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SHORT NOTE

Biometric evaluation of Brazilian Crioula Lageana cattle

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ADDITIONAL KEYWORDS

Animal conservation.
Body size.
Bos Taurus.
Locally adapted breed.

SUMMARY

The aim of the present study was to evaluate biometric measures of Crioula Lageana cattle breed at different ages, to establish patterns of variation of these measures, contributing to the phenotypic characterization of the breed. Body measurements (body length, shoulder height, thoracic perimeter, rump height, rump width and rump length) were collected from 346 animals from three different regions of the Santa Catarina State Plateau (Campos de Curitibanos, Coxilha Rica and Campos de Caçador). The biometric measurements were evaluated in relation to age, gender and region of origin. Statistical analysis was performed using SAS version 9.3. The procedures used included analysis of variance, correlations, cluster, discriminant and canonical analysis. Statistical difference between males and females was observed for all measurements, except rump height, demonstrating sexual dimorphism. Rump height varied up to 3 and 5 years of age and body length varied in animals over 11 years of age; while rump width and thoracic perimeter varied up to 7 and 9 years of age. On average, 50% of the animals were classified correctly, indicating little difference between regions for biometric traits. Also, animals from Campos de Curitibanos were those with greater distance from the other two regions of the Santa Catarina plateau. Correlations between shoulder height, rump width and length were above 0.80. So, rump length could be considered the measurement best suited for assessment of body size of this breed due to the high correlation with the other measures and the easy way to assess this parameter.

Avaliação morfológica da raça bovina Crioula Lageana

PALAVRAS CHAVE ADICIONAIS

Bos Taurus.
Conservação animal.
Raça localmente adaptada.
Tamanho corporal.

RESUMO

O objetivo do presente estudo foi avaliar medidas morfométricas de bovinos da raça Crioula Lageana em diferentes idades, para estabelecer padrões de variação dessas medidas, contribuindo para a caracterização fenotípica da raça. Foram coletadas medidas corporais (comprimento corporal, altura da cernelha, perímetro torácico, altura da garupa, largura da garupa e comprimento de garupa) de 346 animais oriundos de três regiões do Planalto Catarinense (Campos de Curitibanos, Coxilha Rica e Campos de Caçador). As medidas morfométricas foram avaliadas em relação à idade, sexo e região de origem. A análise estatística foi realizada utilizando SAS versão 9.3. Os procedimentos utilizados incluíram análise de variância, correlações, cluster, discriminante e canônica. Foi observada diferença estatística entre machos e fêmeas para todas as medições, exceto altura da garupa, demonstrando o dimorfismo sexual. A altura da garupa variou até 3 e 5 anos de idade e comprimento do corpo variou em animais com mais de 11 anos de idade; enquanto a largura da garupa e perímetro torácico variaram até 7 e 9 anos de idade. Em média, 50% dos animais foram classificados correctamente, o que indica pouca diferença entre as regiões para as características morfométricas. Além disso, animais de Campos de Curitibanos foram os que apresentaram maior distância dos animais das outras regiões do planalto de Santa Catarina. As correlações entre altura da cernelha, largura e comprimento da garupa foram acima de 0,80. Assim, o comprimento da garupa pode ser considerado a medida mais adequada para avaliação do tamanho corporal desta raça, devido à alta correlação com as outras medidas e a facilidade de medição deste parâmetro.

INFORMATION

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INTRODUCTION

Phenotypic characterization is one of the most important steps in any conservation program (Chacón et al., 2008) because provides basis for animal selection process and strategy for the preservation of endangered species (McManus et al., 2001). Knowledge of the biometric features of a breed is critical to the esta-

blishment of reference parameters for the population and is important for planning conservation programs (Tjon and Molina-Flores, 2016; Sánchez Gutiérrez et al., 2018), as well as for later use in animal breeding programs (Ribeiro et al., 2004; Mariz et al., 2016).

Crioula Lageana is, among the locally adapted breeds included in the Brazilian Animal Genetic Resources Program, the only cattle breed adapted to climatic variation of the Southern Brazil, which corresponds to extremes cold and heat (Mariante et al., 2009). At the end of the 80s, the population was reduced to no more than 500 animals of which more than 80% belonged to one breeder (Mariante and Trovo, 1989). Nowadays, after the creation of the Crioula Lageana Brazilian Association in 2003 and the recognition by the Ministry of Agriculture, Livestock and Supply in 2008, the current population exceeds 1,400 animals. The need to preserve the Crioula Lageana breed can be an instrument to improve the rusticity of cattle of high productivity but of low capacity of adaptation to environments with extreme climatic variability and poor vegetation (Mariante et al., 2009; McManus et al., 2009b).

Multivariate analyses in phenotypic characterization studies, using morphological variables, are suitable in assessing the variation within a population and can identifies the existence of subpopulations within a breed when all measured morphological variables are considered simultaneously (Traoré et al., 2008).

Considering that there are few studies on phenotypic variables and its relationship with productive traits characteristics of Brazilian locally adapted breeds (Bianchini et al., 2006; McManus et al., 2010; Carvalho et al., 2013) the aim of the present study was to evaluate biometric measurements of Crioula Lageana cattle at different ages, in three regions of Santa Catarina plateau, in order to establish patterns of variation of these measurements, contributing to the phenotypic characterization of the breed.

MATERIAL AND METHODS

The study was carried out in the Santa Catarina Plateau, located in the central portion of the state of Santa Catarina, between parallels 26°10 'and 28°40' south latitude and meridians 49°10 'and 51° 0' west longitude. The altitude ranges between 700 and 1,800 meters above sea level, with altitudinal gradient declining in east-west direction. The climate, according to Köppen classification system is Cfb type (humid temperate without drought), characterized by cold winters with high incidence of frosts and mild summers (Peel et al., 2007).

Biometric measurements of 346 Crioula Lageana animals **(Figure 1)** located in three regions of Santa Catarina plateau (Coxilha Rica, Campos de Curitibanos and Campos de Caçador) were evaluated. All animals were raised under extensive system based on native pasture. The following body regions were measured: body length (BL) shoulder height (SH), thoracic perimeter (TP), body length (BL), rump height (RH), rump width (RW) and rump length (RL).

The animals were assessed according to the following parameters:

Gender: males (n = 50) and females (n = 296).

Age: the animals were divided into six age groups:

- 1: animals between 2 and 3 years (n = 50).
- 2: animals between 3 and 5 years (n = 55).
- 3: animals between 5 and 7 years (n = 73).
- 4: animals between 7 and 9 years (n = 63).
- 5: animals between 9 and 11 years (n = 56).
- 6: animals older than 11 years (n = 49).

Origin: animals were measured in three regions of Santa Catarina plateau:

- Region 1 - Coxilha Rica (n = 118).
- Region 2 - Campos de Curitibanos (n = 203).

Figure l. A male (A) and a female (B) of the Crioula Lageana cattle breed (Picture authors: Edson Martins and Arthur da Silva Mariante).

Table I. Biometric measurements (cm) of Crioula Lageana cattle by gender and age (Medidas morfológicas (cm) de bovinos Crioula Lageana de acordo com o gênero e a idade).

	BL	SH	TP	RH	RW	RL
Gender						
Males (n=50)	149,3[a]	129,9[a]	185,9[a]	132,8[a]	46,4[b]	49,4[a]
Females (n=246)	145,3[b]	125,5[b]	177,1[b]	131,4[a]	47,5[a]	48,0[b]
Age (years)						
2-3 (n=50)	131,4e	118,8[c]	158,0[c]	125,3[c]	39,5[c]	43,1d
3-5 (n=55)	143,9d	125,1[b]	177,9[b]	133,3[ba]	47,4[b]	47,9[c]
5-7 (n=73)	145,9d[c]	125,4[b]	178,2[b]	131,2[b]	46,7[b]	47,8[c]
7-9 (n=63)	147,4[c]	127,1[ba]	183,0[a]	132,1[ba]	49,2[a]	49,0[b]
9-11 (n=56)	151,0[b]	130,2[a]	185,2[a]	133,8[a]	50,3[a]	50,2[a]
>11 (n=49)	155,2[a]	129,9[a]	185,9[a]	133,7[a]	50,3[a]	51,0[a]
CV	6,32	6,77	5,89	4,69	7,59	6,35

Averages with different letters in the column differ (P<0.05) by Duncan test. CV: coefficient of variation; n: number of animals; BL: body length; SH: shoulder height; TP: thoracic perimeter; RH: rump height; RW: rump width and RL: rump length.

• Region 3 - Campos de Caçador (n = 25).

Statistical analysis was performed using SAS version 9.3 (Statistical Analysis Institute, Cary, North Carolina). The procedures used included analysis of variance (GLM) and correlations (CORR). After standardization, the data underwent multivariate statistical analysis including cluster, discriminant and canonical procedures.

RESULTS AND DISCUSSION

All biometric measures were influenced by age **(Table I)**. The coefficient of variation ranged from 4.69 to 7.59, indicating low individual variation between animals. All biometric measurements, with the exception of rump height, showed differences between males and females. Male and older animals were generally larger, even at advanced ages **(Table I)**.This is in agreement with Bianchini et al. (2006) who, when studying locally adapted cattle breeds, also observed that there were significant differences between gender for all size measurements. Previous studies with Argentine Creole, Lucerna and Pantaneira cattle also reported biometric measurements variations due to gender (Mahecha et al., 2002; Abreu et al., 2005).

Crioula Lageana cattle showed sexual dimorphism. The fact that males and females are noticeably different is common in farm animals due to male secondary sexual traits that give greater physical strength compared to females (McManus et al., 2005). In the present study, rump width was greater in females as result of the pelvic anatomy necessary to allow the passage of the calf at birth. However, difference in rump width between males and females were not observed in previous study with Curraleiro Pe Duro cattle breed, sexual dimorphisms was only reported for some features such as shoulder height, rump height, thoracic perimeter, forehead width and horn length (Carvalho et al., 2013).

Relationship between biometric measurements and age have been reported by several studies (Lôbo et al., 2002; Mahecha et al., 2002; Abreu et al., 2005; Pacheco et al., 2008). However, there is little information in locally adapted breeds in Brazil. In the present work RH, RW and RL increased up to 7, 9 and 11 years respectively. Previous study with Guzerat cattle reported SH and RH variation until 36 months and TP variation until 48 months (Pacheco et al., 2008).

Unlike commercial breeds, which were subjected to artificial selection for productivity traits, natural selection and adaptation to the Santa Catarina plateau were the only factors responsible for the biometric dimensions of Crioula Lageana cattle. This could be one of the reasons responsible for the variation of biometric measurements until older ages, suggesting later development. These findings are in agreement with previous study with Lucerna cattle in Colombia, which observed BL and SH variation up to 7 years of age (Mahecha et al., 2002).

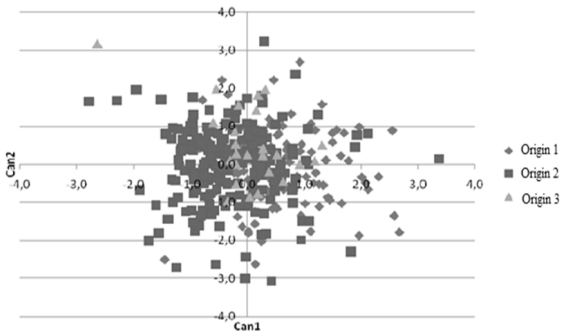

Figure 2. Canonical analysis of Crioula Lageana cattle by region of origin. Origin l: Coxilha Rica (n=118); Origem 2: Campos de Curitibanos; (n=203) and origem 3: Campos de Caçador (n=25) (Análise canónica de bovinos Crioula Lageana de acordo com a regiao de origem. Origem l: Coxilha Rica (n=118); Origem 2: Campos de Curitibanos (n=203) e Origem 3:Campos de Caçador (n=25)).

Table II. Percentage of Crioula Lageana cattle correctly classified in their region of origin in Santa Catarina Plateau using biometric measures (Porcentagem de bovinos Crioula Lageana corretamente classificados em sua região de origem no Planalto de Santa Catarina usando medidas morfológicas).

Origin	Coxilha Rica	Campos de Curitibanos	Campos de Caçador
Coxilha Rica (n=118)	53,38%	22,04%	24,58%
Campos de Curitibanos (n=203)	23,15%	50,25%	26,60%
Campos de Caçador (n=25)	20,00%	28,00%	52,00%

Table III. Pearson correlations between biometric measurements of Crioula Lageana cattle (n = 346) (Correlação de Person entre as medidas morfológicas de bovinos Crioula Lageana (n = 346)).

	SH	TP	RW	RH	RL
BL	0,50	0,77	0,65	0,79	0,78
SH		0,54	0,63	0,51	0,55
TP			0,66	0,83	0,81
RW				0,67	0,68
RH					0,83

BL: body length; SH: shoulder height; TP: thoracic perimeter; RH: rump height; RW: rump width and RL: rump length.

Several authors have used multivariate statistical analysis to verify the relationship between farm animals, grouping them according to measured variables (Castanheira et al., 2010b; McManus et al., 2009a; Adeyemi and Oseni, 2018). In the present study, multivariate discriminant analysis using biometric measurements to assess whether the original classification of the groups were appropriate found that, on average, 50% of the animals were classified correctly, indicating little difference between regions for these traits **(Table II)**.

The canonical discriminant analysis, based on biometric characteristics of Crioula Lageana breed also showed little difference between individuals in the three regions in the first two dimensions of origin in the Plateau of Santa Catarina **(Figure 2)**. These findings were expected as the animals were raised under similar environment and management conditions. Study with Santa Ines and Suffolk sheep also reported an overlay

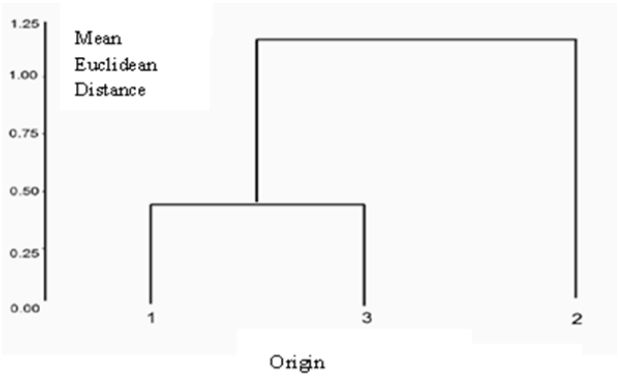

Figure 3. Dendrogram based on the Euclidean distance between animals considering the regions of origin using biometiic measurements. Origin 1: Coxilha Rica (n=118); Origin 2: Campos de Curitibanos (n=203) and Origin 3: Campos de caçador (n=25). (Dendograma baseado na distancia Euclidiana enti·e os animais considerando a regiao de origem usando medidas biométricas. Origem 1: Coxilha Rica (n=118); Origem 2: Campos de Curitibanos (n=203) e Origem 3: Campos de Caçador (n=25)).

indicating that these breeds were grouped due to similar biometric traits (Castanheira et al., 2010a). Nevertheless, a difference was seen in the third dimension (not shown), separating Campos de Curitibanos from the other two origins.

Hierarchical clustering was able to separate the animals in three groups of origin, in which the individuals of Campos de Curitibanos were those with greater distance from the animals of the other two regions of the Santa Catarina plateau **(Figure 3)**.

Considering that this parameters was based on biometric measurements, the difference between animals from Campos de Curitibanos and the other two regions may be a result of the low percentage of males (33% of the total population) and the high percentage of young animals up to 5 years (99% of total population), resulting on average in a smaller population when compared with the animals of Coxilha Rica and Campos de Caçador.

High correlations were observed between all body measurements, ranging from 0.50 to 0.83 **(Table III).** Previous researches with cattle also reported high correlation between biometric measurements (Baker et al., 1988; Hagger and Hofer, 1991; Lôbo et al., 2002; Mahecha et al., 2002). These correlations suggest that there is no need to take several measurements in breeding programs (Winkler et al., 1997).

In this study, correlations between SH, RW and RL were above 0.80. According to Yokoo et al. (2007), when the correlation between the two characteristics is above 0.80, one of them can be used for selecting animals for both traits. Thus, rump length could be considered the measurement best suited for assessment of body size of this breed due to the high correlation with the other measures and the easiness to assess this parameter.

CONCLUSIONS

Natural selection and adaptation to the Santa Catarina plateau environment for centuries, along with

some limited phenotypic selection by farmers, are responsible for the biometric dimensions of Crioula Lageana cattle. The late development of these animals are due to lack of selection for commercial traits, and phenotypic variation exists in the traits measured here which should allow for the creation of a breeding program.

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