PROCESS INTERVENTION TO ASSURE SANITATION OF BEEF CARCASSES AND CUTS

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Summary

The meat industry and Food Safety and Inspection Service (FSIS) strive to minimize carcass contamination during slaughter and subsequent processing. Because microbial contamination during slaughter cannot be avoided completely, decontamination methods must be addressed. This overview emphasizes process intervention studies conducted at Kansas State University to determine the most effective intervention points and technologies to control microbiological hazards in meat and meat products.

Our research shows that trimming of gross contamination followed by washing is a reasonable approach to minimizing microbial contamination on beef carcasses. We also found that sanitation of subprimal cuts may be just as effective as treating the carcass.

Decontamination

Carcasses:

Most bacterial contamination of carcass surfaces occurs during slaughter-dressing procedures and comes from a variety of sources, but mainly from hides and intestinal contents. In addition to good sanitary practices, spraying of carcasses with organic acids, particularly lactic and acetic, can limit bacterial contamination.

Our initial studies considered the fact that the industry and FSIS were evaluating pre-evisceration organic-acid rinsing; therefore, we chose to evaluate other control points. Other reports showed that carcass rinsing, although effective in decreasing microbial counts on the carcass, did not carry through to subprimal and retail cuts. Consequently, we also evaluated treating subprimal cuts with chlorine (200 ppm) or microwave (15 sec per side of each subprimal cut) as process-intervention treatments before vacuum storage.

Our carcass rinse study involved spraying beef carcass sides with water, 200 ppm chlorine, or 3% lactic acid immediately after rail inspection and(or) at the end of an 8 hour spray-chill cycle. All treatment combinations involving either chlorine and(or) lactic acid reduced carcass contamination from .4 to 1.8 logs (1 log equals 90% reduction, 2 logs equals 99% reduction). Lactic acid treatment at both spray times resulted in greater bacterial reduction ($P<.05$) than water and chlorine. However, carcass treatments did not carry through to the subprimal level. Additionally, treating subprimal cuts with chlorine or microwaves had no effect ($P>.05$) on microbial reduction during extended storage.

Subprimals:

We tested the efficacy of spraying 1.5% lactic acid onto subprimal cuts and followed the results of that treatment through to the display of retail cuts. Lactic acid solutions were sprayed on beef strip loins before and(or) after vacuum storage to yield five treatment combinations: i) vacuum packaged control, ii) no treatment prestorage but acid spray poststorage, iii) acid spray prestorage, iv) acid spray prestorage, and water spray poststorage, and v) acid spray pre- and poststorage. After prestorage treatment, all loins were vacuum packaged and stored for 14, 28, 56, 84, or 126 days at either 30 °F or 36 °F.

Acid spray prestorage was more effective than other treatments in reducing bacterial

contamination. Most loins stored at 30 °F had numerically lower microbial counts than those stored at 36 °F, and loins stored at 30 °F following acid treatment had lower microbial counts than control loins.

Upon storage and treatment of the subprimals, 1-inch-thick steaks were fabricated from each loin. Steaks were packaged in oxygen-permeable film and displayed at 36.0±4 °F under 100-foot-candle intensity Deluxe Warm White lighting for 3 and 5 days or tested before display.

Total bacterial counts, presence/absence of *Listeria monocytogenes* and *Salmonella* spp., and instrumental and visual color evaluations were used to determine the microbiological and display quality of steaks. Spraying lactic acid on strip loins both pre- and poststorage, and lactic acid applied prestorage combined with water sprays after storage at 30 °F yielded about a 2 log reduction in bacterial counts of steaks not displayed or displayed for 3 days, and >1.0 log reductions at 5 days of display, compared to controls. Lactic acid treatment pre- and poststorage (30 °F) lengthened the lag phase of microbial growth on steaks. Storage at 30 °F reduced microbial growth compared to 36 °F. *L. monocytogenes* and *Salmonella* spp. were absent from all steaks.

On the basis of color, subprimal storage life and(or) steak display life were slightly shorter for lactic-acid-treated cuts than for controls. However, lactic acid sprays resulted in longer storage life and(or) steak display life when based on bacterial spoilage. A similar result was observed in a companion study involving vacuum-packaged retail cuts that were displayed up to 14 days.

Lactic acid treatment of subprimal cuts carried through to displayed retail cuts and may be more effective than treating carcasses. This is particularly true for aerobically packaged cuts. Good temperature control enhances the carry-through effectiveness of lactic-acid treatment at the subprimal level.

Hot-Fat Trimming

Because the subcutaneous fat layer comprises the major outer surface of the carcass and is most likely to be contaminated during slaughter/dressing practices, trimming of this layer may provide an additional means to remove bacterial contamination on the carcass surfaces. Removal of fat prior to chilling also reduces refrigeration costs and time required for subprimal fabrication. Consequently, we examined the efficacy of hot fat trimming to reduce microbial contamination on beef carcasses and subsequent subprimals.

Immediately after washing, beef carcass sides were either trimmed to .25 inch external fat or left as controls. Trimmed and nontrimmed sides were analyzed for bacterial counts before and after 72 h of chilling. We found no reduction in bacterial counts ($P>.05$) from trimming.

Sides were trimmed with a Whizard knife, which may have smeared microorganisms from one location to another. By 72 hours, hot trimmed sides had numerically lower counts than control sides, indicating that microbial reduction by chilling was greater on trimmed than nontrimmed carcasses.

Subprimals from trimmed and control sides were microbiologically analyzed before (0 day) and after 14 days of vacuum storage. The average bacterial count was higher for trimmed-side than for nontrimmed-side subprimals at both times, indicating that subprimals from trimmed sides may have picked up additional microorganisms during fabrication.

Thus, hot-fat trimming may not be an effective way to improve the microbial quality of meat.

Trimming and(or) Washing

In another study, carcass trimming (fat trimming to remove visible contamination) and washing were studied separately or in combination. Beef carcass sides selected randomly in a commercial processing facility were assigned to one of four groups: i) no trim and no wash (NTNW), ii) trim but no wash (TNW), iii) trim

and wash (TW), and iv) no trim but wash (NTW). Samples were taken at the appropriate point in the normal slaughter process to achieve all treatment combinations.

The greatest reduction (P<.05) in bacterial counts was observed in TNW followed by TW and NTW, with the corresponding mean bacterial reductions relative to NTNW being 3.0, .9, and .3 logs, respectively (Figure 1). Because TW carcasses had bacterial counts that were almost 2 $\log_{10}$ higher than those of TNW samples, recontamination by washing may have been extensive. *Escherichia coli* and coliform counts in NTNW samples were higher (P<.05) than for other treatments.

Because washing probably will be a part of all future decontamination protocols, and because trimming of the entire carcass surface is not commercially practical, trimming of obvious contamination in combination with washing likely would be the most reason able approach to minimize microbial contamination in commercial beef plants.

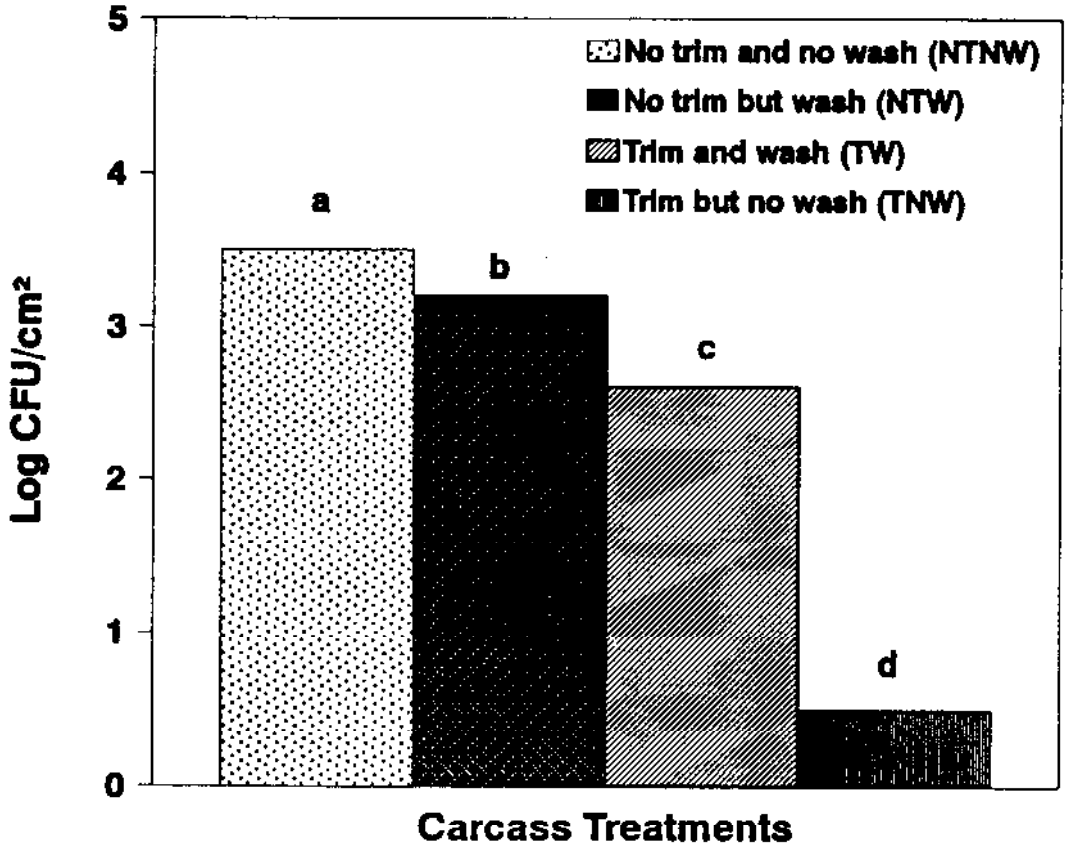

Figure 1. Effect of Trimming and/or Washing on Total Bacterial Populations (Mean $\log_{10}$ Bacterial Colony Forming Units/cm^2) of Beef Carcasses Sampled Immediately before Being Moved to a Cooler