MEAT TENDERISATION OF BEEF MEAT BY DIFFERENT METHODS

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Keywords: tenderstretch, calcium infusion, very fast chilling, meat tenderisation

Introduction

Tenderness is the most important characteristic for meat acceptability and many studies have been carried out to understand meat tenderisation mechanisms, either structural or enzymatic processes, that are affected by production systems, biological factors (such as genotype, age, sex and so on) and technological processes (Dransfield, 1994).
To improve meat tenderness various physical and chemical techniques were checked. In this paper we analyse some principal ones: suspension of beef carcasses by the pelvic girdle (tenderstretch), as an alternative method of carcasses hanging, to produce during rigor a decrease in myofibrils shortening and a connective tissue structural change (Eikelenboom, 1998); very fast chilling (VFC), a fast cooling allows a strong muscle contraction with release of calcium into myofibrils and an outcoming activation of proteolytic enzymes (Joseph, 1996; Van Moeseke, et al. 2001); and *post mortem* $CaCl_2$ injection, that leads to an advanced and increased activity of Ca dependent enzymes (Gerelt *et al.*, 2002).
The aim of this work is to compare these tenderisation methods to establish the effect on meat quality properties, particularly on physical characteristics.

Materials and Methods

Six Friesian young bulls were slaughtered at 16 months of age. After slaughter, the left side was suspended from the aitch bone (pelvic suspension PS) for 24 hours, while the right side from the Achilles tendon (AT). From this latter, *Longissimus thoracis* (Lt) (between 7th and 13th rib) was soon taken and subdivided into three portions to carry out the three different experiments: VFC, obtained by putting a sample into a freezer at -80° C and stored until the core reached 1°C; $CaCl_2$, obtained by injecting 9% of meat weight (wt/wt) with 300mM calcium chloride solution; and the traditional ageing method (Control).
Both carcasses were aged for 8 days and stored at 2°C ±1°C. At dissection, two muscles were removed: *Longissimus thoracis* at the 6th rib (Lt) and *Gluteo biceps* (Gb), where physical analysis at 8 days only were determined, while on VFC, $CaCl_2$ and Control the same parameters but at three different times (24 hour, 5 and 8 days) were studied; in addition, temperature and pH values, with penetration through the meat, were monitored from 8 hours after slaughter with 1 hour steps.
On each sample, the following analysis for physical characteristics were performed:
-Drip loss with gravimetric method on the raw meat preserved at 4°C for 48h (Barton-Gade *et al.*, 1994)
-Cooking loss in a water bath at 75°C for 50 mins using vacuum-packed samples in a polyethylene bag
-Shear force on cooked meat samples (1x1cm cross section and 2cm long), using Warner Bratzler Shear apparatus on an Instron1011.
The statistical analysis of variance was performed using the GLM procedure of the SAS software (SAS 1985) using a bifactorial model (treatment and muscle for tenderstretch test, treatment and time for other tests)

Results and Discussion

The pH of meat samples treated with calcium felt slowly (Figure 1), at two hours from slaughtering already reaching the 5.8 values, the meat pH in the VFC experiment initially rose and then declined faster than the pH of the control group, at 8 hours after slaughtering; the pH of the $CaCl_2$ experiment was always significantly lower than the others until 5 days after slaughter, but at 8 days the differences were reduced obtaining a similar value among the three experiments (5.66). Shear force showed a decreasing trend with time for all experiments (from 10.4 to 8.2kg in average) even if the difference was significant only between 24 h and 5 days in the VFC group.

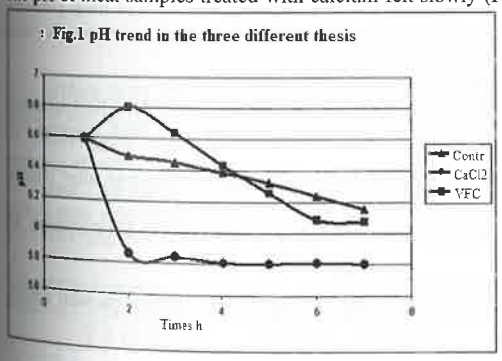

Fig.1 pH trend in the three different thesis

The $CaCl_2$ group showed a more tender meat already at 24h (about 50% less shear force than the control group). In fact, in the first days of ageing there was a greater activation of calcium-dependent enzymes (Gerelt *et al.*, 2002). The VFC experiment showed intermediate results and the greatest difference from the control group was highlighted at 5 days. The cold contraction increases free calcium ions content, that initially tends to increase toughness,

due to shortening, but protease action increase is sufficiently fast and widespread to overlay the effect of contraction (Joseph, 1996).

Table 1: Shear force during aging of *longissimus thoracis* treated with three different methods (kg).

Experiment	Times			Significance	Thesis means
	24h	5d	8d		
Control	12.86	12.16	10.96	ns	11.99
$CaCl_2$	6.56	5.68	4.74	ns	5.60
VFC	11.92	9.20	8.80	*	9.97
Significance	***	***	***		***
Time means	10.44	8.88	8.24	*	RMSE 1.98

*ns = not significant; * = p≤0.05; ** = p≤0.01; *** = p≤0.001.*

Water loss was higher in the $CaCl_2$ group at 24h, due to buffer injection, and in the VFC group where the muscular contraction, due to low temperature, led to flow of liquids from the muscle, but already at 5 days the effect was limited for both groups, at 8 days myofibrillar degradation caused a greater water loss. However drip loss increase with time was found for all experiments.

Table 2: Drip loss percentage during ageing of *longissimus thoracis* treated with three different methods.

Thesis	Times			Significance	Thesis means
	24h	5d	8d		
Control	0.83	1.36	2.05	**	1.41
$CaCl_2$	3.10	2.06	3.65	*	2.93
VFC	2.09	1.55	2.45	*	2.03
Significance	***	ns	**		***
Time means	2.00	1.65	2.71	**	RMSE 0.75

Table 3: Shear force of two different muscles aged with two different methods (kg).

Muscles	Thesis		Significance	Muscle means
	AT	PS		
Lt	6.90	4.47	**	5.70
Gb	4.82	3.80	ns	4.31
Significance	*	ns		*
Thesis means	5.86	4.13	*	RMSE 1.33

Cooked meat in tenderstretched carcasses was significantly more tender, mainly in *Longissimus* muscle; however GB muscle was less tough than LD, probably because the animals were young.
These techniques accelerate the tenderisation process, but differences decrease with meat ageing. In particular calcium injection showed significant effect on meat tenderisation but a lot of problems, particularly for acceptability of this treated product are hard to overcome.

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