Meat characterization of four endangered Galician cattle breeds

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Abstract-Meat quality from 32 male calves of four endangered Galician cattle breeds reared in an extensive production system has been characterised. Breeds included were "Cachena" (CC), "Caldelá" (CL), "Vianesa" (VI) and "Limiá" (LI). Meat quality traits studied were chemical composition, colour parameters, water holding capacity and texture measurements. Breed was not affected by meat quality characteristics. There were no significant differences among breeds in chemical composition, cooking losses and shear firmness. pH values were significant higher in CC than CL breed (5,72 vs 5,46 P<0.01) and yellow index were significant higher in LI than CC (8,54 vs 6,29, P<0.05). CC and CL are the most different breeds regarding meat quality traits.

***Key words*: Endangered Galician cattle breeds, Colour, Texture**

I. INTRODUCTION

Consumers are concerned about meat quality and also about its origin. The creation of meat quality labels, normally under geographical groupings and with specific genotypes and production systems, fitted in the increasing demand by consumers for quality guarantees (Guerrero, 2001). Meat quality trademarks promote the use of local breeds reared under traditional practices. The vast richness of the genetic resources of domestic animals in the region of Galicia was made evident in the Spanish legislation (R.D. 2129/2008). Five Galician breeds are included that Endangered Galician cattle breeds, such as "Cachena" (CC), "Caldelá" (CL), "Vianesa" (VI), "Frieiresa" (FS) and "Limiá" (LI). The loss of biological material is acknowledged, as well as a reduction in genetic variability. In addition, these bovine breeds are rustic and reared under traditional systems. The use of local breeds as an alternative system of beef production has the advantage that these breeds are closely related to the environment, and help to maintain biodiversity and sustainable agricultural production, especially in depressed areas. It is necessary to increase the census of these breeds in order to get a meat production with an acceptable economic profit.

Few studies have been carried out to characterize the production (Justo, Lama, Rivero, & Feijoo, 2004; Sánchez, Vallejo, Iglesias, Álvarez, Fernández, & Salgado, 1992), but there are no studies about meat quality from these breeds.

The aim of this study is to describe the variability of the four Galician bovine breed regarding meat quality traits reared on their typical production system.

II. MATERIALS AND METHODS

II.1. Animal management

32 male calves of the four bovine breed (7, 7, 7, and 11 of CC, CL, VI and LI respectively), were used for this study. All animals are registered in the Record of Births of Stud-Book. Calves were reared in

extensive conditions together with their mothers. Animals were slaughtered at ranged of eight to ten months old. For the four breeds, the slaughter live weight was ranged between 194-301kg for CC and LI respectively. Animals were conventionally slaughtered at a commercial slaughterhouse and carcass were weighted and chilled at 4 ºC in cold chamber immediately after slaughtering for 24 h. After ageing seven days, the *Longisimus Thoracis* (LT) muscle was extracted, from the left half of each carcass, between the fifth and the tenth rib. LT muscle was chilled for 30 minutes in frozen chamber (-18 ºC) to facilitate posterior cuts. LT was cut in a cutter machine (Leader, Milano, Italy) in four steaks of 2.5 cm and one of 1.5 cm of thickness. In the first steak, we realized the determination of pH, colour (luminosity, red and yellow indexes and chroma and hue parameters) and chemical composition (moisture, ashes, protein and intramuscular fat). Second steak was use to extract FAs (data not shown). Third and four steaks were used to measure textural properties (shear force, shear firmness and total work). We use an additional steak of 1.5 cm to evaluate drip loss.

II.2. Analytical methods

pH, colour, myoglobin content were measured according to describe by Franco et al., 2009. A NIRS (Foss Tecator NIRS Neotec 6500, Denmark) was used to determine chemical composition, in duplicate, according to the methodology proposed by (Moreno, Perez, Oliete, Carballo, Franco, & Monserrat, 2007). The water-holding capacity (WHC) was measured in three ways: cooking loss (CL), drips loss (DL) and pressing loss (PL) evaluated according to describe by (Franco, Bispo, González, Vázquez, & Moreno, 2009). To determine texture traits steaks were cooked placing vacuum package bags in a water bath with automatic temperature control (JPSelecta Model Tectron Bio) until reached internal temperature of 70 ºC, controlled by thermocouples type K (Comark, PK23M, UK), connected to a data logger (Comark Dilligence EVG, N3014, UK). After cooking, samples were cooled at room temperature, placing vacuum package bags in a circulatory water bath set at 18 ºC during a period of 30 minutes and percentage cooking loss was recorded. All samples were cut or compressed perpendicular to the muscle fibre direction at a crosshead speed of 3.33 mm/s. The Texture Analyzer (TA-XT2 of Stable Micro Systems, UK) was used. Seven meat pieces of 1x1x2.5 cm (height x width x length) were removed parallel to the muscle fibre direction and were completely cut using a WB shear blade with a triangular slot cutting edge (1 mm of thickness). Maximum shear force, shear firmness and total necessary work performed to cut the sample were obtained.

II.3.Statistical analysis

For the statistical analysis of the results, data were analyzed using the SPSS (version 15.0, USA). One-way analysis of variance (ANOVA) was used to analyze the effect of breed type on meat quality traits. The least squares mean (LSM) were separated using Duncan's t-test. All statistical test of LSM were performed for a significance level $P<0.05$.

III. RESULTS AND DISCUSSION

There were no significant differences among breeds in chemical composition, meat colour, cooking losses and shear firmness (Table 1). pH showed significant differences among breeds ($P<0.01$), these values were in the range of 5.46 to 5.72 for CL and CC respectively, that can be due to the different animals management by the farmers, since pre-slaughter conditions induced stress, the main cause of high pHs in beef animals (Beltran, Jaime, Santolaria, Sañudo, Albertí, & Roncalés, 1997). However all pH

values were below 6, an acceptable beef range (Renerre, 1986). Values in the same range were reported in Holstein-Fresian cows (Franco et al., 2009) and Galician Blond (GB) calves (Oliete, Carballo, Varela, Moreno, Monserrat, & Sanchez, 2006). Intramuscular fat content (IMF) although has not showed significant differences among breeds, the CC breed has presented the highest value and the CL the lowest (1.84 vs 1.28, respectively), as it happened with the pH measure. Depending on several intrinsic factors, such as age, gender or breed, and extrinsic ones, such as feeding system, the amount of IMF could vary (Barker, Mies, Turner, Lunt, & Smith, 1995). These animals have shown very low IMF levels due to they were reared in extensive system, without finishing period prior to slaughter.

The haem pigment myoglobin is the main responsible for the meat colour (MacDougall, 1982). Breed with higher myoglobin content (CC) showed lower luminosity, redness and yellowness values (Table 1). Yellow index has shown significant values ($P<0.05$) among breeds, the higher value was found in LI breed (6.29 in CC vs 8.54 in LI). According to Renerre, 1986, redness is highly correlated to the haem pigment content; however we did not find any significant correlation between these traits. Similar coordinates colour traits were founded by Oliete et al., (2006) in GB calves, whereas Varela et al., 2004 with older GB animals founded lower luminosity values. It has been said that production systems play an important role in differentiating meat samples on the basis of colour (Lanza, Landi, Scerra, Galofaro, & Pennisi, 2009).

CC breed showed the highest global WHC (as sum of PL, CL and DL values), whereas CL presented the lowest values. Different factors affect this capacity of binding water, since the amount of water in the muscle or pH. Breed had no significant effect on shear force (Table 1). Shear firmness and total work data are dependent on maximum shear force value and thus, the analysis of the result is analogous to shear force. The highest values in shear force were shown by the breeds VI (4.50 kg) and CL (4.13 kg) whereas the lowest values corresponded to CC (3.80 kg).

Table 1. *Chemical composition, colour of meat, water holding capacity and textural parameters of LT. in five endangered Galician cattle breeds.*

	CC	VI	CL	LI	SIG	SEM
Chemical Composition						
pH	5,72±0,14 a	5,68±0,12 a	5.46±0.07 b	5.68±0.09 a	**	0.02
Moisture	76,17±0,66	76,40±0,98	76.75±0.49	76.96±0.36	n.s	0.13
Ashes	1,17±0,01	1,17±0,01	1.18±0.006	1.19±0.007	n.s	0.002
Protein	22,64±0,46	22,32±0,38	22.99±0.56	22.59±0.52	n.s	0.09
Intramuscular fat	1,84±0,46	1,79±0,84	1.28±0.32	1.32±0.37	n.s	0.11
Myoglobin	3,50±0,83	3,02±0,80	2.75±0.27	3.16±0.48	n.s	0.12
W.H.C (%)						
Pressing Losses (%)	22,80±2,87	25,32±2,95	25.30±1.69	23.00±1.63	n.s	0.47
Drip Losses (%)	3,55±1,19	3,30±1,19	5.38±3.24	6.19±3.32	n.s	0.48
Cooking Losses (%)	21,61±3,22	25,61±3,09	27.62±4.03	24.83±4.8	n.s	0.77
Meat colour						
Luminosity (L*)	36,61±2,44	39,03±1,90	39.77±1.48	39.05±2.64	n.s	0.43
Index of red (a*)	14,21±1,19	15,43±2,41	16.26±1.44	16.41±1.10	n.s	0.33
Index of yellow (b*)	6,29±1,14 a	7,45±1,63 ab	8.28±0.95 b	8.54±1.22 b	*	0.27
Chroma $\sqrt{(a^{*2} + b^{*2})}$	15,56±1,49	17,14±2,86	18.25±1.71	18.51±1.51	n.s	0.41
Hue (tan-1(b*/a*))	19,79±5,64	23,96±7,02	27.21±5.94	24.02±6.79	n.s	1.22
WB Test						
Shear Force (kg/cm^2)	3,80±1,33	4,50±1,82	4.13±1.36	3.87±1.19	n.s	0.26
Shear Firmness (kg/cm^2)	1,29±0,39	1,64±0,67	1.47±0.58	1.13±0.53	n.s	0.10
Total work (Kg*s)	9,06±2,38	11,13±5,16	10.38±3.32	10.30±4.06	n.s	0.72

Significance: ** ($p<0.01$), * ($p<0.05$), n.s (not significant) Different letter after the mean value within the same row indicate significant differences ($P>0.05$). Units: myoglobin (mg myoglobin/ g fresh meat)

According to tenderness meat bovine classification proposed by Belew, Brooks, McKenna, & Savell, (2003), which consider as a "very tender" meat when WB shear force<3.2 kg, our results showed that the four bovine breeds has shown a mean value of 4.07 kg, considerate as "intermediate tender" meat. Tenderness is affected by some factors, such as breed, livestock system production, IMF content, instrumental measure conditions, cooking procedures and ageing process. We consider that ageing the carcass for seven days, is the factor that higher have influenced the tenderness of the samples.

IV. CONCLUSIONS

Meat from endangered Galician cattle breeds, showed as a very lean meat (<2% in IMF) with a high protein content (>22.2%). In addition, meat samples showed very good water holding capacity and tenderness values less than 5 kg for the four breeds so can be classified as a "tender" meat. These first results obtained in this study are a starting point for the characterization of this type of meat, because nutritional and physicochemical characteristics, respond to the demand required by the current meat consumers.

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