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CHARACTERISTICS OF BEEF TREATED WITH CALCIUM

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INTRODUCTION

When meat is stored at temperatures above freezing, there is an increase in tenderness, water holding capacity and juiciness, with the increase in tenderness being the most important since it has the biggest effect on consumer acceptability (Dransfield, 1986). This tenderization has been attributed to the effect of calpains (Koohmaraie *et al.*, 1988a). It is known that there are two types of calpains in muscle:

- Calpain I, activated by micromolar concentrations of calcium; and
- Calpain II, which is activated by millimolar concentrations of calcium (Ducastaing *et al.*, 1985).

Moreover, it has been reported that calpains induce degradation of myofibrillar components such as protein C, tropomyosin, troponin T, troponin I and Z discs (Alarcon-Rojo, 1990).

The tenderizing effect of conditioning has been accelerated by the addition of calcium in the early post-rigor period (Koohmaraie *et al.*, 1988b; 1989; 1990; Alarcon-Rojo and Dransfield, 1989) and it has been clearly demonstrated that this effect is the result of activation of the calpain proteolytic system (Koohmaraie *et al.*, 1989; 1990).

The aim of this current experiment was to evaluate the effect of calcium on the post-rigor palatability of meat.

MATERIALS AND METHOD

Meat Source

Twenty Hereford x Criollo bovines (18 months old) were slaughtered on the same day and injected with four litres of 0.3M calcium chloride solution in the left leg immediately after dressing. The other leg was used as a control. Carcasses were then chilled at 4°C for 24 hours.

Meat Evaluation

Twenty-four hours after slaughter, the *m.semitendinous* was excised and measurements of pH, water holding capacity (WHC), shear force and sensory evaluation were carried out. pH was determined in a 2.5g of tissue using a Corning pH-meter. Water holding capacity was evaluated using the Plexiglass plates (Grau and Hamm, 1953). Shear force was done using the Warner-Bratzler knife (Voisey, 1975).

Meat Preparation

After the muscle was trimmed out of visible fat and connective tissue, the meat was cut into cubes and cooked in an 80°C water bath for one hour, or until the centre of the meat reached an internal temperature of 80°C. Sensory analyses were carried out by an untrained 15-member panel, which evaluated colour (1=very dark to 9=very light brilliant red) and aroma (1=no perceptible to 9=very strong) in 20 samples of raw meat in two sessions.

The panellists also evaluated 10 random samples (five calcium treated; five untreated) of cooked meat in one session. The panellists used a 1-10 scale to evaluate tenderness (1=very tough; 10=very tender), appearance (1=very attractive; 10=very repulsive), flavour (1=no off-flavour; 10=off-flavour), juiciness (1=very dry; 10=very juicy) and texture (1=coarse; 10=fine).

Statistical Analysis

The data of the results was analyzed by a T-student test (Steel and Torrie, 1986).

RESULTS AND DISCUSSION

The results of pH, shear force and WHC are shown in Table 1. No differences were observed in pH and shear force for the treated meat when compared to control meat ($P>0.05$). For WHC, the calcium treated meat had higher values than the control ($P<0.05$) that might be due to the water added during the calcium injection. The small differences observed in shear force are probably the effect of the early age of the animals in which tenderness is expected to be high.

Table 2 shows the results of sensory evaluation. There were no significant differences ($P>0.05$) in general appearance, flavour and texture. However, the panellists found that the calcium treated meat was more tender ($P<0.05$) and less juicy ($P<0.05$) than the untreated meat. These results indicate that the calcium chloride injection was effective in tenderizing meat. It is believed that the calcium added could have activated the proteolytic calpain system of the muscle. The low juiciness observed in the treated meat could be due to the large amount of liquid lost during cooking and this effect has previously been reported by Wheeler *et al.* (1991). Because meat treated with calcium is more tender than normal meat, the cooking time should not be as long as that required for normal meat. In the present experiment, the cooking treatment was probably longer than needed which could have resulted in drier meat and for this reason our results differ from those of Morgan *et al.* (1991) who found no decrease in juiciness of calcium treated meat.

The results for colour and aroma are shown in Tables 3 and 4. There were no significant differences for any of these characteristics ($P>0.05$) when meat was treated with calcium chloride indicating that calcium does not change the colour or aroma of fresh meat.

CONCLUSIONS

It can be concluded that calcium chloride produces tenderization of meat, improving its quality and acceptability. Furthermore, the calcium chloride did not modify appearance, flavour, texture, aroma and colour of fresh beef.

REFERENCES

ALARCON-ROJO, A., and DRANSFIELD, E. 1989. Effect of calcium ions on texture of beef during conditioning. *Proc. 35th ICMST.* 35:1141.

Table 1. Values of pH, shear force and WHC of bovine m.semitendinous treated with calcium chloride 24 hours after slaughtering (mean values ± standard deviation).

Treatment	pH	SF	WHC
Calcium treated	5.56±0.04[a]	4.33±0.21[a]	30.68±1.6[a]
Control	5.70±0.05[a]	4.99±0.30[a]	23.65±1.7[b]

[a,b,c] Means with different letters within the same column are significantly different.

Table 2. Sensory evaluation of m.semitendinous treated with calcium chloride and cooked 72 hours after slaughter.

Treatment	Calcium treated	Control
Tenderness[1]	6.23±0.27[a]	4.84±0.28[b]
Appearance[2]	4.23±0.23[a]	4.51±0.29[a]
Flavour[3]	4.30±0.27[a]	5.15±0.29[a]
Juiciness[4]	4.72±0.20[a]	6.38±0.27[b]
Texture[5]	6.02±0.24[a]	5.13±0.22[a]

[1] Tenderness scale: 1=very tough to 10=very tender;
[2] Appearance scale: 1=very attractive to 10=repulsive;
[3] Flavour scale: 1=excellent to 10=bad;
[4] Juiciness scale: 1=very dry to 10=very juicy; and
[5] Texture scale: 1=coarse to 10=fine.

Table 3. Sensory analysis for colour of beef m.semitendinosus treated with calcium chloride and cooked 72 hours after stunning. Percentage of panellists for each colour score.

Colour Score*	Calcium treated[ns] (%)	Control (%)
1	0	1.60
2	5.55	9.20
3	7.14	19.60
4	17.46	11.20
5	15.07	8.80
6	9.52	14.40
7	15.87	17.20
8	20.63	10.00
9	8.73	7.60

* Colour scale: 1=very dark to 9=very light brilliant red
[ns] = Not significant (P>0.05).

Table 4. Sensory analysis for colour of beef *m.semitendinosus* treated with calcium chloride and cooked 72 hours after stunning. Percentage of panellists for each aroma score.

Aroma Score*	Calcium treated[ns] (%)	Control (%)
1	12.39	9.41
2	14.52	11.37
3	15.38	18.43
4	14.52	9.41
5	9.82	12.15
6	11.11	11.76
7	9.82	16.86
8	10.68	7.84
9	1.70	2.74

* Aroma scale: 1=no perceptible to 10=very strong
ns Not significant (P>0.05).