# THE PRACTICAL SIGNIFICANCE OF HIGH TEMPERATURE CONDITIONING FOR THE TENDERNESS OF HOT BONED BEEF AND VEAL

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## SUMMARY

The effect of high temperature conditioning of shear force and sarcomere length of electrically stimulated, hot boned beef and veal longissimus muscle was investigated. There was no difference between conditioned and non-conditioned longissimus primals. As compared with electrically stimulated, cold boned beef, hot boned beef loins were similar in tenderness. It is questionable whether time of boning of stimulated veal carcasses affects tenderness. Our results may have been influenced by the occurrence of cold-toughening in cold boned sides that were used as controls. Further experiments should include whole carcasses as controls.

## INTRODUCTION

Since it was shown that blast-chilling systems for the refrigeration of lamb, beef and veal carcasses might be associated with cold shortening, several processing techniques have been advocated to prevent or minimize this phenomenon. Both electrical stimulation and high temperature conditioning have been advocated as effective means to counteract cold-induced toughening.

Electrical stimulation, through accelerating the onset of rigor mortis, prevents cold shortening (Carse 1973; Davey et al. 1976) and it appears that, in addition, a so-called 'extra-tenderising effect' may exist (Vanderkerckhove and Demeijer 1978; Smulders et al 1986) brought about by other mechanisms (Dutson et al. 1980). Hence electrical stimulation has been introduced successfully in accelerated processing systems where beef and veal are hot boned within the first few hours post mortem. It was reported that it promises similar tenderness scores for hot boned - as for (non-stimulated) cold boned meat (Smulders et al. 1988). Model-experiments with small cuts further suggest that under conditions of extremely rapid chilling, electrical stimulation makes hot boned beef as tender as cold boned (Smulders et al. 1981). It was shown that, in addition to electrical stimulation, high temperature conditioning may further reduce the shear forces of small hot boned cuts (Smulders et al. 1984).

It remains unclear whether this effect is still observable when larger primals are (delay-) chilled under practical conditions.

Purpose of the present study was, therefore, to investigate the practical significance of high temperature conditioning for stimulated, hot boned, beef and veal primals by comparing their tenderness of the latter with that of stimulated cold boned counterparts.

## MATERIAL AND METHODS

Three experiments were conducted, involving beef (experiment I) and veal (experiments II and III).

*Experiment I:* Eight cows of the Meuse Rhine IJssel (MRIJ) breed were stimulated electrically within 5 min post mortem (85V, 14Hz, 30s). Within 1 h post mortem the entire righthand longissimus muscle was hot boned. Immediately after excision the muscles were divided in two, and vacuum-packaged. One part was held at 15°C for 5 h (conditioning) and subsequently stored at 1 ± 1°C. The other part was stored at 1 ± 1°C immediately after boning. Using thermocouples the internal temperature of longissimus muscle of both treatment groups was monitored until 15 h post mortem. Immediately after grading (approximately 30 min post mortem) the lefthand carcass-sides were subjected to blast-chilling for 1 h and subsequently stored overnight at 1 ± 1°C. At approximately 24 h post mortem the lefthand side longissimus muscles were cold boned, divided in two parts, vacuum-packaged and stored at 1°C. After twelve days of storage, meat was unpacked and sampled for assessment of sarcomere length and shear force.

*Experiment II* involved 8 Dutch Friesian calves of approximately 22 weeks old. Experimental procedure was essentially the same as in experiment I, except for the applied electrical stimulation for which a high voltage;

Table 1 The effect of a 5 h/15°C conditioning period on the shear force (1A) and sarcomere length (1B) of hot boned beef and veal loins as compared with cold boned controls (n = 8 unless indicated (∇) where n = 16)

1A: Shear force (N $cm^{-2}$)

| | Hot boned | | | Cold boned |
|---|---|---|---|---|
| | Conditioning | No conditioning | Pooled | |
| beef exp. I | 4.59 | 4.52 | 4.56 (∇) | 4.85 (∇) |
| veal exp. II | $2.55^{a*}$ | $2.53^{a}$ | $2.54^{a}$ (∇) | $3.66^{b}$ (∇) |
| veal exp. III | $3.14^{ab}$ | $3.45^{a}$ | $3.29^{b}$ (∇) | $2.68^{a}$ (∇) |

1B: Sarcomere length (µm)

| | Hot boned | | | Cold boned |
|---|---|---|---|---|
| | Conditioning | No conditioning | Pooled | |
| beef exp. I | 1.88 | 1.72 | 1.80 | 1.66 |
| veal exp. II | nd** | nd | nd | nd |
| veal exp. III | $1.82^{ab}$ | $1.77^{b}$ | $1.80^{b}$ (∇) | $1.93^{a}$ (∇) |

* Figures with different superscript are different (p <.05)

** nd = not determined

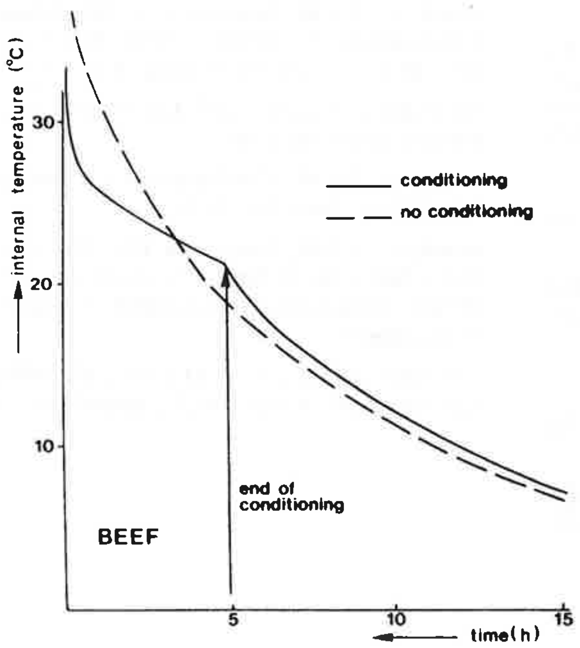


Figure 1. The effect of a 5 h/15°C conditioning period on the temperature fall of hot boned beef loin.

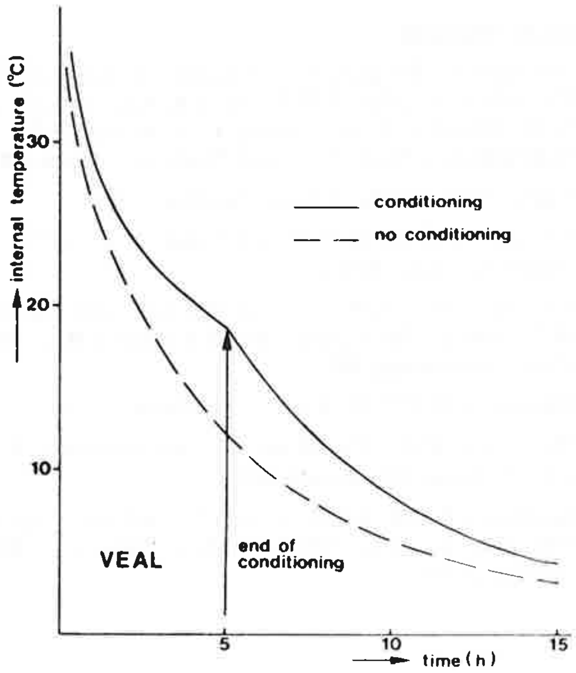


Figure 2. The effect of 5 h/15°C conditioning period on the temperature fall of hot boned veal loin.

low voltage system (3000V, 0.83Hz, 1.5ms pulsewidth/35V, 14Hz) was applied (Smulders and Eikelenboom 1985).

*Experiment III:* Sixteen Dutch Friesian calves of 22 weeks old were electrically stimulated as in experiment II. Eight calves were hot boned and 8 calves were cold boned. Half of the hot boned longissimus muscles was subjected to chilling after 5 h/15°C conditioning, the remaining muscles were chilled immediately at 1 ± 1°C.

Sarcomere lengths measurements were performed according to the procedure described by Koolmees et al. (1986).

Shear force was assessed on samples of approximately 3 cm thick. Samples were heated in polyethylene bags in a water bath for 50 min at 75°C whereafter they were chilled in running tap water for 40 min (Boccard et al. 1981). Using a mechanically driven borer, cylinders of 1 $cm^2$, excised from the cooked samples, where subjected to Instron-Warner Bratzler shear force measurements.

Significance of differences were assessed by Student t-tests (paired, where appropriate).

## RESULTS AND DISCUSSIONS

Table 1A and 1B illustrate that both in hot boned beef and veal, conditioning has no significant effect on either sarcomere length or shear force. These results fail to support earlier observations which indicated a significant effect of conditioning on sarcomere length and shear force of small beef cuts (Smulders et al. 1987). Clearly, chops rapidly respond to external temperature whereas the primals used in the present experiment exhibit a comparatively slow internal temperature fall (Figures 1 and 2). Even with immediate chilling it takes 3-4 h to achieve internal temperatures of 15°C.

The results of experiments I and II show that there are no differences between shear forces of hot and cold boned meat. In experiment III shear forces of cold boned veal were significantly lower than those of hot boned veal. This is probably due to the fast chilling of carcass-sides as opposed to whole carcasses where cooling efficiency of longissimus muscles is much lower. Thus, it cannot be excluded that cold shortening and/or cold toughening (a change in tenderness without concomitant sarcomere length changes; Dutson 1983) has occurred in cold boned sides. Such a phenomenon would mask the effects of stimulation and conditioning. As it is common practice in the veal industry to chill whole carcasses these should constitute the controls in future experiments. However, between-carcass differences, which may be considerable, may have greatly influenced results. More research is necessary to establish if tenderness of veal is adversely affected by hot boning.

## CONCLUSIONS

It appears that in hot boning beef, there is little need for delayed chilling. Electrically stimulated, hot boned beef loins are similar in tenderness as electrically stimulated cold boned counterparts.

It is questionable whether time of boning of stimulated veal carcasses affects tenderness.

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