CARCASS CHARACTERISTICS AND EFFECT OF AGEING TIME IN YEARLING BEEF OF A SPANISH RUSTIC GENOTYPE (MORUCHA) AND OF A GENOTYPE IMPROVED BY CROSSBREEDING WITH THE CHAROLAIS BREED

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INTRODUCTION.

The changes that give rise to conversion of muscle to meat begin with the onset of rigor mortis and continue with the process of ageing, during which muscle tissue is destructured; the most relevant consequence of this is an increase in the tenderness of the meat (Lawrie, 1994). During the ageing of meat, the structure of myofibrilar proteins, of other associated proteins and -although to a lesser extent- of collagen is weakened (Dransfield, 1994). In any case, to a large extent the conditions under which such processes occur as regards temperature and storage characteristics govern the qualities of the final product. Despite this, as reported by Shackeldford *et al.* (1997) the effect of the ageing period depends on the potential tenderness of the muscle from the recently slaughtered animal. In this sense, Campo *et al.* (1998) have considered that the breed or type of crossbreeding of calves is one of the factors responsible of the ageing process. The **aim** of the present study- to characterise two types of quality beef in Salamanca (Spain) coming from animals of different genotypes: Morucha (a rustic breed) and Morucha x Charolais (an improved meat producing cross) with a view to determining the optimum moment for consumption as a function of the evolution of the characteristics of such beef during ageing.

MATERIALS AND METHODS.

Animals: analyses were carried out on 10 samples of loin from animals of 13-14 months of age and with two different genotypes: a rustic genotype, represented by the pure Morucha breed, and an improved genotype, represented by the crossbreeding of Morucha females and Charolais males.

Measurements and analyses: the following data were gathered: classification as a function of conformation and fatness; pH at 45 min and at 24 h after slaughter, cold carcass weight, carcass yield, length carcass and compactness index (weight/length). After 24 hours under refrigeration conditions, the section of the *L. thoracis* muscle between the 6th and 11th ribs was removed. At the level of the 6th rib was measured the area of that muscle and its composition in moisture, fat, protein and heme pigments (Hornsey, 1956).

Following this, the samples were allowed to ageing in the following way. The complete section was kept at 4ºC for three days, after which a slice of approximately 6 cm thickness was removed from the cranial-most zone of the piece, the rest of which was returned to chilling conditions and left for 7, 10 and 14 days. Then, the protocol used for the sample aged for 3 days was re-applied. For each subsample, the L* a* and b* colorimetric parameters were measured using a Minolta CM2002 spectrophotometer. Following this, each of the sub-samples obtained for the different ageing periods was divided into 2 (one portion for sensory analysis and the other for the remaining measurements), vacuum-packed, frozen and held at –20ºC for 2 months. After thawing the corresponding portion, the following parameters were determined: thawing losses (Hamm, 1986); cooking losses (Honickel, 1998), and the instrumental parameters of texture, resistance to 20% and 80% compression in raw meat allowing expansion of the sample, and Warner-Bratzler shear force in cooked meat (Honickel, 1998). Also, the portion destined for the sensory analysis was used to perform an ordering test as a function of ageing time (ISO 8587: 1998).

Statistical analyses: one-way ANOVA was implemented for live weight; carcass weight, yield and length; loin area; $pH_{45'}$, and $pH_{24h.}$ For the rest of the parameters in which both the genotype and the ageing period were taken into account, the analysis was conducted using the split-plot procedure, taking genotype as the plot and ageing time as the subplot.

RESULTS AND DISCUSSION.

The live weight of the animals at slaughtered and the carcass weight was significantly higher in Morucha x Charolais crossbreed animals with respect to the pure Morucha breed animals. These data (table 1) are consistent with the findings reported in the literature (Kempster *et al.*, 1982; Keane *et al.*, 1990), according to which crosses between rustic breeds and breeds eminently destined for meat production give offspring whose weight at slaughtered is greater than that of the rustic breed, although in the present investigation no statistically significant differences were found as regards either carcass yield or in the area of the *L. thoracis* muscle. Regarding carcass classification, although no differences were found between the genotypes as a function of fatness, such differences were seen in the conformation, that of the crossed animals proving to be significantly better. The behaviour of the compactness index (kg of carcass weight/ carcass length) followed a trend parallel to that seen for conformation ($r= 0.847$; $p<0.0001$), the highest value corresponding to the crossed animals since these had greater carcass weight while their carcass length was unaffected ($p>0.1$). This points to the better conformation of the animals with greater weight at maturity than those originating from more early maturity breeds (More O'Ferall and Keane, 1990). The pH values taken at 45 minutes and 24 hours after slaughter did not reveal differences between the two genotypes and were in all cases within the normal range of values.

No significant differences were found as regards the composition in moisture, fat, or protein as a function of genotype, mean values being 75.2, 22.4 and 2.2, respectively for the rustic animals and 76.7, 22.7 and 2.3 for the animals of the improved breed. However, with respect to the myoglobin concentration (mg/g) in *L.thoracis* muscle (5.4 *vs.* 3.56), the concentration of this was significantly higher ($p<0.001$) for the pure Morucha animals than in the crossed-breed animals, in agreement with the data reported by Sañudo et al. (1999).

The values of the colorimetric parameters obtained for the *L.thoracis* muscle (Table 2) show that the highest lightness values corresponded to the crossbreeding animals, while for the a* parameter the highest value was seen in the pure Morucha animals; this was in part due to the high myoglobin concentration in this breed, since in the correlation analysis a significant correlation was observed between both parameters ($p<0.01$). No differences as a function of genotype were observed for the yellowness index. It should be noted that for the colorimetric parameters the effect of the ageing period was not significant and neither was the genotype x ageing time interaction in agreement with the results of Carballo *et al.* (2001), but in contrast to those of other authors (Renerre, 1990), who reported that the colour of the meat becomes less intense as the ageing period progresses. Whereas in the cooking losses no significant differences were observed as a function of genotype, with respect to thawing losses a higher percentage was seen for the meat from the crossbreeding animals; these observations are consistent with the findings of Sañudo *et al.* (1999), who reported a high water holding capacity for the meat from Morucha breed animals. However, no significant effect of the ageing time was observed for either cooking losses or thawing losses and neither was any interaction between genotype and the ageing time observed.

Table 2 also shows the values obtained for the parameters relating to texture, resistance to 20% and 80% compression in raw meat, and shear force in cooked meat; no significant effect of genotype nor any significant interaction between genotype and ageing period were observed. Regarding the effect of the ageing period for both genotypes, it was observed that resistance to 20% compression in raw meat decreased

significantly between 7 and 10 days of ageing, no significant improvement being observed between 10 and 14 days of ageing. The more pronounced decrease in this parameter between days 7 and 10 was also reported by Campo *et al.* (1999), who stated that as from 10 days of ageing the structure of the myofibrils is degraded to a level after which the process tends to stabilise. However, with respect to resistance to 80% compression in raw meat, no significant variation was observed along the ageing period. The maximum resistance force obtained with the Warner-Bratzler test in cooked meat only revealed a significant decrease between days 3 and 7 of ageing, thereafter remaining invariable up to day 14, in agreement with the results reported by Ónega *et al.* (2001).

In the ordering test performed by trained tasters, an interaction between the genotype and ageing period was observed with respect to the general palatability, since whereas for the animals with the pure rustic genotype the tasters found a significant improvement along the 4 ageing periods studied, in the case of the crossed-breed animals they failed to find any improvement as from 10 days of ageing.

Conclusion: meat from rustic breeds, at least according to the expert tasters, would require longer ageing times than meat from crossed breeds (14 *vs.* 10 days), although it would be necessary to take into account the economic implications of this, and arrive at some kind of compromise for commercial production of such breeds.

Table 1: Measurements assessed at the slaughterhouse for the two genotypes.

	MORUCHA	CROSSED	RSD	SIGN.
Final live weight	489,4	595,7	40,82	***
Carcass weight	281,9	342,0	24,65	***
Carcass yield	57,6	57,4	1,32	ns
Conformation	8,1	10,4	1,088	***
Fatness	2,3	2,7	0,472	ns
Carcass length	131,9	133,9	6,23	ns
Compactness Index	2,13	2,55	0,144	***
***L. Thoracis* area**	63,8	60,8	12,06	ns
pH45'	6,62	6,50	0,189	ns
pH24h	5,65	5,73	0,221	ns

***: p>0,001 ns: differences not significant (p>0,1)

Table 2: Colorimetric parameters, thawing and cooking losses the *L. thoracis* muscle as a function of ageing time and genotype.

	AGEING						GENOTYPE			
	3 days	7 days	10 days	14 days	RSD	Sign.	PURE	CROSS	RSD	Sign.
Lightness (L*)	36,26	36,57	37,17	36,67	1,793	ns	35,27	38,08	4,016	**
Redness index (a*)	15,28	14,86	15,63	15,59	0,888	ns	16,28	14,41	2,491	**
Yellowness index (b*)	10,67	11,26	10,65	10,84	1,411	ns	10,30	11,41	3,841	ns
Thawing losses (%)	3,81	3,46	3,44	3,49	1,248	ns	2,94	4,16	2,295	*
Cooking losses (%)	13,30	14,69	14,29	13,99	4,030	ns	14,56	13,58	7,111	ns
20% Compression (N/cm^2)	2,27 [a]	2,18 [a]	1,55 [b]	1,82 [b]	0,698	*	2,01	1,90	1,003	ns
80% Compression (N/cm^2)	105,35	105,67	11,76	116,41	18,35	ns	111,17	108,42	26,45	ns
Warner-Bratzler (kg)	6,25 [a]	5,21 [b]	4,64 [b]	4,44 [b]	1,514	*	5,24	5,04	2,848	ns

**: p<0,01; *: p < 0,05; ns: differences not significant (p>0,1) a,b: indicate significant differences between ageing periods

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