FULL SCALE TEST WITH DECONTAMINATION OF PIG CARCASSES WITH HOT WATER

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Background:

With respect to pathogenic micro organisms, there is an increasing tendency towards introducing maximum permitted levels, which are so low that they are impossible to fulfil with the established slaughter technology. In this connection a major theoretical and practical evaluation of decontamination in general has been fulfilled. This survey documents that decontamination with hot water is the most promising technique with respect to pathogen reduction and economics in Denmark, Jensen et al. (2000).

Objectives

A full-scale test was carried out at a normal Danish abattoir (375 pigs/hr) to document the effect of decontamination with hot water on micro organisms and on consumption of water and energy.

Methods

For the test equipment, that has been developed to decontaminate beef carcasses (Steer-Cleer™), was purchased and modified for handling pork carcasses. The decontamination was carried out in a cabinet, in which carcasses hanging on gambrels and being conveyed on an overhead rail, were showered with hot water, Fig. 1. The decontamination was carried out as the last process on the slaughter line prior to carcass chilling in a blast-chilling tunnel. At a slaughter rate of 375 pigs per hour, the carcasses were treated with water of 80°C for 15 seconds in the cabinet.

Figure 1: Application of water to the carcass.

The process parameters, time and water temperature, were selected to ensure, that the meat colour was reversible. The colour reverted to the carcass during chilling. However, one area in particular (the meat surface at the sternum) had a somewhat greyish colour after chilling due to a too severe heat treatment. In spite of this, the severe treatment of this area was maintained due to the likelihood of the area to be contaminated with pathogenic bacteria.

Decontamination with hot water can be carried out with or without recycling of water. The full scale test was carried out with recycled water. The cabinet was connected to a water treatment unit, in which the water was held for min. 3-4 minutes at 75°C prior to being heated to 79-81°C and subsequently transferred to the cabinet. In total 27 m^3 of water passed through the cabinet per hour. In the water treatment unit gross particles were removed by filtration; foam and small particles were removed by flotation. The turbidity of the water was controlled with an in-line turbidimeter (HACH). Potable water was added automatically to keep the turbidity below 120 NTU.

After full-scale operation of the equipment had been achieved, it was investigated how much the bacterial counts on the carcasses had been reduced. The following were investigated: Total viable count -TVC (NMKL No. 86, 2. ed, 1986), *E. coli* (NMKL No. 147, 4th ed., 1997) and *Salmonella* (NMKL No. 71, 5th ed. 1999).

The reduction of TVC and *E. coli* counts was examined by sampling the same carcasses immediately before and after decontamination, alternately from the left and right sides. In addition, decontaminated and untreated carcasses were examined for *E. coli* after chilling. Samples to be examined for TVC were taken from three areas each of 10 cm^2 (in the abdominal cavity, on the back rind and on the meat side of the neck) by swabbing first with a moist cotton wool swab then with a dry swab. From each sampling site a total of 60 samples were taken before and after decontamination during three days of slaughtering. Samples to be examined for *E. coli* were taken by swabbing a large area with a moist gauze pad – the pelvic duct, the medial face of the hind leg, the belly cut plus sternum and 5 cm of the adjoining rind (1400 cm^2). A total of 150 carcasses were sampled before decontamination, after decontamination and after chilling during three days of slaughtering. Reduction in the occurrence of *Salmonella* has been determined in connection with special slaughter of level 3 pigs (according to the Danish Salmonella action plan). Samples were taken after completion of carcass chilling, i.e. the day after slaughter. Samples were taken by swabbing a large area with a moist gauze pad - the pelvic duct, the medial face of the hind leg, the belly cut plus sternum and 5 cm of the adjoining rind (1400 cm^2). A total of 6045 carcasses were sampled after chilling during a period of 4 months.

The quality of the recycled water was evaluated by examining water samples quantitatively for the contents of sulphite reducing Clostridia (NMKL No. 56, 3rd ed. 1994), *Bacillus cereus* (NMKL No. 67, 4th ed. 1994) and *E. coli* n=30). If the number of thermo-tolerant spores in the recycled water increases, it could lead to an increase in the number of thermo-tolerant organisms on the carcasses. Carcasses were therefore examined for number of sulphite reducing Clostridia and *Bacillus cereus* before and after decontamination and after completion of chilling by swabbing large areas with a moist gauze pad - the pelvic duct, the medial face of the hind leg, the belly cut plus sternum and 5 cm of the adjoining rind (1400 cm^2). A total of 150 carcasses were sampled before decontamination, after decontamination and after chilling during three days of slaughtering.

Bacterial counts were logarithmically transformed prior to statistical calculations. In cases where data sets contained counts below the detection limit, the calculation of means and standard deviations plus the significance calculations were carried out with "proc lifereg" (SAS Institute); this includes an assumption that the log-transformed bacterial counts, which form basis for a mean are normally distributed. The probability of this was controlled using "proc univariate" (SAS Institute). If no other information has been stated in the text, the commented differences in bacterial counts were significant ($p<0.001$).

Results and discussion

The decontamination equipment was able to handle up to 400 carcasses/hr. For decontamination during full production with recycling of the water the consumption of potable water was 18 l/carcass. The supply of steam for heating of water and the electricity was 750 kg/h and 25 kw respectively.

Decontamination reduced the numbers of *E. coli* with more than 2 log-units; chilling reduced the numbers further with 0.7 log-unit. TVC was reduced with 1-1.5 log-unit and Sulfite reducing clostridia were reduced with 1,3 log-unit by decontamination. *Bacillus cereus* was only found on two carcasses and in low numbers (500 cfu/sample). The reduction in Sulfite reducing clostridia was surprisingly big. The explanation could be, that the cells were in the vegetative state and therefore sensitive to heat. Neither sulfite reducing clostridia nor *Bacillus cereus* was found in the water samples.

Based on the reduction in numbers of *E. coli*, it could be expected that decontamination with hot water would result in a major reduction in the occurrence of *Salmonella* on carcasses. This was confirmed by decontamination of carcasses from *Salmonella*-infected herds, where *Salmonella* were found on only 44 out of 6045 carcasses (0.73 %) after decontamination when sampling from 1400 cm^2. When slaughtering *Salmonella* infected herds according to the Danish Salmonella action plan, the frequency of contaminated carcasses is normally >10 % in average.

Conclusions

Decontamination with hot water can result in a major reduction in the number of pathogens on pig carcasses. The process can be carried out with or without recycling of water. None of the results indicate, that spore forming bacteria increase in number as a result of the recycling of the water. Therefore no health concerns are related to recycling.

Permanent discoloration was only seen on the meat surface of the sternum. Discoloration can be avoided, but the effect of decontamination will be less than what was found in the trials.

Pertinent literature

Jensen, T. B. Dalsgaard and H. Christensen. 2000. Decontamination of pig carcasses. Proceedings of the 46th International congress of meat Science and Technology. Pp 674-675.