EVALUATION OF CHANGES IN MICROBIAL POPULATIONS ON BEEF CARCASSES RESULTING FROM STEAM PASTEURIZATION

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Summary

The steam pasteurization process (SPS 400) developed by Frigoscandia Food Process Systems (Bellevue, WA) was effective in reducing bacterial populations in both laboratory and commercial settings. The objective of steam pasteurization and other meat decontamination measures is to extend product shelf life and improve safety by inhibiting or inactivating pathogens, while at the same time maintaining acceptable meat quality characteristics. The effects of steam pasteurization on beef carcass bacterial populations were evaluated at two large commercial beef processing facilities. A shelf-life study also was conducted to determine the microbial profiles of vacuum packaged beef loins from pasteurized and non-pasteurized carcasses. Steam pasteurization greatly reduced total beef carcass bacterial populations and was most effective in reducing gram negative organisms, including potential enteric pathogens of fecal origin. Thus, the relative percentage of gram positive microflora on beef carcass surfaces, especially *Bacillus* spp. and *Staphylococcus* spp., increased.

(Key Words: Steam Pasteurization, Microbial, Populations, Carcasses.)

Introduction

Emerging pathogens and new spoilage organisms continue to generate potential hazards and spoilage problems. Modern sanitation practices, packaging, decontamination technologies, and storage practices could result in emergence of "new" microorganisms and lead to new issues in meat safety. Changes in microflora caused by a decontamination or processing treatment must be evaluated to ensure that new problems are not being created. Conversely, certain decontamination treatments may select for microflora that improve shelf life and even sensory quality. Each decontamination strategy should be evaluated individually to ascertain its effects on the resulting microbiological safety and quality of meat products.

This experiment examined the effects of steam pasteurization on beef carcass microflora. Our goal was to identify the types of native microflora of beef carcasses before and after steam pasteurization and to observe any changes resulting from this treatment, compared to nontreated carcasses. The changes in microflora in vacuum-packaged beef subprimals over time caused by steam pasteurization of carcasses also were analyzed.

Experimental Procedures

Isolates selected for identification in this study were collected during two earlier large in-plant steam pasteurization trials. The isolates from Plant I were chosen randomly from the APC Petrifilm™ before steam pasteurization, after steam pasteurization, and

after 24 hr of chilling; 288 from each period, representing 140 carcasses.

Plant II isolates were picked randomly from the APC Petrifilm™ representing five anatomical locations on 200 carcasses; inside round, loin, mid-line, brisket and neck, 150 before steam pasteurization and 150 after steam pasteurization. Isolates were identified by standard microbial isolation techniques, using commercially available identification test kits.

Boneless strip loins were vacuum packaged to determine microbial changes over time and the effect of steam pasteurization on shelf life. Samples were collected and enumerated microbiologically every 20 days over a 100-day storage period at 34°F.

Results and Discussion

Comparisons in this study are based on relative percentages of isolated colonies remaining on detection media and do not account for the large bacterial reduction in populations by commercial steam pasteurization. In Plant I, steam pasteurization (8 seconds exposure time at 195-201°F) reduced aerobic plate counts (APCs) approximately 1.35 $\log_{10}$ CFU(colony forming units)/cm^2, and that reduction was maintained after a 24-hour chill. A 1 $\log_{10}$ reduction means 90% reduction; 2 $\log_{10}$ is 99% reduction. The population remaining after steam pasteurization was dominated by gram positive, spore-forming rods. *Bacillus* comprised 41.7% of the aerobes before pasteurization, 48.4% immediately after pasteurization, and 37.0% after chilling. The surface microflora was more diverse before pasteurization and after chilling than immediately after treatment.

In Plant II, steam pasteurization (6.5 second steam exposure at 180°F) reduced ($P \leq 0.01$) bacterial populations from 1.84 $\log_{10}$ CFU/cm^2 before pasteurization to 0.84 $\log_{10}$ CFU/cm^2 afterward. A total of 148 APC isolates were identified before pasteurization and 108 afterward. Steam pasteurization virtually eliminated gram negative bacteria, leaving a residual population comprised almost exclusively of gram positive spore-forming rods and cocci. After treatment, *Bacillus* again were predominant. This is a spore-forming microorganism and, therefore, is highly tolerant to heat and other extreme environmental conditions. *B. cereus* does not proliferate well at cold temperatures, so the percentage increase of *Bacillus* does not in increase food safety risk. *Staphylococcus aureus* was not identified in this study.

Aerobic plate counts of pasteurized and nonpasteurized samples were essentially the same prior to fabrication and remained so throughout storage. However, shelf life results were highly influenced by the simultaneous processing of pasteurized and nonpasteurized carcass primals and subprimals, which provided a constant source of cross contamination. *Bacillus* and *Staphylococcus* constituted 60% of the microflora present throughout the shelf-life period.

The reduction in bacterial populations indicates that steam pasteurization is very effective and adaptable to commercial processing facilities. The microflora changes do not appear to be hazardous and occur normally under typical processing conditions.