PHENOTYPIC CHARACTERIZATION OF THE MUTURU AND BUNAJI BREEDS OF CATTLE AT DIFFERENT AGE GROUPS

SHEIDI, Suleiman Shaibu, ATANSUYI, Adewale Johnson, CHINEKE, Clifford Adinma and OSHO, Bamidele Innocent

Breeding and Genetics Unit, Department of Animal Production and Health, Federal University of Technology, Akure, Ondo State, Nigeria.

Corresponding Author: Sheidi, S. S. Breeding and Genetics Unit, Department of Animal Production and Health, Federal University of Technology, Akure, Ondo State, Nigeria. **Email:** sssbala57@gmail.com **Phone:** +234 703 532 0572

Received *July 02, 2024;* ***Revised*** *July 28, 2024;* ***Accepted*** *July 28, 2024*

ABSTRACT

This study was carried out in Ebonyi and Kogi States of Nigeria. Ranched animals were used for the study. A total of one hundred and fifty-two (152) consisting of 76 each of Muturu and Bunaji cattle breeds were used for the study. The study was a symmetrical factorial (2 × 2 × 5) arrangement in a complete randomized design (CRD). The factors include breeds of cattle (Muturu and Bunaji), sex and age groups (one to five years). Linear body traits were measured on individual Muturu and Bunaji cattle with the aid of a flexible tape. A weighing balance was used to take the weight of the animals. The animals were restrained by their handlers to ease the body measurements. Body linear traits (BLT) were measured in centimetres (cm) while BWT was measured in kilograms (kg). The age of the individual animal was determined by the number of the rings on their horns while the polled animal's age was determined by their dentition also Muturu and Bunaji owners have the age records of their animals. The best parameters that predict BWT using BLT were CGH and BLH. The result of this study reveals that the Muturu cattle had lower values for BLT (HWS, CGH, BLH, FLH and TLH) than the Bunaji breed. The study indicates that certain linear parameters varied significantly between Bunaji and Muturu cattle breeds. These differences suggest distinct morphological features unique to each breed. Bunaji cattle exhibited a notable increase in ELH, HLH and FLH compared to Muturu.

Keywords: Cattle, Muturu, Bunaji, Body linear traits, Body weights, Sex

INTRODUCTION

Characterization of local genetic resources assesses variation of morphological traits (Delgado *et al.,* 2001). Variation of morphological traits has played a fundamental role in the classification of livestock based on size and shape (Yakubu *et al.,* 2010). Morphometric characteristics can be grouped into discrete traits (qualitative characters) and continuous traits (quantitative characters) that can be used to assess genetic variation and phylogenetic relationships between various populations (Ebegbulem and Ita, 2016). In animal breeding, the quantitative traits are the major traits of economic interest; they show continuous variation (Nicholas, 2023). Body measurements and body weight (BWT) give thorough descriptions of individuals or populations of animals (Yakubu *et al.,* 2010). Body dimensions have been used to indicate breed, origin and relationship between individuals or populations (Ige *et al.,* 2015). Measurements of body conformations are vital in judging quantitative traits and are useful in developing suitable selection criteria and breed characterization (Lawrence and Fowler, 2002; Sowande and Sobola, 2008). Hence, morphological measurements of the Muturu and

Bunaji cattle can be used for breed characterization and selection decisions (Araujo *et al*., 2006). Characterization of the Muturu and Bunaji cattle will play a major role in identifying variation between populations and the maintenance of these genetic resources. Body measurements can also be used for future improvement at the genetic level (Birteeb and Ozoje, 2012). Therefore, this study was carried out to assess the variation in BWT and BLT and their capacity to differentiate the Muturu and Bunaji cattle into distinct groups.

MATERIALS AND METHODS

Study Locations: The study was carried out in two agroecological zones of Nigeria at selected farms in Ebonyi and Kogi State. Ebonyi State geographic coordinates are (latitude 6° 15′ 0″ N and longitude 8° 5′ 0″ E) (Wikipedia, 2024a). In Ebonyi State, the study was carried out at Onueke Animal Farm in Ezza North Local Government Area, whereas in Kogi State the study was carried out at a farm in Lokoja, the capital city of the State which lies between latitude 7° 48′ 7″ N and longitude 6° 44′ 39″ E of the Greenwich meridian. It is sandwiched to the west and east by the Mount Patti ridge and river Niger respectively with an area of about 3,180 Km^2. Nigeria has two distinct seasons: the wet season from April to October and the dry season from November to March. The annual rainfall ranges from 4.60 to 208.80 mm. Temperature ranges from 6.1 to 40.0^oC (Wikipedia, 2024b).

Studied Animal: Ranched animals were used for the study. A total of one hundred and fifty-two (152) consisting of 76 each of Muturu and Bunaji cattle breeds were used for the study. The study was laid out in a symmetrical factorial (2 × 2 × 5) arrangement in a complete randomized design (CRD). The factors include two breeds of cattle (Muturu and Bunaji), two sexes (male and female) and five age groups (one to five years).

Body Linear Traits: Twelve traits (body weight - BWT, body length - BLH, height at withers - HWS, chest girth - CGH, horn length - HLH, muzzle circumference - MCC, ear length - ELH, hock circumference - HCC, pelvic width - PWH, cannon bone circumference - CBC, facial length - FLH and tail length - TLH) were measured on individual Muturu and Bunaji cattle with the aid of a flexible tape. A weighing band was used to take the weight of the animals. The animals were restrained by their handlers to ease the body measurements. Body linear traits (BLT) were measured in centimetres (cm), while BWT was measured in kilograms (kg). The individual animal's age was determined by the number of the rings on their horns (Bullock and Pickerinc, 1984), while the polled animals' age was determined by their dentition and from the recorded ages of animals kept by the Muturu and Bunaji owners.

Data Analysis: All data collected on BWT and BLT for Muturu and Bunaji breeds of cattle were subjected to t-test analysis using SAS Version 9.4 (SAS, 2014). The level of significance was set at $p<0.05$. The results were presented as means ± standard errors of means as determined from the different populations.

RESULTS

Effect of Breed, Sex and Their Interactions on Body Linear Traits and Body Weight of 1-Year-Old Muturu and Bunaji Cattle: Table 1 presents the effect of breed on BLT and BWT of 1-year-old Muturu and Bunaji cattle breeds. The results highlight significant differences in certain observed parameters, while others were relatively similar between the two breeds.

Notably, Bunaji exhibited a significant increase ($p<0.05$) in ELH (12.36 ± 0.40), HLH (11.66 ± 0.44), HWS (62.87 ± 1.78), FLH (28.62 ± 0.45) and BWT (56.44 ± 2.41) when compared to Muturu. Conversely, Muturu demonstrated significantly higher ($p<0.05$) values in HCC (10.03 ± 0.35) and CBC (11.12 ± 0.19) as compared to the Bunaji breed of cattle. These findings underscore the distinct morphological characteristics between Muturu and Bunaji cattle, emphasizing that certain linear parameters varied significantly between the two breeds.

The assessment of sex differences in the linear parameters of Muturu and Bunaji breeds of 1-year-old cattle, the result reveals that, for the

Table 1: Effect of breed, sex and their interactions on body linear traits and body weight of 1-year-old Muturu and Bunaji breeds of cattle

Breed/Sex		ELH	BLH	CGH	HLH	TLH	MCC	HWS	HCC	PWH	CBC	FLH	BWT
Muturu		10.71 ± 0.44	66.08 ± 4.51	81.38 ± 4.53	5.28 ± 0.88	37.99 ± 1.45	15.03 ± 0.61	58.32 ± 1.71	14.03 ± 0.35*	25.01 ± 0.55	12.12 ± 0.19*	26.19 ± 0.81	55.53 ± 8.16
Bunaji		12.36 ± 0.40*	61.28 ± 0.91	84.01 ± 1.40	11.66 ± 0.44*	42.2 ± 3.54	14.28 ± 0.49	62.87 ± 1.78	13.02 ± 0.34	26.76 ± 0.63	11.13 ± 0.66	28.62 ± 0.45*	56.44 ± 2.41
Male		11.54 ± 0.44	61.86 ± 1.95	81.99 ± 2.60	8.82 ± 1.28	34.29 ± 1.25	13.58 ± 0.44	57.9 ± 1.49	13.60 ± 0.36	25.36 ± 0.54	12.54 ± 0.24*	27.86 ± 0.71	52.64 ± 4.14
Female		11.6 ± 0.55	65.76 ± 4.44	83.71 ± 4.06	9.68 ± 1.01	47.67 ± 2.94*	15.98 ± 0.42*	64.23 ± 1.80	13.38 ± 0.38	26.64 ± 0.72	10.41 ± 0.61	26.94 ± 0.73	60.27 ± 7.52
Muturu	**M**	10.73 ± 1.7	64.08 ± 10.60	82.30 ± 13.10	4.05 ± 2.16	37.98 ± 2.84	14.63 ± 1.11	59.25 ± 6.95	14.28 ± 0.80	23.90 ± 1.04	12.22 ± 0.52*	27.03 ± 3.47	53.83 ± 23.61
	F	10.35 ± 1.16	67.23 ± 16.66	80.30 ± 17.07	6.50 ± 2.38	41.5 ± 4.65*	16.28 ± 2.24	59.70 ± 5.19	14.40 ± 1.32	27.05 ± 1.46	12.30 ± 1.01*	25.3 ± 2.06	55.00 ± 26.62
Bunaji	**M**	12.21 ± 1.15	62.9 ± 3.00	86.21 ± 4.35	11.54 ± 1.95	31.6 ± 3.59	13.06 ± 1.41	58.80 ± 4.56	13.31 ± 1.47	26.59 ± 2.07	13.06 ± 0.96*	28.86 ± 1.42	58.39 ± 8.40
	F	12.53 ± 1.84	59.38 ± 2.68	81.43 ± 4.90	11.8 ± 1.20	54.57 ± 5.85*	15.7 ± 0.85	67.62 ± 4.87	12.68 ± 0.87	26.97 ± 2.66	8.88 ± 1.15	28.35 ± 1.95	54.17 ± 9.20

** = means with superscripts asterisk (*) across a specific column for breed and sex differ significantly (p<0.05) from each other using t-test pairwise comparison. BLT = body linear trait, ELH = ear length, BLH = body length, CGH = chest girth, HLH = horn length, TLH = tail length, MCC = muzzle circumference, HWS = height at withers, HCC = hock circumference, PWH = pelvic width, CBC = cannon borne circumference, FLH = facial length, BWT = body weight*

majority of the observed parameters, there were no significant differences (p>0.05) between the breeds. However, three parameters exhibited notable distinctions. Among these parameters; TLH (47.67 ± 2.94) and MCC (15.98 ± 0.42) were significantly higher (p<0.05) in females compared to male counterparts, indicating that female animals tend to have greater values in these measurements. Conversely, CBC (12.54 ± 0.24) demonstrated a significant decrease (p<0.05) in female animals compared to males.

The examination of the interactions between breeds and sex of 1-year-old Muturu and Bunaji cattle of this study indicates that for most of the parameters, there were no significant differences (p>0.05) in the interaction between breeds and sex. However, in the case of two parameters, namely TLH and CBC, there were noteworthy variations in the interaction between the breed and sex of the study. This insight suggests that, while most observed parameters did not exhibit significant differences (p>0.05) based on the interplay of breed and sex, BWT, HWS, TLH and CBC displayed distinctive patterns influenced by the combination of breed and sex factors.

Effect of Breed, Sex and Their Interactions on Body Linear Traits and Body Weight (kg) of 2-Year-Old Muturu and Bunaji Breeds of Cattle: Table 2 outlines the effect of breed, sex and their interactions on the BLT and BWT of 2 years old Muturu and Bunaji cattle. While most of the parameters did not exhibit significant differences (p>0.05) between the two breeds, there were notable variations in certain measurements. Muturu displayed a significant increase (p<0.05) in ELH (15.77 ± 0.33), CBC (13.65 ± 0.19) and FL (35.6 ± 0.61) compared to Bunaji. On the other hand, Bunaji exhibited a significant increase (p<0.05) in CG (111.14 ± 2.13), HLH (14.54 ± 1.01), HWS (79.24 ± 4.33) and BWT (125.79 ± 6.51) over Muturu in these specific parameters. These findings underscore the breed-specific morphological differences that emerged for the two-year-old Muturu and Bunaji cattle. Understanding these distinctions is crucial for characterizing and managing the genetic traits within each breed. The observed changes in linear parameters and weight contribute valuable information for breed selection, breeding programs and overall livestock management practices.

The assessment of sex differences in the BLT and BWT of 2-year-old Muturu and Bunaji cattle results reveal that, for the majority of the observed parameters, there were no significant differences (p>0.05) between the sexes. However, two parameters, BLH (85.75 ± 3.3) and HLH (13.33 ± 1.32), demonstrated a significant increase (p<0.05) in females compared to males.

These findings indicate that, overall, the morphological characteristics between male and female Muturu and Bunaji cattle were largely similar, with only BLH and HLH showing discernible sex-related differences. Understanding these sex-specific variations in specific BLT is crucial for a comprehensive analysis of the phenotypic traits within these breeds and may have implications for breeding programs and management practices.

The analysis of the interaction's effects between breeds and sex of the 2-year-old Muturu and Bunaji cattle indicates that the majority of the parameters did not exhibit significant differences (p>0.05) in the interaction between breeds and sex. However, there was a noteworthy finding related to BWT, where Bunaji exhibited a significant increase (p<0.05) over Muturu at this stage. Additionally, the results demonstrated a significant increase (p<0.05) in the BWT of males over females. This insight provides valuable information about the dynamics of weight gain within the specific time frame of these two-year age groups, highlighting potential sex-related variations in growth patterns.

Effect of Breed, Sex and their Interactions on Body Linear Traits and Body Weight of 3-year-old Muturu and Bunaji breeds of Cattle: Table 3 displays the impact of breed, sex and their interactions on the BLT and BWT of 3-year-old Muturu and Bunaji cattle. Notably, there were notable disparities between Muturu and Bunaji cattle in the majority of the observed parameters.

Table 2: Effect of breed, sex and their interactions on body linear traits and body weight of 2-year-old Muturu and Bunaji breeds of cattle

Breed/Sex		ELH	BLH	CGH	HLH	TLH	MCC	HWS	HCC	PWH	CBC	FLH	BWT
Muturu		15.77 ± 0.33*	83.48 ± 3.71	103.31 ± 3.71	7.29 ± 0.84	64.52 ± 2.12	19.45 ± 0.53	78.59 ± 2.82	15.92 ± 0.37	35.90 ± 0.67	13.65 ± 0.19*	35.60 ± 0.61*	100.62 ± 10.91
Bunaji		12.33 ± 0.62	80.86 ± 3.02	111.14 ± 2.13*	14.54 ± 1.01*	50.5 ± 3.81	17.33 ± 0.53	79.24 ± 4.33	14.80 ± 0.30	31.86 ± 0.99	12.28 ± 0.39	30.76 ± 1.18	125.79 ± 6.51*
Male		14.08 ± 0.49	77.59 ± 2.93	104.49 ± 3.75	9.59 ± 1.38	58.00 ± 2.86	17.83 ± 0.57	75.33 ± 2.54	14.86 ± 0.19	33.60 ± 0.87	12.68 ± 0.37	32.93 ± 0.97	106.67 ± 10.33
Female		13.91 ± 0.80	85.75 ± 3.30*	109.67 ± 2.53	13.33 ± 1.32*	56.65 ± 4.13	18.77 ± 0.60	81.8 ± 4.09	15.73 ± 0.42	33.97 ± 1.11	13.15 ± 0.35	33.23 ± 1.28	119.27 ± 8.57
Muturu	**M**	14.43 ± 0.56	68.75 ± 6.26	88.48 ± 6.35	6.00 ± 2.94	56.00 ± 2.83	18.00 ± 1.17	68.8 ± 7.37	15.20 ± 0.48	33.13 ± 1.75	13.10 ± 0.50	33.53 ± 1.74	63.00 ± 13.27
	F	15.94 ± 0.71	85.9 ± 9.26	104.02 ± 3.68	8.32 ± 1.79	64.18 ± 2.29	18.82 ± 0.83	77.28 ± 6.27	15.90 ± 0.78	36.22 ± 0.63	13.80 ± 0.49	35.94 ± 0.72	97.00 ± 17.93
Bunaji	**M**	13.05 ± 1.58	79.18 ± 8.41	112.83 ± 5.98	11.98 ± 3.48	54.67 ± 10.76	16.67 ± 1.46	74.95 ± 4.75	14.43 ± 0.45	32.60 ± 3.21	12.12 ± 1.59	31.50 ± 4.07	130.50 ± 19.52
	F	11.79 ± 2.74	82.13 ± 13.52	109.88 ± 9.37	16.46 ± 2.81	47.38 ± 16.39	17.83 ± 2.24	82.45 ± 21.05	15.08 ± 1.44	31.31 ± 4.17	12.41 ± 1.42	30.21 ± 4.85	122.25 ± 28.21

** =means with superscripts asterisk (*) across a specific column for breed and sex differ significantly (p<0.05) from each other using t-test pairwise comparison. BLT = body linear trait, ELH = ear length, BLH = body length, CGH = chest girth, HLH = horn length, TLH = tail length, MCC = muzzle circumference, HWS = height at withers, HCC = hock circumference, PWH = pelvic width, CBC = cannon borne circumference, FLH = facial length, BWT = body weight*

Table 3: Effect of breed, sex and their interactions on body linear traits and body weight of 3-year-old Muturu and Bunaji breeds of cattle

Breed/Sex		ELH	BLH	CGH	HLH	TLH	MCC	HWS	HCC	PWH	CBC	FLH	BWT
Muturu		16.49 ± 0.33*	91.86 ± 2.34	112.55 ± 1.75	8.36 ± 0.71	68.27 ± 1.45*	21.34 ± 0.35*	87.68 ± 0.92	17.48 ± 0.61*	37.24 ± 0.61*	14.58 ± 0.49*	37.54 ± 0.66*	126.08 ± 4.89
Bunaji		14.8 ± 0.48	90.42 ± 4.73	120.67 ± 3.05	16.54 ± 1.79*	58.59 ± 1.96	18.79 ± 0.46	94.91 ± 3.67	15.82 ± 0.29	34.34 ± 0.49	13.39 ± 0.18	33.94 ± 0.39	158.71 ± 10.68*
Male		15.47 ± 0.36	87.07 ± 4.16	115.79 ± 2.77	10.68 ± 1.40*	60.28 ± 2.58	19.75 ± 0.63	89.42 ± 1.31	16.22 ± 0.31	35.67 ± 0.81	13.71 ± 0.15	35.18 ± 0.67	139.92 ± 9.72
Female		15.69 ± 0.59	95.10 ± 3.29	118.06 ± 2.88	15.58 ± 2.15*	65.83 ± 1.49*	20.19 ± 0.47	93.73 ± 4.01	16.95 ± 0.64	35.69 ± 0.53	14.18 ± 0.51	36.03 ± 0.78	147.39 ± 10.02*
Muturu	**M**	16.46 ± 1.42	88.04 ± 8.53	113.74 ± 6.78	7.26 ± 1.40	67.28 ± 7.04	21.34 ± 1.75	87.40 ± 4.93	16.80 ± 1.26	37.44 ± 3.09	13.92 ± 0.44	37.32 ± 2.11	130.00 ± 21.37*
	F	16.58 ± 1.18	94.64 ± 8.19	111.94 ± 7.09	9.46 ± 2.52	67.86 ± 3.37	21.32 ± 0.89	88.04 ± 1.88	18.50 ± 2.91	36.86 ± 1.45	15.46 ± 2.44	38.18 ± 2.94	124.2 ± 16.66
Bunaji	**M**	14.729 ± 0.79	85.92 ± 19.93	117.64 ± 12.67	13.13 ± 5.03	53.87 ± 5.88	18.31 ± 1.72	91.06 ± 4.63	15.80 ± 1.02	34.19 ± 2.26	13.50 ± 0.61	33.53 ± 1.23	148.85 ± 44.17
	F	14.87 ± 2.53	94.91 ± 15.28	123.7 ± 10.01	19.96 ± 6.64	63.3 ± 5.45	19.27 ± 1.74	98.76 ± 18.78	15.84 ± 1.21	34.49 ± 1.43	13.29 ± 0.74	34.35 ± 1.65	168.57 ± 35.77

** =means with superscripts asterisk (*) across a specific column for breed and sex differ significantly (p<0.05) from each other using t-test pairwise comparison. BLT = body linear trait, ELH = ear length, BLH = body length, CGH = chest girth, HLH = horn length, TLH = tail length, MCC = muzzle circumference, HWS = height at withers, HCC = hock circumference, PWH = pelvic width, CBC = cannon borne circumference, FLH = facial length, BWT = body weight*

Muturu exhibited significantly higher ($p<0.05$) values in ELH (16.49 ± 0.33), TLH (60.27 ± 1.45), MCC (21.34 ± 0.35), HCC (17.48 ± 0.61), PWH (35.24 ± 0.61), CBC (14.58 ± 0.49) and FLH (34.54 ± 0.66). Conversely, Bunaji demonstrated significantly higher ($p<0.05$) values in HLH (14.54 ± 1.79), HWS (94.91 ± 3.67) and BWT (158.71 ± 10.68) compared to Muturu. These findings underscore the distinct morphological characteristics and weight variations between 3-year-old Muturu and Bunaji cattle in this study.

The sex effect on the BLT and BWT of 3-year-old Muturu and Bunaji cattle is shown in Table 3. All the observed parameters showed no significant variation ($p>0.05$) between males and females except in HLH and TLH with a significant increase ($p<0.05$) in the value of female animals over the male counterpart.

The interaction between breeds and sex on the BLT and BWT of 3-year-old Muturu and Bunaji breeds of cattle. The result revealed that there were no significant differences ($p>0.05$) in the observed parameter between breed and sexes, but significant increases ($p<0.05$) were observed for some of the parameters in male Muturu over the female and similarly, female Bunaji cattle had a significant increase ($p<0.05$) in BWT than the male counterpart.

Effect of Breed, Sex and their Interactions on Body Linear Traits and Body Weight of 4-year-old Muturu and Bunaji breeds of Cattle: The effect of breed, Sex and their interactions on the BLT and BWT of 4-year-old Muturu and Bunaji cattle shown in Table 4. HLH, HWS and BWT of Bunaji had significantly increased ($p<0.05$) value over the Muturu breed. It was also observed that there were no significant differences ($p>0.05$) in other parameters under consideration.

Effects of sex on the BLT and BWT of 4-year-old Muturu and Bunaji cattle breeds used for this study are shown in Table 4, it shows that there were no significant differences ($p>0.05$) in most of the parameters observed at this age of the studied animals. BLH had a significant increase ($p<0.05$) in males than females. The expression of the interaction between sex and breed of 4-year-old Muturu and Bunaji breeds of cattle are shown in Table 4. It revealed that there were no significant differences ($p>0.05$) in all the observed parameters in the interaction between breeds and sexes.

Effect of Breed, Sex and their Interactions on Body Linear Parameters and BWT of 5-year-old Muturu and Bunaji breeds of Cattle: Observation from the study of 5-year-old Muturu and Bunaji breeds of cattle presented in Table 5 showed that the breed effects on the BLT and BWT of Muturu and Bunaji breed of cattle had a high level of significant differences in almost all the observed parameters. The table revealed that the Bunaji breed had significantly higher ($p<0.05$) values of these parameters than the Muturu breed.

Sex effects on the BLT and BWT of 5-year-old Muturu and Bunaji breeds are shown in Table 5. There was a significant expression of sex effect on TLH and HWS where the female had significantly higher values of these parameters over males. Also observed in Table 5 were non-significant differences ($p>0.05$) in other examined parameters that occurred between sexes.

The expression of the interaction between sex and breed of 5-year-old Muturu and Bunaji cattle is shown in Table 5. It revealed that there were no significant differences ($p>0.05$) in all the observed parameters on the interaction between breeds and sexes.

DISCUSSION

The result of this study reveals that the Muturu cattle had lower values for BLT (HWS, CGH, BLH, FLH and TLH) than the Rahaji breed reported by Yakubu *et al.* (2010). and the Bunaji breed reported by Oduguwa *et al.* (2013). The average HWS of the Muturu cattle in this study is lower than the value obtained for the Bunaji breed reported by Yakubu *et al.* (2010). The average HWS of the Muturu cattle was below the reported maximum range obtained for the Bunaji breed (Ochefu *et al.*, 2020). The lower body linear measurements of the Muturu compared to those of the Bunaji cattle may be due to the genetic make-up of the Muturu cattle that translated into phenotype with lower BLT.

Table 4: **Effect of breed, sex and their interactions on body linear traits and body weight of 4-year-old Muturu and Bunaji breeds of cattle**

Breed/Sex		ELH	BLH	CGH	HLH	TLH	MCC	HWS	HCC	PWH	CBC	FLH	BWT
Muturu		15.51 ± 0.32	100.28 ± 2.60	122.07 ± 2.62	7.87 ± 0.67	65.31 ± 1.69	18.48 ± 0.48	70.79 ± 1.17	17.01 ± 0.65	35.66 ± 0.34	14.28 ± 0.28	36.15 ± 0.48	162.61 ± 9.37
Bunaji		16.41 ± 0.30	97.89 ± 3.19	120.74 ± 2.71	19.36 ± 0.87	66.99 ± 1.50	19.98 ± 0.46	92.70 ± 3.70	16.73 ± 0.47	36.84 ± 0.37	14.27 ± 0.27	36.83 ± 0.51	149.00 ± 9.42
Male		16.05 ± 0.36	104.62 ± 3.14*	123.38 ± 2.98	14.58 ± 1.81	67.14 ± 1.59	19.52 ± 0.51	83.91 ± 4.68	17.19 ± 0.52	36.23 ± 0.42	14.38 ± 0.29	37.17 ± 0.62	163.77 ± 10.65
Female		15.81 ± 0.29	93.69 ± 1.79	119.50 ± 2.22	13.87 ± 1.69	65.07 ± 1.62	18.85 ± 0.49	78.30 ± 2.37	16.57 ± 0.62	36.21 ± 0.34	14.17 ± 0.25	35.77 ± 0.24	148.65 ± 7.88
Muturu	**M**	15.47 ± 1.99	98.63 ± 15.06	119.67 ± 14.69	8.38 ± 2.97	64.93 ± 8.14	19.58 ± 2.51	70.15 ± 4.8	16.15 ± 0.76	35.57 ± 1.50	13.85 ± 0.72	36.23 ± 1.9	153.83 ± 49.6
	F	15.63 ± 1.00	98.03 ± 6.11	120.54 ± 8.65	7.43 ± 1.96	63.29 ± 6.65	17.44 ± 1.11	70.24 ± 2.89	17.36 ± 3.85	35.86 ± 1.35	14.41 ± 1.63	35.61 ± 1.28	156.43 ± 30.82
Bunaji	**M**	16.78 ± 1.00	106.34 ± 11.69	122.38 ± 11.16	19.23 ± 4.61	67.84 ± 5.22	19.5 ± 2.02	97.85 ± 19.57	17.33 ± 2.38	37.25 ± 1.29	14.55 ± 1.50	37.81 ± 2.48	154.88 ± 38.89
	F	16.04 ± 1.30	89.44 ± 7.04	119.10 ± 11.04	19.50 ± 2.20	66.14 ± 6.92	20.45 ± 1.64	87.55 ± 5.02	16.14 ± 0.97	36.44 ± 1.63	13.99 ± 0.23	35.85 ± 0.76	143.13 ± 38.12

** = means with superscripts asterisk (*) across a specific column for breed and sex differ significantly (p<0.05) from each other using t-test pairwise comparison. BLT = body linear trait, ELH = ear length, BLH = body length, CGH = chest girth, HLH = horn length, TLH = tail length, MCC = muzzle circumference, HWS = height at withers, HCC = hock circumference, PWH = pelvic width, CBC = cannon borne circumference, FLH = facial length, BWT = body weight*

Table 5: Effect of breed, sex and their interactions on body linear traits and body weight of 5-year-old Muturu and Bunaji breeds of cattle

Breed/Sex		ELH	BLH	CGH	HLH	TLH	MCC	HWS	HCC	PWH	CBC	FLH	BWT
Muturu		15.63 ± 0.38	101.36 ± 3.06	123.31 ± 2.57	9.07 ± 0.70	64.99 ± 1.81	19.95 ± 0.52	77.96 ± 2.17	16.54 ± 0.48	36.93 ± 0.71	13.89 ± 0.23	36.46 ± 0.74	173.62 ± 9.72
Bunaji		16.93 ± 0.37*	109.13 ± 3.51*	129.16 ± 3.25*	20.36 ± 0.97*	71.56 ± 1.54*	21.45 ± 0.39*	105.11 ± 3.69*	17.57 ± 0.62*	38.43 ± 0.73*	14.64 ± 0.42*	38.76 ± 0.82*	187.26 ± 12.25
Male		15.58 ± 0.44	105.39 ± 3.60	128.13 ± 2.91	13.15 ± 1.61	63.82 ± 2.21	20.02 ± 0.48	82.47 ± 4.69	16.98 ± 0.49	36.29 ± 0.53	14.36 ± 0.38	36.23 ± 0.63	183.47 ± 11.05
Female		16.74 ± 0.33	104.80 ± 3.21	124.57 ± 2.92	17.36 ± 1.53	71.29 ± 1.21*	21.13 ± 0.47	97.05 ± 3.42*	17.07 ± 0.58	38.64 ± 0.76	14.16 ± 0.31	38.53 ± 0.84	177.61 ± 10.83
Muturu	**M**	14.77 ± 2.09	98.59 ± 13.20	121.54 ± 10.85	8.06 ± 2.26	59.66 ± 8.95	19.27 ± 1.83	69.33 ± 4.61	16.08 ± 1.23	35.36 ± 1.23	13.64 ± 0.47	34.76 ± 1.33	162.00 ± 38.37
	F	16.05 ± 1.22	96.67 ± 11.27	119.83 ± 10.34	10.60 ± 2.83	69.37 ± 2.01	20.20 ± 1.68	86.52 ± 3.85	15.95 ± 0.68	37.22 ± 0.94	13.57 ± 0.41	36.93 ± 1.13	155.50 ± 39.27
Bunaji	**M**	16.71 ± 0.76	113.04 ± 14.41	135.47 ± 9.34	19.70 ± 2.90	70.11 ± 6.00	21.43 ± 1.15	101.14 ± 16.69	18.27 ± 2.38	37.97 ± 2.03	15.34 ± 2.07	38.59 ± 2.03	206.71 ± 45.8
	F	17.06 ± 1.96	106.84 ± 15.97	125.48 ± 15.53	20.74 ± 4.92	72.41 ± 7.21	21.46 ± 2.02	107.42 ± 15.99	17.17 ± 2.91	38.7 ± 3.77	14.23 ± 1.65	38.86 ± 4.34	175.92 ± 56.06

** = means with superscripts asterisk (*) across a specific column for breed and sex differ significantly (p<0.05) from each other using t-test pairwise comparison. BLT = body linear trait, ELH = ear length, BLH = body length, CGH = chest girth, HLH = horn length, TLH = tail length, MCC = muzzle circumference, HWS = height at withers, HCC = hock circumference, PWH = pelvic width, CBC = cannon borne circumference, FLH = facial length, BWT = body weight*

Height at withers (HWS), CGH and BLH of the Muturu cattle were within the ranges reported by Adebambo (2001) and AGTR (2024) for the same breed. However, the CBC value in the present study is higher than the value reported by Adebambo (2001). Similarly, ELH, BLH, CGH, MCC, HCC and FLH of the Muturu and Bunaji cattle breed in the present study were less than the value reported for the Bunaji cattle (Yakubu *et al.,* 2010) and Savannah Muturu cattle (Gwaza *et al.,* 2018). The lower value obtained in this study may be due to differences in the genetic makeup as well as adaptation to fit into forested vegetation for effective grazing. The Muturu cattle are comparatively smaller animals compared to the Bunaji cattle, this small body conformation of Muturu cattle may be due to adaptations and the genetic makeup.

The study indicates that certain linear parameters varied significantly between Bunaji and Muturu cattle breeds. These differences suggest distinct morphological features unique to each breed. Bunaji cattle exhibited a notable increase in ELH, HLH and FLH compared to Muturu. This suggests that Bunaji cattle may have longer ears, a larger head circumference and a longer face compared to Muturu cattle.

Conversely, Muturu cattle demonstrated significantly higher values in HCC and CBC compared to Bunaji. This implies that Muturu cattle have larger hindquarter circumference and CBC compared to Bunaji. The present study also reveals that 1-year-old Muturu and Bunaji breeds of cattle have the lowest values for all the traits investigated. CGH significantly good descriptors for the size and weight at the different stages of the development. This is because the association between BWT and the investigated BLT were positive. The BLT of Muturu and Bunaji breeds of cattle observed in the present study have lower values (ELH, BLH, CGH, HWS, MCC, HCC, CBC, PWH, TLH and FLH) than those reported by Daikwo *et al.* (2018) for the Savannah Muturu breed and within the range reported by Yakubu *et al.* (2010) for Bunaji cattle breeds. Yakubu *et al.* (2021) reported genetic diversity and morphological traits of indigenous cattle breeds in Nigeria. These studies provide insights into the genetic basis and morphological variations within and between these breeds. Ayo *et al.* (2011) explored the functional morphology and adaptation of indigenous cattle breeds in various environments. Understanding how morphological traits relate to adaptation and performance can shed light on the significance of the observed differences between Muturu and Bunaji cattle. This variation may be due to BWT and the size of the dams due to genotype by environmental interaction that resulted in reduced body sizes of the Muturu breeds to cope with the thick forest vegetation in the South.

The assessment of sex differences in the linear parameters of Muturu and Bunaji cattle of 1-year-old reveals that, for most of the observed parameters, there were no significant differences between the breeds. However, three parameters exhibited notable distinctions. Among these parameters, MCC was significantly higher in females than males, indicating that female animals tended to have greater values in these measurements. Conversely, CBC demonstrated a significant decrease in female animals compared to males, this finding is similar to the reports of Daikwo *et al.* (2018) and Gwaza *et al.* (2018).

An earlier study analyzed the morphometric traits of four Nigerian cattle breeds (Bunaji, Sokoto Gudali, Rahaji and Kuri) and reported that there were significant differences in body measurements between breeds, sex and age (Yakubu *et al.,* 2021). In a study that compared the effect of breed, sex and age on weight and linear body measurements of N'dama, Muturu and White Fulani cattle, it was reported that there were significant differences in live weight and linear body measurements between breeds, sex and age (Oduguwa *et al.,* 2013).

The present study reported that sex differences in the linear parameters of Muturu and Bunaji cattle were significant for some parameters, with females tending to have greater values in TLH and MCC, while CBC was significantly lower in females compared to males. This finding agreed with the report of Ochefu *et al.* (2020). These differences can be attributed to the size and genetic influence. Sex differences in the linear parameters of Muturu and Bunaji cattle have been studied to determine the effects of breed and sex on body measurements. The study reported that for most of the observed

parameters, there were no significant differences between the breeds as agreed with the earlier findings of Ogunnupebi *et al*. (2019) and Ochefu *et al.* (2020).

Linear body measurements have characterised breeds, evaluated breed performance and predicted live weight gain. This study reported that females were significantly superior to males in all the body measurements taken, which aligns with the submission of various workers (Ochefu *et al.,* 2020). The influence of sex on BWT and some morphometric traits indicates the usual difference between sexes due to hormonal actions leading to differential growth rates (Ochefu *et al*., 2020).

The examination of the interactions between breeds and sex indicates that, for the majority of the parameters, there were no significant differences in the interaction between breeds and sex. However, in the case of two parameters, namely TLH and CBC, there were noteworthy variations in the interaction between the breed and sex during the 1-year-old of the study. This insight suggests that while most observed parameters did not exhibit significant differences based on the interplay of breed and sex, TLH and CBC displayed distinctive patterns influenced by the combination of breed and sex factors (Ochefu *et al*., 2020). This finding was supported by previous research that showed sex-related differences in morphometric traits in various animal species, including goats, sheep, cattle and buffalo. These differences are attributed to the usual between-sex differential hormonal effects on growth Ochefu *et al*. (2020)

For instance, a study on the morphometric traits of four indigenous cattle breeds in Nigeria reported that breed and sex were the main sources of variation in almost all the linear traits studied. The study also reported that N'dama had higher linear body dimensions than other breeds in the study, indicating the influence of breed and sex on body measurements (Ochefu *et al*., 2020). These results suggest that breed has an impact on the linear parameters and weight of Bunaji and Muturu cattle. The study highlights the importance of considering breed when evaluating the performance and predicting the live weight gain of these cattle breeds. The findings also indicated that there were specific parameters where breed differences are more pronounced, such as ELH, CBC and FLH for Muturu and CGH, HLH and BWT for Bunaji. These differences may be attributed to genetic factors, environmental influences, or a combination of both (Morenikeji *et al.,* 2021).

The search results provided additional information on the effects of breed and sex on the linear parameters and weight of the two cattle breeds, as well as the prediction of linear, quadratic and cubic functions. The studies cited showed that breed and sex were important sources of variation in linear traits such as BLH, Heart girth (HGH), HWS and huck circumference (HCC) (Morenikeji *et al.,* 2021). The results also revealed that breed and age significantly influenced live weight and linear body measurements in cattle Ochefu *et al.* (2020).

Conclusion: The BLT and BWT of the Muturu and Bunaji breeds of cattle varied across breed, sex and age group. Furthermore, the positive relationships between BWT and linear body measurements at various stages indicated that an increase in the growth rate of any of the components would correspondingly increase live weight gain.

ACKNOWLEDGEMENTS

The authors appreciate the efforts of cattle ranch owners and farmers in Ebonyi and Kogi States for their cooperation in the course of this research.

REFERENCES

ADEBAMBO, O. A. (2001). The Muturu: A rare sacred breed of cattle in Nigeria. *Animal Genetic Resources*, 31: 27 – 36.

AGTR (2024). *Muturu Cattle Breeds.* Animal Genetics Training Resources (AGTR), http://agtr.ilri.cgiar.org/muturu.html Accessed July 04, 2024.

ARAUJO, J. P., MACHADO, H., CANTALAPIEDRA, J., IGLESIAS, A., PETIM-BATISTA F., COLACO, J. and SANCHEZ, L. (2006). Biometric analysis of Portuguese Minhota cattle. *In: Proceedings 8th World Congress on Genetics Applied to*

Livestock Production, August 13 – 18, 2006, Belo Horizonte, MG, Brazil.

AYO, J. O., OBIDI, J. A. and REKWOT, P. I. (2011). Effects of heat stress on the well-being, fertility, and hatchability of chickens in the Northern Guinea Savannah Zone of Nigeria: A review. *International Scholarly Research Notices*, 2011: 838606. https://doi.org/10.5402/2011/838606

BIRTEEB, P. T. and OZOJE M. O. (2012). Prediction of live body weight from linear body measurement of West African long-legged and West African dwarf sheep in Northern Ghana. *Online Journal of Animal and Feed Research,* 2(5): 425 – 434.

BULLOCK, D. J. and PICKERINC, S. P. (1984). The validity of horn ring counts to determine the age of Scottish feral goats (*Capra* (domestic)). *Journal of Zoology*, 202(4): 561 – 564.

DAIKWO, S. I., OGAH, D. M., AMUDA, A. J. and DIKE, U. A. (2018). Prediction of body weight of Savanna Muturu cattle (*Bos brachyceros*). *Asian Journal of Research in Animal and Veterinary Sciences*, 1(3): 168 – 173.

DELGADO, J. V., BARBA, C., CAMACHO, M. E., SERENO, F. T. P. S., MARTÍNEZ, A. and VEGA-PLA, J. L. (2001). Caracterización de los animales domésticos en España. *Animal Genetic Resources/Resources Génétiques Animales/Recursos Genéticos Animales*, 29: 7 – 18.

EBEGBULEM, V. N. and ITA, U. R. (2016). Conservation of genetic diversity: Its relevance in poultry production. *Animal Molecular Breeding*, 6(3): 1 – 5.

GWAZA, D. S., YAHAYA, A. and AGEBA, M. (2018). Population trends, distribution, status and strategies for genetic improvement and conservation of the Savanah Muturu on free range in the Benue trough of Nigeria. *Journal of Research and Reports on Genetics,* 2(1): 19 – 25.

IGE, A. O., ADEDEJI, T. A., OJEDAPO, L. O., OBAFEMI, S. O. and ARIYO, O. O. (2015). Linear body measurement relationship in white Fulani cattle in derived savannah zone of Nigeria. *Journal of Biology, Agriculture and Healthcare*, 5(15): 1 – 6.

LAWRENCE, T. L. J. and FOWLER, V. R. (2002). *Growth of Farm Animals*. 2nd Edition, CABI Publishing, Wallingford, Oxon, United Kingdom.

MORENIKEJI, O. B., OGUNSHOLA, O. J., AKINYEMI, M. O., WHETO, M. and CHINEKE, C. A. (2021). Breed and sex effects on morphometric parameters of four indigenous cattle in Nigeria. *Archivos de Zootecnia*, 70(269): 6 – 12.

NICHOLAS, F. W. (2023). Quantitative variation. *In: Introduction to Veterinary Genetics.* Oxford Online Edition, Oxford Academic, United Kingdom. https://doi.org/10.1093/oso/9780198542933.003.0014 Accessed July 03, 2024.

OCHEFU, J., LADOKUN, A. O., SMITH, O. F., IPOSU, S. O., OKWELUM, N. and OMIRE, O. (2020). Breed and gender effects on blood profile of Muturu and Bunaji cattle in Benue and Ogun State, Nigeria. *Nigerian Journal of Animal Science*, 22(2): 32 – 39.

ODUGUWA, B. O., ADEDEJI, A. A., SOWANDE, S. O., ISAH, O. A. and AMOLE, T. A. (2013). Estimation of live weight from linear body measurements of three African breeds of cattle under extensive management system in Nigeria. *Nigerian Journal of Animal Science*, 15: 1 – 9.

OGUNNUPEBI, J. T., MBAMALU, C. H., ODOH, I. A., IGWE, R. O., OLORUNLEKE, S. O. and ADEOLU, A. I. (2019). Variation and distribution of qualitative characters, and assessment of body linear measurement among Muturu breed of cattle in Ebonyi State. *Nigerian Journal of Animal Production*, 46(4): 1 – 8.

SAS (2014). *Statistical Analysis Software. Users' Guide Statistics Version 9.4.* SAS Institute Incorporated, Cary, North Carolina, United States.

SOWANDE, O. S. and SOBOLA. O. S. (2008). Body measurements of West African dwarf sheep as parameters for

estimation of live weight. *Tropical Animal Health Production*.40: 433 – 439.

WIKIPEDIA (2024a). *Ebonyi State*. https://en.wikipedia.org/wiki/Ebonyi_State Accessed July 3, 2024.

WIKIPEDIA (2024b). *Lokoja*. https://en.wikipedia.org/wiki/Lokoja Accessed July 3, 2024.

5670 A., ABDULLAH, A. R., RAJI, A. O. and OSENI, S. O. (2021). Multivariate principal component analysis of the morphometric traits of some cattle breeds in Nigeria. *Journal of Animal and Plant Sciences*, 31(3): 681 – 689.

YAKUBU, A., IDAHOR, K. O., HARUNA, H. S., WHETO, M. and AMUSAN, S. (2010). Multivariate analysis of phenotypic differentiation in Bunaji and Sokoto Gudali cattle. *Acta Agriculturae Slovenica*, 96(2): 75 – 80.