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Variation of Body Measurements in Borgou Cattle Breed in North Benin, West Africa

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Abstract

Studying body development in animals is an essential component for improving their production. The objective of this study was to study body measurements with regard to sex and age in Borgou cattle breed reared at the Okpara Breeding Farm. Data were collected on 244 animals (including 114 males and 120 females) distributed in 0-6, 6-12, 12-24, 24-36, 36-48 and >48 months classes. Data were compared using Student t-test in R software. The results showed that age had a very significant effect ($p<0.001$) on all measurements. For age groups 0-6, 6-12, 12-24 and >48 months, males presented higher values for body measurements than females on the measurements ($p<0.05$). However, for 24-36 months, the values of measurements such as Height at the withers, Height at the sacrum, Distance from the Head until the Ischium, Body length, Head length, Pelvic width, Head width, and Chest Perimeter were higher in females ($p<0.05$). Over 48 months, only the values obtained for Pelvic width were significantly higher in females ($p<0.001$). The results of this study can be used in selection and genetic improvement processes of Borgou cattle to improve the contribution of cattle farming to agricultural GDP in Benin.

KEYWORDS
Measurements, Sex, Age, Borgou breed, Okpara

INTRODUCTION

Local breeds are generally perceived as low productive animals, but they are known for their strong adaptation to the local climate (Banerjee, 2015; Dauda *et al*., 2018; Gwaza *et al*., 2018). To make these animals more productive, it is necessary to control their phenotypic features which may vary according to breeds. Today, the analysis of morphological traits in animals is considered as an important asset in the knowledge and orientation of production in livestock farming (Birteeb *et al*., 2014; Boujenane, 2015; Boujenane *et al*., 2016; Putra *et al*., 2020). In Benin, the most dominant cattle breed remains the Borgou breed if one takes into account crossbred cattle. In fact, the Borgou cattle breed is the result of a long stabilized cross between shorthorn bulls (Somba and secondarily Lagunaire) with Zebu, mainly the White Fulani. Originally from the Borgou Department in Benin, its geographic distribution reaches Nigeria (Kétéku), Burkina Faso (Méré) and Togo. Unfortunately, this breed is currently facing severe and uncontrolled crossbreeding in traditional systems where it becomes increasingly difficult to find purebred Borgou cattle (Dehoux and Housou-Vê, 1993; Worogo *et al*., 2020, 2022). But, the State of Benin, for nearly seven decades, very early proceeded to the establishment of a nucleus of this breed at the Okpara Breeding Farm which still abounds in pure subjects for conservation and genetic improvement purposes. Although some research works have focused on the analysis of weight performance and productivity of the Borgou cattle breed (Youssao *et al*., 2013; Alkoiret *et al*., 2016; Worogo *et al*., 2018), this breed is still little known on its body measurements features which are nevertheless useful for selection and genetic progress purposes (Youssao *et al*., 2009; Youssao, 2015; Worogo *et al*., 2021). Thus, this study was initiated to document some quantitative measurements of this breed with regard to age and sex at the Okpara Breeding Farm in northern Benin.

MATERIALS AND METHODS

Study area

The collection of data on body measurements of Borgou cattle was carried out at the Okpara Breeding Farm. The Okpara Breeding Farm (2°39'and 2°53' east longitude, and between 9 ° 6 'and 9 ° 21' north latitude) is a state farm located in the Department of Borgou, Municipality of Tchaourou and precisely in a borough of Parakou (Kika, 15 km from Parakou). It was created in 1952 and covers 33,000 hectares of which barely 15% are exploited. The climate is Sudanese with an alternating rainy season (May to October) and a dry season (November to April) where the harmattan blows between December and February. The mean annual rainfall is 1,200 mm and the mean annual temperature varies between 26 and 27°C. The relief is made of a crystalline peneplain with hills of very hard rock; large depressions can be observed there which favor the mobilization of rainwater towards the Okpara river. The vegetation consists of savannah dominated by

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Andropogon gayanus and is affected each year by uncontrolled bush fires.

Data collection

Measurements and weight were collected from 234 animals (including 114 males and 120 females) from November 2019 to January 2020. Body measurements were taken by the same operator on animals at rest, calm, in a plumb position and with their heads held high without exaggeration. All the measurements were taken by the same person for avoiding effects between recorders. A flexible "BAHCO" tape rule was used for circumference measurements while a measuring stick was used for the other measurements (Worogo *et al.* 2021). These body traits were recorded considering the FAO (2012) guidelines to phenotypic characterization of animal genetic resources. Thus, the following body traits were taken; height at withers (HW), back height (BH), height at sacrum (HS), tail length (TL), head length (HdL), thurl width (TW), distance of head until the ischium (DHI), shoulder width (SW), pelvic width (PW), hip width (HipW), body length (BL), canon perimeter (CP), chest width (CW), head width (HdW), chest girth (CG) and rump length (RL). Data on the age and sex of the animals were determined using the animals' ear-tags and record sheets available on the farm.

Statistical analysis

Data were classified according to the following age (0-6, 6-12, 12-24, 24-36, 36-48 and >48 months) and then age*sex groups. The values were presented as means ± standard deviations and compared using Student t-test. Statistical analysis was performed using R.4.0.2 software (R Core Team, 2020).

RESULTS

Effect of age on body measurements

The results of the statistical analysis show that all measurements were very significantly influenced by the age of the animals ($p<0.001$) and show that the measurements change with

Table 1. Changes in body measurements with regard to age in Borgou cattle

Age (months)	N	Measurements (cm)			
		HW	BH	HS	TL
		***	***	***	***
0-6	46	73.56±6.96^{a}	74.86±8.15^{a}	74.69±8.78^{a}	38.52±5.27^{a}
6-12	40	93.35±4.87^{b}	92.15±5.60^{b}	96.35±6.81^{b}	45.65±3.46^{b}
12-24	40	107.70±5.83^{c}	106.60±4.63^{c}	111.15±5.99^{c}	60.10±4.56^{c}
24-36	22	108.00±3.57^{c}	108.18±6.21^{cd}	112.18±4.75^{c}	60.45±5.11^{c}
36-48	38	115.05±5.72^{d}	112.89±5.86^{d}	118.31±3.79^{d}	67.00±4.63^{c}
>48	48	127.87±10.41^{e}	128.37±6.50^{e}	130.37±6.12^{e}	89.54±5.38^{d}
		DHI	BL	RL	HdL
		***	***	***	***
0-6	46	81.04±7.20^{a}	60.82±6.61^{a}	15.30±1.79^{a}	25.08±3.15^{a}
6-12	40	104.05±15.44^{b}	71.60±8.48^{b}	17.95±1.76^{b}	31.30±2.66^{b}
12-24	40	133.55±6.62^{c}	99.90±6.55^{c}	22.05±2.08^{c}	38.95±1.93^{c}
24-36	22	135.81±9.20^{cd}	97.54±6.37^{c}	22.81±1.78^{c}	38.72±3.54^{c}
36-48	38	140.31±8.85^{d}	104.42±6.32^{c}	23.00±1.43^{c}	39.68±2.00^{c}
>48	48	167.79±11.04^{e}	115.29±7.34^{d}	30.58±4.52^{d}	45.52±2.60^{d}
		SW	CW	HipW	TW
		***	***	***	***
0-6	46	24.17±4.93^{a}	14.65±1.53^{a}	16.73±1.58^{a}	19.08±2.20^{a}
6-12	40	38.75±4.28^{b}	17.10±1.97^{b}	20.45±2.20^{b}	24.25±2.65^{b}
12-24	40	53.60±5.19^{c}	20.55±2.38^{c}	28.80±2.34^{c}	27.10±2.35^{c}
24-36	22	55.36±4.58^{c}	21.18±1.56^{c}	28.45±1.47^{c}	27.18±2.26^{c}
36-48	38	58.73±5.02^{c}	20.89±1.18^{c}	31.05±1.59^{d}	28.52±2.91^{c}
>48	48	68.87±15.96^{d}	24.04±2.48^{d}	36.75±3.97^{e}	33.50±3.84^{d}
		PW	HdW	CG	CP
		***	***	***	***
0-6	46	10.95±1.47^{a}	15.34±1.35^{a}	72.13±8.57^{a}	11.43±1.02^{a}
6-12	40	12.95±1.98^{b}	16.25±1.42^{b}	93.10±7.42^{b}	13.40±1.29^{b}
12-24	40	18.00±1.89^{c}	19.20±1.34^{c}	122.40±5.19^{c}	18.10±2.07^{c}
24-36	22	17.27±1.16^{c}	18.72±0.88^{c}	123.31±4.60^{c}	17.36±0.90^{c}
36-48	38	19.36±1.23^{d}	19.47±0.76^{c}	133.15±8.99^{d}	18.81±0.84^{c}
>48	48	21.60±2.85^{e}	21.83±1.56^{d}	154.04±8.57^{e}	19.85±3.25^{d}

a,b,c: Means with different superscripts on the same column differ significantly ($p<0.05$). HW: Height at Withers, BH: Back Height, HS: Height at sacrum, TL: Tail length DHI: distance of head until the ischium, BL: Body Length, RL: Rump Length, HdL: Head Length, SW: Shoulder Width, CW: Chest Width, HipW: Hip width, TW: Thurl Width, PW: Pelvic width, HdW: Head Width, CG: Chest Girth, CP: Canon Perimeter, S: Significance, NS: Non significant, **: $p<0.01$, ***: $p<0.001$

age of the animals (Table 1). All the measurements taken were significantly different between animals aged 0-6 months and those aged 6-12 months. On the other hand, animals aged 12-24 months and 24-36 months did not show any significant differences for the measurements carried out. Older animals (>48 months) showed higher values for all the measurements followed by animals aged 36-48 months. Nevertheless, animals aged 36-48 months presented non-statistically different values with animals aged 12-24 months and 24-36 months for BH, TL, BL, RL, HdL, SW, CW, TW, HdW, and CP. It can also be observed that the values recorded for CP between animals aged 36-48 months and >48 months are statistically close.

Variation of body measurements in male and female Borgou cattle aged 0-6 months and 6-12 months

The body traits in Borgou cattle aged 0-6 months (n=24 and n=22 for males and females respectively) and those aged 6-12 months (n=20 and n=20 for males and females respectively) are presented in Table 2. From birth to 6 months, the animals showed no significant difference (p>0.05) for measurements such as HW, BH, TL, DHI, BL, RL, HipW, TW, HdW, CW between males and females. On the other hand, significant differences were found for measurements HS (p<0.05), HdL (p<0.01), SW (p<0.01), CW (0.05), PW (p<0.001) and CP (p<0.001) with a dominance of males over females.

From 6 to 12 months, significant differences between males and females were observed for HW (p<0.01), BH (p<0.01), HS (p<0.05), DHI (p<0.001), BL (p<0.001), HdL (p<0.001), SW (p<0.01), HipW (p<0.05), HdW (p<0.01), CW (p<0.05) and CW (p<0.01) with a superiority of males over females. In contrast, measurements such as TL, RL, CW, TW, PW showed no significant difference between males and females (p>0.05).

Variation of body measurements in male and female Borgou cattle aged 12-24 months and 24-36 months

The body characteristics in Borgou cattle aged 12-24 months (n=20 and n=20 for males and females respectively) and those aged 24-36 months (n=12 and n=10 for males and females respectively) are presented in Table 3. Between 12 and 24 months, significant differences between male and female Borgou cattle were observed for HW (p<0.05), BL (p<0.001), SW (p<0.001), CW (p<0.05), PW (p<0.05) and CP (p<0.01) with dominance of males over females. Furthermore, for the same life period, the differences observed between males and females did not present any

Table 2. Changes of body measurements in Borgou cattle aged 0-6 months and 6-12 months

Factors		Measurements (cm)			
Age (months)	Sex	HW	BH	HS	TL
0-6		NS	NS	*	NS
	M	74.75±7.56[a]	77.08±8.61[a]	77.25±10.07a	39.58±5.86a
	F	72.27±6.15[a]	72.45±7.02[a]	71.90±6.20b	37.36±4.39a
6-12		**	**	*	NS
	M	95.50±4.03[a]	94.70±4.23[a]	98.60±5.71[a]	45.60±3.05[a]
	F	91.20±4.76[b]	89.60±5.73[b]	94.10±7.21[b]	45.70±3.92[a]
		DHI	BL	RL	HdL
0-6		NS	NS	NS	**
	M	80.83±7.88[a]	61.58±6.90[a]	15.41±1.52[a]	26.25±2.80[a]
	F	81.27±6.54[a]	60.00±6.32[a]	15.18±2.08[a]	23.81±3.08b
6-12		***	***	NS	***
	M	111.90±14.93[a]	75.90±6.36[a]	17.90±0.96[a]	32.80±2.23[a]
	F	96.20±11.69[b]	67.30±8.25[b]	18.00±2.33[a]	29.80±2.19[b]
		SW	CW	HipW	TW
0-6		**	*	NS	NS
	M	26.00±4.98[a]	15.16±1.49[a]	16.66±1.83[a]	18.75±2.32[a]
	F	22.18±4.11[b]	14.09±1.41[b]	16.81±1.29[a]	19.45±2.06[a]
6-12		**	NS	*	NS
	M	40.80±3.27[a]	17.60±1.53[a]	21.20±1.64[a]	23.90±2.95[a]
	F	36.70±4.25[b]	16.60±2.25[a]	19.70±2.47[b]	24.60±2.34[a]
		PW	HdW	CG	CP
0-6		***	NS	NS	***
	M	11.83±0.91[a]	15.41±1.13[a]	72.66±8.40[a]	11.91±0.97[a]
	F	10.00±1.38[b]	15.27±1.57[a]	71.54±8.40[a]	10.90±0.81[b]
6-12		NS	**	*	*
	M	13.20±2.28[a]	16.90±1.16[a]	95.80±6.30[a]	13.80±1.10[a]
	F	12.70±1.65[a]	15.60±1.39[b]	90.40±7.62[b]	13.00±1.37[b]

a,b,c: Means with different superscripts on the same column differ significantly. HW: Height at Withers, BH: Back Height, HS: Height at sacrum, TL: Tail length DHI: distance of head until the ischium, BL: Body Length, RL: Rump Length, HdL: Head Length, SW: Shoulder Width, CW: Chest Width, HipW: Hip width, TW: Thurl Width, PW: Pelvic width, HdW: Head Width, CG: Chest Girth, CP: Canon Perimeter, S: Significance, NS: Non significant,*: p<0.05; **: p<0.01, ***: p<0.001

significant differences (p>0.05) for measurements such as BH, HS, TL, DHI, RL and HdL.

Between 24 and 36 months, the differences observed between males and females were significant for BH (p<0.01), HS (p<0.001), DHI (p<0.05), BL (p<0.001), HdL (p<0.01), PW (p<0.01), HdW (p<0.001), CW (p<0.001) with a superiority of females over males. The difference was also significant for TL but with a superiority of males over females (p<0.05). In addition, HW, RL, HipW, TW, and CP showed no significant difference between males and females (p>0.05).

Variation of body measurements in male and female Borgou cattle aged 36-48 months and >48 months

The morphometric traits of Borgou cattle aged 36-48 months (n=9 and n=10 respectively for males and females) and those over 48 months (n=10 and n=14 respectively for males and females) are presented in Table 4. From 36 to 48 months, the measurements showing significant differences between males and females were HW (p<0.001), BH (p<0.001), CW (p<0.01), PW (p<0.05), CW (p<0.05) and CP (p<0.05) for which the values recorded in males were higher than those in females. The other measurements (HS, TL, DHI, BL, RL, HdL, SW, HipW, TW and HdW did not show significant differences between males and females (p>0.05). For Borgou cattle over 48 months, males dominated females for HW (p<0.001), BH (p<0.001), HS (p<0.001), TL (p<0.01), DHI (p<0.001), HdL (P <0.01), SW (P <0.001), CW (P <0.01), HipW (p<0.001), TW (p<0.001), PW (p<0.001), HdW (p<0.001), CW (p<0.001) and CP (p<0.001). Females only showed higher values for the RL for animals older than 48 months.

DISCUSSION

This study was undertaken to assess changes in body measurements regarding age and sex in Borgou cattle reared at the Okpara Breeding Farm. All the measurements collected reached their maximum at the highest class (>48months) in this Borgou breed. The present study took into account six different age groups and revealed that the age of the animals had a significant effect on the body measurements; which means that these measurements gradually increase with the age of the animals. Other authors have also reported that the age of animals influences the measurements in cattle. For example, Hadiuzzaman *et al*. (2010)

Table 3. Changes of body measurements in male and female Borgou cattle aged 12-24 months and 24-36 months

Factors		Measurements (cm)			
Age (months)	Sex	HW	BH	HS	TL
12-24		*	NS	NS	NS
	M	110.00±6.68[a]	106.90±5.03[a]	110.30±6.13[a]	61.40±5.11[a]
	F	105.40±3.76[b]	106.30±4.30[a]	112.00±5.87[a]	58.80±3.60[a]
24-36		NS	**	***	*
	M	107.33±2.74[a]	105.00±4.30[b]	109.33±1.66[b]	61.50±5.80[a]
	F	108.80±4.39[a]	112.00±6.14[a]	115.60±5.05[a]	58.00±2.74[b]
		DHI	BL	RL	HdL
12-24		NS	***	NS	NS
	M	133.90±4.06[a]	103.30±4.98[a]	22.40±1.78[a]	38.40±2.21[a]
	F	133.20±8.56[a]	96.50±6.24[b]	21.70±2.10[a]	39.5±1.46[a]
24-36		*	***	NS	**
	M	131.66±8.79[b]	93.33±4.81[b]	22.66±1.55[a]	37.00±3.66[b]
	F	140.80±7.25[a]	102.60±3.80[a]	23.00±2.10[a]	40.80±2.04[a]
		SW	CW	HipW	TW
12-24		***	*	NS	NS
	M	56.90±4.73[a]	21.30±2.86[a]	29.50±2.83[a]	27.70±2.47[a]
	F	50.30±3.18[b]	19.80±1.50[b]	28.10±1.48[a]	26.5±2.11[a]
24-36		***	*	NS	NS
	M	58.33±2.46[a]	21.83±1.74[a]	28.00±1.59[a]	27.50±2.15[a]
	F	51.80±3.96[b]	20.40±0.84[b]	29.00±1.15[a]	26.80±2.44[a]
		PW	HdW	CG	CP
12-24		*	NS	NS	**
	M	18.70±2.20[a]	19.60±1.53[a]	122.80±5.55[a]	19.00±2.29[a]
	F	17.30±1.21[b]	18.80±1.00[a]	122.00±4.92[a]	17.20±1.36[b]
24-36		**	***	***	NS
	M	16.66±1.15[b]	18.16±0.71[b]	120.25±2.12[b]	17.66±0.98[a]
	F	18.00±0.66[a]	19.40±0.51[a]	127.00±4.05[a]	17.00±0.66[a]

a,b,c: Means with different superscripts on the same column differ significantly. HW: Height at Withers, BH: Back Height, HS: Height at sacrum, TL: Tail length DHI: distance of head until the ischium, BL: Body Length, RL: Rump Length, HdL: Head Length, SW: Shoulder Width, CW: Chest Width, HipW: Hip width, TW: Thurl Width, PW: Pelvic width, HdW: Head Width, CG: Chest Girth, CP: Canon Perimeter, S: Significance, NS: Non significant,*: p<0.05; **: p<0.01, ***: p<0.001

considered twelve age classes in Red Chittagong cattle and reported the effect of age on changes in body measurements in these animals.

For Height at the withers, only two age groups (0-6 months, 24-36 months) showed a significant difference between males and females. For all other classes, males significantly dominated females. For the same breed, Alkoiret *et al.* (2016) came to similar findings when reporting that at the ages of 6 and 12 months, the Height at the withers was more marked in males than females (94.6±2.8 vs 88.9±1.6 and 106.5±3.1 vs. 103.1±2.5 for the two age groups respectively). The values obtained for Height at the withers in Borgou cattle aged 0-6 months are close to those of Red Chittagong cattle aged 1-7 months (72.29±0.31, SE) in Bangladesh according to the report of Hadiuzzaman *et al.* (2010). Considering this same source, Borgou cattle aged 6-12 months have a higher height at the withers than Red Chittagong cattle aged 7-12 months (93.35±4.87, SD vs 81.48±0.40). For this same measurement, the values collected in the present study for animals aged 12-24 months, 24-36 months, 36-48 months and >48 months are higher than those reported for Red Chittagong cattle according to the age groups reasonably close to findings from this study (13-18, 19-24, 25-30, 31-36, 37-42, 43-48, 49-54, 55-60, 61-66 and >66 months). On the other hand, Rashid *et al.* (2016) reported higher values for Crossbred Brahman cattle in Bangladesh compared to Borgou cattle: 108±0.8 in Crossbred Brahman cattle aged 9-12 months vs 93.35±4.87 in Borgou cattle aged 6-12 months; 119±0.79 in Crossbred Brahman cattle aged 21-24 months vs. 107.70±5.83 in Borgou cattle aged 12-24 months for this measurement (Height at the withers).

This study revealed that between 0-6 months, the BL of males and females were 61.58±6.90 and 60.00±6.32, respectively, without any significant difference. These values are lower than those reported by Alkoiret *et al.* (2016) on the same breed since they reported values of 79.5±0.5 and 75.1±0.8 at 3 months; then 80.3±1.0 and 80.0±1.8 respectively in both sexes with a significant difference at 3 months and a non-significant difference at 6 months. Between 6-12 months of age, the present study revealed that the BL in males (75.90±6.36) was statistically different from that of females (67.30±8.25). Between 12-24 months, the difference was also significant for this measurement (103.30±4.98 in males and 96.50±6.24 in females). The obtained findings are different from those of Alkoiret *et al.* (2016). In fact, at 12 months age, these authors documented values of 93.4±1.4 and 93.5±2.2 respectively in males and females without significant difference for the same measurement and at 24 months; the values were 106.5±2.8 and 107.0±4.5 in Borgou male and female respectively with no significant difference. The BL appears to be narrower in the Borgou breed compared to the Red Chittagong breed. In fact, for BL, we recorded 60.8±6.61 in the Borgou breed between 0-6 months vs 68.70±0.42 in the Red Chittagong breed between

Table 4. Changes of body measurements in male and female Borgou cattle aged 36-48 months and >48 months

Factors		Measurements (cm)			
Factors	Sex	HW	BH	HS	TL
36-48		***	***	NS	NS
	M	119.44±4.03[a]	116.66±5.04[a]	118.55±3.11[a]	68.00±4.87[a]
	F	111.10±3.82[b]	109.50±4.31[b]	118.10±4.38[a]	67.10±4.33[a]
>48		***	***	***	**
	M	137.50±4.63[a]	133.70±4.30[a]	134.30±4.84[a]	94.00±4.37[a]
	F	121.00±7.48[b]	124.57±4.95[b]	127.57±5.41[b]	82.78±5.41[b]
		DHI	BL	RL	HdL
36-48		NS	NS	NS	NS
	M	142.00±8.51[a]	105.11±6.74[a]	23.33±0.97[a]	39.55±1.19[a]
	F	138.80±9.10[a]	103.80±6.03[a]	22.70±1.71[a]	39.80±2.54[a]
>48		***	NS	***	**
	M	176.30±7.15[a]	117.10±7.91[a]	28.00±1.77[b]	46.70±1.94[a]
	F	161.71±9.19[b]	114.00±6.76[a]	32.42±4.99[a]	44.67±2.71[b]
		SW	CW	HipW	TW
36-48		NS	**	NS	NS
	M	58.88±5.89[a]	21.44±1.29[a]	31.44±1.68[a]	28.77±3.17[a]
	F	58.60±4.25[a]	20.40±0.82[b]	30.70±1.45[a]	28.30±2.71[a]
>48		***	**	***	***
	M	85.80±7.29[a]	25.20±2.58[a]	40.70±1.94[a]	35.60±3.31[a]
	F	56.78±6.49[b]	23.21±2.07[b]	33.92±2.22[b]	32.00±3.52[b]
		PW	HdW	CG	CP
36-48		*	NS	*	***
	M	19.88±1.13[a]	19.66±0.84[a]	136.77±10.46[a]	19.38±0.47[a]
	F	18.90±1.16[b]	19.30±0.65[a]	129.90±5.99[b]	18.30±0.76[b]
>48		***	***	***	***
	M	24.10±2.26[a]	23.10±1.16[a]	161.40±2.01[a]	23.05±1.81[a]
	F	19.82±1.61[b]	20.92±1.11[b]	148.78±7.50[b]	17.57±1.76[b]

a,b,c: Means with different superscripts on the same column differ significantly. HW: Height at Withers, BH: Back Height, HS: Height at sacrum, TL: Tail length DHI: distance of head until the ischium, BL: Body Length, RL: Rump Length, HdL: Head Length, SW: Shoulder Width, CW: Chest Width, HipW: Hip width, TW: Thurl Width, PW: Pelvic width, HdW: Head Width, CG: Chest Girth, CP: Canon Perimeter, S: Significance, NS: Non significant,*: p<0.05; **: p<0.01, ***: p<0.001

1-6 months; 71.60±8.48 in the Borgou breed between 6-12 months vs 73.66±0.44 in the Red Chittagong breed between 7-12 months. On the other hand, the trend is reversed for age groups over 12 months. Hadiuzzaman *et al*. (2010) found lower values for all the remaining age groups (13-18 months to >66 months) compared to Borgou cattle (12-24 months to >48 months). In addition, Rashid *et al*. (2015) reported higher values (for BL) in Crossbred Brahman cattle in Bangladesh compared to Borgou cattle: 105±0.96 in Crossbred Brahman cattle aged 9-12 months vs 71.60±8.48 in Borgou cattle aged 9-12 months. 6-12 months; 124±1.30 in Crossbred Brahman cattle aged 21-24 months vs. 99.90±6.55 in Borgou cattle aged 12-24 months.

Chest width appears to be less developed in the Borgou breed at ages 0-6 months (14.65±1.53) and 6-12 months (17.10±1.97) months compared to that of the Red Chittagong breed at 1-6 months (18.15±0.35), 7-12 months (18.59±0.40). After 24 months, this value is similar to that of Red Chittagong cattle (20.61±0.25); after 36 months and 48 months, this becomes lower than that of Red Chittagong cattle regarding the same age (21.18±1.56 vs 25.23±0.35 and 20.89±1.1 vs 26.23±0.33 respectively).

As for hip width, the values recorded for the Borgou breed in this study are greater than those of Red Chittagong cattle when comparing all the age groups: 16.73±1.58 in the Borgou breed at 0-6 months vs 15.66±0.36 for the Red Chittagong at 1-6 months; 20.45±2.20 in the Borgou breed at 6-12 months vs 17.55±0.40 in the Red Chittagong at 7-12 months; 28.80±2.34 in the Borgou breed at 12-24 months vs 22.36±0.43 at 19-24 months in the Red Chittagong; 28.45±1.47 in the Borgou breed at 24-36 months vs. 26.31±0.41 in the Red Chittagong at 31-36 months; 31.05±1.59 in the Borgou breed at 36-48 months vs. 26.57±0.38 in the Red Chittagong at 43-48 months and 36.75±3.97 in the Borgou breed at >48 months vs. 29.34±0.42 in the Red Chittagong at 61-66 months.

The thurl width turns out to be less developed in the Borgou breed than the Red Chittagong at the age of 6 months (19.08±2.20 in the Borgou breed between 0-6 months vs 21.56±0.45 in the Red Chittagong between 1-6 months); at 48 months (28.52±2.91 in the Borgou breed between 36-48 months vs 30.29±0.49 in the Red Chittagong between 43-48 months). However, Borgou cattle over 48 months of age show similar values for thurl width compared to 49-54 month-old Red Chittagong cattle (33.50±3.84 vs 33.30±0.40) but these values remain lower than those of Red Chittagong cattle for the age groups 61-66 months (36.60±0.55) and +66 months (37.95±0.48).

Compared to Red Chittagong cattle, Pelvic width is shorter in Borgou cattle at all age groups considered. We can note 15.30±1.79 in the Borgou breed between 0-6 months vs 20.65±0.43 in Red Chittagong cattle between 1-6 months; 17.95±1.76 in the Borgou breed between 6-12 months vs 21.62±0.38 in Red Chittagong cattle between 7-12 months; 22.05±2.08 in the Borgou breed between 12-24 months vs 26.62±0.31 in Red Chittagong cattle between 19-24 months; 22.81±1.78 in the Borgou breed between 24-36 months vs 31.07±0.33 in Red Chittagong cattle between 31-36 months; 23.00±1.43 in the Borgou breed between 36-48 months vs 37.07±0.51 in Red Chittagong cattle between 43-48 months and 30.58±4.52 in Borgou cattle >48 months vs 34.19±0.60 in Red Chittagong cattle between 49-54 months.

In the current study, the measurements of Chest girth between males (72.66±8.40) and females (71.54±8.40) were not significantly different for the age group of 0-6 months but between 6-12 months, the males gained the upper hand over the females (95.80±6.30 vs 90.40±7.62). But between 12-24 months, the females had caught up with the males and dominated the males between 24-36 months (127.00±4.05 vs 120.25±2.12). At advanced ages, males regained the upper hand over females (136.77±10.46 vs 129.90±5.99 at 36-48 months and 161.40±2.01 vs 148.78±7.50 at >48 months). Alkoiret *et al*. (2016) reported a significant difference only for animals aged 6 months with a dominance of males over females (95.6±3.4 vs 90.9±1.6) on the same breed. The Chest girth of Borgou cattle showed significant lower values compared to those of Crossbred Brahman cattle in Bangladesh according to the values reported by Rashid *et al*. (2016): 93.10±7.42 in Borgou cattle aged 6-12 months vs. 127±1.53 for Crossbred Brahman cattle aged 9-12 months (i.e. about 25% less than Crossbred Brahman cattle); 122.40±5.19 in Borgou cattle aged 12-24 months vs 151±1.57 in Crossbred Brahman cattle aged 21-24 months (i.e. about 20% less than Crossbred Brahman cattle).

CONCLUSION

This study enabled us to explore changes on body measurements in Borgou cattle considering age and sex. From the obtained results, it appears that all the morphological measurements in the Borgou cattle generally increased with age and most measurements are more noticeable in males. This study constitutes important documentation for the determination of type and function indicators in Borgou cattle in Benin.

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CONFLICT OF INTEREST

The authors declare no conflict of interest

REFERENCES

Alkoiret, I.T., Gbangboché, A.B, Toukourou, Y., Toure, F.Z., 2016. Performances de croissance des bovins Borgou et N'Dama à la Ferme d'Élevage de l'Okpara au nord Bénin. Journal of Animal & Plant Sciences 29, 4638-4650.

Banerjee, S. 2015. Morphometrical and production traits of Bengal sheep in West Bengal, India. Animal Genetic Resources 57, 57–71

Birteeb, P.T., Peters, S.O., Ozoje, M.O., 2014. Analysis of the body structure of Djallonke sheep using a multideterminant approach. Animal Genetic Resources 54, 65–72.

Boujenane, I., 2015. Multivariate Characterisation of Oulmes-Zaer and Tidili Cattle Using the Morphological Traits. Iranian Journal of Applied Animal Science 5, 293-299.

Boujenane, I., Derqaoui, L., Nouamane, G., 2016. Morphological differentiation between two Morrocan goat breeds. Journal of Livestock Science and Technologies 4, 31-38.

Dauda, A., Anya, M.I., Ayuk, A.A., Okon, B.I., Eburu, P.O., 2018. Application of morphological indices and distribution of qualitative traits of cattle in Obudu grass plateau-cross river state. Research and Reports on Genetics 2, 5-9.

Dehoux, J.P., Hounsou-Ve, G., 1993. Productivité de la race bovine Borgou selon les systèmes d'élevage traditionnels au Nord-Est du Bénin. Revue mondiale de zootechnie 74, 36–48.

FAO, 2012. Phenotypic characterization of animal genetic resources. FAO Animal Production and Health Guidelines No. 11. Rome.

Gwaza, D.S., Yahaya, A., 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. Research and Reports on Genetics. 2, 19-25

Hadiuzzaman, M., Bhuiyan, A.K.F.H., Bhuiyan, M.S.A., Habib M.A., 2010. Morphometric characteristics of Red Chittagong cattle in a nucleus herd. Bangladesh Journal of Animal Science 39, 44 – 51 ISSN 0003-3588

Putra, W.P.B., Said, S., Arifin, J., 2020. Principal component analysis (pca) of body measurements and body indices in the Pasundan cows. Black Sea Journal of Agriculture 3, 49-55.

R Core Team 2020. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Rashid, M.M., Hoque, M.A., Huque, K.S., Bhuiyan, A.K.F.H., 2016. Prediction

of live weight for Brahman crossbred cattle using linear body measurements in rural area. Advances in Animal and Veterinary Sciences 4, 99-106.

Worogo, H.S.S., Tchokponhoué, U., Idrissou, Y., Assani, A.S., Alabi, C.D.A., Azalou, M., Adjassin, J.S., Alkoiret I.T., 2021. Principal component analysis of biometric traits in Borgou cattle breed reared in situ conservation farm in northern Benin. Iranian Journal of Applied Animal Science 11, 241-247

Worogo, S.S.H, Attakpa E., Offoumon T.L.F., Idrissou R., Assani, AS., Alabi, C.D.A., Idrissou, Y., Alkoirret, I.T., 2022. Herd features in Borgou cattle farming systems in north Benin. Adv. Anim. Vet. Sci. 10, 62-67.

Worogo, S.S.H., Idrissou R., Assani, S.A, Alabi, C.D.A., Adjassin, S.J, Azalou M., Idrissou Y., Assogba, B.G.C., Alkoiret I.T., 2020. Towards community-based in situ conservation strategies: a typological analysis of Borgou cattle herding systems in northeastern Benin. Tropical Animal Health and Production 52, 1055–1064

Worogo, S.S.H., Idrissou, Y., Assani, A.S., Assogba, B.C.G., Alkoiret, I.T., 2018. Growth Performance at Weaning of Borgou Cattle in Northern Benin. Haya: The Saudi Journal of Life Sciences (SJLS) 3, 474-480.

Youssao A.K.I., 2015. Programme National d'Amélioration Génétique. Rapport annuel du Projet d'Appui aux Filières Lait et Viande (PAFILAV). Cotonou, Bénin, p.12.

Youssao, A.K.I., Dahouda, M., Attakpa, E.Y., Koutinhouin, G.B., Ahounou, G.S., Toleba, S.S., Balogoun, B.S., 2013. Diversité des systèmes d'élevages de bovins de race bovine Borgou dans la zone soudanienne du Bénin / International Journal of Biological and Chemical Sciences 7, 125-146.

Youssao, A.K.I., Koutinhouin, G.B., Kpodekon, T.M., Agnandjo, H., Toure, Z., Ahissou, A., 2009. Influence d'une sélection phénotypique sur les performances de croissance et les caractères de développements musculaire et squelettique de jeunes bovins de race Borgou à la Ferme d'Elevage de l'Okpara (Bénin). Annales de Médécine Vétérinaire 153, 105-111.