Breed and Ageing Time Effects on Textural Sensory Characteristics of Beef Strip Loin Steaks

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Background. The palatability of beef affects consumers' purchasing decisions (Savell *et al.*, 1987). Tenderness is usually considered the most important criteria of consumer acceptability and it affects its final consumption decision (Boleman *et al.*, 1997). Many factors have been shown to affect the tenderisation process of beef meat, both technologic and productive. Within the productive ones, breed is a main component controlled in the beef meat quality labels.

Objectives. To assess the evolution of the textural sensory characteristics of beef meat in animals with different productive purposes, along the ageing time, was the aim of the present study.

Material and Methods. Six yearlings, entire males, from each of the following seven European breeds were studied: Asturiana de los Valles (DM) (double muscled breed from the North of Spain), Brown Swiss (BS) (double purpose breed), Pirenaica and Rubia Gallega (FG) (Northern Spanish meat purpose breeds with fast growth located in the Pyrenees and in Galicia respectively) and Avileña, Morucha and Retinta breeds (RT)(rustic breeds from the Centre and West of Spain).

Animals were slaughtered at a EU-licensed commercial abattoir. After chilling at 4ºC for 24 hours, visual fatness and carcass conformation were scored following the EUROP grading (Table 1). Muscle, bone and fat tissue composition of the left side were obtained from commercial joints (Table 1). Intramuscular fat content (IMF) was analysed in the eyeloin of the 11th rib.

The strip loin was removed from the left side posterior to the 11th rib and the longissimus muscle was obtained. 2-cm thick steaks were cut, randomly assigned either to one of six postmortem periods and individually vacuum packaged. Those steaks with one day of ageing were frozen immediately. The rest of samples were kept at 4ºC until the ageing time reached 3, 7, 10, 14 and 21 days. Then they were frozen and stored at -18 ºC. 24 hours before each panel session steaks were thawed at 4ºC. Meat was cooked in a double plate grill at 200 ºC until it reached 70 ºC of internal temperature.

An eleven-member trained sensory panel assessed tenderness (defined as the opposite to the force required to bite through the sample with the molars), juiciness (amount of moisture released by the sample after the first two chews), fibrosity (amount of fibres perceived after four chews) and residue (amount of connective tissue perceived previous to the deglution) in an unstructurated 9-points scale. Statistical analyses were made using the GLM procedures of SAS (1998) for a 6 (ageing time) x 4 (breed group) factorial arrangement of an unbalanced randomized completely block design, and for the breed effect by time. Means were compared using LSD.

Table 1. Productive, carcass characteristics and intramuscular fat content on different breed types included in the experiment.

	Double muscle	Brown Swiss	Fast growth	Rustic	sed
DGW [a](kg)	1.36 ^{z}	1.74 ^{y}	1.67 ^{y}	1.32 ^{z}	0.035
Carcass yield [b]	68.83 ^{w}	60.06 ^{y}	63.00 ^{x}	58.60 ^{z}	0.234
Conformation [c]	E ^{x}	R+ ^{y}	U- ^{y}	R- ^{z}	0.167
Fatness [d]	1 ^{z}	3- ^{x}	2+ ^{y}	3 ^{x}	0.209
Muscle [e] %	80.05 ^{y}	70.39 ^{z}	74.39 ^{y}	69.88 ^{z}	0.110
Fat [e] %	15.79 ^{z}	20.22 ^{x}	17.71 ^{y}	19.15 ^{x}	0.198
Bone [e] %	4.16 ^{z}	9.39 ^{x}	7.90 ^{y}	10.97 ^{w}	0.231
IMF [f] %	0.97 ^{z}	3.03 ^{x}	2.02 ^{y}	3.22 ^{x}	0.130

[a] Daily gain weight. [b] Cold carcass weight*100/Slaughter live weight. [c] EUROP carcass classification. [d] 1-5 fatness classification (1, very low - 5, very high). [e] Muscle, fat and bone carcass composition, from the dissection of commercial joints. [f] Intramuscular fat content. $^{w, x, y, z}$. Means in the same row lacking a common superscript letter differ ($p<0.001$). Means in the same row without superscripts do not differ.

Table 2. Significance of main effects in the studied sensory descriptors.

	Ageing	Breed type	A*B
Tenderness	***	*	*
Juiciness	**	n.s.	n.s.
Fibrosity	***	n.s.	n.s.
Residue	***	*	n.s.

Results and Discussion.

Aging time has been the main effect in all the studied characteristics (Table 2). Breed type had an influence only in tenderness and residue ($p<0.05$). An interaction between ageing time and breed type was found in tenderness. Its score was higher as ageing time

increased in all the breed groups (Table 3). At early postmortem time DM breed type showed the highest tenderness, probably due to its double muscled condition with a higher number of cells (Lazzaroni *et al.*, 1994) and the lower proportion of stable non-reducible collagen cross links (Bailey *et al.*, 1982). At late postmortem time RT type showed the most tender meat, probably due to a different postmortem proteolysis (Shackelford *et al.*, 1991). At 21 days of ageing no significant differences were found, as ageing time reduces the toughness differences among breeds (O'Connor *et al.*, 1997). Juiciness at late postmortem time was scored higher in BS, FG and RT breed type than in DM, partially due to its low amount of IMF and a low water holding capacity that could be influenced by an early postmortem myofibrillar degradation. Fibrosity and residue descriptors showed an opposite evolution related to tenderness, since the sensorial scores were lower as ageing time increased, due to the degradation of the myofibrilar and connective tissue (Geesink *et al.*, 1995, Nishimura *et al.*, 1996).

Table 3. Tenderness and juiciness average values in every breed type (double muscle (DM), dual-purpose (BS), fast growth (FG) and rustic (RT)) at every aging time (1, 3, 7, 10, 14 and 21 days).

	Tenderness [a]					Juiciness [b]				
Ageing	**DM**	**BS**	**FG**	**RT**	**s.e.d**	**DM**	**BS**	**FG**	**RT**	**s.e.d**
1	5.36^{y}	4.76^{z}	4.82^{z}	4.49^{z}	0.075	4.78^{y}	4.39^{yz}	4.19^{z}	4.42^{yz}	0.081
3	5.39	5.11	5.04	5.01	0.074	3.98	4.05	4.11	5.01	0.077
7	5.60^{y}	5.24^{z}	5.76^{y}	5.68^{y}	0.078	4.59	4.69	4.68	4.36	0.085
10	5.83^{yz}	5.56^{z}	6.07^{y}	5.69^{z}	0.075	4.22	4.32	4.71	4.65	0.082
14	5.95^{yz}	5.48^{z}	5.97^{y}	6.04^{y}	0.072	4.30^{yz}	4.00^{z}	4.47^{yz}	4.48^{y}	0.080
21	6.11	6.45	6.14	6.29	0.078	4.18^{z}	4.59^{yz}	4.57^{yz}	4.69^{y}	0.084

[a] 1, very tough-9, very tender. [b] 1, very dry-9, very juicy. ^{y,z} Means in the same row lacking a common superscript letter differ ($p<0.05$). Means in the same row without superscripts do not differ significantly.

Conclusions. Results show the existing variability in the ageing evolution of the meat depending on the breed type. These findings suggest an early consumption of double muscled breed meat after the slaughter and a larger period for the rustic breeds for assessing an optimum value according to consumer expectations.

Table 4. Fibrosity and residue average values in every breed type (double muscle (DM), dual-purpose (BS), fast growth (FG) and rustic (RT)) at every aging time (1, 3, 7, 10, 14 and 21 days).

	Fibrosity [a]					Residue [b]				
Ageing	**DM**	**BS**	**FG**	**RT**	**s.e.d**	**DM**	**BS**	**FG**	**RT**	**s.e.d**
1	4.24	4.65	4.66	4.63	0.094	4.13	3.73	4.00	3.99	0.096
3	4.18	4.00	4.22	4.39	0.086	4.04	3.86	3.61	3.82	0.093
7	4.50^{y}	3.98^{yz}	3.68^{z}	3.90^{z}	0.083	4.01^{y}	3.41^{yz}	3.42^{z}	3.42^{z}	0.088
10	3.98	3.82	3.81	3.81	0.082	3.62	3.29	3.63	3.42	0.088
14	3.61^{yz}	4.04^{y}	3.54^{yz}	3.52^{z}	0.082	3.64^{yz}	3.33^{yz}	3.58^{y}	3.17^{z}	0.086
21	3.90	3.61	3.51	3.63	0.083	3.65	3.29	3.42	3.31	0.094

[a] 1, very low fibrosity-9, very high fibrosity. [b] 1, low amount of residue-9, large amount of residue. ^{y,z} Means in the same row lacking a common superscript letter differ ($p<0.05$). Means in the same row without superscripts do not differ significantly.

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