THE EFFECT OF HOT VS COLD BONING ON THE QUALITY OF RETAIL CUTS PREPARED FROM PRIMALS FROM SKINNED PIG CARCASSES

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SUMMARY
The effects of hot boning on the microbiological and sensory quality of skinned pork primals were evaluated. Hot boned primals, chilled for one day, and cold boned primals were cut up into retail cuts which were vacuum packaged and stored at 2±2°C.
Hot boning resulted in markedly less total carcass weight loss, 0.9% higher meat yields and a similar sensory quality as compared with cold boning. Hot boning primals had significantly higher colony counts. However, this did not affect the bacteriological quality of retail cuts. It is concluded that hot boning might be a good alternative for cold boning provided that, by strictly adhering to Good Manufacturing Practices, one achieves levels of microbial decontamination that are well below the levels generally considered to be safe.

INTRODUCTION

Hot boning of pork has traditionally been practiced in (Eastern) Europe in the processing of meat products. However, hot boning may also be beneficial for the production of fresh pork (Reagan, 1983; Smulders & Van Laack, 1988). Major advantages claimed by the scientific literature are less refrigeration costs (Henrickson, 1982; Cutbertson, 1980), higher turnover (Henrickson, 1982), better water-binding resulting in lesser drip formation (Honikel & Reagan, 1987; Woltersdorf & Troeger, 1987). Amongst others, effects of hot boning on meat quality are attributed to a faster chilling rate of hot boned primals as compared with the meat on the carcass (Daudin & Culioli, 1987; James, 1987). Modern pig slaughter technology relies on the scalding and singeing of the animal. The thermal stress, that results from these dehairing procedures may have a negative influence on meat quality (Takacs & Biro, 1988). Furthermore, scalding water may increase the microbial contamination of the carcass and thus result in a shorter storage life of the pig meat (Schaeffer-Seidler et al., 1984; Jones et al., 1984).
It has been suggested (Takacs & Biro, 1985; Troeger & Woltersdorf, 1987) that skinning of pig carcasses might contribute to the production of meat with a very low bacterial load, Also, Troeger and Woltersdorf (1987) reported that meat from skinned pig carcasses had a better sensory quality than meat from carcasses that had been scalded.

The purpose of this study was to evaluate if the meat quality of skinned pig carcasses from the Dutch commercial supply, might be further improved by hot deboning. In addition, the bacteriological condition of the hot boned primal- and retail cuts was monitored.

MATERIALS AND METHODS

In a pilot plant 8 large White/Dutch Landrace cross-bred pigs were slaughtered and skinned with a vertical drum skinner. All righthandside primals were excised within 1 h post mortem. Cold boning of the left handside primals was conducted after overnight storage at 1±1°C. After every two carcass sides cutting tables were cleaned, disinfected and dried. Hot boned primals were wrapped in a O_2-permeable film for one day to avoid rapid desiccation. Cold boned primals (immediately after deboning) and hot boned primals (after 1 day of chilling) were cut up into retail cuts which were vacuum packaged in a film with low O_2-permeability (<30 ml $O_2/m^2/24$ h at 1 atm at 25°C). After 7 days of storage at 2±2°C the meat was unpacked and the sensory quality traits assessed according to the procedures described by Smulders (1986).
The shoulder (M. triceps brachii) and belly were sampled for purposes of bacteriological monitoring, relying on the method described by Van Laack and Smulders (1988). At day 0 and 1 pri-

mals were sampled on the outer surface. At day 7 retail cuts were sampled on the cut surface.
Unless indicated otherwise, comparisons between hot and cold boning were made between muscles within a carcass. Statistical significance of differences was tested by Student t-test ($p<0.05$; pair-wise were appropiate).

RESULTS AND DISCUSSION

Table 1 Carcass yield of hot boned righthandsides and cold boned lefthandsides of skinned pig carcasses as assessed by weighing immediately before and after boning (expressed as %)

	Hot boned	Cold boned
Meat yield	63.5[a*]	62.3[b]
Fat yield	14.6	14.3
Bone yield	10.8	10.4
Total weight loss	0.25[a]	1.81[b]

* means with different superscripts differ significantly ($p<0.05$).

In Table 1 the yields of hot vs cold boned carcass sides are presented. The total weight loss after hot boning was significantly lower than after cold boning ($p<0.05$). We attribute this difference mainly to the increased meat yield which was 1.2% higher after hot than after cold boning.
It was very difficult to prepare retail cuts from hot boned primals when these were still warm. The resulting cut distortion was unacceptable. Therefore the hot boned meat was chilled for one additional day before cutting was started. This extended chilling period was expected to reduce the economic benefits of hot boning because of moisture loss through evaporation and drip. Yet, as can be seen from Table 2, the maximal drip-loss during the day storage was only 0.25%. Hence, the total difference in meat yield was 0.9% in favour of hot boning.
We anticipated that hot boning would lead to faster chilling rates,and therefore to minimal rates of protein denaturation (Penny, 1977; Tarrant, 1977; Taylor et al., 1980-1981). The latter would lead to an increased waterholding capacity and thus to less drip formation. However, in the present experiment the differences between hot and cold boning were very small

Table 2 Drip losses of hot boned primals during 1 day of storage at 1±1°C (n=8 except where indicated) (%)

Ham	0.16±0.06
Shoulder	0.22±0.09 (n=7)
Loin	0.22±0.05
Tenderloin	0.25±0.13 (n=7)
Belly	0.17±0.03

Table 3 Drip losses of retail cuts from hot and cold boned primals vacuum packaged after 7 days of storage (%)

	Hot boned	Cold boned
Ham (M. semimembranosus)	5.9	6.1
Loin (M. longissimus)	3.7	4.4
Shoulder (M. triceps brachii)	3.7[b]	2.6[a*]
Belly	2.2	1.7

* means with different superscripts differ significantly ($p<0.05$).

and loins lost less weight than cold boned counterparts; cuts from shoulders and bellies on the other hand lost more weight after hot than after cold boning. The absence of significant differences is probably explained by the excellent quality of the cold boned meat. At 80 min post mortem the loin pH was 6.55 at a muscle temperature of 30°C. Thus the waterholding potential of the cold boned meat was very high to start with so that hot boning could add little more. Although pH-fall was relatively slow, skinning and hot boning did not induce cold shortening. Sarcomere lengths of hot and cold boned loin samples were similar (Table 4). Shear forces of hot

boned loins were slightly, but insignificantly, lower than those of the cold boned ones (Table 4).

Table 4 Sarcomere length and shear force of hot and cold boned longissimus dorsi cuts after 7 days of vacuum storage at 1±1°C (n=8)

	Hot boned	Cold boned
Shear force ($kg\ cm^{-2}$)	4.20	4.65
Sarcomere length (μm)	1.75	1.74

From the point of view of yield and sensory meat quality, hot boning of skinned pig carcasses seems to be feasible. Before such novel slaughter and processing techniques are introduced widely, it is imperative to establish if hygienic drawbacks might ensue.
Tables 5a and 5b include the results of the bacteriological examination of the hot and cold boned meat. Hot boned primals had significantly higher colony counts than cold boned primals. This may be due to the sticky surface and the higher temperature of the hot meat which could have led to higher initial levels of contamination (Smulders & Eikelenboom, 1987). Furthermore there was a considerable increase (>0.5 log/cm^2) in colony counts during

Table 5a Microbiological condition (log/cm^2) of hot and cold boned primals [belly (B) and shoulder (S) (day 1)]

		Primals	
		Hot boned	Cold boned
Aerobic mesophilic colony count	B	3.92^{b*}	3.13^{a}
	S	3.44^{b}	2.56^{a}
Enterobacteriaceae	B	2.45^{b}	1.55^{a}
	S	2.36^{b}	1.86^{a}
Lactic acid bacteria	B	3.22^{b}	2.58^{a}
	S	3.18^{b}	2.48^{a}

* means with different superscripts differ significantly ($p<0.05$).

Table 5b Microbiological condition (log/cm^2) of hot and cold boned retail cuts [belly (B) and shoulder (S) (day 7)]

		Retail cuts	
		Hot boned	Cold boned
Aerobic mesophilic colony count	B	3.20	2.99
	S	2.35	2.14
Enterobacteriaceae	B	2.18	2.17
	S	1.63	1.50
Lactic acid bacteria	B	2.58	3008
	S	3.09	2.93

* means with different superscripts differ significantly ($p<0.05$).

one day of storage. Probably the circumstances for microbial growth would have been smaller, had the hot boned meat been vacuum packaged immediately after excision (Apple & Terlizzi, 1983). Clearly, vacuum packaging with the purpose of storage for only one day is far too expensive in meat industry practice and would reduce the economic benefits of hot boning considerably.
The contamination of both hot and cold boned meat was well below the levels generally considered acceptable for conventionally produced pork (Salm et al., 1978). The experimental procedure followed does not allow for deciding whether these levels were the result of skinning or of the intensified cleaning and disinfection procedure.
Colony counts on retail cuts from hot and cold boned primals were similar. Differences existing on primals did not affect the quality of the retail cuts significantly. This is in agreement with the findings of Greer et al. (1983) who showed that hygiene during retail cutting was far more important than the initial contamination of primals to be cut.

CONCLUSION

Hot boning of skinned pig carcass followed by retail cutting after one day of refrigerated storage, results in markedly less weight loss and similar sensory meat quality as cold boning. Microbiological monitoring indicates

that hot boned meat might represent a greater risk. By strict adherence to Good Manufacturing Practices one might still achieve contamination levels that are well below the levels generally considered to be safe.

ACKNOWLEDGEMENTS
The assistance of Miss F. Oudendag B.Sc. and Mr J. van der Palen is gratefully acknowledged. This study was supported by the Netherlands Commodity Board for Livestock and Meat at Rijswijk and by Porkhof pork processors at IJsselsteyn, The Netherlands.

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