smallholder farmers in Nigeria and other tropical regions facing similar climatic challenges.

#### **Morphometric Traits as Indicators of Development and Production Potential**

The significant differences observed in linear body measurements among the strains provide valuable insights into their distinct growth patterns and body conformation. These morphometric traits are widely recognized as reliable indicators of growth, development, and potential meat yield in chickens (Lamido *et al.*, 2024; Yakubu *et al.*, 2009). For instance, the greater body length and thigh length in Naked Neck birds at later ages suggest a more robust skeletal and muscular development, which is directly correlated with meat production efficiency (Rajkumar *et al.*, 2011). Furthermore, significantly longer shank lengths ( $8.04 \pm 0.26$  cm), observed in the genotype, suggests that the necked neck gene might have pleiotropic effects on skeletal development or that selection for this gene in the FUNAAB Alpha line has co-selected for robust morphometric frames. Similarly, according to Fernandes *et al.* (2023) shank length is a trait often associated with better heat dissipation capacity through the legs, which are unfeathered and rich in blood vessels. The fluctuating patterns in heart girth and wing length development across strains indicate that different genetic backgrounds may prioritize the growth of certain body parts at different developmental stages, possibly reflecting varying physiological demands or genetic growth curves (Abdulraheem *et al.*, 2023). The observation that Frizzle Feather birds exhibited greater body length at earlier ages, but were surpassed by Naked Neck at 12 weeks, highlights the dynamic nature of growth and the importance of evaluating performance over the entire production cycle. Similarly, the initial superiority of Normal Feather birds in wing length and neck length, followed by Naked Neck dominance in wing length at later stages, suggests that while Normal Feather birds might have a more 'standard' or ancestral body plan, the Naked Neck strain develops a more elongated and perhaps more efficient body structure for heat dissipation and mobility in its environment. These variations underscore the importance of considering specific genetic strains and their unique morphometric profiles when

selecting birds for particular production objectives in tropical climates (Oleforuh-Okoleh *et al.*, 2023). The curling of feathers in FF birds reduces the thickness of the insulating air layer, which, while aiding heat loss, might also lead to higher metabolic costs in certain environmental fluctuations, potentially explaining their slightly lower weight gain compared to the necked neck and normal feather groups (Abdulraheem *et al.*, 2020).

#### **Sexual Dimorphism in Growth and its Implications**

The consistent and highly significant superiority of male chickens in both body weight and all linear body measurements across all strains and age groups is a well-established biological phenomenon in poultry production (Fayeye *et al.*, 2019). This sexual dimorphism is primarily driven by hormonal differences, particularly higher levels of androgens in males, which promote protein synthesis and muscle accretion, leading to faster growth rates and larger mature body sizes (Sola-Ojo and Ayorinde, 2009). Genetic factors also play a crucial role, with sex-linked genes influencing growth-related traits. The findings from this study further confirm this universal trend in FUNAAB Alpha chickens, emphasizing that sex is a major determinant of growth and development within this improved indigenous breed. The pronounced sexual dimorphism has important implications for poultry management and breeding strategies. For instance, separate rearing of male and female birds could allow for optimized feeding regimes and management practices tailored to their distinct growth potentials, thereby improving feed conversion efficiency and overall productivity (Fayeye *et al.*, 2019). In breeding programs, understanding the extent of sexual dimorphism is crucial for accurate selection of breeding stock and for predicting the performance of progeny. The consistent male advantage suggests that selection for growth traits could be more effective when considering sex-specific performance, especially in meat-type production systems.

#### **CONCLUSION**

1. This study demonstrates that the FUNAAB Alpha chicken strain exhibits significant morphometric and physiological diversity driven by feathering genes, sex, and age.
2. Higher body weight observed in the three strains of FUNAAB Alpha compared to indigenous chicken.

3. The Naked Neck strain of FUNAAB Alpha chickens exhibits superior growth performance, as evidenced by significantly higher body weight and favorable linear body measurements, compared to Normal Feather and Frizzle Feather strains when reared in a semi-arid tropical environment.
4. Male chickens consistently outperform females in all growth parameters, evidence of sexual dimorphism

### Recommendation

1. Cross breeding: FUNAAB Alpha chicken can be used to improve the growth performance of the indigenous chicken.
2. Genotype-Specific Breeding: Breeding programs should focus on the propagation of the Naked Neck (Na) gene within the FUNAAB Alpha strain to maximize growth performance in hot climates.
3. Morphometric Selection Indices: Develop selection indices that incorporate body length and shank length as primary indirect markers for body weight improvement.
4. Sex-Specific Management: Given the significant sexual dimorphism observed, sex-specific management strategies, such as separate rearing of males and females, could be implemented to optimize feed utilization and growth rates for specific production goals.

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