A comparison of the yield of saleable meat from hot and cold boned beef carcasses

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Introduction

Abattoirs are facing increasing pressure to improve efficiency and reduce costs. One procedure which has been promoted as a potential means to reduce costs and increase the yield of saleable meat is hot-boning. Hot-boning means that the carcass is boned out soon after slaughter; it is not new, as same-day boning has been practised on a limited scale for many years.

Some research workers (Schmidt & Keman 1974, Cuthbertson 1977, 1982, Taylor et al 1980, Taylor 1983) have claimed that much of the weight lost during the chilling of beef sides can be saved if the meat is boned and packed as soon as possible after slaughter. Besides improved yield, other advantages (e.g. energy savings) are claimed for hot boning. However, in the Australian situation there are some operational problems yet to be overcome before commercial implementation can proceed.

This work describes the results obtained in trials conducted in a commercial boning room and undertaken to determine if hot-boning of beef would provide an increased yield of saleable meat when conventional boning procedures, as currently practised by the Australian meat industry, are used.

Procedure

Powell et al (1982) undertook work consisting of three trials to examine the yield from both manufacturing and domestic trade carcasses.

Subsequent to an analysis of their results trials were carried out utilizing more animals. The manufacturing grade animals were 26 aged cows with an average dressed weight of 153 kg while the domestic trade animals were 28 young steers (dentition 0 to 2 teeth) with an average dressed weight of 233 kg and an average fat cover at the 12/13th rib of 9 mm.

The manufacturing grade animals were boned and packed to U.S. specification and 85% chemical lean. The primal cuts from the trade steers were trimmed to 6-12 mm fat cover, and vacuum packed. The remaining meat was packed as manufacturing meat to U.S. specification and 85% chemical lean. In both cases the trimmings were kept separate for processing in the on-plant smallgoods department.

All trials were carried out in one export registered meatworks where, after normal slaughter and dressing, the beef was electrically stimulated on an automatic side stimulator at the end of the dressing chain (1100V peak with 14.3 pps for 90s, approx. 35 minutes after stunning). The sides were weighed approximately 15 minutes after washing using a load cell (Toledo TT500 S type load cell with 8132 indicator) mounted in the chiller.

The air temperature in the chiller was maintained at 2°C to 5°C and the air velocity was in the range 0.5 to 1.5 m/s. One side from each animal was randomly assigned to hot boning and the other to cold boning. Prior to hot boning, sides were held in the chiller for 60-120 minutes and for cold boning for approx. 24 hours.

The hot-boned sides were chilled for 60-120 minutes because it has been shown (Shaw & Bouton 1979) that hot-boned, electrically stimulated (ES) meat has tenderness comparable with cold-boned, non-stimulated meat provided the beef carcasses to be hot-boned are held for 1½ hours after ES to allow the muscle pH to fall to 6.0 - 6.1 before boning. They also noted that this delay, which also allows the surface fat to dry and firm slightly, makes (in the opinion of the boners and slicers) the meat easier and safer to handle.

Sides of beef were weighed out of the chiller on the same load cell as that used to weigh them in. Within 15 minutes of leaving the chiller each side was quartered and boned and the meat sliced, packed, weighed and despatched from the boning room to the carton freezer or chiller. All meat, bones, fat and trim from each side were weighed out of the boning room using a carton scale (Toledo model 2084/8134 platform scale). After weighing, the bones (except large leg bones) were processed through a Protecon deboning machine, the bone waste going to the rendering department along with the fat trim and the meat paste to the smallgoods department. Each side of beef was followed individually through the boning room and all product was cleared from the table and packed before the boner commenced the next side. Where possible the same boners and slicers were used for each trial.

The boning teams (boners, slicers and packers) were drawn from the workforce at the meatworks and the boning procedures were those currently used at that works which are typical of those used by the Australian meat industry.

Both the load cell and carton scales were calibrated before and after each trial (± 0.025 kg for the load cell and ± 0.01 kg for the carton scales).

Results and discussion

Powell et al (1982) showed that weight loss from the hot sides was approx. 0.5% during 1½ hours in the chiller. There appeared no increase in yield between hot and cold boned trade steers whilst a slight increase in yield was evident for hot over cold boned manufacturing grade cow. Because of the small number of animals in these trials no statistically significant results were obtained.

Another observation by Powell et al (1982) was that the amount of fat trimmed by slicers varied between hot and cold sides. In discussions with slicers it appeared that the slicing of fat from hot boned primals required a slight change of technique to that used for cold boned primals. More fat than normal was trimmed from the hot cuts if care was not taken during trimming. This could of course be reflected in the yield results.

The question of meat remaining on the bone, especially in the rib area, was also examined by Powell et al (1982). Their results showed that, whether the sides were boned hot or cold, the bones weighed the same indicating this was not a likely problem area.

Tables 1 and 2 detail the results for two trials conducted in a licensed export boning room using current Australian side-boning procedures.

TABLE 1: BONING YIELD FOR MANUFACTURING GRADE COWS+

	Hot boned (%)++	Cold boned (%)++	Significance of Difference
Hot weight	100	100	-
Boning weight+++	99.0	97.9	***
Manufacturing meat# (includes trimming)	65.8	64.4	**
Bones	28.1	28.3	N.S.
Fat	5.1	5.2	N.S.
Other losses during boning (e.g. evaporative)	0.0	0.0	N.S.

\+ Av. body weight = 153 kg; No. = 26

++ Percentages are of hot weight (rounded to 1 decimal place)

+++ After approx. 1½ hrs (hot) and 24 hours (cold) chilling

\# Packed to U.S. specification and 85% chemical lean

Significance: N.S. - not significant; ** $P < .01$; *** $P < .001$

TABLE 2: BONING YIELD FOR TRADE STEERS+

	Hot boned (%)++	Cold boned (%)++	Significance of Difference
Hot weight	100	100	-
Boning weight+++	99.4	98.5	***
Primal cuts	46.3	46.5	N.S.
Manufacturing meat# (includes trimming)	22.2	22.2	N.S.
(Meat Yield)	(68.5)	(68.7)	N.S.
Bones	20.0	19.2	***
Fat	10.5	10.4	N.S.
Other losses during boning (e.g. evaporative)	0.4	0.2	***

\+ Av. body wt. = 233.4 kg: No. = 28

++ Percentages are of hot weight (rounded to 1 decimal place)

+++ After approx. 1½ hours (hot) and 24 hours (cold) chilling

\# Packed to U.S. specification and 85% chemical lean

Significance: N.S. - not significant; *** $P < .001$

The results for manufacturing cow (Table 1) show that a significant ($P < 0.01$) increase in meat yield of 1.4% was achieved for hot boning compared with cold boning.

There were no significant differences in yield between the hot and cold boned sides for the trade steers (Table 2).

The differences obtained in the cow and steer trials are unlikely to be sex-related but rather the consequence of different boning, slicing and packing procedures followed for manufacturing grade animals and trade type animals.

The procedures followed for the trials included a dwell time in the chiller for the hot boned sides. This was so that the surface fat would harden such that the boners and slicers were confident that there was not a safety issue involved with sloppy meat or fat and that existing commercial procedures could be used. A weight loss (1% for cows, 0.6% for trade steers) was recorded during this time. In much of the previous work as indicated in the introduction the bodies were boned directly off the slaughter line and this loss for hot boned sides was not evident. This could indicate why the previously reported results show an increase in yield for hot compared with cold boned bodies.

For cows and for steers (Table I and 2) the fat yield was not significantly different between hot and cold boned sides indicating that the slicers had probably managed to overcome the earlier problem of cutting too deeply into warm fat.

The bones of hot-boned steer sides were heavier than the cold-boned equivalents. This difference was due to extra meat in the vicinity of the rib bones and was recovered as mechanically deboned meat. A visual assessment of the hind legs indicated that after hot boning, there was no more meat left than after cold boning, in fact they looked 'cleaner'. The boners commented that "the knife has to be sharper for ribbing hot meat as the hot meat falls away from the blade".

TABLE 3: % YIELD OF ONE BONING TEAM AND THE MEAN OF ALL TEAMS (for manufacturing grade cows)

	Individual Team	Mean of all the Teams+
Hot weight	100	100
Boning wt. Hot	99.0	99.0
Cold	97.9	97.9
Manufacturing meat Hot (includes trimming)	65.6	65.8
Cold	63.1	64.4
Bones Hot	27.8	28.1
Cold	28.3	28.3
Fat Hot	5.6	5.1
Cold	6.6	5.3

Percentages are of hot weight (rounded to 1 decimal place)

+ From Table I

Table 3 details the yields for one boning and slicing team and the mean of yields for all teams (3) in the trial with the manufacturing grade cows. This team boned nine sides hot and the next day boned the matching sides cold. Procedural difficulties prevented the other teams from boning matching sides.

Table 4 details yields for each boning and slicing team for the trade steer trial. Each team boned seven sides hot and the next day boned the matching sides cold.

TABLE 4: % YIELD BY BONING TEAMS - (Domestic trade steers)

	Team 1	Team 2	Team 3	Team 4	Mean of all+ Teams
Hot weight	100	100	100	100	100
Boning wt. Hot	99.4	99.5	99.5	99.4	99.4
Cold	98.5	98.4	98.4	98.6	98.5
Primals Hot	45.5	47.4	46.1	46.3	46.3
Cold	46.5	47.2	46.0	46.4	46.5
Other Meat Hot	23.7	20.8	22.5	21.8	22.2
Cold	22.9	22.0	21.7	22.2	22.2
(Yield) Hot	69.2	68.2	68.6	68.1	68.5
Cold	69.4	69.2	67.7	68.6	68.7
Bones Hot	20.4	20.4	19.2	19.8	20.0
Cold	20.0	19.6	18.6	18.6	19.2
Fat Hot	9.3	10.5	11.2	11.2	10.5
Cold	8.9	9.3	11.9	11.3	10.4
Other Losses Hot	0.4	0.4	0.5	0.3	0.4
Cold	0.2	0.2	0.2	0.1	0.2

Percentages are of hot weight (rounded to 1 decimal place)

+ From Table 2

Tables 3 and 4 show that the difference between boning/slicing teams (up to 1.7% in Table 4) is of the same order as the difference between the hot and cold boning methods.

For example Team 1 recorded the highest meat yield (69.4%) and Team 3 the lowest (67.7%) for cold boning. However the weights of the bones were 20.0% and 18.6% for Teams 1 and 3 respectively. This is the reverse of what is expected from the above yield figures. The explanation for this anomaly is obtained by noting that the fat weights were 8.9% and 11.9% for Teams 1 and 3 respectively. It is clear that boner 3 removes more meat than boner 1, however slicer 3 removes 3% more fat than slicer 1 thus substantially reducing the yield for Team 3.

The boning/slicing teams had no hot boning experience prior to these trials. With practice yields could improve on those found in these trials.

Conclusions

Using current Australian boning procedures an increase of 1.4% in meat yield can be obtained for manufacturing grade cow when hot boning replaces cold boning. An improved yield for trade steers has not yet been shown.

The variation in performance between the individual boning/slicing teams for each boning method (cold and hot) is as large as that between cold and hot boning.

It remains to be seen if a lengthy experience of hot boning will allow boning/slicing teams to achieve the higher yields which are theoretically possible.

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