'Cachena', a Bovine Rustic Portuguese Extensively Reared Autochthonous Breed: Meat Texture Analysis

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‘Cachena’, a bovine rustic Portuguese extensively reared autochthonous breed: meat texture analysis

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Key words: autochthonous bovine breed; meat quality; instrumental texture; sensory analysis

Abstract

‘Cachena’ is one of the world’s smallest bovine breeds. Extremely rustic and wild, they are extensively reared, and fed with natural pastures. Meat valorisation is essential to preserve this breed, with a limited livestock.

‘Cachena’’s meat is tender, juicy, low-fat, and highly appreciated due to the association of animal, *terroir* and producer, balanced by the ecosystem’s sustainability.

The aim of this study was to increase the weight of *Longissimus dorsi* (LD) and *Psoas major* (PM) muscles, without depreciating their sensory quality.

Two groups of 16 animals were slaughtered: (A) 9-17 months old animals with 140-225 kg slaughter live weight (SLW); (B) 17-20 months old animals with 260-335 kg SLW. LD and PM muscles’ fresh weight was recorded, and microbiological and physicochemical parameters (pH and a_W) were evaluated two days, while instrumental texture (Texture Profile Analysis (TPA) and Warner-Bratzler shear force (WBSF)) and sensory analyses by a trained sensory panel were performed four days after slaughter. Microbiological analyses were conducted following international standards to ensure food safety.

LD and PM weights significantly increased with the animals’ age (P<0.01, LD, and P<0.001, PM). pH values were similar for both groups and a_W was significantly higher in group A (P<0.001).

Listeria monocytogenes and *Salmonella* spp. were not detected in any of the analysed samples.

All analysed meat samples were generally tender, with PM tender than LD. Group A meat was tender (P<0.001) and easier to chew (P<0.001), for both muscles. Nevertheless, WBSF was higher (P<0.001).

Regarding sensory analysis, no significant differences were observed in hardness, elasticity, succulence, and global appreciation between the two groups for LD meat. Moreover, fibrousness values were higher in group A (P<0,01).

The higher SLW, from older ‘Cachena’ animals, associated to larger meat cuts, does not decrease meat tenderness.

Introduction

‘Cachena’ is one of the world’s smallest bovine breeds with a height of less than 1.15 m. Extremely rustic and wild, they are extensively reared, and fed with natural pastures. The male and female adult weight 450 and 250Kg, respectively. The total herd is small, 235 males and 7094 females, and is considered as a part of Portuguese genetic heritage. It is reared in South Alentejo, a very poor agricultural region of Portugal, therefore the meat valorisation is essential to preserve this breed, with a so limited livestock (www.cachena.pt).

‘Cachena’s meat is tender, juicy, low-fat, and highly appreciated due to the association of animal, *terroir* and producer, balanced by the ecosystem’s sustainability. However, the best meat cuts are small, which may condition its consumption. Moreover, the different tenderness of these noble meat cuts between distinct animals, has been reported by retailers as a major problem to consumption and a reason for complaints.

Texture is one of the most important attributes for the decision of the consumer and is influenced by several factors, such as the animal’s genetics, the feeding regime, its age, and weight at slaughter, as well as pre-slaughter handling practices. Additionally, tenderness has been reported to vary with meat cut, and between animals for the same meat cut. The influence of the abovementioned factors in the sensory attributes of meat are very important for producers and retailers to meet the consumers' requirements.

The main goal of the GO-CACHENA project is to understand the relationships between genetics, feeding, age and weight of animals, with the quality of this delightful meat. The present study is part of GO-CACHENA and intends to analyse the relationship between the weight of two meat cuts – *Longissimus dorsi* (LD) and *Psoas major* (PS) – and their sensory attributes.

Methods and Study Site

The animals were reared in a farm in Barrancos (South of Portugal) and were slaughtered at slaughterhouse (Beja, South of Portugal). Two groups of 16 animals were slaughtered: (A) 9-17 months old animals with 140-225 kg slaughter live weight (SLW); (B) 17-20 months old animals with 260-335 kg SLW. LD and PM muscles' fresh weights were recorded, and microbiological and physicochemical parameters (pH and a_W) were determined two days after slaughtering in fresh meat. On the other hand, instrumental texture (Texture Profile Analysis (TPA) and Warner-Bratzler shear force (WBSF)) and sensory analysis by a trained panel were evaluated four days post-slaughter in cooked meat.

Microbiological analyses were conducted following international standards (ISO) to ensure food safety.

After sample homogenisation, pH was measured in duplicate with a pH meter (HI 9025; electrode FC 230B) equipped with a pH electrode (FC 230B, Hanna Instruments, USA) according to the procedures described in ISO 2917, and water activity (a_W) was determined using a Rotronic Hygrometer station (Rotronic Hygroskop DT) previously calibrated at 20 ± 1 ◦C with EA00-SCS, EA50-SCS and EA80-SCS Humidity Standards (Rotronic, Ettlingen, Germany).

2.5 cm thick steaks of each muscle were grilled in an electric grill until a temperature of 40 °C and were then flipped once and grilled until a final temperature of 71 °C was reached. To monitor the temperature of each steak throughout the cooking, a portable digital thermometer was used. Once cooked and cooled to room temperature, steak samples were packed in sealed plastic bags and cooled at 2 ± 1 ºC overnight. After TPA in a TA.HD.Plus (©Stable MicroSystems, UK) texture analyser, six rectangular pieces (1x1x2.5cm) of cooked steaks were cut along the muscle fibres, and sheared perpendicular to the fibre with a WBSF device with a V-shaped blade attached to the texturometer (Fabre et al., 2018; Veiseth-Kent et al., 2018).

For sensory analysis, samples were kept warm until serving. Panellists were served with 1x1x2.5 cm samples in a covered plate, labelled with three-digit-codes. Panellists were trained to scale each attribute on a 15-cm intensity scale (0 = none and 15 = intense), where the middle point is considered the optimum value for each attribute (tenderness, elasticity, succulence and fibrousness) (ISO 4121:2003).

Data were analysed according to analysis of variance (ANOVA) using StatisticaTM v. 12.0, software (StatSoft Inc, 1984–2014) for the factors group and muscle type. Differences between groups were identified based on Tukey's Honest Significant Difference (Tukey's HSD) test ($P < 0.05$).

Results

Table 1 shows LD and PM muscles fresh weights of Group A and Group B. These values are significantly different ($P<0.001$), confirming that the fresh weight of these muscles increases with the animals' age.

Table 1 – Fresh weights (Kg) of *Longissimus dorsi* (LD) and *Psoas major* (PM) muscles from the two groups of animals (mean ± sd)

MUSCLES	GROUP A	GROUP B	P VALUE
LD	5.608 ± 0.652	7.003 ± 0.878	P<0.001
PM	1.563 ± 0.157	2.225 ± 0.356	P<0.001

No significant differences were detected in pH and a_W values between the two muscles. Table 2 presents pH and a_W mean values for the two groups. Unlike pH values, a_W revealed significant differences between the two groups.

Table 2 – Physicochemical parameters pH and aW of the meat cuts of the two groups of animals (mean ± sd)

	GROUP A	GROUP B	P VALUE
pH	5.844 ± 0.210	5.864 ± 0.250	ns
a_W	0.983 ± 0.004	0.960 ± 0.007	P < 0.001

ns – no significance

Listeria monocytogenes and *Salmonella* spp. were not detected in any of the analysed samples.

Regarding instrumental texture analysis, hardness values were 15.59 N ± 7.48 and 10.92 N ± 3.21 (P<0.001), for LD and PM muscles, respectively. Chewiness values were 5.95 J ± 3.50 and 3.99 J ± 1.64 (P<0.001), and springiness values were 0.57 mm ± 0.10 and 0.60 mm ± 0.10 (P<0.05), respectively, for LD and PM muscles. Therefore, PM could be considered tender and easier to chew than LD. On the other hand, shear force was higher (P<0.001) for LD than for PM, with values of 30.121 N ± 9.129 and 25.898 N ± 5.78, respectively.

Table 3 shows the values obtained with TPA and WBSF for LD and PM muscles, for each group of animals. The meat of group A animals, which were younger and lighter, is generally tender (P<0.001) and easier to chew (P<0.001) than the meat from elder and heavier group B animals. The springiness is slightly higher in PM than in LD muscles (P<0.05), with however no significant differences between group A and group B animals. Regarding shear force values, they were significantly higher for group A (P<0.001), and inversely related with TPA hardness and chewiness values.

Table 3 – Texture Profile Analysis (TPA) and WBSF of LD and PM muscles for the two animal groups (mean ± sd)

GROUP (G)	GROUP A		GROUP B		SIGNIFICANCE		
MUSCLE (M)	LD	PM	LD	PM	G	M	GxM
TPA Hardness (N)	12.06 ± 5.41	9.99 ± 2.99	18.56 ±7.71	11.57 ± 3.22	***	***	***
TPA Chewiness (J)	4.54 ± 2.40	3.82 ± 1.64	7.13 ± 3.83	4.11 ± 1.64	***	***	***
TPA Springiness (mm)	0.56 ± 0.10	0.61 ± 0.11	0.58 ± 0.11	0.6 ± 0.1	ns	**	ns
WB Shear Force (N)	36.20 ± 8.91	28.92± 5.37	24.98 ± 5.42	23.69 ± 5.07	***	***	***

*** P < 0.001; ** P < 0.01; ns – no significance

Sensory analysis was performed only for LD muscle. A previous experiment with the sensory panel had revealed PM muscle as very tender. If there were differences between the two groups, they will occur in the LD muscle, a less tender muscle. Additionally, the PM muscle was too small to provide enough samples to the entire sensory panel. Table 4 shows the results for the different sensory attributes.

Table 4 – Sensory attributes of LD muscle in each group of animals (mean ± sd)

ATTRIBUTE	GROUP A	GROUP B	P VALUE
Tenderness	7.66 ± 1.84	7.74 ± 1.64	ns
Elasticity	7.16 ± 2.06	7.37 ± 1.88	ns
Succulence	6.96 ± 1.80	6.72 ± 1.65	ns
Fibrousness	7.38 ± 2.45	6.79 ± 2.21	P < 0.01
Overall acceptability	9.71 ± 3.13	10.20 ± 2.7	ns

ns – no significance

Succulence and fibrousness were higher in group A, while tenderness and elasticity were higher in group B meat samples. Overall, panellists preferred LD meat samples from heavier (group B) animals.

It should be noted that the results obtained for all attributes, but overall acceptability, showed values close to the optimum, namely 7.50.

These results are in accordance with the hardness and chewiness TPA values, higher in group B meat samples.

Discussion

'Cachena' meat samples were found to be generally tender and were highly appreciated by the panel of trained assessors.

As expected, older group B animals had higher muscle weights.

Concerning physicochemical parameters, group B lower a_W values might be due to higher water content in the meat of younger animals.

Regarding TPA, our results showed that PM meat samples were generally tender and easier to chew, which may be due to the structure of the *Psoas major* (PM) muscle that has more type I fibres than muscles such as *Longissimus thoracis* or *Semitendinosus*. Type I fibres have a smaller diameter when compared to other fibres (Lang et al., 2017). Furthermore, the same authors reported muscles with a low percentage of type IIB and a high percentage of type I fibres to be tender. Comparing the meat samples from the two animal groups, *Psoas major* (PM) was the most tender and the easiest to chew. Nevertheless, WBSF values were higher in group A meat samples. Assessing TPA and WSBF values together, both methods evaluated meat texture in a different way. WBSF cuts the meat fibres perpendicularly, as do incisor teeth, while TPA mimics the chewing with molar teeth compressing meat fibres (Novakovi and Tomasevi, 2017; Ricardo-Rodrigues et al., 2020). Novakovi and Tomasevi (2017) consider that both methods are useful for instrumental measurement of meat texture, with greater importance for TPA in raw beef texture evaluations.

Considering sensory analysis, group B LD meat samples were less tender and more elastic than those from group A. Hardness and springiness values followed this same tendency in TPA. Although with no significant differences between the two groups, panellists found group A meat samples to be slightly more tender than group B samples, confirming the results obtained in the TPA. Succulence and fibrousness values were higher in group A meat samples. The higher succulence values in group A samples might be related with the higher a_W values observed for group A meat cuts.

Finally, panellists overall preferred group B meat samples, although no statistically different scores were given. Moreover, it must be highlighted that a maximum score of 15 was possible for the "Overall acceptability" sensory attribute. Therefore, considering the values generally given by panellists to all meat samples, it is possible to conclude 'Cachena' meat was highly appreciated.

In the present study, we observed some differences in the quality attributes of meat samples from different muscles and coming from animals with different ages and live weights at slaughter. These differences, although statistically significant, were not very expressive. Taking the overall preference of panellists into account, it might be acceptable to commercialise larger meat cuts from older animals, with the consequent higher income for the producers of 'Cachena' animals.

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