BREED, WEIGHT AND AGEING EFFECTS ON MEAT LAMB TENDERNESS ASSESSED BY CONSUMERS

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Background

The tenderness of meat is one of the most important characteristics for the average consumer (Tornberg, 1996). They prefer tender meat to tough meat. Although consumers can observe meat colour and fatness at the moment of purchasing, what about tenderness? What can they do to obtain tender meat? It is a complex problem because there are a lot of factors that determine meat resistance to chewing (Sañudo et al., 1998), such as the breed, genre, age, slaughter weight, etc., which we cannot easily control, and others that can help modify the original tenderness, such as the ageing or the tenderisation processes.

Objectives

To study the effect of breed [Rasa Aragonesa (meat breed), Churra (daily breed) and Merino Español (meat breed) Spanish breeds], slaughter weight (10-12 kg, 20-22 kg and 30-32 kg live weights) and ageing time (1, 2, 4, 8 or 16 days) on lamb meat tenderness, in two different muscles (*Semitendinosus* and *Semimembranosus*), assessed by consumers.

Methods

One hundred and eighty male lambs were analysed, 20 by each breed-slaughter weight. The lightest lambs in each breed (unweaned) were slaughtered at the region of origin, in order to avoid transport stress which can modify tenderness (Apple et al., 1995). The rest were divided in two lots according to slaughter weight, and fattened in the same place (indoors) with concentrate and cereal straw ad libitum. When the reached the appropriate slaughter weight, they were sent to the abattoir. Carcasses were refrigerated for 24 hours and samples were taken from each half carcass. Each muscle (*Semitendinosus* and *Semimembranosus*) was vacuum packed and randomly aged for 1, 2, 4, 8 or 16 days at 3 ºC. After ageing the vacuum packed samples were blast frozen and stored at –20 ºC until assessment. Muscles were thawed under running tap water before cooking. They were cooked on a pre-heated double hot-plate grill at 200 ºC until the internal temperature was 70 ºC and cut into 20 mm slices. The samples were served hot and were tasted and compared by consumers (n= 265) in three different plates to compare weights, breeds and ageing times. Tenderness was assessed on a scale of 1 (very tough) to 10 (very tender).
Results were analysed using the GLM procedures in the SPSS 8.0 package and the Duncan test to compare means.

Results and discussions

Significant differences were found for all the studied factors (breed, slaughter weight, ageing and muscle), as shown in Tables 1 and 2.
Breed effect was more noticeable in the SM, where the Merino breed was more tender for light and early fattening lambs, and the Churra breed for suckling animals.
Slaughter weight had more influence on ST than SM. The suckling lambs were the most tender of the three breeds, which is normal because the collagen of young animals is more soluble (Young and Braggins, 1993); no differences were found in ST at the other slaughter weights. For SM, tenderness clearly varied with slaughter weight in the Churra breed for the youngest animals, maybe because it is precocious and a high milk producer, so its lambs have more fat at early ages which helps to make the meat more tender (Sañudo et al., 2000).
The **ageing** effect was clearer on SM, where tenderness increased with ageing time. On ST ageing occurred faster and differences were less evident. Tenderness decreased in the meat of suckling lambs that was aged for long period, perhaps because water loss increases with increased ageing time (Koohmaraie et al., 1990).
The type of **muscle** had the greatest influence on tenderness. In almost all cases *Semitendinosus* (ST) was more tender than *Semimembranosus* (SM), however, this difference was smaller for longer ageing times. This implies that tenderness differences due to muscle characteristics could be overcome with ageing.

Conclusions

Slaughter weight, ageing and breed are decisive factors regarding lamb meat tenderness, as well as the muscle considered. There were also some significant interactions between breed or weight and ageing time.

Pertinent literature

■Apple J.K., Dikeman M.E., Minton J.E., McMurphy R.M., Fedde M.R., Leith D.E. and Unruh J.A., 1995. Effects of restraint and isolation stress and epidural blockade endocrine and blood metabolite status, muscle glycogen metabolism, and incidence of dark-cutting *Longissimus* muscle of sheep. Journal of Animal Science 73, 2295-2307.■ Koohmaraie M., Whipple G. and Crouse J.D., 1990. Acceleration of postmortem tenderisation in lamb and Brahman-cross beef carcasses through infusion of calcium chloride. Journal of Animal Science 68, 1278-1283.■ Sañudo C., Sánchez A., Alfonso M., 1998. Small ruminant production systems and factors affecting lamb meat quality. Meat Science, Vol. 49, S29-S64.■ Sañudo C., Alfonso M, Sánchez A., Delfa R. and Teixeira A., 2000. Carcass and meat quality in light lambs from different fat classes in the EU carcass classification system. Meat Science, Vol 56, 89-94.■ Tornberg E., 1996. Biophysical aspects of meat tenderness. Meat Science, Vol. 43, S175-S191.■ Young O. and Braggins T.J., 1993. Tenderness of ovine *Semimembranosus*: is collagen concentration or solubility the critical factor?. Meat Science 35, 213-222.■

Acknowledgements

Table 1. Significance and F values for tenderness assessed by consumers in lamb meat according to the studied factors: breed, weight, ageing and muscle.

	BREED (B)	WEIGHT (W)	AGEING (A)	MUSCLE (M)	B x W	B x A	B x M	W x A	W x M	A x M	B x W x A	B x W x M	B x A x M	W x A x M	B x W x A x M
F	42.99	112.85	25.17	437.02	12.74	2.16	12.40	2.14	8.69	16.71	1.40	1.60	1.11	3.08	1.00
Sig.	***	***	***	***	***	*	***	*	***	***	N.S.	N.S.	N.S.	**	N.S.

***= P≤ 0.001;   **= P≤ 0.01;   *=P≤0.05

Table 2. Tenderness assessed by consumers (means and standard deviation) on two muscles (*Semitendinosus* and *Semimembranosus*) for three different Spanish breeds (Rasa Aragonesa, Churra and Merino Español) slaughtered at three live weights (10-12 kg, 20-22 kg and 30-32 kg) and aged for different times (1, 2, 4, 8 or 16 days).

SLAUGHTER WEIGHT AND LAMB TYPE			10-12 kg (Suckling lamb)					20-22 kg (Light lamb)					30-32 kg (Early fattening lamb)				
	AGEING (Days)		1	2	4	8	16	1	2	4	8	16	1	2	4	8	16
Semitendinosus (ST)	RASA ARAGONESA	x	7.28^{bksxi}	7.95^{bkxi}	7.12^{aksxi}	7.30^{bksxi}	6.85^{aksh}	6.15^{aksi}	6.45^{aksi}	6.18^{aksi}	5.82^{aksi}	6.42^{aksh}	6.05^{aksi}	6.48^{aksi}	6.52^{aksi}	6.68^{abksi}	6.35^{aksi}
		s.d.	2.00	1.82	1.87	1.90	2.18	2.35	1.98	2.06	2.14	1.91	2.53	2.32	2.24	2.42	2.55
	CHURRA	x	7.92^{bksxi}	8.30^{bkxi}	8.22^{blxi}	7.90^{bksxi}	7.17^{aksh}	5.88^{aksh}	5.90^{aksi}	6.28^{aksh}	6.12^{aklsi}	6.65^{aksi}	5.20^{aksi}	6.42^{akxi}	5.82^{aksxi}	6.25^{akxi}	6.32^{akxi}
		s.d.	1.86	1.94	1.73	1.41	1.69	2.69	2.46	1.81	2.05	2.24	2.49	2.53	1.92	2.01	1.89
	MERINO ESPAÑOL	x	7.65^{bksi}	8.05^{bksi}	8.00^{clsi}	8.10^{bksi}	7.45^{aksh}	6.52^{aksi}	6.88^{aksh}	6.75^{bksh}	6.95^{alsh}	6.98^{aksh}	5.79^{aksi}	6.38^{aksxi}	5.78^{aksh}	6.78^{aksxh}	6.88^{akxh}
		s.d.	1.86	1.91	1.94	1.93	2.05	2.02	1.98	1.50	2.20	1.73	2.04	2.30	2.08	2.14	2.05
Semimembranosus (SM)	RASA ARAGONESA	x	4.32^{aksh}	5.13^{bksxh}	4.22^{aksh}	5.68^{bkxh}	5.95^{bkxh}	3.88^{aksh}	4.08^{aksh}	4.75^{aksh}	4.35^{aksh}	6.35^{bklxh}	3.45^{aksh}	4.52^{abkxh}	4.82^{aklxh}	4.80^{abkxh}	4.90^{akxh}
		s.d.	2.20	2.33	2.02	2.43	2.54	2.36	2.39	2.32	1.83	2.02	2.02	1.85	1.96	2.02	1.82
	CHURRA	x	5.18^{bksh}	5.68^{bksxh}	6.38^{blxh}	6.45^{bkxh}	8.05^{blyi}	4.90^{blsxh}	4.00^{aksh}	5.50^{bkxh}	4.35^{aksh}	5.60^{akxh}	3.80^{aklsh}	3.92^{aksh}	4.18^{aksh}	4.75^{aksxh}	5.32^{akxh}
		s.d.	2.15	2.37	2.08	2.66	2.04	1.97	2.16	2.50	1.90	1.85	2.15	2.16	2.26	2.57	1.99
	MERINO ESPAÑOL	x	4.95^{aksh}	5.98^{bkxyh}	5.62^{alsxh}	6.72^{akyzh}	7.38^{blzh}	4.98^{alsh}	6.08^{blxh}	6.62^{blxyh}	7.13^{alyh}	6.55^{ablxyh}	4.48^{alsh}	4.78^{aksh}	5.32^{alsh}	6.58^{alxh}	6.25^{alxh}
		s.d.	2.46	2.30	2.22	2.15	1.86	2.13	1.74	1.70	2.27	1.84	2.10	2.19	1.79	2.22	1.97

a, b, c – Different superscripts (within muscle, ageing and breed) represent significant differences between weights (P≤0.05).
k, l - Different superscripts (within muscle, ageing and weight) represent significant differences between breeds (P≤0.05).
s, x, y, z - Different superscripts (within muscle, weight and breed) represent significant differences between ageing times (P≤0.05).
h, i - Different superscripts (within weight, ageing and breed) represent significant differences between muscles (P≤0.05).