A MICROBIOLOGICAL ASSESSMENT OF THE MAIN POINTS OF BEEF CARCASS CONTAMINATION ON NORTHERN IRELAND SLAUGHTER LINES.

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Background

The red meat industry in Northern Ireland must export a considerable proportion of its product (figures have been estimated as up to 80 percent [Anon. 1998]), due to production exceeding the quantity that can be consumed locally. This brings with it an increasing emphasis on producing a quality product, as meat plants endeavour to sell more beef directly to overseas retail and catering customers. Since beef from Northern Ireland must compete in remote markets with local produce, it must reach the point of sale as a high quality product commanding a premium price in order to offset transportation costs. A microbiological survey of meat quality, based on sponge swab sampling of the brisket, indicated a relatively low degree of microbiological contamination (Murray, Gilmour and Madden, 2001) and hence high microbial quality. To further control contamination the main points of microbial contamination of the brisket along the slaughter line were investigated.

Objective

International meat inspecting authorities are encouraging slaughtering plants to implement HACCP systems, which are a practical, cost effective approach to ensuring the safety and quality of meat and meat products (Sheridan 1995). In order to objectively identify critical control points (CCP), swab samples were taken from seven Northern Ireland abattoirs at three points along the kill-line with carcasses being swabbed on the brisket (1000cm^2) using the sponge-swab technique. Swab samples were analysed for total viable counts (TVC), to assess the hygienic characteristics of the slaughter and dressing process, and for Enterobacteriaceae (enteros), which are an indicator of the health risks associated with faecal contamination during processing (Ingram & Roberts 1976; Gill *et al*. 1996).

Methods

Wearing sterile gloves (Aladan Corp., Dothan, AL, USA), an area of 1000cm^2 was outlined on the brisket using ing a plastic ruler, which was sanitised between each carcass using an alcohol wipe (Medi-Wipe™, Smith & Nephew Medical Ltd., Hull, England). Measurements were taken by locating the elbow and drawing an imaginary line medially to the mid-line, which was the starting point. The area was 'dimpled' onto the brisket by measuring 50cm up the mid-line, then 20cm laterally, then 50cm down and 20cm medially to complete an area of 1000cm^2. Once the sampling area had been marked out, a stomacher bag containing a sponge-swab was opened along the seal using sterile scissors, which were also sanitised between each swab. The swab was removed from the bag and used to firmly rub all over the sampling area approximately 20 times horizontally and 20 times vertically, then turned over to the other side and the procedure repeated. The swab was returned to its original bag, which was sealed with tape and placed in a cool-box for transportation back to the laboratory. Following serial dilution in maximum recovery diluent, each sample was plated in quadruplicate onto nutrient agar (NA), malt extract agar plus chloramphenicol (MEA+C), and violet red bile glucose agar (VRBG) with overlay. Duplicate plates were incubated at 37°C and 22°C for 48 hours (NA for 72 hours) and characteristic colonies counted for MEA+C and VRBG. At one abattoir , sampling (n=100) was carried out at three CCPs, which had been identified by the plant management. Brisket sampling was performed 1) as soon as was practicable after the hide had been removed and before the site was subjected to any further manipulation (H), 2) after splitting the carcass (S) and 3) after high pressure washing with water, prior to the entry of the carcass into the chill (W). For the remaining six abattoirs studied, samples (n=15 per sample point) were collected at points H and W only.

Results And discussion

All microbiology results are presented as Log_{10}(colony forming units/cm^2). The detailed study of a single abattoir showed that briskets of the beef carcasses sampled carried few enteros (Table 1), as previously reported (Murray, Gilmour and Madden, 2001).

Site sampled	TVC 37°C	TVC 22°C	Entero 37°C	Entero 22°C
After hide removal (H)	3.51^a	3.22^c	0.62^e	0.19^g
After carcass splitting (S)	3.59^a	3.21^c	0.68^e	0.32^g
After final wash (W)	3.25^b	3.08^d	1.04^f	0.86^h

Table 1. Mean counts detected (n=100) on briskets, as Log_{10}(colony forming units/cm^2). Superscripts indicate statistically significant differences ($P<0.05$) within, and between, columns. The study was conducted in a single abattoir sampled on five occasions. Entero results are mean of positive samples only.

Cattle faeces taken immediately post-mortem were studied as part of this work, and found to contain approximately 5 x10^5 enteros/g (37°C), hence from the entero (37 °C) results it can be concluded that negligible transfer of faecal material to the brisket occurred. Both sets of TVC results indicated that the majority of microbial contamination of the brisket took place immediately after hide-pulling, presumably by airborne bacteria released as the mechanical removal of the hide took place. This is indicated by the fact that counts were maximal on sampling immediately after hide pulling. Subsequently no major contamination of the brisket appears to have occurred, and after washing numbers fell slightly. Thus hide pulling itself was identified as a critical control point with no significant microbial contamination applied after that point. To test if this observation was unique to the abattoir studied, carcasses (n=15) were sampled in each of 6 further abattoirs, at sites H and W only.

Again low contamination by enteros was observed with most carcasses (54%) at site H showing no detectable enteros after incubation at 22°C. At 37°C a third of carcasses showed no detectable enteros at the same site and the overall counts were less than 6 cfu/cm^2, Table 2. Again negligible transfer of faecal material to the brisket must have occurred and the results also imply that evisceration practices were good since washing, which took place in all of the abattoirs studied, has been reported as causing faecal contamination of the posterior region to be redistributed to the anterior region (Bell, 1997). This appears to happen in the abattoirs sampled (Table 1 and Table 2) since entero counts were highest after washing but the total numbers seen were very low. Thus bunging and evisceration must be undertaken in a consistently careful manner in Northern Ireland abattoirs.

Site sampled	TVC 37°C	TVC 22°C	Entero 37°C	Entero 22°C
After hide removal (H)	3.55a	2.83c	0.60e	0.63e
After final wash (W)	3.25b	2.47d	0.74e	0.65e

Table 2. Mean counts detected (n=90) on briskets, as Log_{10} (colony forming units/cm^2). Superscripts indicate statistically significant differences ($P<0.05$) within, and between, columns. The study was conducted in six abattoirs, each sampled once. Entero results are mean of positive samples only.

The results for both TVC incubations confirm that bacterial numbers are again highest immediately after hide pulling. Thus the mechanical removal of the hide appears to dislodge large numbers of bacteria which then contaminate the brisket. No subsequent operations on the slaughter and dressing line cause a significant increase in the number of bacteria detected on the brisket and, in fact, a statistically significant fall is observed. The study of Murray, Gilmour and Madden, 2001, implied that the overall quality of beef carcasses was good in Northern Ireland and this work shows that for further improvements to be made it will be necessary to carefully analyse the hide-pulling procedure in order to minimise the spread of micro-organisms at this point. A clean removal of the hide may, however, allow other critical control points along the slaughter and evisceration line to be revealed hence requiring more studies to be performed. In such a case the sponge swabbing procedure could once more be gainfully employed.

Conclusions

Sampling of the briskets of beef cattle along the slaughter and evisceration lines of Northern Ireland abattoirs revealed that the hide pulling procedure resulted in most microbial contamination. Hence to further reduce the levels of bacteria on beef carcasses it will be necessary to develop, and evaluate, more hygienic hide removal procedures.

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