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MEAT SAFETY GAINS BY DE-BONING OF INTACT CARCASSES

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Introduction

Carcass contamination with CNS tissue has been an important issue since Bovine Spongiform Encephalopathy (BSE) was considered as a zoonosis. The significance of the carcass splitting saw in connection with contamination of carcasses by CNS tissue is documented (1). In addition, the possibility of contamination of the carcass by bacteria via the splitting saw also exists. De-boning implemented on intact carcasses with an intact spinal column would eliminate disruption of the spinal cord and its dissemination on the carcass. The food safety aspects of de-boning intact carcasses might also be considered as additional gains of hot boning in general. Such gains are reduction of the mass of carcass tissue requiring chilling and a potential to avoid weight loss from the meat during refrigeration since meat is vacuum- packed on removal from the carcass. Technically, hot boning also requires less manual labour than traditional de-boning of chilled meat. However, de-boning of intact carcasses needs more space and different facilities and may be more complicated than the working operations based on carcass halves or quarters. Accordingly, the food safety aspects of hot boning of intact carcasses have to be discussed in a cost benefit context.

Objectives

Our main objectives were to investigate whether de-boning of intact carcasses might have a positive influence on the degree of both bacteriological and CNS related contamination on carcass surfaces and also in meat from such carcasses.

Methodology

Sample collection from carcasses

The cattle were slaughtered in an abattoir with a capacity of slaughtering and hot boning of about 100 animals on a daily basis. Eighteen carcasses were kept intact during slaughtering and dressing (range 187.2 - 388.5 kg) and compared to forty-five carcasses (range 206,6 - 376.7 kg) split by an automatic circular saw on the same slaughter line (Landteknikk A/L, Oslo, Norway).

Both GFAP and S-100β proteins have been used as indicators for contamination of carcasses with CNS tissue (2). Samples for detection of these two proteins from both split (n =10) and intact carcasses (n = 10) were collected from five internal (no. 1 - 5) and five external regions (no. 6 - 10) on both sides (Figure 1). These surface samples were collected using synthetic sponges (Sydney Heath & Son, Stoke on Trent, UK), and placed into 20 ml PBS, 0.5 % Triton-X-100.

Collection of microbiological samples was performed by swabbing 100 cm^{2}^ from leg, pelvic duct, belly, back, and elbow (letters a - e) (Figure 1) from both split (n = 25) and intact carcasses (n = 10).

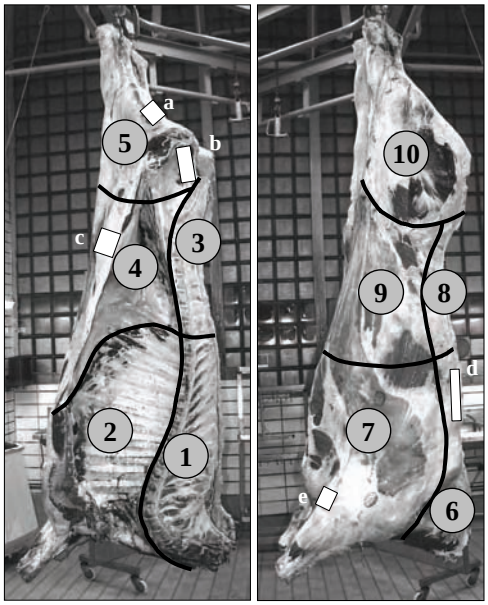

Figure 1. Schematic diagram of the ten areas (indicated by numbers) swabbed on the internal and the external surfaces of each half (left and right) of the split beef carcass. When swabbing intact carcasses, areas no. 1 and 3 on the internal surface were not relevant used. Microbiological sampling sites are indicated by letters.

Sample collection from minced meat

After meat inspection and trimming, the split carcasses were quartered with a manual circular saw and transported into the hot boning department and processed continuously. About 200 g of minced meat from split carcasses (n = 35) was sampled at random on the same days that the intact carcasses were processed. To avoid cross-contamination from split-carcasses, the intact carcasses (n = 16) were de-boned in a separate room. Minced meat from these carcasses was processed by a separate mincer (The Biro® Mfg Co, Marblehead, Ohio, USA). The mincer was washed and disinfected by hot water before use and between each carcass. About 200 g of minced meat from each of the intact carcasses was also sampled. For detection of CNS contamination and microbiological investigation, each sample was divided into two plastic bags.

Storage

Samples for detection of CNS contamination were stored at 4 ^{o}C for 48 hours and then frozen at -70 ^{o}C prior to analysis. Samples for microbiological analyses were stored at 4 ^{o}C for 24 hours before sample preparation and analysis.

Detection of CNS contamination

A modification of the capture ELISA (enzyme linked immunosorbent assay) for GFAP (3) and S-100β (2) was used to detect CNS contamination of beef carcasses and minced meat.

Microbiological methods

The following parameters were investigated:

- Aerobic microorganisms (4),
- *Enterobacteriaceae* (5),
- *E. coli* (6).

Statistical analyses

t-test (Microsoft Excel, 2000)

Results & Discussion

Results are presented in Tables 1 and 2. In general, the contamination of split carcasses is caused by the carcass splitting saw, providing transport of CNS material and bacteria by direct contact, water sprays and via aerosols. Sample sites near the vertical incision of the splitting saw had higher levels of CNS indicators and bacteria than sites far from this incision.

Table 1. Average CNS contamination illustrated by the levels of GFAP and S-100 β on intact and split beef carcasses and in minced meat from these sources (Standard deviation). The results are expressed as ng/mg total protein. ND = not detectable. GFAP and S-100 β are considered to have a background level in "normal" meat of about 2 ng/mg

Parameter/source	Carcasses		Minced meat	
	Intact (n=10)	Split (n=10)	Intact (n=16)	Split (n=35)
GFAP	0.14 (0.62)[a]	88.40 (174.88)	ND (-)	0.00 (0.03)
S-100 β	0.95 (1.37)[a]	52.92 (134.76)	17.37 (8.90)	16.12 (9.37)

[a] $p < 0.01$

Although the levels of CNS carcass contamination were significantly lower in intact carcasses compared to split carcasses, these differences were much reduced and were not significant in minced meat. In relation to bacteria, the same dilution effect was not seen in minced meat. The levels of bacteria were the same in both intact and split carcasses except for the sample sites along the back (*Enterobacteriaceae* and *E. coli*). However, the levels of Total viable count and *Enterobacteriaceae* were significantly lower in minced meat from intact carcasses.

Table 2. Average contamination illustrated by total viable count (TVC), *Enterobacteriaceae*, and *E. coli* on intact and split beef carcasses and in minced meat from these sources (Standard deviation). The results are expressed as log CFU/cm^2 from carcass surfaces and log CFU/g minced meat. ND = not detectable

Parameter/source	Carcass		Back		Minced meat	
	Intact (n=10)	Split (n=25)	Intact (n=10)	Split (n=25)	Intact (n=20)	Split (n=10)
TVC	4.27 (0.87)	4.16 (0.91)	3.61 (0.88)	3.87 (0.59)	3.20 (0.28)[a]	4.21 (0.59)
Enterobacteriaceae	0.87 (0.99)	1.20 (1.03)	0.14 (0.29)[a]	1.61 (0.90)	0.62 (1.04)[a]	3.01 (0.87)
E. coli	0.24 (0.71)	0.40 (0.70)	ND (-)[a]	0.62 (0.61)	0.11 (0.48)	0.31 (0.66)

[a] $p < 0.01$

Conclusions

Both positive food safety aspects and additional general economic gains by hot boning of intact carcasses seem to over-shadow some negative practical and economic factors in a cost benefit context.

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