MEAT AND FAT QUALITY OF MILKFED CALVES OF THE SPANISH BROWN SWISS BREED. EFFECT OF THE LEVEL OF INTAKE

Vieira, C[1]., García-Cachán, M.D.[1], Cerdeño, A.[2], Mantecón, A. R.[2]
[1] Estación Tecnológica de la Carne. Junta de Castilla y León. Apdo.58-37770 Guijuelo-Salamanca (Spain)
[2] Estación Agrícola Experimental, CSIC. Apdo. 788-24080 Grulleros-León (Spain)

INTRODUCTION.

Traditionally, meat from milkfed calves has been associated with pale colour, high juiciness, tenderness and low visible fat amounts. In fact, in the past such meat was considered as the highest quality meat. However, nowadays the use of lacking iron milk substitutes in the rearing of milkfed calves has conducted to animals whose meat has a similar aspect but differs considerably from that obtained under traditional production systems.

The rearing of veal calves on the basis of traditional systems, using only cow's milk, may offer an alternative to the current system as long as the quality of the final product can be guaranteed.

The main **objective** of the present work was to assess the quality parameters of the meat and the composition in fatty acids of different fat depots in Spanish Brown Swiss veal carcasses fed with cow's milk as a function of the level of intake.

MATERIALS AND METHODS.

Animals: seventeen 15 days old Spanish Brown Swiss calves, were used; the animals were individually allocated and were divided into two experimental groups. Group A (8 calves) was fed *ad libitum* with cow's milk twice daily, while group B (9 calves) received a diet restricted to 70% over the first 2.5 months and after that they fed *ad libitum* until slaughter, when they reached 5 months of age in both groups.

Measurements and analyses: after a 24 h at 4ºC, the following colorimetric measurements were made on the left side of the carcasses: lightness (L*), redness index (a*) and yellowness index (b*). The measurements were taken on the surface of the *Cutaneus trunci* and *Pectoralis profundus* muscles and subcutaneous fat, using a Minolta CM-2002 spectrophotometer. The section corresponding to the 6th rib was dissected and on the *Longissiumus thoracis* muscle the following measurements were made: colorimetric parameters, area, heme pigments (Horsney, 1956), total collagen, moisture, fat and protein (MAPA, 1981), and soluble collagen (Hill, 1966). The fatty acid profile of the subcutaneous, intermuscular and intramuscular fat depots was measured by gas chromatography.

The section between the 7th and 11th ribs was used to determine the water holding capacity measured as drip losses (Honikel, 1997), filter paper press method (Vallejo, 1971), cooking losses, thawing losses and texture were measured with a TA-XT2 texturemeter (Honikel, 1997). These measurements involved 20% and 80% compression in raw meat (kg/cm^2) and maximum shear force (kg) in cooked meat, using a Warner-Bratzler shear test. A sensory analysis was performed with the participation of 8 trained panelist, who assessed the odour, tenderness, juiciness, flavour and overall palatability of the samples on a 1-9 continue scale. Triangular tests were also conducted to detect differences between the two levels of milk intake. Statistical analyses of the results were performed using the SPSS 9.0 Statistical Package.

RESULTS AND DISCUSSION.

As shown in table 1, there were no statistically significant differences in moisture, fat, protein and myoglobin between the two levels of milk intake assayed. Regarding the values obtained for the percentage of collagen in *L. thoracis* muscle, statistically significant differences ($p<0.05$) were observed between the two treatments, the highest value corresponding to the animals that received a restricted diet during the first part of the study. The data obtained for soluble collagen, showed only a trend for this to be higher ($p<0.1$) in the group B.

The values of the colorimetric parameters measured in carcass on the *C. trunci* muscle of group A were 50.61, 7.72 and 10.05 for L*, a* and b*, respectively, and 50.29, 8.97 and 11.01 for the animals from group B. The values obtained for L* a* and b* in the *P. profundus* muscle were 42.49, 13.06 and 9.89 for treatment A and 40.52, 15.31 and 11.42 for treatment B. In subcutaneous fat, the values obtained for these parameters were 72.76, 0.57 and 2.65 for the animals from group A and 71.10, 0.43 and 3.62 for the animals from group B. As regards the colorimetric parameters, no significant differences were found between the levels of milk intake studied at any of the locations considered.

The values of the colorimetric parameters obtained in *L. thoracis* muscle are shown in table 2. As may be seen, there were no statistically significant differences between the two feeding strategies considered. The values of the redness index were slightly higher than those reported in the literature for milkfed calves (Guignot et al., 1992), probably because in those cases animals were feeding with milk substitutes with iron levels lower than those found in cow's milk.

The water holding capacity, measured as drip losses and by filter paper press losses, did not reveal significant differences between the experimental treatments. The values obtained for drip losses were 3.05 and 3.19% and 17.35% and 18.22% by filter paper press method for treatments A and B respectively. The percentages of thawing loss were 2.63% for treatment A and 1.84% for treatment B, with no significant differences between these values. Regarding cooking, there were no significant differences between the treatments either, the values being 20.68% and 21.49% respectively for treatments A and B. The percentages of the fractions obtained after dissecting the portion corresponding to the 6th rib for the A and B treatments were as follows respectively: 17.66% and 20.02% for bone; 51.60 and 50.05% for the whole muscle; 11.63 and 12.09% for the *L. thoracis* muscle; 3.08 and 2.34% for the subcutaneous fat, and finally 9.94 and 8.47% for the intermuscular fat. No significant differences between ($p<0,05$) the two levels of intake were found for any of these fractions.

Table 2 summarises the values obtained for the parameters relating to texture, 20% and 80% compression in raw meat together with the values for the maximum shear force in cooked meat. No significant differences between the treatments were observed for any of these three parameters. The same table also shows the results obtained in the sensory analysis of the *L.thoracis* muscle. Statistically significant differences ($p<0.5$) were found for tenderness, being more tender the meat from the calves fed *ad libitum* throughout the assay period. These animals also scored slightly higher on the flavour intensity scale ($p<0.1$) than the other group. In the triangular tests, the panelists were able to discriminate the meat from both treatments, pointing that tenderness is the most valued sensory parameter.

Regarding saturation of the different fat depots (table 3), highly significant differences were found between them, the highest proportion of polyunsaturated fatty acids corresponding to the intramuscular fat and the highest percentage of monounsaturated fatty acids to the subcutaneous fraction, being the intermuscular fraction the most saturated. This distribution of the different types of fatty acids as a function of their degree of saturation is consistent with the results of Hornick *et al.* (1998), who associated a high degree of unsaturation of the intramuscular fat with a predominance of structural phospholipids rich in unsaturated fatty acids.

Significant differences were observed in the degree of fat saturation as a function of the milk intake levels studied. In this sense, the animals receiving cow's milk *ad libitum* throughout the experimental period, overall showed a more unsaturated fat ($p<0.05$), largely due to the higher percentage of monounsaturated fatty acids ($p<0.05$), since no differences were found in the amount of polyunsaturated fatty acids.

The highest percentage of saturated fat ($p<0.05$) corresponded to the calves that consumed a restricted diet during the first months of the experimental period. Although no differences in fatness were observed, an aspect positively associated with the presence of saturated fat (Perry *et al.*, 1995), the consumption of a greater amount of milk in the last part of the study by these animals could explain the results obtained. A positive correlation between the percentage of intramuscular fat and its degree of saturation ($p<0.05$) was observed. Likewise, the expected positive correlation between the melting point and the degree of saturation of the fat was confirmed ($p<0.05$).

Conclusion: the calves *ad libitum* fed with cow's milk provided more tender meat, had a lower collagen content and an overall less saturated fat than the other group. The most unsaturated fat fraction was the intramuscular fat, followed by subcutaneous fat and finally intermuscular fat, which showed the highest percentage of saturated fatty acids.

Table 1: Chemical composition of *L .thoracis* muscle.

	Level of intake		Analysis of variance	
Parameter	**Ad libitum**	**Restricted**	**RSD**	**Sign.**
Moisture (%)	75.74	76.59	1.513	ns
Ether Extract (% DM)	5.43	5.89	2.054	ns
Crude protein (% DM)	90.63	90.92	1.929	ns
Total collagen (% DM)	0.32	0.35	0.047	*
Soluble collagen (% DM)	0.09	0.14	0.048	+
Myoglobin (mg Mb/g muscle)	2.06	2.41	0.975	ns

* = p<0,05; + = p<0,1; ns: differences not significant

Table 2: Colorimetric, textural and sensory parameters of *L. thoracis* muscle.

	Level of intake		Analysis of variance	
Parameter	**Ad libitum**	**Restricted**	**RSD**	**Sign.**
L* (*l. thoracis*)	45.48	44.46	3.508	ns
a* (*l. thoracis*)	8.20	8.70	2.282	ns
b* (*l. thoracis*)	10.63	10.32	1.302	ns
Texture 20% compression (kg/cm^2)	0.15	0.18	0.041	ns
Texture 80% compression (kg/cm^2)	12.30	14.30	2.469	ns
Warner-Bratzler peak force (kg)	6.14	6.01	1.690	ns
[a]Odour	5.12	5.50	0.577	ns
[a]Tenderness	5.62	4.69	0.654	*
[a]Juiciness	4.28	3.98	0.679	ns
[a]Flavour	5.14	4.67	0.532	+
[a]Palatability	4.15	4.07	0.652	ns

* = p<0,05; + = p<0,1; ns: differences not significant a: increasing intensity scale from 1 to 9.

Table 3: Fat components of treatment (level of intake) and location of fat.

	Level of intake		Location			Analysis of variance			
Parameter	**Ad libitum**	**Restricted.**	**Subcut.**	**Intermusc.**	**Intramusc.**	**L I**	**L**	**L I*L**	**RSD**
SFA	46.28	47.43	46.34^b	51.14^a	43.17^b	**	***	ns	8.922
USFA	46.17	44.59	44.95^b	42.22^c	49.22^a	*	***	ns	2.425
MUFA	41.43	39.63	42.52^a	39.32^b	39.53^b	*	**	ns	1.049
PUFA	4.15	4.37	1.66^b	2.25^b	9.33^a	ns	***	ns	1.972

SFA: satured fatty acids (%); USFA: unsatured fatty acids (%); MUFA: monounsatured fatty acids; PUFA: polyunsatured fatty acids (%).
L I : level of intake; L: location of fat
a, b, c: values with different superscripts indicate significant differences among the different locations of the fat.
*** = p<0,001; ** = p<0,01; * = p<0,05; + = p<0,1; ns: differences not significant

ACKNOWLEDGEMENTS

This work was supported by the project INIA SC 99-013-C2. C. Vieira gratefully acknowledges receipt of a grant from the INIA (Ministry of Science and Technology, Spain).

REFERENCES

GUIGNOT, F., QUICHINI, Y., RENERRE, M., LACOURT, A., MONIN, G. (1992). *J. Sci. Food Agric.*, **58**, 523-539.
HILL, F. (1966). J. Food Sci. , 31, 161-166.
HONICKEL, K. O. (1997). *Meat Sci.*, **49**, 447-457
HORNICK, J. L., VAN EANEAMEN, C., CLINQUART, A., DIEZ, M., ISTASSE, L. (1998). *J. Anim. Sci.*, **76**, 249-259.
HORNSEY, H. C. (1956). *J. Sci. Food Agric.*, **8**, 534-540
MAPA Orden de 7 de septiembre de 1981. BOE de 14 de octubre.
PERRY; D., NICHOLLS, P. J., THOMPSON, J. M. (1995). *J. Anim. Sci.*, **76**, 87-95.