Carcass characterization of four endangered Galician cattle breeds

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Abstract-32 male calves from four endangered Galician cattle breed were reared in their typical production system and their carcass quality traits were studied. Breeds studied were "Cachena" (CC), "Caldelá" (CL), "Vianesa" (VI) and "Limiá" (LI). Carcass weight, conformation, fatness level and carcass measurement were obtained. Also primal cuts from fore and hind quarter were obtained. Animals slaughtered reached a carcass weight of 92 to 136 kg for CC and LI respectively. Kill-out proportion did not differ among the breed types, reaching a mean value of 48%. Carcass measurements were significantly different among breeds; values were greater for VI and LI against CC breed. Even though CC was the smallest breed, it represented the breed with more muscle (around 73.5) and less fat (3.12) in the carcass. HQ proportion was about 66% of mean value for all breed studied.

***Keywords*: Endangered cattle breed, Carcass morphology, Primal cuts, Extensive system**

I. INTRODUCTION

The vast genetic richness of domestic animals in the autonomous region of Galicia was made evident in Spanish legislation (R.D. 2129/2008) which also served to bring the Official Catalogue of Livestock Breeds in Spain up to date. A bovine breed in promotion Rubia Galega (RG) appears in this catalogue, along with five other breeds that merit special protection, such as: Cachena (CC), Caldelá (CL), Vianesa (VI), Frieiresa (FS) and Limiá (LI) cows. The loss of biological material is acknowledged as well as a reduction in genetic variability. These bovine breeds are rustic and they are reared under traditional systems. The use of local breeds as an alternative beef production system has important advantages, as these breeds are closely related to the environment and they help to maintain biodiversity and sustainable agricultural production, especially in depressed areas. A first step in the management of these resources includes their identification, description and characterization. The current market situation determines local breeds to be produced in restrictive areas but it is necessary to increase their census and to guarantee that the production of this kind of meat reaches acceptable economic profits.

Few studies have been carried out to characterize these breeds production (Sanchez, Vallejo, Iglesias, Alvarez, Fernandez, & Salgado, 1992; Justo, Lama, Rivero, & Feijóo, 2004), but there are no studies about carcass characteristics or meat quality.

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

II. MATERIALS AND METHODS

II.1. Animal management

32 male calves from four bovine breeds (7 CC, 7 CL, 7 VI, and 11 LI) were used in 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 when they were ranged of eight-ten months years old. Animals were conventionally slaughtered at a commercial abattoir and carcasses were weighed (hot carcasses weight, HCW). The killing out percentage was calculated as the ratio between HCW and slaughter weight. Carcasses were classified by using a conformation score, according to the EUROP scale (Conformation: P=1, O=2, R=3, U=4, E=5) (E.C. 1249/2008), and a fatness score average, according to the European classification fatness score scale, which ranges from 1 (low fat) to 5 (very high fat) (E.C. 1249/2008).

II.2. Carcass measurements

At this point the left half-carcasses were moved to the research centre pilot plant and the following carcass measurements were made: length of carcass (LC), length of leg (LL), width of leg (WL), and internal depth of chest (IDC) as it is described by De Boer, Dumont, Pomeroy, & Weniger, (1974) whereas perimeter of leg (PL) was performed as Carballo, Monserrat, & Sanchez, (2000). All these measurements were done to

assess carcass morphology. Carcass compactness index (CCI) = (HCW / LC) and hindlimb compactness index (LTI) = (LL / WL) were also calculated (Espejo, Garcia, Lopez, Izquierdo, Robles & Costela, 2000).

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 carcass measurement and primal cuts. 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

Slaughter traits, carcass measurements and primal cuts are shown in Table 1. Slaughter weight and hot carcass weight were significantly different among breeds, with the lowest values for CC and the highest for LI. CC reached around 92 kg HCW, whereas carcass weight ranged between 120-136 kg for the rest of the breeds. Kill-out proportion did not differ among breed types, reaching a mean value of 48%. This is lower than the 53.2 % founded by Carballo, Oliete, Moreno, Sanchez, & Monserrat, (2004) in RG and it is also smaller than finding by Piedrafita et al. (2003), working with seven Spanish breed (range between 56.3 to 58.1%). However similar values (48.8%) were founded in other rustic endangered cattle breed, such as "Asturiana de la Montaña" (Vallejo, Alonso, Revuelta, Cima, & Cañón, 1991).

There were no significant differences in carcass conformation or carcass fatness level among the four breeds. Carcass conformation score and fatness level were lower for VI, whereas higher values were obtained for CC breed. Although, conformation and fatness scores are subjective measures which will depend on the scorer's kill, only two animals from LI breed reached R conformation. Our values for conformation were lesser than those of Carballo et al. (2004).

Carcass measurements were significantly different among breeds, greater for VI and LI against CC. Carcass measurement confirmed the body shape diversity between breeds, CC having shorter carcasses than VI (97 vs. 108 cm) and shorter leg (63 vs. 72 cm). Also, variables related to the volume of the leg, such as WL, EDC and PL were significant ($P<0.05$) for LI and VI. Differences between CC and CL in carcass measurements were small and not significant except for perimeter of leg. CCI denotes the carcass compactness and it was significant higher in VI and LI breeds (1.25 vs. 0.94). Our values were lesser than those found by other authors (Carballo et al., 2004; Alberti et al., 2005). LI were superior to the rest of breeds, because they had better conformation, intermediate fat (only CC had less fat) and the best carcass ratios (CCI and LTI) which proves its better shape and greater compactness.

Front and hind quarter as a proportion of the carcass side and the proportions of the individual FQ and HQ joints are shown in Table 1. Breed type had statistically significant effect on the proportionality some individual joints in the FQ: shoulder clod, top blade, chuck, neck and foreshank, however, only full plate, loin, hindshank and heel of round were affected in HQ. HQ is the part of the carcass where several of the most valuable primal cuts are located, like loin, tenderloin, topsises, silverside or eye of round.

There were no significant ($P>0.05$) differences among breeds in FQ and HQ carcass percentage and tisular composition except for fat content. Proportions of HQ were higher for CC than for other breeds. VI had also more sum of bone and fat and less muscle compared to the other breed. Proportions for HQ were superior in around 2% to those showed by Carballo et al. (2004) in RG. The muscles of the hind limb and the spine grow relatively slowly in the later stages of maturity, while the muscles of the neck and thorax grow more rapidly (Robelin & Tulloh, 1992). The consequence of this phenomenon is a relative proportional decrease of the most valuable part of the carcass, i.e. the hind limb and back, with increasing maturity. According to Berg, Andersen, & Liboriussen, (1978) bone proportion generally declines and fat proportion increases with increasing weight. The heaviest animals belonged to VI and LI in our research; these two groups had higher fat content and less bone, although differences were very small and not significant statistically.

IV. CONCLUSIONS

The production and management systems that had been used in this study are similar to the most common beef production practices in Galicia (grass-based production). However, it is not possible to draw general conclusions due to the relatively small number of animals we can conclude that:

-LI and VI were superior to CC and CL in terms of live weight and carcass production, but all breeds were similar in terms of kill-out and muscle percentage.

-Shape and compactness carcass were better for LI breed than for others breeds.

-The proportion of FQ, HQ, meat and bone was not affected significantly ($P>0.05$) by breed type. HQ proportion was about 66% of mean value for all breeds. It is important, because this part of the carcass had the most high-priced joints in the carcass.

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Table 1. *Age, live weight, carcass weight, EUROP conformation, fatness scores, carcass measurements and carcass cut from different breed type.*

	CC	VI	CL	LI	SEM	SIG
Years old	271±25	270±14	261±12	277±58	6.64	n.s.
Slaughter weight	194±27 a	273±51 b	246±67 ab	301±65 b	12.39	**
HCW	92,2±14,8 a	129,4±26,3 b	120,2±35,1 ab	136,4±29,7 b	5.58	*
Killing out	47,26±1,10	47,31±1,49	48,46±1,51	47,72±0.95	0.24	n.s.
Conformation	2,0±0.0	1,57±0.53	1,71±0.48	2,00±0,63	0.09	n.s.
Fatness level	2,0±0.0	1.28±0.48	1.33±1.63	1,54±0,52	0.14	n.s.
Carcass measurements (cm)						
LL	63.92±3.44 a	72.82±3.43 b	67,4±3,9 a	72,7±3,7 b	0.90	***
LC	97,71±2,37 a	109,42±6,11 b	102,2±9,3 a	108,5±4,6 b	1.30	**
WL	13,71±1,25 a	16,15±1,09 b	15,57±2,77 ab	17,00±2,04b	0.39	*
PL	78,21±3,97 a	87,57±4,19 b	87,8±8,1 b	89,9±10,5 b	1.53	*
EDC	50,64±2,86 a	55,21±2,73 b	53,4±3,3 ab	55,7±4,0 b	0.66	*
CCI	0,94±0,13 a	1,17±0,18 ab	1,15±0,24 ab	1,25±0,25 b	0.04	*
LTI	4,68±0,25	4,51±0,16	4,41±0,60	4,31±0,41	0.07	n.s.
Primal cuts (%) FRONT QUARTER						
Shoulder clod	3,89±0,30 ab	3,57±0,14 a	4,32±0,53 ab	4,52±1,08 b	0.13	*
Top blade	1,64±0,25 b	1,30±0,11 a	1,50±0,29 ab	1,46±0,16 ab	0.04	*
Chuck tender	1,37±0,27	1,15±0,10	1,29±0,14	1,31±0,11	0.03	n.s.
Chuck	5,29±0,98 c	4,30±0,71 b	3,17±0,56 a	3,91±0,76 ab	0.18	***
Neck	5,07±1,50 ab	5,38±0,83 b	4,41±0,28 a	4,15±0,51 a	0.17	*
Blade	0,52±0,07	0,55±0,07	0,60±0,04	0,68±0,24	0.02	n.s.
Foreshank	3,50±0,70 a	3,21±0,22 a	4,15±0,64 b	3,34±0,19 a	0.10	**
Brisket	3,02±1,25	2,84±0,47	2,66±0,38	2,72±0,38	0.11	n.s.
Lean	0,77±0,17 a	1,52±0,50 b	0,78±0,99 a	1,61±0,63 b	0.13	*
Fat	0,81±0,84 a	2,82±0,93 c	1,62±0,98 ab	1,84±0,63 b	0.18	**
Bone	6,79±1,70 a	7,91±2,57 ab	9,55±1,27 b	8,74±1,16 b	0.33	*
HIND QUARTER						
Full plate	10,52±0,57 a	10,08±1,17 a	8,12±3,17 b	10,03±0,74 a	0.31	*
Loin	10,95±1,97 a	8,64±1,77 b	10,65±2,87 a	8,15±0,76 b	0.38	**
Tenderloin	1,95±0,08	1,98±0,13	2,05±0,24	1,98±0,17	0.02	n.s.
Topside	6,97±0,46	7,20±0,51	7,51±0,55	6,97±0,44	0.09	n.s.
Eye round	1,73±0,19	1,78±0,11	1,81±0,16	2,36±1,30	0.14	n.s.
Hindshank	1,70±0,08 a	1,90±0,10 b	1,95±0,28 b	1,87±0,12 ab	0.03	*
Thick flank	4,11±0,39	4,22±0,31	4,31±0,34	4,12±0,36	0.06	n.s.
Flank steak	2,76±0,33	2,85±0,20	2,98±0,24	2,77±0,12	0.04	n.s.
Rump	0,86±0,13	0,83±0,05	0,85±0,03	0,84±0,08	0.01	n.s.
Silverside	4,90±0,61	4,72±0,30	5,12±0,51	5,22±0,44	0.08	n.s.
Heel of round	1,53±0,25 a	1,75±0,09 bc	1,78±0,09 c	1,59±0,15 ab	0.03	*
Lean	0,33±0,20	0,55±0,20	1,03±1,22	0,95±0,43	0.12	n.s.
Brisket bone	3,97±1,19 a	3,07±0,20 b	2,98±0,51 b	2,76±0,39 b	0.13	**
Loin bone	4,77±0,72 a	4,37±0,38 a	3,67±0,85 b	4,18±0,23 ab	0.11	**
Hip bone	7,96±0,86	8,82±0,80	8,34±0,86	8,58±0,87	0.15	n.s.
Fat	2,28±0,97	2,56±0,68	2,69±0,84	3,22±0,84	0.15	n.s.
CARCASS PERCENTAGE AND TISULAR COMPOSITION (%)						
Front quarter	32,73±1.60	34,60±2,46	34,09±2.10	34,33±1,05	0.32	n.s.
Hind quarter	67,00±1,60	65,39± 2.46	65,91±2.10	65,66±1,05	0.32	n.s.
Meat	73,49±1,96	71,14±3,30	71,69±3,11	72,28±2,22	0.51	n.s.
Bone	23,58±3,67	23,38±2,93	24,09±2,30	23,42±2,15	0.50	n.s.
Fat	3,12±1,81 a	5,26±0,71 b	4,21±1,60 ab	4,30±0,84 ab	0.27	*
Meat/bone	3,21±0,56	3,06±0,48	3,00±0,38	3,11±0,37	0.08	n.s.

Significance: *** ($p<0.001$), ** ($p<0.01$), * ($p<0.05$), n.s (not significant)

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