COATS COLOUR CHARACTERIZATIONS OF THE MUTURU AND BUNAJI CATTLE BREEDS IN EBONYI AND KOGI STATE, NIGERIA

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ABSTRACT

Coat colour in cattle is a complex trait that is influenced by various genetic and environmental factors. 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. Data collected from the study were subjected to descriptive statistics and ANOVA. The frequency and distribution of different coat colours in the cattle breeds indicated that the Bunaji breed has a higher frequency of PWT coat colour (88.20%) than the Muturu breed (0.00%). The frequency of other coat colours such as WSB, SBK and BWP is also different between the two breeds. The frequency of WSB coat colour in the Muturu breed is 5.30%, while in the Bunaji breed, is 9.20%. The frequency of SBK coat colour in the Muturu breed is 63.20%, while in the Bunaji breed, is 0.00%. The frequency of BSW coat colour in the Muturu breed is 7.90%, while in the Bunaji breed, is 1.30%. The frequency of BWP coat colour in the Muturu breed is 0.00%, while in the Bunaji breed, is 1.30%.

Keywords: Cattle, Muturu, Bunaji, Coat colour, Breed, Sex

INTRODUCTION

Morphometric characterisation of the Muturu breed revealed colour shades of ebony black, fawn, black and white, black with white patches, and white with brown or black spots of varying frequencies ranging from 39 – 90%. Over 60% of the population from a study in Nigeria were predominantly black, corresponding to an ecological adaptation of the animal in the country's southern region where it is highly distributed (Adebambo, 2001); the lighter shades occur more among the Northern varieties. Karnuah *et al.* (2018) reported that cattle can be characterised based on their phenotypic and/or genetic traits. The commonly used phenotypic characters include coat colour, horn (shape and size), hair, live weight and body measurements. Raji *et al.* (2007) reported characterization based on quantitative criteria such as body measurements and other phenotypes and concluded that within-population variability can be greater than between-population variability. Morphometric characters are easy to monitor and they facilitate the use of ethnological characterization and at the same time institute reliable racial discriminants (Ali *et al.,* 2021). Numerous studies have examined various body dimensions of beef cattle to describe more thoroughly biological variation and to interpret the relationship with measures of performance, productivity and carcass characteristics (Seo *et al.,* 2021).

Body measurements of beef cattle are used for several purposes including; prediction of growth rate, body conditions, conformation, carcass trait and pattern of development in cattle (Kenny *et al.,* 2018; Hozáková *et al.,* 2020; Seo *et al.,* 2021). There is little available literature on

the phenotypic characterization of the Bunaji cattle breed in Nigeria. Characterization of animal genetic resources (AnGR) encompasses all activities associated with the identification, quantitative and qualitative description of breed populations and the natural habitat and production systems to which they are or are not adapted (Asamoah-Boaheng and Sam, 2016). It is generally accepted that the highest amount of genetic diversity in the populations of livestock is found in the developing world where record keeping is poor, and the risk of extinction is high and on the increase. Recently, the loss of genetic diversity within indigenous livestock breeds has been a major concern (Ali *et al.,* 2021). Every year many species and breeds of animals become extinct thereby decreasing the biodiversity and genetic variation of populations.

Thus, breeds and species that have a tradition of breeding for many centuries, unique genotypes, and aesthetic and cultural values are being lost (Adamczyk *et al*., 2008). This study aimed to assess body coat colour variation among the Muturu and Bunaji breeds of cattle in Ebonyi and Kogi States of Nigeria.

MATERIALS AND METHODS

Study Locations: The study was carried out between July 2023 and March 2024 in two agroecological zones of Nigeria at selected farms in Ebonyi and Kogi States. Ebonyi State's geographic coordinates are (latitude 6° 15'N and 6°.25'N and longitude 8°05'E and 8.083° 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 Ya Bako Farm in Lokoja, the capital city of the State which lies between latitude 7.45^0 and 7.52^0 North and longitude 6.41^0 and to 6.45^0 East of the Greenwich meridian (Wikipedia, 2024b). It is sandwiched to the west and east by the Mount Patti ridge and River Niger respectively with an area of about five hundred and seventy-seven square kilometres. Nigeria has two distinct seasons the wet season which lasts from April to October and the dry season which lasts from November to March. The annual rainfall ranges from 4.60 to 208.80 mm. Temperature ranges from 6.1 to 40.0°C (Wikipedia, 2024b).

Experimental Animal: The experiment was carried out in Ebonyi and Kogi States of Nigeria. Farmers' animals were used for the experiment. A total of one hundred and fifty-two (152) consisting of 76 each from Muturu and Bunaji breeds of cattle (Figures 1 and 2) were used for the experiment. The experiment is 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).

Figure 1: Herd of Muturu breed of cattle in Onueke Animal Farm in Ezza North Local Government Area, Ebonyi State

Figure 2: Herd of Bunaji breed of cattle in Ya Bako Farm in Lokoja, Kogi State

Experimental Procedure and Materials Used: Physical assessments of the body coat colour of individual animals were taken using a digital camera and phenotypic identification.

One-on-one discussions and oral interviews with the farmers were carried out to obtain information from farmers. GPS gadgets and cameras were used to identify the location and to photograph the colour patterns respectively.

Parameters Measured: Body coat colours and coat colour distributions were assessed. Muturu and Bunaji breeds of cattle were grouped according to coat colour; solid black (SBK), black with spotted white (BSW), white with spotted black (WSB), black with white patches (BWP), pure white (PWT) and white with black patches (WBP) respectively. Body linear parameters measured using flexible tape in centimetres included ear length (ELH), body length (BLH), chest girth (CGH), head length (HLH), tail length (TLH), muzzle circumference (MCC), heart length at wither (HLW), hock circumference (HCC), pelvic width (PWT), cannon circumference (CCC) and facial length (FLH). The body weight (BWT) was calculated using the Lambourne formula: $BWT = (CCC^2 \times BLH) / 10.840$, where BWT = body weight (kg), CCC = chest circumference (cm), BLH = body length (cm), 10.840 = provision of the Lambourne formula (Hasan *et al.*, 2020).

Data Analysis: The data collected from the study were subjected to descriptive statistics and analysis of variance (ANOVA). The level of significance was set at $p<0.05$. The results were presented as percentages and means ± standard errors of means determined by the different populations.

RESULTS

The Body Linear Parameters Grouped According to Coat Colour Grades of Muturu and Bunaji Breeds of Cattle: Coat colour in cattle is a complex trait that is influenced by various genetic and environmental factors. Table 1 shows the frequency and distribution of different coat colours in Muturu and Bunaji cattle breeds. The results indicate that the Bunaji breed has a higher frequency of pure white (PWT) coat colour (88.20%) than the Muturu breed (0.00%). The frequency of other coat colours such as white with spotted black (WSB), solid black (SBK) and black with white patches (BWP) is also different between the two breeds. The frequency of PWT coat colour in the Muturu breed is 0.00%, while in the Bunaji breed, is 88.20%. The frequency of WSB coat colour in the Muturu breed is 5.30%, while in the Bunaji breed, is 9.20%. The frequency of SBK coat colour in the Muturu breed is 63.20%, while in the Bunaji breed, is 0.00%. The frequency of BSW coat colour in the Muturu breed is 7.90%, while in the Bunaji breed, is 1.30%. The frequency of BWP coat colour in the Muturu breed is 0.00%, while in the Bunaji breed, is 1.30%. The distribution of coat colour within each breed also varies. For example, in the Bunaji breed, the distribution of PWT coat colour is 100.00%, while in the Muturu breed, it is 36.40%. The distribution of WSB coat colour in the Bunaji breed is 5.30%, while in the Muturu breed, it is 47.40%. The distribution of SBK coat colour in the Bunaji breed is 0.00%, while in the Muturu breed, is 100.00%. The distribution of BSW coat colour in the Bunaji breed is 1.30%, while in the Muturu breed, is 0.00%. The distribution of BWP coat colour in the Bunaji breed is 1.30%, while in the Muturu breed, is 0.00%.

The Effect of Coat Colour on Body Linear Parameters and Body Weight of the Muturu Breed of Cattle: Table 2 presents the relationship between coat colours, body linear parameters and BWT of the Muturu breed. The results highlight significant differences in certain observed coat colours, while others remained relatively consistent within the breeds. Notably, BWP Muturu breed exhibited a substantial increase in ELH (15.94 ± 0.50 cm), BLH (94.66 ± 4.68 cm), CGH (114.99 ± 5.06 cm), TLH (66.66 ± 2.88 cm), MCC (19.82 ± 0.89 cm), HLW (79.28 ± 3.38 cm), PWH (36.96 ± 1.19 cm), FLH (36.15 ± 1.41) and BWT (146.07 ± 15.48 kg) when compared to other coat colour under investigations. Conversely, the WSB Muturu breed demonstrated significantly higher values in HLH (9.03 ± 1.01 cm) as compared to other coat colour variants.

Table 1: Distribution of coat colour grades among Muturu and Bunaji breeds of cattle

Breed	Interactions	Coat colour					
		PWT	WSB	WBP	BWP	SBK	BSW
Muturu	Count	0.00^{a}	4.00^{b}	0.00^{a}	18.00^{d}	48.00^{e}	6.00^{c}
	Within breed (%)	0.00^{a}	5.30^{b}	0.00^{a}	23.70^{d}	63.20^{e}	7.90^{c}
	Within coat colour (%)	0.00^{a}	36.40^{b}	0.00^{a}	94.70^{d}	100.00^{e}	100.00^{e}
Bunaji	Count	67.00^{d}	7.00^{c}	1.00^{b}	1.00^{b}	00.00^{a}	00.00^{a}
	Within breed (%)	88.20^{d}	9.20^{c}	1.30^{b}	1.30^{b}	00.00^{a}	00.00^{a}
	Within coat colour (%)	100.00^{d}	63.60^{c}	100.00^{d}	5.30^{b}	00.00^{a}	00.00^{a}

SBK = solid black, BSW = black with spotted white, WSB = white with spotted black, BWP = black with white patches, PWT = Pure white, WBP = White with black Patches, abcd = percentages alone a row with different letter superscripts are significantly different ($p<0.05$)

Table 2: Relationship between coat colours, body linear parameters and body weight of Muturu breed of cattle

Parameters	BSW	BWP	SBK	WSB
ELH	14.24 ± 1.33^{b}	15.94 ± 0.50^{d}	14.90 ± 0.32^{c}	13.38 ± 1.67^{a}
BLH	85.46 ± 9.79^{c}	94.66 ± 4.68^{d}	91.13 ± 2.47^{b}	82.05 ± 4.21^{a}
CGH	109.44 ± 11.02^{b}	114.99 ± 5.06^{d}	111.33 ± 2.60^{c}	98.90 ± 4.93a
HLH	4.33 ± 1.13^{a}	8.06 ± 0.72^{b}	8.02 ± 0.44^{b}	9.03 ± 1.01^{c}
TLH	57.56 ± 8.25^{b}	66.66 ± 2.88^{d}	60.45 ± 1.61^{c}	55.85 ± 7.72^{a}
MCC	17.36 ± 1.71^{a}	19.82 ± 0.89^{d}	18.86 ± 0.34^{b}	19.03 ± 1.28^{c}
HLW	69.00 ± 5.89^{a}	79.28 ± 3.38^{d}	74.21 ± 1.49^{c}	73.06 ± 6.72^{b}
HCC	18.02 ± 2.26^{d}	17.07 ± 0.64^{c}	15.89 ± 0.26^{a}	16.50 ± 0.66^{b}
PWT	32.16 ± 3.24^{a}	36.96 ± 1.19^{d}	34.39 ± 0.60^{c}	32.00 ± 3.51^{b}
CCC	14.16 ± 1.12^{d}	14.05 ± 0.35^{c}	13.67 ± 0.17^{b}	13.58 ± 0.34^{a}
FLH	33.82 ± 2.60^{b}	36.15 ± 1.41^{d}	34.66 ± 0.57^{c}	32.50 ± 3.07^{a}
BWT	127.4 ± 30.40^{b}	146.07 ± 15.48^{d}	130.08 ± 7.56^{c}	117.08 ± 27.55^{a}

SBK = solid black, BSW = black with spotted white, WSB = white with spotted black, BWP = black with white patches, ELH = Ear Length, BLH =Body Length, CGH = Chest Girth, HLH = Head Length, TLH = Tail Length, MCC = Muzzle Circumference, HLW = Heart length at wither, HCC = Hock Circumference, PWT = Pelvic Width, CCC = Cannon Circumference, FLH = Facial Length, BWT = Body Weight, abcd = means alone a row with different letter superscripts are significantly different ($p<0.05$)

However, the BSW Muturu breed exhibited a notable significant increase in CCC (18.02 ± 2.26 cm) as compared with other coat colour variants. These findings underscore the distinct morphological and coat colour characteristics within the Muturu breed of cattle, emphasizing that certain linear parameters varied significantly according to coat colour within the breed.

The Effect of Coat Colour on Body Linear Parameters and Body Weight of the Bunaji Breed of Cattle: Table 3 presents the relationship between coat colours, body linear parameters and BWT of the Bunaji breed of cattle. The results highlight significant differences in certain observed coat colours, while others remained relatively consistent within the breeds. Notably, the WBP Bunaji breed exhibited a substantial increase in ELH (22.00 ± 0.40 cm), BLH (123.00 ± 2.00 cm), CGH (135.00 ± 0.70 cm), HLH (27.00 ± 3.01 cm), TLH (70.00 ± 0.30 cm), MCC (21.20 ± 2.04 cm), HLW (132.00 ± 0.80 cm), PWH (37.80 ± 0.07 cm), FLH (36.80 ± 1.00 cm) and BWT (214.00 ± 1.59 kg) when compared to other coat colour under investigations. Conversely, the PWT Bunaji breed demonstrated significantly higher values in HCC (15.88 ± 0.29 cm) and CCC (13.48 ± 0.24 cm) as compared to other coat colour variants. However, the WSB Bunaji breed exhibited the lowest CCC (11.74 ± 0.94 cm) as compared to other coat colour variants. These findings underscore the distinct morphological and coat colour variations within the Bunaji breed of cattle, emphasizing that certain linear parameters varied significantly according to coat colour within the breed.

DISCUSSION

The Muturu cattle are well adapted to the abiotic and biotic conditions in Ezza South Local Government Area of Ebonyi State. This finding conforms with the report of Adebambo (2001) who also reported that the breed is native to the rainforest vegetation.

Table 3: Relationship between coat colours, body linear parameters and body weight of Bunaji breed of cattle

Parameters	BWP	PWT	WBP	WSB
ELH	15.30 ± 0.50^{c}	14.82 ± 0.29^{b}	22.00 ± 0.40^{d}	13.51 ± 1.12^{a}
BLH	87.20 ± 0.20^{b}	90.47 ± 2.50^{c}	123.00 ± 2.00^{d}	80.36 ± 8.40^{a}
CGH	131.00 ± 2.60^{c}	115.17 ± 2.18^{b}	135.00 ± 0.70^{d}	105.83 ± 9.14^{a}
HLH	19.00 ± 1.00^{c}	17.02 ± 0.63^{b}	27.00 ± 3.01^{d}	13.91 ± 1.83^{a}
TLH	58.10 ± 1.67^{b}	59.89 ± 1.72^{c}	70.00 ± 0.30^{d}	52.37 ± 6.59^{a}
MCC	19.50 ± 0.72^{c}	18.73 ± 0.36^{b}	21.20 ± 2.04^{d}	17.53 ± 1.56^{a}
HLW	98.30 ± 3.10^{c}	88.96 ± 2.40^{b}	132.00 ± 0.80^{d}	77.81 ± 6.56^{a}
HCC	15.00 ± 0.19^{a}	15.88 ± 0.29^{c}	15.00 ± 2.00^{a}	15.14 ± 1.01^{b}
PWT	32.00 ± 0.31^{b}	34.43 ± 0.56^{c}	37.80 ± 0.07^{d}	31.11 ± 2.61^{a}
CCC	12.00 ± 0.13^{b}	13.48 ± 0.24^{d}	13.10 ± 0.10^{c}	11.74 ± 0.94^{a}
FLH	33.00 ± 0.30^{b}	34.49 ± 0.56^{c}	36.80 ± 1.00^{d}	31.86 ± 2.42^{a}
BWT	196.00 ± 0.05^{b}	140.64 ± 6.82^{c}	214.00 ± 1.59^{d}	118 ± 25.11^{a}

BWP = Black with white patches, PWT= Pure white, WBP = White with black Patches, WSB = White with spotted black, ELH = Ear Length, BLH =Body Length, CGH = Chest Girth, HLH = Head Length, TLH = Tail Length, MCC = Muzzle Circumference, HLW = Heart length at wither, HCC = Hock Circumference, PWT = Pelvic Width, CCC = Cannon Circumference, FLH = Facial Length, BWT = Body Weight, abcd = means alone a row with different letter superscripts are significantly different (p<0.05)

The distribution of the Muturu cattle as depicted in this study is consistent with the earlier report that these populations are not widely distributed in the rainforest zone as reported by Sheidi *et al.* (2021). This is also in agreement with the report of Adebambo (2001) who reported that the Muturu cattle were once widespread but are now uncommon. The Bunaji cattle are found in all parts of Nigeria. This finding is in agreement with the report of (Kubkomawa, 2017) who reported that white Fulani or Bunaji cattle are the most numerous and widespread of all Nigerian cattle breeds.

The colour shades of Muturu cattle observed in the study areas include SBK, BSW, WSB, BWP and PWT. These are similar to the coloured variants and morphometric characterization of the Muturu breed of cattle observed by (Adebambo, 2001) in the Southern agroecological zone of Nigeria. The SBK and PWT coat colours are dominant among the coats investigated which constitute (63.20%) and (88.20%) of Muturu and Bunaji breeds of cattle respectively which conforms with the report of Gwaza *et al.* (2018) on Savanna Muturu and Kubkomawa (2017) on white Fulani or Bunaji cattle. The effect of the dilution gene causing white-coloured animals was also observed. The multiplicity of these colour types shows that the Muturu and Bunaji cattle breed is not yet standardized and it was also an indication of an uncontrolled breeding method in their production system. Furthermore, the preponderance of the black and pure white coat colours indicates the high genotypic frequency of the dominant melanocortin 1 receptor gene (MC1R) within the Muturu and Bunaji cattle population.

Coat colour grades affected body weight in both Muturu and Bunaji cattle breeds. The BWP and WBP coat colour had higher body weight followed by SBK and PWT coat colour grades of unequal dimension and distribution. The BSW and WSB body weight of unequal distribution coat colour grades had similar average body weights in the Muturu breed, a different trend was observed between BSW and WSB coat colour in the Bunaji breed with BSW having a significantly higher body weight than WSB. Variation in body weight influenced by coat colour can be a result of genetic divergence due to uncontrolled breeding. Body weight is a breeding characteristic. The variation in body weight of the Muturu and Bunaji cattle between and within the breed according to coat colour variants may be due to stabilized genetic groups; this observation is similar to the report by Gwaza *et al.* (2018) on Savannah Muturu cattle. The significant effect of ELH, BLH, CGH, HLH, TLH, MCC, HLW, PWH, FLH, HCC and CCC between and within the two breeds may be due to some variation in quantitative traits loci of genes that govern the expression of these body linear traits and coat colours. This finding is in line with the report of N'goran *et al.* (2018) who reported that coat colour variants have a significant effect on body linear parameters.

The existence of different coat colour patterns, ranging from SBK, BSW, WSB, and BWP of the Muturu breed and BWP, PWT, WBP and WSB of the Bunaji cattle breed are indications of the genetic divergence of both breeds of cattle in Nigeria. The numerous coat colour grades may be connected to allelic differentiation through random sampling, genetic drift, and natural and artificial selection facilitated by small herd populations. High levels of inbreeding as well as uncontrolled crossbreeding may have also contributed to the observed coat colour variants and genetic divergence of coat colours of the Muturu and Bunaji cattle in Nigeria. This finding is similar to the report of Adebambo (2001) and Gwaza *et al.* (2018) on Muturu cattle and Kubkomawa (2017) on Bunaji cattle. Variation in body weight influenced by coat colour could be a result of genetic divergence due to uncontrolled breeding. Body weight is a breeding characteristic. The variation in body weight of the Muturu and Bunaji breeds of cattle according to coat colour variants may be due to stabilized genetic groups; this observation is similar to the report of Gwaza *et al.* (2018) on Savannah Muturu cattle.

Conclusion: There were several coat colour grades in both breeds of cattle (solid black and pure white) are the most dominating coat colours in Muturu and Bunaji cattle respectively.

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