MICROBIAL EVALUATION OF STEAM PASTEURIZATION AND COMPARISON OF EXCISION VERSUS SPONGE SAMPLING RECOVERY

D. L. Retzlaff, R. K. Phebus, S. A. Rueger, J. L. Marsden, and C. L. Kastner

Summary

The use of steam pasteurization (SPS 400™; Frigoscandia, Bellevue, WA) as a viable commercial-scale intervention method to treat pre-rigor beef carcasses uniformly has been evaluated for temperatures from 180° to 201°F. Effectiveness at lower temperatures (minimum atmospheric temperature of 170°F) has not been evaluated. Previous studies of steam pasteurization used excision sampling. However, the USDA-FSIS has suggested use of nondestructive sampling of chilled beef carcasses for generic *Escherichia coli*, so we compared excision and sponge sampling in a commercial slaughter facility. Twenty-eight beef carcasses were monitored to determine the effectiveness of steam pasteurization and to compare the two sampling methods. Total aerobic mesophilic bacteria, *E. coli*, and coliform counts were all reduced ($P \leq 0.01$) by steam pasteurization. Sponge sampling of carcasses for *E. coli.* provided lower recovery ($P \leq 0.01$) than excision sampling. None of 28 carcasses tested positive by sponge sampling; however, six of the same carcasses were positive (0.39-23.6 CFU/cm^2) by excision sampling immediately adjacent to the sponged area. The SPS 400™ steam pasteurization unit, operating at a minimum atmospheric temperature of 170°F reduced ($P \leq 0.01$) all bacterial populations on pre-rigor beef carcasses. Excision data, compared to previous commercial evaluations of the SPS 400™ at a slightly higher operating atmospheric temperature, provided comparable total reductions, but a few more *E. coli* survived at 170°F.

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

Introduction

Microbiological safety of the food supply has been under intense scrutiny. Foodborne disease outbreaks and large food recalls are causing increased concerns by consumers and producers. New regulations have been implemented by the USDA-FSIS to minimize contamination and proliferation of pathogens in food.

Steam pasteurization, an intervention method that has been tested and verified in commercial slaughter facilities, has reduced both indigenous flora and pathogens on freshly slaughtered beef carcasses.

Our study evaluated the effectiveness of a steam pasteurization system (SPS 400™) operating at 170°F, based on microbial enumeration at several steps. Microbial recoveries from chilled beef carcasses using excision and sponge sampling methods also were compared.

Experimental Procedures

Twenty-eight randomly selected carcasses were sampled immediately before and after steam pasteurization and after 18-24 hours in

the cooler. All carcasses were surface sampled using a circular coring device to excise 21.2 cm^2 of tissue at three locations (rump, flank, and brisket) to create a composite sample of 63.6 cm^2. All chilled carcasses (18-24 hour) were surface sampled using both the coring device (excision) and the USDA-FSIS sponge sampling method at adjacent locations on the same carcass. All samples were shipped overnight to the Kansas State University Food Microbiology Laboratory (Manhattan, KS) in insulated coolers with cold-packs. During shipment, temperatures were monitored by data loggers and remained below 45°F.

All samples were enumuated within 1 day of collection for total aerobic mesophilic bacteria, *Escherichia coli*, and coliforms, using appropriate Petrifilm™ plates. The excision samples were diluted with 0.1% peptone diluent. Sponges were rehydrated according to USDA-FSIS methods using Butterfield's phosphate buffered dilution water (FDA Bacteriological Analytical Method). All plates were incubated 48 hours at 95°F. Data were converted to $\log_{10}$ colony forming units (CFU) per cm^2 and mean values determined at each sampling step. A value one-half the detection limit was reported for samples with no colonies on the lowest dilution, in order to be able to perform statistical analysis. Statistical significance ($P \leq 0.01$) was determined using Proc GLM in the Statistical Analysis System (SAS) for each bacterial type.

Results and Discussion

Total aerobic mesophilic bacteria, *E. coli*, and coliform counts were lower ($P \leq 0.01$) after than before steam pasteurization and remained lower after a 18-24 hour chill. Bacterial counts after 18-24 hours in the cooler and immediately after steam pasteurization were similar ($P > 0.01$).

Counts were lower ($P \leq 0.01$) with sponge samples than excision samples for all bacteria. Detection limits were 0.39 CFU/ cm^2 for the excision method and 0.04 CFU/cm^2 for the sponge method. This means that the sponge method should detect bacterial colony forming units, including *E. coli* colonies, more often than the excision method. However, in this study no *E. coli* colonies were detected with sponge sampling, whereas *E. coli* colonies were detected on some of the same carcasses using the excision sampling method.

Escherichia coli counts were compared to the performance criterion of 9 CFU published in the Federal Register, July 25, 1996. Only three unacceptable results were identified and were from carcasses sampled before steam pasteurization. Using the excision method, one chilled carcass had a marginal level of *E. coli*. All chilled carcasses had acceptable test results for *E. coli* with sponge sampling. In conclusion, steam pasteurization decreased ($P \leq 0.01$) all bacterial counts. All excision samples from chilled carcasses indicate that the slaughter process was in compliance with FSIS *E. coli* criteria. However, reduction in SPS 400™ operating temperatures should be avoided if possible, as a margin of safety.

The sponge sampling method revealed lower ($P \leq 0.01$) counts for all bacterial types, compared to excision sampling.