

# Characterization of carcasses of Zebu cattle raised in a semiarid region according to sex

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**ABSTRACT** - The objective was to group and characterize Zebu cattle carcasses according to sex. Data from 15,002 carcasses of cattle raised in the semiarid region of the state of Minas Gerais, Brazil, were used. The carcass characteristics analyzed were weight, conformation, subcutaneous fat, number of permanent incisor teeth (PIT), and sex (uncastrated males, castrated males, females (up to six PIT), and cows (eight PIT)). Cluster analysis was applied to establish the relationship between sex and carcass characteristics. Four clusters were identified according to sex, and 60% of the total variance in the data set is explained by the clusters. Uncastrated males appear together in a single group (Cluster 1), which demonstrates homogeneity in their carcass characteristics. The heaviest group was Cluster 1. The castrated males appear in three groups, some of them (33.58%) grouped with the majority of cows (92.85%), which indicates that these carcasses did not achieve the quality required by the industry. Another part of the castrated males (41.84%) presented characteristics required by the industry. The females appear in all clusters. Except for uncastrated males and cows, the effect of sex (castrated males and females) on the carcass characteristics of Zebu cattle from the semiarid region of the Minas Gerais does not assure similar characteristics. Therefore, the improvement of carcass quality, using castration as the central grading criterion, should be reviewed not to overemphasize this item.

**Keywords:** beef cattle, Caatinga, Nellore, uncastrated male

## 1. Introduction

In Brazil, carcasses are classified according to the criteria of Brazilian Normative Instruction 9 as of May 4, 2004 (Brasil, 2004). In this instruction, the evaluated parameters are sex, maturity, weight, and carcass finishing. Uncastrated males, castrated males, heifers, and cows are the sexes described in this legislation. In brief, carcasses of uncastrated males showed greater weight and percentage of muscles and lower subcutaneous fat cover than castrated males (Vittori et al., 2006; Pinheiro et al., 2009; Mueller et al., 2019). Females have lower carcass weight than castrated males (Vaz et al., 2010) due to lower adult weight.

Brazilian slaughterhouses disclose grading manuals with desirable patterns of measures. Usually, the measures sought are: carcasses weighing between 240 and 330 kg, fat cover between 3 and 10 mm, and maturity between zero and six permanent incisor teeth (PIT). They also do not subsidize and/or penalize uncastrated carcasses, but express an explicit preference for castrated males. Although sex has an influence on carcass composition, according to Baêta and Souza (1997), the environment can cause differences in productivity and, consequently, carcass characteristics. Thus, due to changes in the environment, the question is whether sex really groups carcasses with similar characteristics and whether it is a fact that the carcasses of castrated males have measures desired by the industry. In addition to the weight and fat cover of the carcasses, the age is also considered to determine early finishing, defined by Lanna (1997) as animals that reach the body composition of the carcass suitable for slaughter at a young age.

In view of the above, the objective was to group and characterize carcasses of cattle from the semiarid region of the state of Minas Gerais according to sex.

## 2. Material and Methods

Data from 15,002 carcasses of Zebu cattle from 2007 and 2008 (Table 1) were used. After fasting, cattle were slaughtered after stunning with a bolt gun. Inspection work on the slaughter lines was carried out by a team of inspection agents duly trained to carry out the post-mortem inspection under the supervision and responsibility of an official veterinary of the Federal Inspection Service (Ferreira et al., 2014). The variables analyzed in the study were hot carcass weight, carcass conformation, subcutaneous fat score, sex, and number of incisor teeth. The animals, randomly included in the survey, belonged to 32 cities and 56 farms (98.87% of the finishing cattle on pasture) from the semiarid region of Minas Gerais, Brazil. The cities of the study and the percentage of animals in each one are as follows: Janaúba (17.77%), Itacarambi (14.38%), Jaíba (10.07%), Montes Claros (9.99%), São João da Ponte (8.55%), Capitão Enéas (7.75%), Jequitaiá (6.00%), Francisco Sá (4.43%), São Francisco (3.95%), Verdelândia (3.90%), Brasília de Minas (1.71%), Matias Cardoso (1.56%), Patis (1.52%), Francisco Dumont (1.36%), Brasilândia de Minas (1.22%), Rubelita (0.69%), Espinosa (0.57%), Engenheiro Navarro (0.50%), Joaquim Felício (0.49%), Manga (0.49%), São João do Pacuí (0.43%), Claro dos Poções (0.42%), Coração de Jesus (0.29%), Salinas (0.29%), São João da Lagoa (0.29%), Mirabela (0.26%), Juramento (0.25%), Pedras de Maria da Cruz (0.25%), Varzelândia (0.22%), Januária (0.14%), Ponto Chique (0.14%), and Pai Pedro (0.13%).

For the sex evaluation, carcasses were classified according to Normative Instruction 9, dated May 4, 2004 of the Ministry of Agriculture, Livestock, and Supply (Brasil, 2004). In this study, four categories were evaluated: uncastrated males, castrated males, females (up to six PIT), and cows (eight PIT). The hot carcass weight was obtained by the sum of the half-carcasses measured in the inspection line. The number of incisor teeth of each animal was determined by reading the dental arch on the inspection line.

**Table 1** - Characteristics of bovine carcasses according to sex

	Sex			
	Uncastrated males	Cows <sup>1</sup>	Females <sup>2</sup>	Castrated males
No. animals	3781	1524	1993	7704
HCW (kg)	273.32±32.99	205.21±28.41	165.36±39.45	251.17±28.31
Age (PIT)	3.45±1.58	8.00±0.00	2.36±1.96	4.83±1.81
Conformation	1.87±0.21	1.70±0.01	1.45±0.18	1.73±0.30
SFS	2.36±0.72	2.66±0.63	2.23±0.90	2.66±0.56

No. animals - sampling number; HCW - hot carcass weight; PIT - permanent incisor teeth; conformation - mean conformation score (1 to 3; inferior, good and excellent, respectively); SFS - mean subcutaneous fat score (1 to 5; absent, scarce, moderate, considerable amount, and excessive, respectively).

<sup>1</sup> Cows - eight PIT.

<sup>2</sup> Females - up to six PIT.

The subcutaneous fat score and carcass conformation were visually evaluated in the slaughterhouse during the passage of the carcasses on the inspection line. A slaughterhouse employee, previously trained, assessed the subcutaneous fat score and the carcass conformation (Brasil, 2004). The subcutaneous fat score followed the carcass classification scale from 1 to 5 (Félicio, 2011), in which 1 corresponded to the absence of fat (0-1 mm), 2 indicated scarce fat (>1 to <3 mm), 3 indicated a moderate amount of fat (3-6 mm), 4 indicated a considerable amount (>6 to 10 mm), and 5 indicated an excessive amount of fat (>10 mm). The conformation was evaluated by the classification scale of carcasses from 1 to 3, with 1 = subconcave or concave carcass, 2 = rectilinear carcass, and 3 = subconvex or convex carcass.

Cluster analysis (centroid clustering) was applied to establish the relationship between the sex categories of the animals evaluated in this study and the similarity or dissimilarity between them in relation to the carcass characteristics (carcass weight, age, conformation, and subcutaneous fat score). Clusters were made using the carcass characteristics, and then the sexes in each group were evaluated. The number of clusters was not specified before the analysis; the Statistica software (version 8.0) used automatic methods based on a cross-validation to determine the best-fitting clusters. For the dissimilarity measure, the Euclidean distance was used, which is a coefficient that produces the degree of dissimilarity based on the distance between clusters. A chi-square test was used to test the difference between clusters ( $P < 0.05$ ).

### 3. Results

Four clusters were identified according to sex (Table 2), and 60% of the total variance in the data set is explained by the clusters. The uncastrated males appeared in a single group (Cluster 1). The heaviest group was Cluster 1 ( $256.96 \pm 56.13$  kg). The castrated males appeared in three groups, some of them grouped with cows (33.58%) (Cluster 2). Another part of the castrated males presented an early finishing (41.84%) (Cluster 4). Cluster 4 was the group with the highest subcutaneous fat score ( $2.95 \pm 0.47$ ). Cluster 3 (cows, female, and castrated males) was the lightest group with the lowest fat score ( $1.71 \pm 0.45$ ). The females appeared in all clusters.

Cluster 1 presented the highest distance of centroids from k-means of the clusters when compared with the others, thus being the least similar (Table 3). The other clusters presented a greater degree of similarity to each other.

**Table 2** - Bovine carcasses of different sexes grouped according to their similarity

	Cluster <sup>1</sup>			
	1	2	3	4
Sex (%)				
Uncastrated males	100.00	0.00	0.00	0.00
Cows <sup>2</sup>	0.00	92.85	7.15	0.00
Females <sup>3</sup>	25.04	8.48	22.03	44.45
Castrated males	0.00	33.58	24.58	41.84
HCW (kg)	$256.96 \pm 56.13$	$235.90 \pm 39.18$	$221.04 \pm 47.30$	$240.26 \pm 35.57$
Age (PIT)	$3.10 \pm 1.78$	$6.96 \pm 0.98$	$4.66 \pm 1.06$	$2.06 \pm 1.16$
Conformation	$1.81 \pm 0.26$	$1.69 \pm 0.25$	$1.60 \pm 0.34$	$1.75 \pm 0.23$
SFS	$2.25 \pm 0.76$	$2.88 \pm 0.37$	$1.71 \pm 0.45$	$2.95 \pm 0.47$

HCW - hot carcass weight; PIT - permanent incisor teeth; conformation - mean conformation score (1 to 3; inferior, good and excellent, respectively); SFS - mean subcutaneous fat score (1 to 5; absent, scarce, moderate, considerable amount, and excessive, respectively).

<sup>1</sup> P-value = 0.01.

<sup>2</sup> Cows - eight PIT.

<sup>3</sup> Females - up to six PIT.

**Table 3** - Distance of centroids from k-means of the clusters<sup>1</sup>

	Cluster <sup>1</sup>			
	1	2	3	4
Cluster 1	0.00	1.13	1.04	1.02
Cluster 2	1.13	0.00	0.43	0.51
Cluster 3	1.04	0.43	0.00	0.38
Cluster 4	1.02	0.51	0.38	0.00

<sup>1</sup> P-value = 0.01.

Cluster 1 = uncastrated males and females; cluster 2 = cows, females, and castrated males; cluster 3 = cows, females, and castrated males; cluster 4 = females and castrated males.

## 4. Discussion

The carcasses of the uncastrated males presented a defined pattern in relation to their characteristics, since all the carcasses were grouped in the same cluster. It is also noted that this cluster presented greater weight among the four groups, as males have higher adult weight (Restle et al., 1994; Restle et al., 1996; Restle and Vaz, 1997). However, beef from bulls has the lowest consumer overall acceptance (Mueller et al., 2019).

To be considered of good quality, a carcass must have a minimum fat thickness of 3 mm (Luchiari Filho, 2000), which was not achieved by any cluster. The amount of fat is important because, during cooling, it reduces losses by exudation and maintains the good visual appearance of the carcass (Brondani et al., 2006). Increasing the energy level of the diet may increase the fat cover of the carcass of the animals (Silva et al., 2008); however, most of the time, the financial return for the producer with the increase of the subcutaneous fat cover is low and is a subject of discussion between producers and industry.

Taking the prerequisites imposed by the industry as ideal (carcasses weighing between 240 and 330 kg, fat cover between 3 and 10 mm, and maturity between zero and six PIT), the carcasses of Cluster 4 came closest to meeting them. It is observed that this group is formed by females and castrated males, both finishing earlier than uncastrated males (Luchiari Filho, 2000); thus, they achieved better fat finishing with weight within the range considered adequate.

However, there is a scattered distribution of carcasses of females and castrated males in different clusters. It is observed that, unlike Cluster 1, castrated males were distributed in three clusters; therefore, in this case, sex was not determinant in standardizing the carcass characteristics of these animals. Castrated males tend to have a lower growth rate, with gain composition characterized by lower protein and higher fat content, resulting in lower feed efficiency, when compared with uncastrated males, within the same contemporary group (Purchas, 1991). The water deficit in the region, as reported by the National Institute of Meteorology (INMET) (Brasil, 2017), reduces available nutrients, resulting in even greater difficulties for animals to reach slaughter body weight, especially for the castrated males that have lower feed efficiency. As a consequence, a significant part of the carcasses of castrated males were in the same cluster as the cows, a class of animals known to result in lower-quality meat. Therefore, it is necessary to invest in techniques that increase the availability of nutrients in the semiarid region. The females appear in all clusters, possibly because of the variation in age (zero to six PIT).

The results of conformation of the animals of this study reflect the frequent observation that carcasses of *Bos taurus indicus* cattle are usually classified as rectilinear, due to the lower deposition of muscle compared with that of *Bos taurus taurus* (Silva et al., 2008).

## 5. Conclusions

Except for uncastrated males and cows, the effect of sex (castrated males and females) on carcass characteristics of Zebu cattle from the semiarid region of the state of Minas Gerais does not assure

similar characteristics. Therefore, the improvement of carcass quality, using castration as the central grading criterion, should be reviewed not to overemphasize this item.

## Conflict of Interest

The authors declare no conflict of interest.

## Author Contributions

Conceptualization: F.V. Silva and L.L.S. Oliveira. Data curation: F.M. Ferraz and F.V. Silva. Formal analysis: F.V. Silva. Methodology: F.V. Silva. Writing-original draft: F.M. Ferraz. Writing-review & editing: F.V. Silva, L.L.S. Oliveira, I. Borges, D.D. Alves and V.R. Rocha Júnior.

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## References

- Baêta, F. C. and Souza, C. F. 1997. Ambiência em edificações rurais: conforto animal. UFV, Viçosa, MG.
- Brasil. 2004. Ministério da Agricultura, Pecuária e Abastecimento. Sistema brasileiro de classificação de carcaças de bovinos. Instrução Normativa nº 09/2004. Ministério da Agricultura, Brasília. Available at: <<https://www.defesa.agricultura.sp.gov.br/legislacoes/instrucao-normativa-9-de-04-05-2004,643.html>>. Accessed on: Oct. 03, 2017.
- Brasil. 2017. Instituto Nacional de Meteorologia. Banco de dados meteorológicos para ensino e pesquisa. Available at: <<http://www.inmet.gov.br/portal/index.php?r=bdmep/bdmep>>. Accessed on: Apr. 15, 2019.
- Brondani, I. L.; Sampaio, A. A. M.; Restle, J.; Alves Filho, D. C.; Freitas, L. S.; Amaral, G. A.; Silveira, M. F. and Cezimbra, I. M. 2006. Composição física da carcaça e aspectos qualitativos da carne de bovinos de diferentes raças alimentados com diferentes níveis de energia. *Revista Brasileira de Zootecnia* 35:2034-2042. <https://doi.org/10.1590/S1516-35982006000700022>
- Felício, P. E. 2011. Classificação, tipificação e qualidade da carne bovina. p.127-133. In: VI Congresso Brasileiro de Ciência e Tecnologia de Carnes. Anais de Palestras. São Pedro, SP.
- Ferreira, M. M.; Revoredo, T. B.; Ragazzi, J. P.; Soares, V. E.; Ferraldo, A. S.; Mendonça, R. P. and Lopes, W. D. Z. 2014. Prevalência, distribuição espacial e fatores de risco para cisticercose bovina no estado de São Paulo. *Pesquisa Veterinária Brasileira* 34:1181-1185. <https://doi.org/10.1590/S0100-736X2014001200006>
- Lanna, D. P. D. 1997. Fatores condicionantes e predisponentes da puberdade e da idade de abate. p.41-78. In: Anais do 4º Simpósio sobre Pecuária de Corte, 1996. Piracicaba, FEALQ.
- Luchiari Filho, A. 2000. Pecuária da carne bovina. A. Luchiari Filho, São Paulo.
- Mueller, L. F.; Balieiro, J. C. C.; Ferrinho, A. M.; Martins, T. S.; Corte, R. R. P. S.; Amorin, T. R.; Furlan, J. J. M.; Baldi, F. and Pereira, A. S. C. 2019. Gender status effect on carcass and meat quality traits of feedlot Angus × Nelore cattle. *Animal Science Journal* 90:1078-1089. <https://doi.org/10.1111/asj.13250>
- Pinheiro, R. M. K.; Silva, T. J. P. and Viana, J. H. M. 2009. Influência do grupo genético, condição sexual e tratamento antiparasitário nas medidas de área de olho do lombo e espessura de gordura *in vivo* e na carcaça de bovinos de corte. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia* 61:676-681. <https://doi.org/10.1590/S0102-09352009000300022>
- Purchas, R. W. 1991. Effect of sex and castration on growth and composition. p.203-254. In: Growth regulation in farm animals – Advances in meat research. vol. 7. Pearson, A. M. and Dutson, T. R., eds. Elsevier, London.
- Restle, J. and Vaz, F. N. 1997. Aspectos quantitativos da carcaça de machos Hereford, inteiros e castrados, abatidos aos quatorze meses. *Pesquisa Agropecuária Brasileira* 32:1091-1095.
- Restle, J.; Grassi, C. and Feijó, G. L. D. 1994. Características de carcaça de bovinos de corte não-castrados ou castrados em diferentes idades. *Pesquisa Agropecuária Brasileira* 29:1603-1607.
- Restle, J.; Grassi, C. and Feijó, G. L. D. 1996. Características das carcaças e da carne de bovinos inteiros ou submetidos a duas formas de castração, em condições de pastagem. *Revista da Sociedade Brasileira de Zootecnia* 25:334-343.
- Silva, F. V.; Rocha Júnior, V. R.; Barros, R. C.; Pires, D. A. A.; Menezes, G. C. C. and Caldeira, L. A. 2008. Ganho de peso e características de carcaça de bovinos Nelore castrados ou não-castrados terminados em confinamento. *Revista Brasileira de Zootecnia* 37:2199-2205. <https://doi.org/10.1590/S1516-35982008001200018>

Vaz, F. N.; Restle, J.; Arboite, M. Z.; Pascoal, L. L.; Alves Filho, D. C. and Pacheco, R. F. 2010. Características de carcaça e da carne de novilhos e novilhas superjovens, terminados com suplementação em pastagem cultivada. *Ciência Animal Brasileira* 11:42-52. <https://doi.org/10.5216/cab.v11i1.5131>

Vittori, A.; Queiroz, A. C.; Resende, F. D.; Gesualdi Júnior, A.; Alleoni, G. F.; Razook, A. G.; Figueiredo, L. A. and Gesualdi, A. C. L. S. 2006. Características de carcaça de bovinos de diferentes grupos genéticos, castrados e não-castrados, em fase de terminação. *Revista Brasileira de Zootecnia* 35:2085-2092. <https://doi.org/10.1590/S1516-35982006000700028>