Morphometric differentiation of mixed coat coloured cattle in Obudu Grass Plateau, South-South Nigeria.

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Abstract

Obudu Grass Plateau for phenotypic traits measurement. The phenotypic traits measured were Body Weight (BW), Body Length (BL), Height Withers (HW), Head Length (HDL), Head Width (HDW), Ear Length (EL), Horn Length (HL), Tail Length (TL), Dewlap width (DW), Scrotal Circumference (SC), Udder Circumference (UC), Number of Teats (NOT), F Fore Length (FLG), Hind Length (HLG), Cannon Circumference (CCF), Horn circumference (HNC), Cannon Length (CL), Rump Width (RW), Rump Length (RL), Heart Girth (HG). The data were analysed using SPSS. The fixed effects of age and lots on phenotypic traits were tested using linear model. The result revealed age and lots have significant (P<0.05) effect on phenotypic traits of cattle in Obudu cattle ranch. The result of correlation among phenotypic traits showed body weight has positive correlation rp (+) with all the phenotypic traits, while cannon length had negative rp (-) correlation with all the phenotypic traits except scrotal circumference (SC), udder circumference (UC) and body weight (BW). The positive correlation among phenotypic traits could be used for improvement because improvement in one will lead to improvement in others. The study will be useful in planning for selection and breeding programmes of cattle.

Keywords: Phenotypic, Traits, Cattle, Correlation.

Accepted on November 30, 2018

Introduction

The characterization of local genetic resources depends on the knowledge of the variation of morphological traits, which have played a very fundamental role in classification of livestock based on size and shape [1]. Size and conformation are important characteristics in meat animals especially ruminants. Traditionally, animals are usually assessed visually, which is a subjective method of judgment [2]. The need for characterization of livestock breeds is a cornerstone for understanding their uniqueness and ability to thrive under various agro climates [3]. The "phenotype" of an animal is the resultant of the genetics and its peerless blending with the environment where it thrives. The phenotype is further subjected to the social and aesthetic relationships of the owners and the aim for which they were developed [4]. Phenotypic characterization is all the more important for livestock that can thrive well under changing climatic conditions and in unfavourable environments [5]. "Phenotypic characterization of livestock generally refers to the process of identifying distinct breed populations and describing their external and production characteristics within a given production environment", [6]. Thus, it becomes necessary to phenotypically characterize the livestock before applying advanced characterization techniques [6]. Physical body measurements are of very common use in husbandry and phenotypic characterization of cattle. Common physical body measurements used in phenotypic characterization of cattle include body weight, heart girth, withers height, body length, ear length, horn length, muzzle circumference, hock circumference and tail length among several others. However, based on relatively large numbers of loci, body measurements have a continuous expression and may be directly correlated to body size and associated production traits [7]. This paper was designed to investigate the effect of age and lots on phenotypic traits of multiple crossed cattle as well as correlation among these traits.

Materials and Methods

Study area

The study area is the Obudu Grass Plateau located in the Obanliku Local Government Area of Cross River State, South-South Nigeria. It lies between longitude 90° 22' 00" and 90° 22' 45" E, and latitude 60° 21' 30" and 60° 22' 30" N, with an approximate area of 104 sqm^2, and a height of about 1576 m above sea level [8]. Obudu Plateau is bounded in the north by Benue State, northeast by the Republic of Cameroon, to the southeast by Boki Local Government Area in Cross River State of Nigeria. The area is situated within the tropics but it has a climate that is likened to temperate region with mean daily temperatures range between 15°C and 22°C. It has a mean annual rainfall of about 4300 mm with highest rainfall of about 76.2 cm usually recorded in August while the lowest of 0.76 cm is usually recorded in December [9]. The Obudu Plateau is part of the Precambrian Basement Complex of Nigeria [8].

Management system of the experimental animals

The animals were managed under extensive system with little or no provision of shelter in the day and night. The animals are kept in lots in the night and the lots are fence with stick or barb wires. The calves were separated from the cows in the night. They grazed during the day time on natural pasture. Adequate health care was in existent while uncontrolled breeding was also practice. Other management practice such as hand pick of ticks; castration and mineral salt were given as supplement.

Phenotypic traits

A total of 333 (153 females and 150 males) were randomly sampled from the population of cattle in Obudu for phenotypic traits measurement. The phenotypic traits measured were Body Weight (BW), Body Length (BL), Height Withers (HW), Head Length (HDL), Head Width (HDW), Ear Length (EL), Horn Length (HL), Tail Length (TL), Dewlap width (DW), Scrotal Circumference (SC), Udder Circumference (UC), Number of Teats (NOT), F Fore Length (FLG), Hind Length (HLG), Cannon Circumference (CCF), Horn circumference (HNC), Cannon Length (CL), Rump Width (RW), Rump Length (RL), Heart Girth (HG). The body weight was measured with glasfiber band with model number WJ515. Height-at-wither was measured with two meter rule while other phenotypic traits were measured with graduated tape. The measurements were done in the morning before the animals were released for grazing. All the measurements were carried out by same person in order to avoid inter individual variations.

Statistical analysis

The data set was analysed using SPSS. The fixed effects of age and lots on phenotypic traits were tested using linear model given as follows:

$$Yijk = \mu + Ai + Lj + eijk$$

Where: Yijk=Individual observation of each body traits.

μ=Overall mean.

Ai=Fixed effect of i^{th} age.

Sj=Fixed effect of j^{th} lot.

eijw=Random residual error asocial with record of each animal.

Data set were also subjected to Pearson correlation analysis.

Results and Discussion

The results of effect of age on phenotypic traits are presented in Table 1. All the phenotypic traits showed significance ($p<0.05$) difference with change in age except dewlap width, horn circumference, head length, ear length, fore leg, hind leg and rump length. The phenotypic traits change with increase in age from 0-3 years to 10-12 years beside, phenotypic traits such as body weight, head length, chest circumference, rump length, head width, dewlap width, udder circumference, fore leg and hind leg decrease with age above 12 years. This may be due to old age or the animal is at the diminishing point. Although other parameters that showed statistical the same also follow the same trend which increases in age. These findings agreed to the result of Adejoro and Salako [10] who reported that the general positive influence of age of the animals on body size and weight is not surprising since the size and shape of the animals is expected to increase with increasing age of the animal. The result from this study also concurred with the report of Dauda et al. [11] who opined that Age and sex have great influence on body traits of animals. The author further stated that increase in age leads to increase in body trait; this could be term as growth. At 10-12 year may be ideal age for selection in cattle because it is the age that exposed most or all the phenotypic traits. Since Body size and shape measured objectively could improve selection for growth by enabling the breeder to recognize early maturing and late maturing animals of different sizes. Measurement of various body conformations are of value in judging quantitative characteristics of meat animals and are also helpful in developing suitable selection criteria [12,13].

The results of effect of lots on phenotypic traits are presented in Table 2. The results revealed that animals in lots 8 are superior in body weight, body length, height-at-wither, head length, head width, ear length, horn length, horn circumference, tail length, dewlap width, heart girth, rump length, rump width, scrotal circumference, hind leg, fore leg except udder circumference was superior in lot 9 and cannon length in lot 1. The superiority of animals in lot 8 over other lots in the study area could be due to differences in breeds and good management practices such as hand pick of ticks, castration and deworming. Besides, the body length in this study ranges from (80.00-124.00) cm which is lower than the findings of Yakubu et al. [1] who reported value of 175.29 cm and 179.02 cm for Bunaji and Sokoto Gudali cattle respectively. Height-at-wither in this study revealed (100.40-s135.77) cm is higher than 111.84 cm and 127.50 cm for Bunaji and Sokoto Gudali respectively as reported by Yakubu et al. [1]. The estimates obtained for height at withers of adult cattle in this study is also higher than those of the Nandi (110-122) cm, Mongalla (100–110) cm [14], and Mexican Criollo Chinampo (101-117) cm [15] but lower than Sudan Baggara (115.9-148.80) cm [16]. The heart girth values in this study ranges from (122.76-170.41) cm are, however, higher than the range of 122-127 cm reported for North Bengal Grey cattle in Bangladesh [16]. The tail length, rump length and rump width in this study ranges from (75.80-101.87) cm and (25.60-40.36) cm respectively. This agreed with the value of tail length 76.81 cm and 84.27 cm and rump length of 39.06 cm and 42.17 cm for Bunaji and Sokoto Gudali respectively as reported by Yakubu et al. [1]. The author further opined that Comparative measurements of morphometric traits can provide evidence of breed relationships and size. The variations in phenotypic traits on lots may be connected with individual's potentials and true to type. Since morphometric measurements have been used to evaluate the characteristics of various breeds of animals and could provide useful information on the suitability of animals for selection [17,18]. The results of correlation among phenotypic traits are presented in Table 3. The correlation among phenotypic traits, body weight positively correlated (rp) with all the phenotypic. The rp are highly significant ($p<0.01$) and ranges from low 0.031 to high 0.943. The positive correlations that exist between body weight and all the phenotypic traits could mean that they are controlled by same gene (pleiotropic), similarly it is an indication that any of those phenotypic trait could serve as a predictor of body weight [19]. This may also be that improvement in one trait may also lead to improvement in

Table 1. *Effect of age on phenotypic traits.*

Parameters	0-3 years	4-6 years	7-9 years	10-12 years	>12 year	SEM
Body weight	272.88^{c}	413.56^{ab}	456.33^{a}	424.00^{ab}	358.00^{ab}	9.161
Body length	94.89^{b}	110.56^{ab}	108.83^{ab}	111.75^{ab}	121.00^{a}	1.289
Height-at-wither	116.80^{c}	130.30^{ab}	129.50^{b}	131.92^{a}	138.00^{a}	1.188
Head length	42.29	48.19	50.17	49.67	48.00	777
Head width	18.79^{b}	20.38^{ab}	19.33^{ab}	19.38^{ab}	19.00^{ab}	436
Ear length	20.51	21.20	22.83	22.33	21.00	267
Horn length	21.65^{c}	38.77^{b}	47.67^{ab}	54.58^{a}	55.00^{a}	1.262
Horn circumference	17.41	18.89	18.83	18.75	18.00	454
Tail length	86.16^{b}	99.70^{ab}	101.50^{ab}	104.00^{ab}	112.00^{a}	1484
Dewlap width	15.07	17.86	18.33	18.50	14.00	640
Udder circumference	51.50^{ab}	48.41^{ab}	60.00^{a}	54.50^{ab}	43.00^{b}	1.533
Number of teat	4.03^{b}	4.00^{b}	4.00^{b}	4.00^{b}	6.00^{a}	034
Fore limb	81.51	90.63	88.50	89.00	79.00	903
Hind limb	98.22	105.34	104.50	104.33	100.00	1.042
Cannon circumference	18.04^{b}	21.88^{b}	22.00^{b}	23.47^{b}	26.00^{b}	2.002
Cannon length	66.37^{a}	68.41^{a}	65.33^{a}	68.17^{a}	63.00^{a}	1700
Rump width	31.81^{b}	40.00^{a}	42.33^{a}	41.17^{a}	42.00^{a}	1240
Rump length	19.30	19.97	20.17	20.67	17.00	856
Heart girth	144.34^{b}	170.77^{a}	175.80^{a}	166.15^{a}	162.20^{a}	1.686

Table 2. *Effect of lots on phenotypic traits.*

	Lots									
Parameters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**SEM**
Body weight	289.91^{bc}	313.21^{bc}	363.75^{ab}	335.58^{bc}	170.20^{d}	276.40^{bc}	298.55^{bc}	440.91^{a}	266.25^{c}	9.286
Body length	87.95^{bc}	93.52^{cd}	105.93^{bc}	102.03^{bc}	80.00^{e}	102.40^{bc}	107.27^{b}	124.00^{a}	102.06^{bc}	1.295
Height at withers	115.94^{b}	119.55^{b}	123.98^{b}	122.29^{b}	100.40^{c}	117.72^{b}	120.45^{b}	135.77^{a}	127.13^{ab}	1.200
Head length	43.52	44.86^{3}	44.14^{5}	45.79^{2}	39.00^{8}	44.20^{4}	41.45^{7}	47.73^{1}	43.25^{6}	0.777
Head width	19.87ab	19.95ab	18.21^{bc}	18.58^{bc}	15.40^{c}	18.00^{bc}	17.09^{bc}	22.45^{a}	16.38^{bc}	0.368
Ear length	19.59ab	20.67ab	21.18^{a}	21.95^{a}	18.00^{c}	20.63^{ab}	19.91^{ab}	22.23^{a}	20.03ab	0.271
Horn length	26.50^{b}	27.09^{b}	34.82^{b}	27.17^{b}	13.20^{c}	22.45^{c}	23.41^{bc}	46.95^{a}	24.88^{ab}	1.272
Tail length	87.83^{abcd}	87.59^{abcd}	95.21^{abc}	96.45^{ab}	75.80^{d}	88.20^{abcd}	78.91^{cd}	101.87^{a}	84.50^{bcd}	1.552
Dewlap width	12.22^{ab}	17.03^{a}	18.54^{a}	17.47^{a}	9.70^{b}	14.50^{ab}	14.36^{ab}	19.30^{a}	14.39^{ab}	0.652
Scrotal	26.00	28.55	25.00	28.25	16.00	22.58	24.33	53.00	19.33	1.795
Udder Circumference	50.60	58.60	51.00	45.11	--	--	54.00	50.14	61.00	1.555
number teat	4.00^{b}	4.00^{b}	4.00^{b}	4.08^{b}	4.50^{a}	4.00^{b}	4.00^{b}	4.00^{b}	4.00^{b}	0.028
Fore limb	86.70	85.69	86.43	82.36	75.40	82.40	81.18	88.64	80.00	0.914
Hind limb	94.93^{a}	102.34^{a}	103.06a	97.68^{a}	88.00^{b}	97.90^{a}	98.36^{a}	108.36^{a}	101.38^{a}	1.061
Cannon circumference	28.00^{bcd}	36.09^{abc}	49.00^{ab}	31.95^{bcd}	13.80^{d}	21.90^{cd}	39.00^{abc}	55.55^{a}	23.50^{cd}	2.039
Circumference horn	19.50^{a}	17.59^{a}	18.21^{a}	18.92^{a}	12.70^{c}	18.00^{ab}	13.55^{bc}	20.41^{a}	17.75^{cd}	0.457
cannon length	67.74^{a}	52.96b	37.34^{d}	54.88^{a}	62.80^{a}	62.80^{a}	54.09^{a}	36.64^{b}	63.00^{a}	1.786
Rump length	31.65^{bc}	33.24^{ab}	37.57^{ab}	35.79^{ab}	25.60c	32.90^{ab}	34.45^{ab}	40.36^{b}	36.38^{ab}	0.584
Rump width	20.13^{b}	18.69^{b}	19.14^{b}	18.45^{b}	16.00^{b}	16.90^{b}	18.91^{b}	20.00^{b}	31.93^{b}	0.0074
Heart girth	149.06^{bc}	154.05^{abc}	161.47^{abc}	153.47^{abc}	122.76^{d}	144.97^{d}	148.98^{bc}	170.41^{a}	143.44^{c}	1.71

abcd=Mean with different superscripts on the same row differ significantly (p<0.05) SEM=Standard Error of means

Table 3. *Correlation among phenotypic traits.*

	BW	BL	HW	HL	Head W	EL	Horn L	TL	DL	SC	UC	Fore LL	HLL	C.CF	HC	CL	RW	RL
BW																		
BL	0.737**																	
HW	0.841**	0.758**																
HL	0.504**	0.340*	0.462*															
Head W	0.392*	0.286	0.414*	0.404**														
EL	0.386*	0.312*	0.373*	0.123	0.182													
Horn L	0.73**	0.606**	0.680**	0.408*	0.343*	0.372*												
TL	0.553**	0.498*	0.482*	0.348*	0.235	0.319*	0.342*											
DL	0.346*	0.295	0.373*	0.176	0.183	0.271	0.223	0.191										
SC	0.632**	0.486*	0.574**	0.431*	0.202	0.158	0.144	0.391*	0.589**									
UC	0.031	0.026	0.090	0.311*	0.088	0.045	0.126	-0.046	0.087									
Fore LL	0.530**	0.358*	0.535**	0.306*	0.297	0.173*	0.389*	0.389*	0.142	0.319*	0.137							
Hind LL	0.535**	0.457*	0.544**	0.365*	0.295	0.199*	0.405*	0.405*	0.188*	0.212	0.264	0.465*						
C.CF	0.618**	0.500**	0.470*	0.413*	0.255	0.15	0.610**	0.610**	0.16	0.241	-0.075	0.363*	0.275					
HC	0.663**	0.554**	0.666**	0.643**	0.625**	0.360*	0.463*	0.463*	0.196	0.473*	-0.094	0.577*	0.467*	0.212**				
CL	0.421*	-0.41	-0.275	-0.349*	-0.125	-0.124	-0.495*	-0.495*	-0.14	0.151	0.034	-0.192	-0.113	-0.919**	-0.088			
RW	0.810**	0.763**	0.773**	0.504**	0.225	0.301*	0.646**	0.525**	0.240	0.521**	0.316*	0.429*	0.453*	0.553**	0.577**	-0.435**		
RL	0.103	0.115	0.142	0.06	0.036	-0.22	0.094	0.094	0.043	0.014	0.259	0.037	0.111	0.042	0.134	0.77	0.137	
HG	0.943**	0.723**	0.815**	0.505**	0.402*	0.316*	0.676**	0.519**	0.323*	0.589**	0.157	0.546**	0.653**	0.612**	0.648**	-0.418**	0.816**	0.117

**=Highly significant (p<0.001).*= significant (p<0.05) KEY: BW=Body Weight, BL=Body Length, HW=Height Withers, HL=Head Length, HW=Head Width, EL=Ear Length, Horn L= Horn Length, TL=Tail Length, DL=Dewlap Length, SC=Scrotal Circumference, UC=Udder Circumference, No. T= Number of Teats, F LL=Forelimb Length, H LL=Hind limp Length, C.CF=Cannon Circumference, HC=Horn circumference, CL=Cannon Length, RW=Rump Width, RL=Rump Length, HG=Heart Girth.

other traits. Cannon length (CL) correlated rp negative with all the phenotypic traits except scrotal circumference (SC), udder circumference (UC) and body weight (BW). Those phenotypic traits that are negatively correlated means that improvement in one trait may lead to decrease in the other traits [19].

Conclusion

Based on this study age and lots had effect on phenotypic traits of cattle in Obudu cattle ranch. Body weight showed positive correlation with all phenotypic traits, while cannon length showed negative correlation with the entire phenotypic trait except UC, SC and BW. The positive correlation among phenotypic traits could be used for improvement because improvement in one will lead to improvement in others. The study will be useful in planning for selection and breeding programmes of cattle.

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