CHARACTERISTICS OF BEEF STEAKS FROM "CARNE DE LA SIERRA DE GUADARRAMA" QUALITY LABEL

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Introduction

The term meat quality includes a sum of parameters that in short are: pH, colour, texture, water holding capacity, quantity and composition of fat, quantity and types of collagen and sensory attributes. Tenderness and colour are particularly important. While the first determines the consumer's satisfaction, the second causes a consumer's response and decision to buy or not to buy the product. Researchers have found a relationship between ultimate muscle pH (Watanabe *et al.*, 1995), muscle colour (Wulf *et al.*, 1996) and meat tenderness. Because of its importance in the carcass and its high commercial value, M. *longissimus dorsi* (thoracic part) (LD) is considered as an indicator of tenderness and is used in several studies like this. The objective of this study was to assess the effects of sex and ageing time on the tenderisation process using both instrumental and sensory tests.

Materials and Methods

Nineteen male and eleven female beef animals with the label de PGI "Carne de la Sierra de Guadarrama" (a Protected Geographical Indication from Madrid) were used in this study. These animals were entire males and females of 13-15 months old, with near 241 kg HCW for females and 399 kg for males and carcass classification values from U to R, and levels of fatness from 1 to 4. They were slaughtered in a commercial abattoir and processed according to the rules. Carcasses were weighed and classified by an official of the PGI and chilled under commercial conditions during three ageing intervals: 1 (from 3 to 6 days), 2 (from 7 to 9 days) and 3 (since 10 to 14 days). After the ageing period, M. *longissimus dorsi* (LD) was removed and sliced into 2 cm thick steaks that were vacuum packaged and randomly assigned to subsequent analyses. Meat quality parameters measured were: pH, colour, TPA (texture profile analysis), water-holding capacity, total collagen content and its solubility, and intramuscular fat quantity. To measure texture, we used the TPA (texture profile analysis) test on raw samples and steaks cut in pieces of 1 cm^2 with muscle fibres parallel to the longitudinal axis in order to apply the force transversal to the muscle fibres. Meat samples were analysed in a texturometer with a cylindrical 10 mm-diameter probe of ebonite and a deformation force of 75%. Sensory analysis was carried as described by Onega *et al.*, (2000) on samples for hardness, springiness and juiciness, complete with the parameters fat sensation (in mouth), flavour intensity, number of chewings until swallowing and overall. Scales used to assess intensity of every parameter were interval scales 10 cm long. Meat steaks were grilled to 80ºC (internal temperature) and cut into 1 cm^3 samples. 12-15 trained assessors tasted each muscle/animal/ageing combination. Each assessor tasted 6 portions of meat per session (2 replicates for each muscle). Statistical analysis of the data was made using the analysis of covariance of the GLM procedure of Statgraphics Plus (1994), with hot carcass weight used as covariate. The Duncan test was used to analyse differences between means.

Results and Discussion

The effects of gender and the three ageing intervals in LD muscle on pH, water-holding capacity, intramuscular fat, collagen composition, and colour parameters are shown in Table 1.

The percentage of intramuscular fat was higher in females than males and shows a significant effect (as expected) and lightly higher values for females than those found by Ruiz de Huidobro *et al.*, (2003) for the same PGI meat label. Total collagen content, insoluble collagen and solubility were highest in males although only with significant effects in solubility and insoluble collagen ($P<0.05$). Ageing had no significant effect on any collagen parameters. pH had quantitative interaction between studied factors. In water-holding capacity it was observed that early ageing (3 to 6 days) showed a higher liquid expulsion than half or long ageing. Ruiz de Huidobro *et al.*, (2003) found that WHC increased significantly during ageing one to six days in heifers, while in bulls there was no significant variation. Expelled water (%) in heifers' meat was reduced significantly during the first and third days but then remained unchanged until the sixth day. The factors studied had no influence on product colour.

Table 1: Arithmetic means and mean squares of error for pH, WHC, intramuscular fat, collagen and colour parameters of LD at different ageing periods and in both sexes.

	Gender (G)			Ageing (A)					
	Male	Female	Sig	1	2	3	Sig	G x A	MSE
pH	5,44	5,47	NS	5,44[a]	5,51[b]	5,41[a]	*	*	0.005
WHC (%)	14,33	12,71	NS	15,48[a]	12,66[b]	12,41[b]	*	NS	8,62
Intramuscular fat (%)	2,57	4,38	*	3,70	3,79	2,94	NS	NS	1,64
TC (mg/g muscle)	6,48	6,06	NS	6,09	6,34	6,38	NS	NS	2,02
IC (mg/g muscle)	5,42	4,45	*	4,59	5,19	5,03	NS	NS	1,71
Solubility (%)	22,67	10,00	*	15,71	16,36	16,94	NS	NS	70,29
L*	37,52	38,18	NS	37,93	36,76	38,86	NS	NS	5,83
a*	17,11	17,73	NS	15,72	17,31	19,22	NS	NS	22,67
b*	8,58	10,08	NS	8,41	9,11	10,48	NS	NS	4,52
C*	19,19	20,56	NS	17,94	19,62	22,06	NS	NS	24,81
H*	26,71	30,61	NS	28,69	27,76	29,53	NS	NS	14,98

Means in the same row not followed by a common letter differ significantly ($p \leq 0.05$). Sig: Significance; NS (non significance). MSE: mean square of the error. Ageing 1 (3 to 6 days), 2 (7 to 9 days) and 3 (since 10 to 14 days).

Effects of gender and the three ageing intervals on muscle on textural and sensorial parameters in LD are shown in Table 2. Aged meat during a half period interval (7 to 9 days) displayed the lowest hardness and springiness (by TPA) than the other intervals in both sex. Chewiness by compression measurement presented a qualitative interaction between gender and ageing interval. From early ageing (3 to 6 days) to medium ageing (7 to 9 days) chewiness decreased in both sex, but at long ageing (10 to 14 days) the female meat samples had higher values of chewiness than the male. According to sensorial analysis, female's meat was less hard and springy than male's, due to its higher intramuscular fat. Also, females showed higher flavour intensity. By consequence, this meat was best when evaluated by assessors. No significant differences were found in juiciness, fat sensation and number of chewings. Sensorial parameters, including overall, were similar in all three ageing intervals.

Table 2: Arithmetic means and mean squares of the error of textural and sensorial parameters of LD at different ageing period and in both sex.

	Gender (G)			Ageing (A)					
	Male	Female	Sig	1	2	3	Sig	G x A	MSE
TPA Hardness (N)	175,77	207,45	NS	204,93[a]	158,14[b]	211,75[a]	*	NS	1981,13
TPA Springiness (g)	75,43	76,97	NS	76,27[ab]	74,71[a]	77,63[b]	*	NS	6,26
TPA Chewiness	3714,4	5085,7	*	4795,8[a]	3522,8[b]	4881,6[a]	*	*	896404
Hardness	4,84	3,45	*	4,11	4,04	4,31	NS	NS	0,80
Springiness	4,38	3,70	*	4,00	3,88	4,22	NS	NS	0,63
Juiciness	2,48	2,86	NS	2,74	2,60	2,67	NS	NS	0,59
Fat sensation	2,49	2,59	NS	2,65	2,58	2,39	NS	NS	0,26
Flavour intensity	4,12	4,96	*	4,64	4,32	4,65	NS	NS	0,46
Chewings (number)	22,27	20,43	NS	23,16	20,24	20,64	NS	NS	20,89
Overall	4,50	5,26	*	4,65	4,90	5,08	NS	NS	0,41

Means in the same row not followed by a common letter differ significantly ($p \leq 0.05$). Sig: Significance; NS (non significance). MSE: mean square of the error. Ageing 1 (3 to 6 days), 2 (7 to 9 days) and 3 (since 10 to 14 days).

Conclusions

There was a tendency for "better overall" with increase in ageing period but the effect was not significant. The samples of female meat were less hard and springy and had a higher flavour intensity than males, probably due to the higher intramuscular fatness in the former. However all meats studied were considered poor for hardness.

References

Ruiz de Huidobro F., Miguel E., Blázquez B. and Onega E. (2003). A comparison between two methods (Warner-Bratzler and texture profile analysis) for testing either raw meat or cooked meat. Meat Science, 69: 527-536.

Watanabe A., Daly C.C and Devine C.E (1995). The effects of the ultimate pH of meat on tenderness changes during ageing. Meat Science, 42: 67-68.

Wulf D.M., Morgan J.B., Tatum J.D. and Smith G.C. (1996). Effects of animal age, marbling score, capastatin activity, subprimal cut, calcium injection, and degree of doneness on the palatability of steaks from Limousin steers. Journal of Animal Science, 74, 569-576.