MEAT QUALITY OF FIGHTING BULLS

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BACKGROUND

Although the major aim of fighting bull production (Lidia) is the rearing of bulls with particular behaviour characteristics, an increase in the value of the meat from the bulls could benefit the system. The young bulls stay with their mothers until weaning at 7 or 8 months of age and are then reared in extensive grazing systems until the moment of the bull fight at 3 (young bulls) to 4 or 5 years (bulls) of age.

Consumers have little knowledge of the quality of meat from fighting bulls, which may be affect by the emotional and physical stress that the animal suffers during the bull fight. Meat from fighting bulls is not always available, does not have a clearly defined price and tends to be available only during the periods of major bull fighting fiestas.

OBJECTIVE

The purpose of the present work was to characterise meat from fighting bulls by determining parameters related to its sensory quality. Clear charactersation might contribute to the establishment of a quality label that could improve marketing of this kind of meat.

MATERIALS AND METHODS

30 bulls killed in bull fights in the *Feria de San Fermin* in Pamplona in 1995 and 1997 were used. *Longissimus dorsi* muscle was removed 48 h post-mortem and it was cut in steaks, that were vacuum packaged (Egarvac, 99%) and stored under refrigeration for 5 days. The studied parameters were:

- pH was measured at the 5th-6th rib of the carcass 60 min (time 0), 12 h and 24 h after slaughter (penetrating electrode).
- Chemical composition after 7 days of ageing (2+5) (*Proteins*, Kjeldhal method (UNE 55-020); *Total fat content* (Soxhlet method ISO-1443-1973); *Ashes* (ISO-R-936); *Moisture* (ISO-1442-1973); *Total and soluble collagen* (Hill, 1966; Bergman and Loxley, 1961; Cross et al., 1973); *Total heminic pigments* (Hornsey, 1956); *Total aerobic plate counts* on PCA (Difco®), *Enterobacteriaceae* on VRBGA (Difco®).
- Extraction of the lipid fraction (Bligh and Dyer, 1959) and quantification of total fatty acids (gas chromatography, column HP-FFAP).
- CIE L*a*b*, C* and H* parameters were measured after 2 and 7 days of ageing with a MINOLTA CM2002, illuminant 56 and standard observer 10°; the evolution of the reflectance spectra was determined immediately after cutting the meat (time 0) and after 1, 5 and 7 days of exposure to the air.
- Shear force (Warner-Bratzler), water holding capacity (Grau and Hamm, 1953) and cooking loses.

The results were analysed with the SPSS 6.1.2. (1995) program; the analysis of Variance and the Tuckey test were applied to the data.

RESULTS AND DISCUSSION

The chemical composition of the samples (Table 1) was similar to results for beef (Lawrie, 1977). However, the low fat content, compared with animals from other breeds slaughtered at the same age, might be due to the breed type or to the livestock system. The high total heminic pigment content of the *longissimus dorsi* muscle,was higher than in meat from other cattle breeds (Lawrie, 1977).

The pH decreased to 5.9 at 12 h *post-mortem* but then increase to 6.3 at 24 h (fig. 1). Total aerobic plate counts and *Enterobacteriaceae* counts after 7 days of ageing reflected a good hygienic quality (Table 1).

Table 2 shows the fatty acid content in the intramuscular fat. It is characterised by high oleic (C18:1w9) and linolenic (C18:3w3) fatty acids contents and by a lower amount of linoleic (C18:2w6) fatty acid in relation with the results obtained in beef from other Spanish breeds (Lizaso et al., 1997).

CIE L*a*b* colour parameters are shown in table 3. After 2 days of ageing meat colour was dark red and of high intensity. Even though all the meat had a final pH value higher than 6.0 (fig. 1), the reflectance curves (fig. 2) showed a normal colour evolution for beef (Lizaso et al., 1997). The difference between this evolution and that of DFD meat is that the latter has low reflectance and low oxygenation ratio of the myoglobine pigment (MacDougal, 1982). As a consequence, it must be pointed out that even though the final pH (pH_{24}) was higher than 6.0, the evolution of colour did not reflect the stressing conditions that the animals were submitted to during the bullfighting

No decrease in the shear force of meat was observed during ageing ($p<0.01$, Table 4). This might be attributed to the low shear force values found in meat 48 h post-mortem and to the high pH value in the muscle, that might have led to an increase in the m-calpain activity, thus increasing meat tenderness (O'Halloran et al, 1994; Watanabe et al., 1995).

Water holding capacity (WHC) and fat content are related to the juiciness of meat. During ageing, there was a significant decrease in the amount of water loss by the meat ($p<0.01$, Table 4), possibly due to modifications in the myofibrillar proteins.

CONCLUSIONS

Beef from fighting bulls of Lidia breed is produced in an extensive production system, and is charactericed by its intense red colour, low fat content and a low shear force value, all of which give this meat different organoleptic characteristics that differ from those of beef from other cattle breeds.

Table 1. Parameters measured in the *longissimus dorsi* muscle after 7 days of ageing

Moisture (%)	75.10 ± 0.47
Protein (%)	21.07 ± 0.25
Fat (%)	1.01 ± 0.14
Ashes (%)	1.44 ± 0.35
Total collagen (%)	3.90 ± 0.18
Soluble collagen(%)	4.64 ± 0.28
Mb (mg/g)	10.86±0.23
PCA	5.04±0.39
Enterobacteriaceae (log)	3.85 ± 0.49

(1) Soluble collagen is expressed as the porcentage of total collagen

Table 2. Fatty acid content (%) of the intramuscular fat of *longissimus dorsi* muscle after 7 days of ageing

Miristic	C14:0	2.49
Palmitic	C16:0	24.42
Palmitoleic	C16:1w7	2.98
Stearic	C18:0	15.54
Oleic	cisC18:1w9	38.01
Linoleic	C18:2w6	12.20
Linolenic	C18:3w3	0.68
Σ Sat/ Σ Insat		0.74

Table 3. Evolution of the colour of meat from fighting bulls during ageing (2 and 7 days).

	Days of ageing		
	2 days	**7 days**	
L*	28,94±0,46	28,14±0,66	ns
a*	22,31±0,55	17,47±0,76	***
b*	6,10±0,54	3,78±0,48	***
C*	23.18±0.65	17.96±0.76	***
H*	14.97±1.06[a]	12.30±1.55	*

ns= p>0,05; * p<0,05; *** p<0,001

Table 4. Evolution of the shear force and juiciness (WHC, cooking losses) during ageing (2 and 7 days).

	Days of ageing		
	2 days	**7 days**	
Shear force (kg/cm^2)	4,3	3,1	ns
WHC (1)	22,56	19,32	***
Cooking losses (%)	16,59	17,52	*

(1) WHC is mesured as the porcentage of water lose; ns= p>0,05; * p<0,05; *** p<0,001

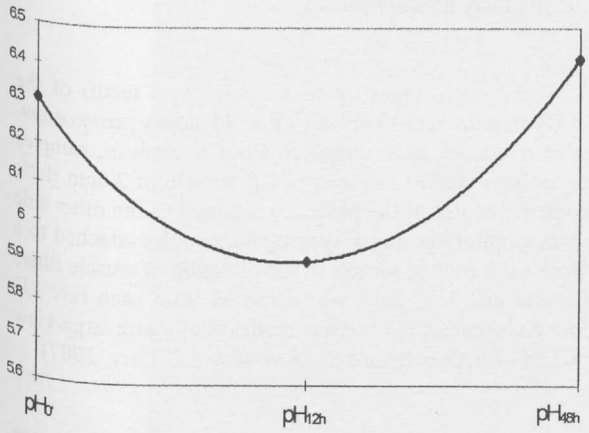

Fig. 1.- Evolution of the pH of meat

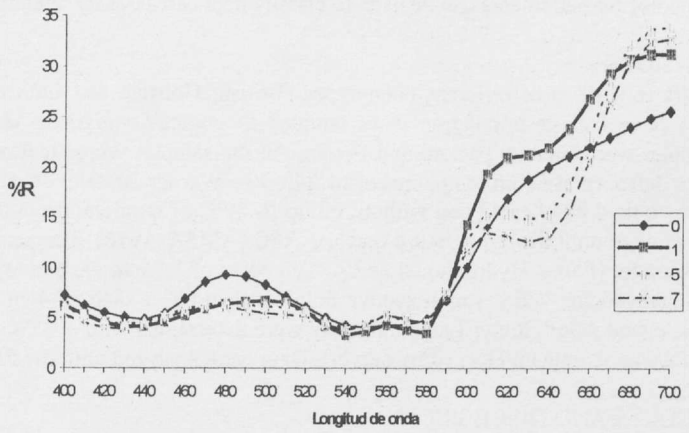

Fig. 2.- Evolution of the reflectance spectra of meat colour

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