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EVALUATION OF A COMMERCIAL HOT WATER DECONTAMINATION CABINET

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Key Words: Decontamination; Hot Water; *E. coli*

BACKGROUND

Bacteria capable of causing food poisoning have been isolated from all the common animals used for human nutrition. Many organisms have been implicated as food-born pathogens. The most common bacteria associated with food poisoning are the salmonellae, however, more recently enteropathogenic *Escherichia coli* such as strain O157:H7 have received notoriety. International attention is becoming more and more focused on the microbiological quality of meat. This has resulted in increased interest in methods of reducing the numbers of pathogenic bacteria present on carcasses immediately after slaughter. In response to the increased interest in food hygiene, the U.S. Department of Agriculture has proposed pathogen reduction and Hazard Analysis and Critical Control Point (HACCP) programs. An integral part of these programs is the proposed introduction of a mandatory antimicrobial treatment, applied prior to the chilling operation. Of the several options available, hot water is the only non-chemical treatment. The use of hot water to destroy bacteria on the surface of meat is not new. Smith and Graham (1987) reported a 3 Log_{10} reduction in the numbers of *E. coli* when inoculated meat pieces were dipped into water at 80^{0}C for 10 seconds. In this study a commercial hot water decontamination cabinet, installed in an abattoir processing beef carcasses, was assessed to determine the reduction in bacterial numbers on carcasses artificially contaminated with faeces. The physical and microbiological quality of the carcasses were assessed before and after treatment to determine the commercial viability of the cabinet.

OBJECT

The object of this study was to determine the microbiological efficacy of a hot water decontamination cabinet operating under commercial conditions in an abattoir processing beef cattle.

MATERIALS AND METHODS

A faecal inoculum was prepared from 100 g of faeces collected on the day prior to the inoculation. The faeces were suspended in water and the suspension passed through a course filter to remove large particulate matter. Areas on the carcasses were inoculated using a swab soaked in the inoculum. Samples measuring 25 cm^2 were excised from the inoculated area before and after treatment using aseptic techniques. The samples were immediately placed at 0^{0}C and transported to the laboratory for microbiological assessment; samples were processed the following day. Samples were analysed for mesophilic coliforms using a pour plate recovery method. Samples were weighed and made up to 250 g with 0.1 % Neutralised Soya Peptone (Oxoid L44), before being stomached (Lab-blender 400) for one minute. Aliquotes were pour plated in 5 mls of Tryptone Soya Agar (Oxoid CM131) and incubated for 2 hours at 37^{0}C to allow any damaged cells to recover. The plates were then overlayed with 10 mls of Violet Red Bile Agar (Oxoid CM107) and incubated overnight at 42^{0}C. All red colonies were counted and the count reported as the number of mesophilic coliforms per cm^2. Greater then 90% of the colonies on the plates were identified as *E. coli* using Petrifilm™ *E. coli* plates. The temperature of the water passing over the surface of the carcass was measured at one second intervals during treatment using copper constantan thermocouples located one to two millimetres above the surface of the carcass. The temperatures were recorded using a Data Taker ™. The decontamination cabinet was situated at the end of the slaughter floor prior to the chillers. The cabinet consisted of a closed unit approximately 3.5 metres long and was able to deliver 20 litres of water per second. The water was directed onto the carcasses via flumes located within the cabinet, the flumes occupied the first 1.6 metres of the cabinet. Water used for the cabinet was recycled with make up water being added throughout the day. The economic viability of the cabinet relies on the water being recycled, estimates of the cost of the operation per side treated have yet to be determined.

RESULTS AND DISCUSSION

Initial trials were carried out at a water temperature of 79°C and a residence time in the cabinet of 30 seconds. Under these conditions it was possible to achieve a mean reduction in inoculated *E. coli* numbers of 4 Log_{10} (99.99%), the minimum reduction found at any individual site was 2.71 Log_{10} (99.8%), the initial number of *E. coli* inoculated onto the sides was approximately 4.6 Log_{10}. The Log_{10} reduction in *E. coli* numbers, for carcasses processed through the cabinet, can be described using an equation developed by Davey (1989);

$$\text{Log reduction} = \frac{\text{Temperature} - 44.41}{24.77 - 0.5361 \times \text{time}}$$

Using this equation the mean Log_{10} reduction in *E. coli* numbers for carcasses treated at 79°C for 30 seconds should be 3.98 Log_{10}, this is in close agreement with the observed value of 4.0 Log_{10}. After treatment the sides appeared bleached with some areas having a cooked appearance. The treated sides did not fully recover after chilling overnight, with some areas remaining bleached. Management at the works rated the test sides as commercially unacceptable. Further trials were conducted on uninoculated beef sides to determine the operating parameters that allow the production of commercially acceptable carcasses. It was found that carcasses treated at 69 or 73°C for 30 seconds showed no or very little permanent discolouration. Results indicated that heavy, grain fed, animals are less likely to show permanent discolouration then lighter, lower quality (lower fat cover) animals. Heavy sides when treated at 79°C for 17 seconds showed little or no permanent discolouration. Inoculated carcasses treated at 79°C with a residence time of 17 seconds showed a mean reduction in *E. coli* numbers of 2.05 Log_{10}. The predicted reduction for carcasses treated at 79°C for 17 seconds is 2.2 Log_{10}, this is in close agreement with the observed reduction. The U.S. pathogen reduction program, in its present form, calls for the use of a decontamination process before beef sides are chilled. The time/temperature recommended in the proposed U.S. program, for effective hot water decontamination, is 74°C for 10 seconds. The predicted log reduction under these conditions would be 1.5 Log_{10}, therefore, operating the cabinet at 79°C gives some margin of safety. Because there are a number of time/temperature combinations possible the operating parameters of the cabinet need to be adjusted to suit environmental and operational conditions found in the plant. When the appearance of the side after treatment is not so important, for example if the side is to be used to produce manufacturing meat (and subsequently hamburger patties), the temperature or time of treatment can be increased to ensure a larger reduction in the numbers of *E. coli*, Salmonellae, and other pathogenic bacteria. Work has yet to be carried out to determine the effect of the cabinet on spoilage bacteria, especially those associated with the spoilage of vacuum packaged meat products, to see if meat derived from treated sides has an increased shelf life over that from untreated sides. At this stage the cabinet is still in the developmental stage, with refinements of the design still under way. Problems with cleaning the recycle water so as to avoid the build up of solids are slowly being solved. Further design modification are being made to overcome condensation problems associated with the cabinets close proximity to the chillers. When these problems have been addressed the cabinet will be evaluated during full commercial operation and the physical and microbiological quality of both the sides and the recycled water will be determined.

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