Effect of hot boning on meat yield from beef carcasses

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SUMMARY

Quantitative differences in yield between hot boning and cold boning of beef carcasses have been examined. Factory trials have shown that hot boned joints can be cooled to 7°C in only 16 hours from slaughter - half the time required for beef sides. Hot meat lost weight by evaporation during butchery but subsequent losses during chilling were avoided. More meat was left on bones after hot boning and this cancelled out the advantage of reduced evaporation loss. Consequently there was no difference in weight of usable meat into the vacuum packs.

Hot boning avoided the surface drying and discoloration which incur trimming losses from conventionally chilled beef sides and this made more meat available for retail preparation. Hot boning increased retail yield of beef by 2%. To this should be added the potential savings in refrigeration and time from hot boning.

INTRODUCTION

In recent years hot boning of beef has attracted considerable interest in the meat industry, particularly for those wishing to improve efficiency and reduce production costs. Investigations have been carried out throughout the world by research and development organisations to evaluate the potential advantages of hot boning and its consequences on meat quality (2,3,5,9). Although most have shown that there are benefits in terms of quantity and quality from hot boning beef, industry has been slow to accept this new technology. As yet, there are few commercial beef hot boning operations.

In the UK, studies at the MRI (8) indicated the potential for increased meat yield from hot boning without loss of eating quality. Economic yield can be influenced not only by water losses at various stages during chilling, boning and storage but also by the type of butchery and efficiency of bone trimming. Consequently, the earlier investigations were followed by two factory trials involving research, slaughtering and marketing organisations, principally to ascertain whether the yield advantages which were indicated under controlled laboratory conditions could be achieved in a factory operation.

Beef joints taken from a carcass within 1 or 2 hours of slaughter are particularly susceptible to cold shortening, and therefore where chilling was designed to be rapid, carcasses were electrically stimulated to avoid toughening (1). In some cases, as an alternative to stimulation, toughness was avoided by a delay period before carcasses were chilled.

EXPERIMENTAL

Each of the two factory trials reported here used 16 Hereford x Friesian steers (carcass weights 254 - 308 kg), one side of each for hot boning and the other for cold boning after chilling.

Butchery It was decided that carcasses would be hot boned hanging on the rail and, since the style of butchery would differ from cold boning, a method of hot boning was devised to incorporate some features of muscle seaming but still produce primal joints as similar as possible to conventional cold boned joints.

Trimming of hot fat to a consistent standard is difficult, and for comparison in these trials all the associated fat was vacuum packed with each joint, hot and cold.

All joints were vacuum packed on a Swissvac machine in either nylon/polyethylene or Cryovac BB1 bags (W.R. Grace Ltd.).

Treatments - Trial A Eight carcasses were electrically stimulated (MEDAL High Voltage Stimulator) approximately 20 minutes after slaughter using 4 x 22 sec periods of 700 v (peak) and 25 pulses/sec.

After splitting, opposite sides of each carcass were allocated for either hot or cold boning.

Hot Boning commenced approximately 1 h after slaughter, and joints were vacuum packed and placed in trays in a chiller at 1°C for 24 hr to reduce the temperature below 7°C in the centre of the largest joint. After this time all joints were transferred for storage at 1°C until 7 days post-slaughter.

The opposite sides which were destined for cold boning were placed in the same chiller for 24 hr to reach less than 7°C in the deep leg before butchery, vacuum packing and storage until 7 days post-slaughter.

A further 8 carcasses were not stimulated before splitting and allocation of sides to hot or cold boning. Hot boning commenced 1 h after slaughter and, after packing, the joints were held at 10°C for 10 hr before transfer to a chiller at 1°C for storage until 7 days post-slaughter.

The opposite sides destined for cold boning were held at 10°C for 10 hr before transfer to a chiller at 1°C for 38 hr. They were then removed, cold boned and the joints vacuum packed before storage at 1°C until 7 days post-slaughter.

Trial B All 16 carcasses were electrically stimulated (MEDAL Low Voltage Stimulator) immediately after sticking. Fourteen pulses/sec at 90 v (peak) were applied for 60 sec via the captive bolt hole. All carcasses were then split and opposite sides allocated to either hot or cold boning as in Trial A.

After hot boning and vacuum packing one side of each carcass, joints were laid on trays and placed in a chiller at 0°C to reach less than 7°C within 24 hr. They were then transferred for storage at 1°C until 7 days post-slaughter.

Sides for cold boning were placed in a chiller at 3°C to achieve deep leg temperatures below 7°C in 36 hr. After 48 hr. they were cold boned and joints vacuum packed and stored at 1°C until 7 days post-slaughter.

Assessment At 7 days post-slaughter all vacuum packs were opened and the weight of drip in each recorded.

Meat, bone and trimmings were weighed at every stage so that meat yield and losses could be accurately compared. Temperatures were recorded in carcasses and joints during chilling.

Retail Yield In Trial A, the joints removed from vacuum packs at 7 days post-slaughter were trimmed and prepared for retail sale as specified by the participating marketing company. Again all weights were recorded so that the quantities of meat for retailing and the relative values for hot and cold boning could be compared.

RESULTS

Chilling Fig. 1 shows the mean cooling curve for the centres of the largest and therefore most slowly cooled hot boned joints in Trial B. Also shown, for comparison, is a cooling curve for the deepest point in a 125 kg beef side exposed to similar chilling conditions. It can be seen that with side chilling it took 32 hr. to chill the whole of the meat below 7°C; with hot boning, this temperature was reached in only 16 hr.

Meat Yield Neither electrical stimulation nor the different chilling treatments used in these trials had an appreciable effect on meat yield. This report will therefore concentrate on differences between hot and cold boning treatments.

Tables 1 and 2 compare yields from opposite sides of carcasses. Table 1 includes the results of both trials using a total of 32 carcasses and shows yield data up to the end of vacuum packed storage. In both trials, the weight of bone and trimmings was greater from hot boning and almost cancelled out the advantage of reduced evaporative weight loss. The evaporation data showed that, although hot boning avoided losses during chilling, the hot meat lost more weight during the hot boning operation itself. In all cases the effect of gains and losses was that there was very little difference between hot and cold boning in the amount of meat into or out of the vacuum pack.

Table 2 shows the retail yield of hot and cold beef from Trial A. The joints removed from vacuum packs after storage in this trial were trimmed and prepared for retailing. There was less waste trim with hot boning and this resulted in more usable meat. When prepared for retailing, the hot boned sides gave approximately 1% more meat, representing a 2% increase in total retail value over cold boned sides.

DISCUSSION

Although there were small differences in experimental procedure in the two trials, the results shown in Table 1 are consistent and similar to the earlier laboratory findings (8). Although no increase in yield at the primal joint stage is shown with hot boning, the results need closer scrutiny. During conventional chilling, beef sides can lose between 1 and 2% weight and undoubtedly most of this evaporative loss can be avoided by hot boning the carcass and vacuum packing joints as soon as possible

Fig. 1. Cooling rate of hot boned beef joints in Trial B compared with that of a 125 kg side under similar chilling conditions.

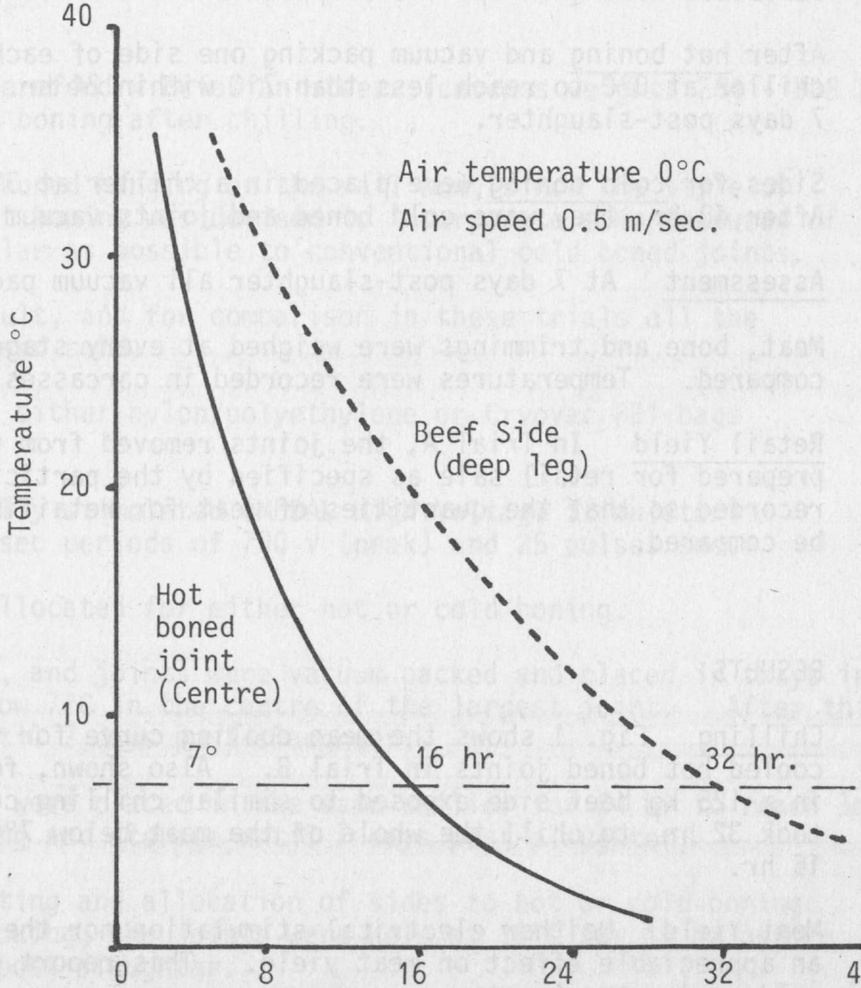

Table 1 *Comparison of meat yield from hot and cold boned beef carcasses. Results from two factory trials, each using 16 carcasses.*

	Trial A		Trial B	
	Hot	Cold	Hot	Cold
	(% hot side wt.)			
Wt. of meat into vacuum pack	81.2	81.5	81.5	81.4
Wt. of bone and waste trimmings	18.1	16.9	17.7	16.7
Evaporative wt. loss during chilling and butchery	0.7	1.6	0.8	1.9
Wt. of meat out of vacuum pack (after 7 days storage)	80.9	81.3	81.2	81.0
Drip loss (after 7 days storage)	0.3	0.2	0.3	0.4

Table 2 Comparison of retail yield from hot and cold boned beef carcasses. Results from Trial A using 16 carcasses prepared for retailing

	Hot	Cold
	(% hot side wt.)	
Wt. of meat and associated fat out of pack	80.9	81.3
Wt. of usable meat after trimming	62.5	61.7
Wt. of waste fat, trimmings and losses	15.0	16.3
Wt. of retail joints	66.2	65.2
Retail value (related to 250 kg carcass)	£2.63 per kg.	£2.58 per kg.

ie: 2% added value from hot boning

after slaughter. Weight can also be lost however by evaporation during hot butchery and the evaporation losses shown against hot boning in Table 1 were almost wholly incurred at this stage, exacerbated by the necessarily detailed weighing of component parts of the carcass. The advantage at this stage from hot boning was consequently less than might have been expected.

Another apparent disadvantage with hot boning is the higher weight of bone and trimmings. This has also been noted in earlier work at the Meat Research Institute and by other workers. Joseph and Hood (6) reported 1% greater bone weight and Schmidt and Keman (7) also found higher losses with hot boning. Experiments at the Meat Research Institute have confirmed that the difference is due to more meat left on the bones. This problem can be attributed to lack of experience with hot boning, since factories where it has been practised over a period report no such difference.

One of the attractive features claimed for hot boning is the reduction in drip loss. Although this advantage is plainly evident in factories practising hot boning, the drip from some joints being virtually eliminated over 1 - 2 weeks storage, it was not the case in these trials. However, the general level of drip was so low over 1 week's storage, even with the cold boned joints, that differences were unlikely to be noticeable.

Information is lacking on the effect of hot boning on yield of meat prepared as retail cuts. It has been suggested in a previous paper (8) that the advantage from hot boning might be more clearly seen at the retail stage and an important feature of Trial A was the preparation of retail cuts from hot and cold boned joints. To be commercially realistic the preparation was carried out by butchers cutting to a company specification for typical retail cuts.

The results in Table 2 confirm the earlier suggestion on retail yield and show a pronounced advantage with hot boning. This is almost entirely due to less requirement for trimming with hot boned joints. During conventional chilling, the exposed surfaces of beef sides dry out, become discoloured and may become unsaleable. These surfaces are generally trimmed off during retail preparation and represent a weight loss. Because they are in packs during chilling, hot boned joints do not suffer such loss, and in this trial more meat was available for retail preparation. The style of butchery, involving elements of muscle seaming, also enhanced the yield advantage and the final yield of meat from the hot boned sides was 1% higher. This meat had a retail value which was 2% higher than that from the cold boned sides.

This result in itself shows the commercial advantage of hot boning beef, but to it should be added the potential for increased yield at earlier stages of butchery and the fact that, if electrically stimulated, hot boned meat can be chilled in half the time required for sides. In addition, there are quality advantages to be derived from hot boning (9) and considerable potential savings in terms of refrigeration, building and production time. When all of these are taken into account, hot boning of beef must become commercially *attractive to the meat industry.*

Acknowledgement

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