Morphological Characterization of Bonga and Horro Indigenous Sheep Breeds under Smallholder conditions in Ethiopia

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Abstract

Characterization of animal genetic resource is a pre-requisite for designing proper breeding strategies. This study was conducted to morphologically and biometri-cally characterize Bonga and Horro indigenous sheep breeds of the smallholders. A total of 10 traits which included body weight, body length, chest width, wither height, chest width, pelvic width, tail length, tail circumference, ear length and scrotal circumference were measured from 755 Bonga and 820 Horro sheep kept by smallholder farmers. For the analyses of quantitative data, the main effects of breed and dentition were fitted in the model within each sex groups. In both of the breeds the coat color is dominated by brown which is found in plain and patchy patterns. Polldness is common in both of the breeds. Coat pattern, coat color, tail conformation and ear orientation were found to significantly (P<0.01) differ between the two breeds. More of the animals in Horro had plain coat pattern, brown coat color, and semi-pendulous ear orientation. Horro females had significantly (P<0.01) greater values for chest girth, wither height and tail length than Bonga females. On the contrary, Bonga ewe's had significantly (P<0.01) higher values than Horro with respect to body weight, body length, chest width, pelvic width and ear length. Horro male had higher values (P< 0.01) for chest girth; wither height and scrotal circumference than Bonga males. With the exceptions of ear length, tail circumference, tail length and body condition score, age was found to have a significant influence (P<0.01) on most body measurements in both sexes. The two breeds can be classified as large breeds and should be given emphasis for their improvement and conservation since they can better thrive and produce where disease and internal parasites are problems. To explore the genetic potential of Bonga sheep there is a need to undertake performance testing studies under improved management conditions unlike Horro sheep where there is good deal information on performance the breed.

Key words: Bonga sheep, Horro sheep, Adiyo, Horro, morphological characters

Introduction

Sheep population of Ethiopia is estimated at 24 million heads, with majority (75%) of these being kept in small scale mixed farms in the highland regions, while the remaining 25% are found in the lowlands (Tibbo, 2006). The majority of sheep kept in Ethiopia are indigenous to the country. These are valuable genetic resources adapted to the harsh climatic conditions of the country, resistant and/or tolerant to parasites and diseases and have the ability to efficiently utilize limited feed resources (Solomon *et al.,* 2007) and might be more productive under low input systems of smallholders than exotic breeds. They provide regular cash income through sale of live animal and skins, are living bank against the various environmental calamities (crop failure, drought, flooding) and have socio-cultural values for diverse traditional communities. Therefore, there is a need to study variation among the breeds so as to facilitate their efficient utilization and conservations. Past studies were limited in their scope as they were concentrated only on few indigenous sheep breeds or are based on few animals compared to the whole population. Information on morphological characteristics is a prerequisite to the development of sustainable breed improvement, utilization and conservation strategies. For example, community based breeding strategies warrant that the breeds have to be well studied, and traits, which make them unique, be characterised phenotypically and genetically (Baker and Gray, 2003). The objective of this study was, therefore, to morphologically characterize indigenous Bonga and Horro sheep breeds.

Materials and Methods

Study areas

The study was carried out in Adiyo Kaka (Southern Nations, Nationalities and Peoples' Regional State of Ethiopia) and Horro (Oromia Regional State of Ethiopia) districts from December 2007 to March 2008. Adiyo Kaka falls within longitude of 36º 47'E and latitude of 7º 26'N with altitude ranging from 500 to 3500 meters. The temperature in the area can be as high as 36 ºC and can also reach lowest value of 3 ºC (SUDACA, 2007). Horro district is situated within longitude of 36º 47'E and latitude of 7º 26'N with altitude ranging from 1800 to 2835 meters HARDO (HARDO, 2006).

Morphological characters studied

A total of 1575 (755 Bonga and 820 Horro sheep) were randomly sampled from the study districts. The categorical traits scored were: coat pattern, coat color type, head profile, ear orientation, presence or absence of ruff, presence or absence of wattle, tail conformation, and body condition. Likewise, the quantitative traits measured for both male and female were: live body weight (BW, measured using a 100kg portable weighing scale graduated at 500gm interval); body length (BL, measured as the horizontal distance from the point of shoulder to the pin bone); chest girth (CG, the circumference behind the forelegs); wither height (WH, the height from the bottom of the front foot to the highest point of the shoulder between the withers); pelvic width (PW, the distance between the pelvic bones, across dorsum); chest width (CW, the width of the chest between the briskets); tail length (TL, the length of tail from the base to the tip); tail circumference (TC, the circumference of the tail at its widest part); ear length (EL, the length of the ear on its exterior side from its root at the poll to the tip); and scrotal circumference (SC, the circumference of the testis at the widest part). Body measurements were obtained by the use of measuring tape calibrated in centimeters (cm) after restraining and holding the animals in an unforced position. In addition, the age of animals was estimated from dentition to support the age information given by farmers. Based on dentition, sampled sheep were categorized as 0 dentition (only for males), one pair of permanent incisors, two pairs of permanent incisors, three pairs of permanent incisors and four pairs of permanent incisors following Wilson and Durkin (1984) (Table 1). Body condition score (BCS) was assessed subjectively and scored using the 5 point scale (1= very thin, 2 = thin, 3 = average, 4 = fat and 5 = Very fat/

obese) for both of the sexes according to Hassamo *et al.* (1986). Body score of an animal was done by feeling the back bone with the thumb and the end of the short ribs with fingers tips immediately behind the last ribs.

Table1. Size of samples of the studied flock

Breed	Number of animals used for qualitative and quantitative measurements					
	Female				Male	
	1PPI	2PPI	3PPI	4PPI	1-4PPI	Total
Bonga	85	102	169	325	74	755
Horro	61	138	90	503	28	820
Total	146	240	259	828	102	1575

Estimate ages of sample population: 1PPI = 15.5 months; 2PPI months= 22.5 months; 3 PPI = 28 months; 4 PPI = 39 months (Wilson and Durkin, 1984).

Data Analysis

Qualitative data from individual observation were analyzed for the breeds and sexes separately using SAS (2003). Chi-square test was employed to test for independence between the categorical variables. Owing to the low number of males in each dentition class, quantitative data sets were analyzed for the two sexes (female and intact male) separately fitting breed and dentition and their interaction in the model (models 1). Four dentition classes for females namely 1, 2, 3 and 4 and two dentition classes for male 0-1 and ≥ 2 were used. The General Linear Model (GLM) procedure of SAS (2003) was employed to analyze quantitative variables. Tukey Kramer test was used to separate means of effects with three or more levels which were significant in the least squares analysis of variance (SAS, 2003).

Model used for the least - squares analysis in females and males was: $Y_{ijk} = \mu +$

$B_i + D_j + (B \times D)_{ij} + e_{ijk}$

Where: Y_{ijk} = Observed body weight or linear measurements

μ = Overall mean

B_i = the fixed effect of ith breed (i = Bonga, Horro)

D_j = the fixed effect of jth dentition classes (j = 1PP, 2PPI, 3PPI, 4PPI) $(B \times D)_{ij}$ = Breed by dentition interaction effect

e_{ijk} = random error

Results and Discussion

Categorical traits

Bonga sheep

The proportion of categorical traits for Bonga sheep is presented in Table 2. The Bonga sheep have a characteristic of fat-tailed which hangs just at the hocks or below the hocks. About 67% of the sampled population had straight and tip down ward tail where as the remaining 33% carry straight and twisted end tail. In both of the sexes, the predominant coat pattern was plain (63.8%) though the proportion of patchy (32.6) is high. The commonest color was brown (46.9%) in both sexes, followed by mixture of brown and white (21.2%). This result is in agreement with the earlier report of Tibbo and Ginbar (2004) that the majority of Bonga sheep had brown coat color. The presence of wattle is low (5.1%) in both sexes. This is in agreement with the work of Tibbo and Ginbar (2004). It was observed that ruff is the feature of male (13.4%) and was absent in females. Both the males and females were devoid of horn. Higher proportions of females were docked (81.1%) whereas none of the males were docked. A picture of representative Bonga ewe and ram are depicted in Fig. 1 and 2, respectively.

Table 2. Summary of the qualitative traits in the female and male Bonga sheep

Character	Attributes	Sex				Total	
		Female		Male			
		No.	%	No.	%	No.	%
Coat colour pattern	Plain	448	63.8	100	63.7	548	63.8
	Patchy	232	33.0	48	30.6	280	32.6
	Spotted	22	3.1	9	5.7	31	3.6
	Overall	702	100.0	157	100.0	859	100.0
Coat color type	White	64	9.1	14	8.9	78	9.1
	Brown	329	46.9	74	47.1	403	46.9
	Black	20	2.8	1	0.6	21	2.4
	Grey	5	0.7	2	1.3	7	0.8
	Creamy white	34	4.8	8	5.1	42	4.9
	White and black with white dominant	11	1.6	7	4.5	18	2.1
	Brown and White with brown dominant	151	21.5	31	19.7	182	21.2
	Brown and White with white dominant	70	10.0	15	9.6	85	9.9
	Black and white with black dominant	18	2.6	5	3.2	23	2.7
	Overall	702	100.0	157	100.0	859	100.0

Character	Attributes	Sex				Total	
		Female		Male			
		No.	%	No.	%	No.	%
Head profile	Straight	557	79.3	35	22.3	592	68.9
	Slightly convex	145	20.7	122	77.7	267	31.1
	Overall	702	100.0	157	100.0	859	100.0
Tail conformation	Straight and tip down ward	91	69.6	43	62.3	134	67.0
	Straight and twisted end	40	30.5	26	37.7	66	33.0
	Overall	131	100	69	100.0	200	100.0
Wattle	Present	41	5.8	3	1.9	44	5.1
	Absent	661	94.2	154	98.1	815	94. 9
	Overall	702	100.0	157	100.0	859	100.0
Ruff	Present	-	-	21	13.4	21	13.4
	Absent	-	-	136	86.6	136	86.6
	Overall	-	-	157	100.0	157	100.0
Ear form	Horizontal	74	10.5	11	7.0	85	9.9
	Semi-pendulous	628	89.5	146	93.0	774	90.1
	Overall	702	100.0	157	100.0	859	100.0

Figure 1. Adult Female Bonga sheep

Figure 2. Adult male Bonga sheep

Horro sheep

The proportion of categorical traits for Bonga sheep is presented in Table 3. Horro sheep is fat-tailed and the tail commonly hangs below the hocks. Straight downward tail and twisted end tail were observed in 69.6% and 30.4% of the sampled populations, respectively. In Horro breed the common coat pattern was plain (87.5%). Brown coat color (56.2%) was predominantly observed followed by creamy white (20.4%). This is in agreement with the earlier report of Galal (1983) and Tibbo *et al*. (2004) that the majority of Horro sheep had brown coat color.

Table 3. Summary of the qualitative traits in the female and male Horro population

Character	Attribute	Sex				Total	
Female	Male						
		No.	%	No.	%	No.	%
Coat color pattern	Plain	715	87.5	60	87.0	775	87.5
	Patchy	85	10.4	9	13.0	94	10.6
	Spotted	17	2.1	-	-	17	1.9
	Overall	817	100.0	69	100.0	886	100
Coat color type	White	34	4.2	4	5.8	38	4.3
	Brown	454	55.6	44	63.8	498	56.2
	Black	48	5.9	-	-	48	4.4
	Grey	9	1.1	-	-	9	1.0
Creamy white		168	20.6	13	18.8	181	20.4
White and black with white dominant		1	0.1	1	1.4	2	0.2
Brown and White with brown dominant		61	7.5	7	10.1	68	7.7
Brown and White with white dominant		39	4.8	-	-	39	4.4
Black and white with black dominant		3	0.4	-	-	3	0.3
	Overall	817	100.0	69	100	886	100.0
Head profile	Straight	803	98.3	18	26.1	821	92.7
Slightly convex		14	1.7	51	73.9	65	7.3
	Overall	817	100.0	69	100.0	886	100.0
Tail form	Straight and tip down ward	574	70.3	43	62.3	617	69.6
Straight and twisted end		243	29.7	26	37.7	269	30.4
	Overall	817	100.0	69	100.0	886	100
Wattle	Present	49	6.0	3	4.3	52	5.9
	Absent	768	94.0	66	95.7	834	94.1
	Overall	817	100.0	69	100.0	886	100.0
Ear form	Horizontal	23	2.8	-	-	23	2.6
Semi-pendulous		794	97.2	69	100.0	863	97.4
	Overall	817	100.0	69	100	886	100
	Present	-	-	24	34.8	24	34.8
Ruff	Absent			45	65.2	45	65.2
	Overall	-	-	69	100.0	69	100.0

However, solid white (4.3%) and solid black (4.4%) colors were rarely observed. The higher proportion of animals with brown coat color could be a reflection of strong selection for animals manifesting brown color. Generally, horn is not the feature of the breed. Wattle was observed only in 5.9% of the cases

(6.0% females and 4.3% of males); ruff was identified only in about 34.8% of the males. Similar proportion (5%) of wattle was reported for the same breed from on-station flock (Tibbo *et al*., 2004). Some of the categorical traits like coat color and tail type observed in both of breeds may appear to have economic importance. The chi-square test of independence of categorical variables in the two breeds sample population indicated that among the variables considered in this study coat pattern, coat color, tail conformation and ear orientation were found to significantly (P<0.01) differ between the two breeds. More of the animals in Horro had plain coat pattern, brown coat color, and semi-pendulous ear orientation. A picture of representative Horro ewe and ram are depicted in Fig. 3 and 4, respectively

Figure 3. Adult Female Horro sheep

Figure 4. Adult Male Horro sheep

Live body weight and linear measurements

***Breed effect*:** For female sheep**, t**he results of least squares analysis indicated that breed has a significant effect (P<0.01) on body weight and other body measurements except tail circumference and body condition score (P>0.05) (Tables 4 and 5). Bonga females had significantly higher values for body weight, body length, chest width, pelvic width, and ear length (P<0.01) than Horro female. On the other hand, Horro ewes' had greater values for chest girth, wither height, and tail length (P<0.01). Results for body weight and linear measurements of male sheep revealed that Horro males had significantly larger (P<0.01) chest girth, wither height, chest width, scrotal circumference and body condition score than Bonga males (Tables 6 and 7). Bonga male on the other hand had longer (P<0.01) ear length than Horro male. The disparity on the effect of sex on body measurement might be associated with the fact that most data of the males in Bonga sheep were taken from younger age group and for Horro they were from advanced age groups. The overall scrotal circumferences for Horro and Bonga males were 27.17±0.48cm and 23.02±0.47cm, respectively. The values obtained for body weight in this study were lower than those reported by Solomon *et al.* (2007). The much lower values in body weight in the present study may be due to difference in pasture availability or animals of different age groups were considered. Body weight in adult females of Bonga sheep is higher than most indigenous sheep breeds (Sisay, 2000; Solomon, 2007). Figures for body length, height at wither and chest girth in females of both breeds observed in this study were higher than those reported for central highland sheep, rift valley and north-western highland sheep (Sisay, 2000) and Gumuz sheep (Solomon, 2007). The value of scrotal circumference for Bonga ram is within the rage of earlier report of Tibbo and Ginbar (2004) which was 22 to 30cm. The observed scrota circumference for Horro male was the same as that reported previously for the breed (Solomon and Thwaites, 1997) which was 27cm. A scrotal circumference is an indirect measure of ram fertility and used to asses breeding soundness of ram and it has high heritability (Söderquist and Hulten, 2006).

Age effect: In females of the two breeds, age was found to strongly influence (P< 0.01) live body weight and other linear measurements with exception of ear length, tail circumference, tail length and body condition scores (P>0.05). The insignificant difference for these traits doesn't mean there is no growth, rather it implies that there is no much difference for adult animals. Animals in dentition group 3 and 4 had higher values than those of dentition groups 1 and 2. This shows that younger animals (in dentition one and two) were still growing compared to animals at advanced age. Likewise, in males, dentition significantly (P<0.01) affected body weight, body length, chest girth; wither height, tail length, and scrotal circumference (P<0.05). Nsoso et al. (2004) also reported these trends in Tswana sheep. For body weight, body length, chest girth and wither height in females of both breeds, larger variation was observed between animals in dentition 6 and 7. The lower variation observed between animals in dentition 3 and 4 was due to the attainment of matured body weight at those ages. This is in accordance with the report of Samuel and Salako (2008) who reported a sharp decline in body weight and other traits between age groups 3-4 years and 4-5 years in West African Dwarf goat. The fact that the two breeds reached their highest body weight and linear measurements (BL, CG, and WH) at their oldest age group (4PPI) is explained by physiology, as large sized animals continue to grow until maturity (Mekasha, 2007). This further confirmed that the two breeds under consideration are classified as large and late maturing. This is in agreement with findings of Mekasha (2007) that large sized indigenous bucks reach maturity at later age as compared to early maturing small sized bucks.

Table 4. Least squares means (LSM) ± standard error (SE) for the effects of breed, dentition and breed by dentition interaction on the live body weight and body measurements in female Bonga and Horro sheep breeds

Effects and level	N	BW	BL	CG	WH	CW
Overall	1487	30.76 ± 0.27	68.28 ± 0.11	73.36 ± 0.13	68.77 ± 0.11	14.15 ± 0.05
C.V		14.35	4.97	5.19	4.69	11.12
R2		0.29	0.19	0.24	0.17	0.08
Breed		**	**	**	**	**
Bonga	688	31.87 ± 0.19	69.16 ± 0.15	72.92 ± 0.17	68.12 ± 0.14	14.52 ± 0.07
Horro	792	27.65 ± 0.21	67.40 ± .164	73.81 ± 0.19	69.43 ± 0.16	13.78 ± 0.08
Age groups		**	**	**	**	**
1PPI	146	26.81 ± 0.37a	66.19 ± 0.29 a	70.62 ± 0.33 a	67.17 ± 0.27 a	13.63 ± 0.13 a
2PPI	247	28.62 ± 0.29 b	67.38 ± 0.22 b	72.31 ± 0.25 b	68.26 ± 0.21 b	13.92 ± 0.10 a
3PPI	259	30.81 ± 0.29 c	68.99 ± 0.22 c	74.35 ± 0.25 c	69.41 ± 0.21 c	14.36 ± 0.10 b
4 PPI	825	32.79 ± 0.16 d	70.56 ± 0.13 d	76.19 ± 0.14 d	70.26 ± 0.12 d	14.68 ± 0.06 c
B × D		Ns	Ns	Ns	**	Ns
Bonga						
1PPI	85	28.69 ± 0.48	67.20 ± 0.37	70.19 ± 0.4	66.82 ± 0.35	14.07 ± 0.17
2PPI	102	31.12 ± 0.42	68.41 ± 0.33	72.20 ± 0.37	68.10 ± 0.31	14.24 ± 0.15
3PPI	169	32.79 ± 0.34	69.63 ± 0.26	73.93 ± 0.29	68.33 ± 0.25	14.79 ± 0.12
4 PPI	325	34.88 ± 0.25	71.40 ± 0.19	75.34 ± 0.22	69.22 ± 0.18	14.97 ± 0.09
Horro						
1PPI	61	24.92 ± 0.57	65.18 ± 0.44	71.03 ± 0.49	67.51± 0.42	13.18 ± 0.20
2PPI	138	26.12 ± 0.57	66.36 ± 0.29	72.43 ± 0.33	68.42 ± 0.28	13.59 ± 0.14
3PPI	90	28.84 ± 0.47	68.37 ± 0.36	74.76 ± 0.41	70.49 ± 0.34	13.93 ± 0.17
4 PPI	503	30.71 ± 0.19	69.71 ± 0.15c	77.03 ± 0.17	71.29 ± 0.15	14.39 ± 0.07

[a,b,c,d] means in the same column with different superscripts within the specified dentition group are significantly different (P<0.05); Ns = Non-significant (P>0.05); ** P < 0.01

Scrotal circumference differed significantly between the age-classes (P<0.05). As age advances scrotal circumference tends to increase. But, to give conclusive information further study is suggested with large sample size. Despite the lower body weight recorded for Horro ewe, body condition score was not significantly (P>0.05) different between females of the two breeds. This showed that in some cases there was no direct relationship between body weight and body condition score. This phenomenon is attributed to the fact that body condition score reflects body lipids more than body weight as the later is affected by gut contents which vary according to the type and quantity of feed available. This fully agrees with reports of Nsoso *et al*. (2003) and Cisse *et al*. (2002) who indicated that body weight in Tswana goat and in Sahel goats, respectively did not always parallel with body condition scores.

Table 5. Least squares means (LSM) ± standard error (SE) for the effects of breed, dentition and breed by dentition interaction on the live body weight and body measurements in female Bonga and Horro sheep breeds

Effects and level	N	PW	EL	TL	TC	BC
Over all	1487	20.33 ± 0.05	11.55 ± 0.03	33.62 ± 0.21	16.00 ± 0.17	2.48 ± 0.02
C.V		7.32	8.05	11.20	20.00	28.46
R2		0.04	0.01	0.07	0.01	0.03
Breed		**	**	**	Ns	Ns
Bonga	688	20.52 ± 0.06	11.62 ± 0.04	32.07 ± 0.37	15.92 ± 0.30	2.52 ± 0.03
Horro	792	20.15 ± 0.07	11.48 ± 0.05	35.18 ± 0.19	16.08 ± 0.15	2.44 ± 0.03
Age groups		**	Ns	Ns	Ns	Ns
1PPI	146	19.92 ± 0.13 a	11.48 ± 0.08	33.16 ± 0.49	15.99 ± 0.41	2.44 ± 0.06
2PPI	247	20.22 ± 0.09 ab	11.47 ± 0.06	33.60 ± 0.45	15.50 ± 0.37	2.47 ± 0.05
3PPI	259	20.49 ± 0.09 bc	11.63 ± 0.06	33.93 ± 0.41	16.35 ± 0.34	2.52 ± 0.05
4 PPI	825	20.69 ± 0.05 c	11.61 ± 0.03	33.81 ± 0.28	16.16 ± 0.23	2.49 ± 0.03
B × D		Ns	Ns	Ns	Ns	NS
Bonga						
1PPI	85	20.21 ± 0.16	11.59 ± 0.10	31.52 ± 0.85	16.83 ± 0.70	2.38 ± 0.08
2PPI	102	20.43 ± 0.14	11.57 ± 0.09	32.05 ± 0.83	15.14 ± 0.68	2.46 ± 0.07
3PPI	169	20.49 ± 0.12	11.67 ± 0.07	32.40 ± 0.71	16.15 ± 0.59	2.58 ± 0.05
4PPI	325	20.94 ± 0.08	11.64 ± 0.05	32.29 ± 0.53	16.22 ± 0.43	2.65 ± 0.04
Horro						
1PPI	61	19.62 ± 0.19	11.38 ± 0.12	34.79 ± 0.49	15.15 ± 0.41	2.51 ± 0.09
2PPI	138	20.01 ± 0.13	11.38 ± 0.08	35.16 ± 0.33	15.87 ± 0.27	2.49 ± 0.06
3PPI	90	20.51 ± 0.16	11.59 ± 0.09	35.46 ± 0.41	16.56 ± 0.34	2.46 ± 0.07
4 PPI	503	20.45 ± 0.07	11.59 ± 0.04	35.33 ± 0.17	16.10 ± 0.14	2.33 ± 0.03

[a,b,c,d] means on the same column with different superscripts within the specified dentition group are significantly different ($p < 0.05$); Ns = Non-significant ($P>0.05$); ** $P< 0.01$

Table 6. Least squares means (LSM) ± standard error (SE) for the main effect of breeds and dentition and breed by dentition interaction on the live body weight and body measurements in male Bonga and Horro sheep breeds

Effects and level	N	BW	BL	CG	WH	CW	SC
Over all	102	30.68 ± 0.85	68.78 ± 0.65	73.06 ± 0.75	69.09 ± 0.62	14.74 ± 0.25	25.09 ± 0.34
C.V		21.45	7.09	7.72	6.77	12.55	8.37
R2		0.19	0.22	0.35	0.38	0.10	0.53
Breed		Ns	Ns	**	**	**	**
Bonga	74	29.70 ± 0.17	68.27 ± 0.89	70.0 ± 1.03	66.53 ± 0.85	14.07 ± 0.35	23.02 ± 0.47
Horro	28	31.66 ± 1.23	69.30 ± 0.94	76.12 ± 1.08	71.66 ± 0.90	15.42 ± 0.36	27.17 ± 0.48
Age groups		**	**	**	**	Ns	*
1PPI	76	27.83 ± 1.06	66.19 ± 0.81	70.89 ± 0.93	66.96 ± 0.77	14.758 ± 0.31	24.39 ± 0.36
≥ 2PPI	26	33.54 ± 1.33	71.36 ± 1.01	75.23 ± 1.17	71.24 ± 0.97	14.73 ± 0.39	25.80 ± 0.57

Ns = Non-significant (P>0.05); * P < 0.05; ** P< 0.01; BW

Table 7. Least squares means (LSM) ± standard error (SE) for the main effect of breeds and dentition and breed by dentition interaction on the live body weight and body measurements in male Bonga and Horro sheep breeds

Effects and level	N	PW	EL	TC	TL	BCS
Over all	102	19.48 ± 0.32	10.98 ± 0.12	22.15 ± 0.69	36.46 ± 0.68	2.97± 0.10
C.V		12.37	8.20	23.27	13.87	26.56
R2		0.11	0.11	0.11	0.22	0.17
Breed		Ns	**	Ns	Ns	*
Bonga	74	19.03 ± 0.45	11.33 ± 0.17	20.85 ± 0.97	35.40 ± 0.96	2.71 ±0.138
Horro	28	19.92 ± 0.47	10.65 ± 0.18	23.46 ± 0.97	37.52 ± 0.95	3.23 ± 0.15
Age groups		Ns	Ns	Ns	**	Ns
1PPI	76	18.86 ± 0.40	10.95 ± 0.16	21.30 ± 0.83	34.35 ± 0.82	2.82 ± 0.13
>2PPI	26	20.09 ± 0.51	11.03 ± 0.19	23.00 ±1.09	38.58 ± 1.07	3.12 ± 0.16

Ns = Non-significant (P> 0.05); *P < 0.05; ** P<0.01

Conclusion

The two breeds can be classified as large breeds and emphasis should be given for their improvement and conservation since they better thrive and produce where disease and internal parasites are prevalent. To fill the information gap and to explore the genetic potential of Bonga sheep there is a need to undertake performance testing studies under improved management conditions.

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