MASSEY UNIVERSITY

INVESTIGATION OF HYGIENE ASPECTS OF PIG PROCESSING USING THE HACCP CONCEPT

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ABSTRACT

Contamination of fresh meat by pathogenic and spoilage microorganisms can occur at any stage of the slaughter process. Pathogens which are frequently found in fresh meat and which pose a public health problem include *Salmonella* spp. *Campylobacter* spp. and *Yersinia* spp. Contamination with spoilage bacteria affects the storage stability and shelf life of meats.

Factors that contribute to meat spoilage include physical damage, biochemical changes in the meat tissues and the activity of microorganisms, of which bacteria are undoubtedly the most important. Fresh meats present a rich medium for the support of microbial growth and will ultimately be rendered unacceptable to consumers as a consequence of spoilage due to such growth. The source of spoilage bacteria can be the slaughter animals themselves, the environment, water and personnel working in the processing plants.

This study was conducted to determine the effect of some processing operations on the level of contamination of the pig carcass with aerobic bacteria and to establish microbial quality control points based on the Hazards Analysis Critical Control Point (HACCP) principles. As a component of the HACCP system and a step in the setting up of an HACCP plan for microbial quality control of fresh carcass meat, this study aims at identifying hazards at various stages of processing, evaluating preventive measures and establishing critical control points. Where appropriate, corrective measures to ensure that bacterial contamination is within an acceptable level are recommended.

The study was carried out at a processing plant in the North Island of New Zealand during the period April to July 1998. Based on observations at the plant, a flow chart of pig processing was drawn up. A number of processing stages were selected as points where potential risks of bacterial contamination were

most likely to occur. These points initially included dehairing, polishing and scraping, evisceration, and inspection. Eight visits to the abattoir were made and a total of 32 paired swab samples from carcasses at each process stage were collected. With four process stages selected for sampling, the total number of samples was 128. In addition, 12 scalding tank water samples were collected for analysis. All samples were processed in the Microbiology Laboratory at Massey University. The aerobic plate count (APC) technique employing incubation at 30°C for 3 days was used for enumeration of aerobic bacteria. A matrix table was designed for entering APC data after each count. The mean of colony forming units per square cm (CFU/cm^2) for pig carcass surfaces and CFU/ml for scalding water were calculated and $\log_{10}$ transformation was performed.

The highest mean APC was found after the carcasses had passed the dehairing machine (5.1 $\log_{10}$/cm^2, ST.D. = 0.57) and the lowest number before the dehairing step (4.31 $\log_{10}$/cm^2, ST.D. = 0.61). A rapid increase in APC at the dehairing stage indicated a heavy recontamination of the pig carcass with bacteria from the equipment and from detritus accumulated during the operation. After the operation, the count gradually decreased to 4.4 $\log_{10}$/cm^2, ST.D. = 0.38 at the post-evisceration point but then slightly rose again to 4.5 $\log_{10}$/cm^2, ST.D. = 0.4 at the post-inspection step. The increase in the APC at the dehairing stage by 0.8 $\log_{10}$/cm^2 ($p = 0.0002$, $n = 16$) is significant. There was little change in the APC at the polishing and scraping and evisceration stages. There was an insignificant difference of 0.2 $\log_{10}$/cm^2 in the APC between samples taken at the start and at the end of the shift.

The scalding water temperature fluctuated between 60°C and 67.5 °C (mean = 63.2, n = 12). Bacterial contamination of the scalding water remained almost unchanged with time (2.55 $\log_{10}$/ml at the beginning and 2.62 $\log_{10}$/ml at the end of the shift). An expected inverse correlation between scalding water counts and water temperature could not be verified.

Although this study is confined to the microbiological assessment of only a few operational stages that can contribute to the storage quality of fresh pork, the results showed that recontamination of the pig carcass at the dehairing stage is serious and may pose potential safety and quality hazards. Control of bacterial contamination at this step is likely to have a beneficial effect on the microbial quality and safety of the final products. A quality Critical Control Point should be established at the dehairing step which can be considered as a safety CCP as well. However, some technological modification at this step such as installation of hot water showers to make the operation "specifically designed", may be needed to meet the criteria for establishing a CCP. At the polishing and scraping step the results of the study indicated a slight decline in bacterial numbers, provided that brushing and washing of the carcasses was done properly. Any deviation from the normal procedure e.g. inadequate water supply to the brush and scraping table, reduced frequency of hand and knife washing, or increased frequency of touching the carcass by the worker's hands, is likely to result in an increased level of bacterial contamination. Monitoring measures and corrective actions at this stage could be crucial for maintaining an effective CCP. At the evisceration step, preventive measures such as plugging or tying the anus should be considered. This step could be an important CCP for both quality and safety. Further investigations are required to assess the effect of meat inspection procedures on the spread of bacteria from multiple incisions of lymph nodes, internal organs and tonsils. If this step were to be considered a CCP, it would mainly have safety implications.

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