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DECONTAMINATION OF BEEF CARCASSES AND SUBPRIMAL CUTS

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Summary

Lactic acid sprays effectively reduce the microbial load on both carcasses and subprimal cuts. Lactic acid decontamination of subprimals appears to carry through to retail cuts during display. Because of recontamination during fabrication, treating subprimals may be more effective than treating carcasses. This information will allow us to identify the most critical control points at which to employ decontamination practices designed to reduce the incidence of pathogenic bacteria and extend shelf life.

(Key Words: Microbiology, Decontamination, Carcass, Subprimal.)

Introduction

This report summarizes our Food Safety Consortium results and integrates previous research, current industry practices, and efficacy of decontamination practices at various critical control points (process step that leads to unacceptable microbial contamination if not properly controlled). We have completed a series of integrated studies in an attempt to identify the most critical and effective intervention points and technologies for controlling microbial contamination and assuring food safety.

To maximize safety and extend shelf life of meat and meat products, the meat industry and the Food Safety and Inspection Service (FSIS) strive to minimize carcass contamination during slaughter and subsequent processing. However, microbial contamination during slaughter cannot be avoided completely.

In addition to good manufacturing practices designed to minimize contamination and trimming of contaminated areas, spraying carcasses with hot water and sanitizers has been employed to reduce contamination. Although spraying/rinsing techniques have reduced microbial counts on carcasses, their effect does not necessarily carry over to resultant subprimal and retail cuts, trim used for further processing, and meat byproducts. The efficacy of trimming contaminated areas needs additional investigation. The industry and FSIS have worked together to supplement traditional carcass decontamination efforts with organic (lactic or acetic) acid rinsing because of its effectiveness for carcass decontamination.

Because industry and FSIS were evaluating pre-evisceration organic acid rinsing, our initial studies evaluated rinsing carcasses with sanitizers at other control points. We decided to rinse carcasses immediately after rail inspection and/or after spray chilling. Carcass rinsing was effective in decreasing

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microbial counts on the carcass, but it did not carry through to resultant subprimal and retail cuts, so we also rinsed subprimal cuts before vacuum storage.

Experimental Procedures and Results and Discussion

We evaluated microbiological quality of carcasses as affected by sprays of water (W), 200 ppm chlorine (C), and 3% lactic acid (L) applied immediately after rail inspection and again following 8 h spray-chill cycle in nine different combinations (W+W, C+W, L+W, W+C, C+C, L+C, W+L, C+L, and L+L). Samples for microbial counts were taken just before and just after spray treatments that followed rail inspection, spray chilling, and 3 days of aging. Six subprimals from each treated carcass were assigned randomly to the following treatments: 1) vacuum packaged (VP); 2) sprayed with C and VP (C+VP); 3) VP and microwaved (VP+MW); 4) inoculated with pathogens (*Listeria monocytogenes*, *Salmonella enteritidis*, *Escherichia coli* 0157:H7, and *Yersinia enterocolitica*) and VP (P+VP); 5) P+C+VP; and 6) P+VP+MW). All products were stored at 34°F and sampled for aerobic plate counts (APCs) and/or pathogen at 4, 10, 15, 20, 30, 60, 90, and 120 days of vacuum storage.

All treatment combinations involving either chlorine or lactic acid reduced carcass contamination. The decrease in mean log₁₀ APCs ranged from 0.4 to 1.8. A 1 log decrease is a 90% reduction, and a 2 log decrease equals a 99% reduction. The L+L treatment combination showed the greatest reduction. Also, most treatment combinations involving lactic acid tended to decontaminate better than those without acid (Figure 1). However, carcass decontamination did not carry over to subprimal cuts (Figure 2). Additionally, treating subprimal cuts did not effectively reduce APCs during extended storage (Figure 3). Maximum growth (6.0-7.0 log₁₀ colony forming units, CFUs/cm²) was reached at 60 days and did not change during the remainder of storage.

Following pathogen inoculation, *Salmonella* did not grow; *Listeria* increased gradually from 10 to 60 days, then declined from 60 to 120 days. *Yersinia* and *Escherichia* counts were not affected consistently by treatment.

Treating subprimal cuts with chlorine was not effective. Because lactic acid was effective on carcasses, we tested it on subprimal cuts and evaluated the carryover to retail cuts during display. That study involved spraying 1.5% lactic acid solution (v/v) on beef strip loins A) immediately before vacuum packaging, B) immediately after opening the vacuum bag at the end of storage, C) before vacuum packaging and again at the end of storage, and D) before vacuum packaging, with a water rinse at the end of storage. Loins were evaluated at once or stored for 14, 28, 56, 84, or 126 days. Two different storage temperatures (30 and 36°F) were used. Microbiological analyses (total aerobic plate count and presence or absence of *Salmonella* and *Listeria*) were conducted, and the overall appearance of strip loins was evaluated after the specified storage times.

We found:

- 1) Acid-treated loins had lower counts than nonacid-treated loins.
- 2) Spraying loins with lactic acid prior to vacuum packaging was more effective than spraying with acid at the end of storage.
- 3) Storage at 30°F was more effective than storage at 36°F.
- 4) Proper temperature control was at least as effective as acid treatment.

Retail cuts from the subprimals were also evaluated. Upon removal of the subprimals from storage, 1 inch-thick steaks were cut from each loin. They were packaged in oxygen-permeable polyvinylchloride film and evaluated immediately and after display at 36 ± 3°F under 100 foot candles of Warm White Deluxe fluorescent lighting for 3 or 5 days.

Lactic acid applied to strip loins both pre- and poststorage, and lactic acid applied prestorage with water sprays after 84 days of storage at 30°F yielded up to 2 log (99%) reductions in APCs of steaks not displayed or displayed for 3 days and >1.0 log (90%) reductions at 5 days of display. Lactic acid treatment pre- and post- 30°F-storage increased the length of the lag phase of microbial growth, thus increasing display life. Lactic acid was most effective at the colder (30 vs. 36°F) storage temperature. *L. monocytogenes* and *Salmonella* spp. were absent from all steaks.

On the basis of color, subprimal storage and/or display life were slightly shorter for lactic acid treated cuts than for controls. However, on the basis of bacterial counts, lactic acid sprays applied to strip loins resulted in longer storage life and/or

steak display life. Preliminary data indicate similar results for companion vacuum-packaged retail cuts that were displayed for up to 14 d. However, the magnitude of the microbial reduction from acid treatment of the subprimal was less.

Lactic acid treatment of subprimal cuts appears to carry through to retail cuts during display and is more effective than treating carcasses, especially when retail cuts are packaged in oxygen-permeable film. Good temperature control enhanced the carryover effectiveness of lactic acid treatment at the subprimal level.

Details of the preceding studies are presented in the next two reports.

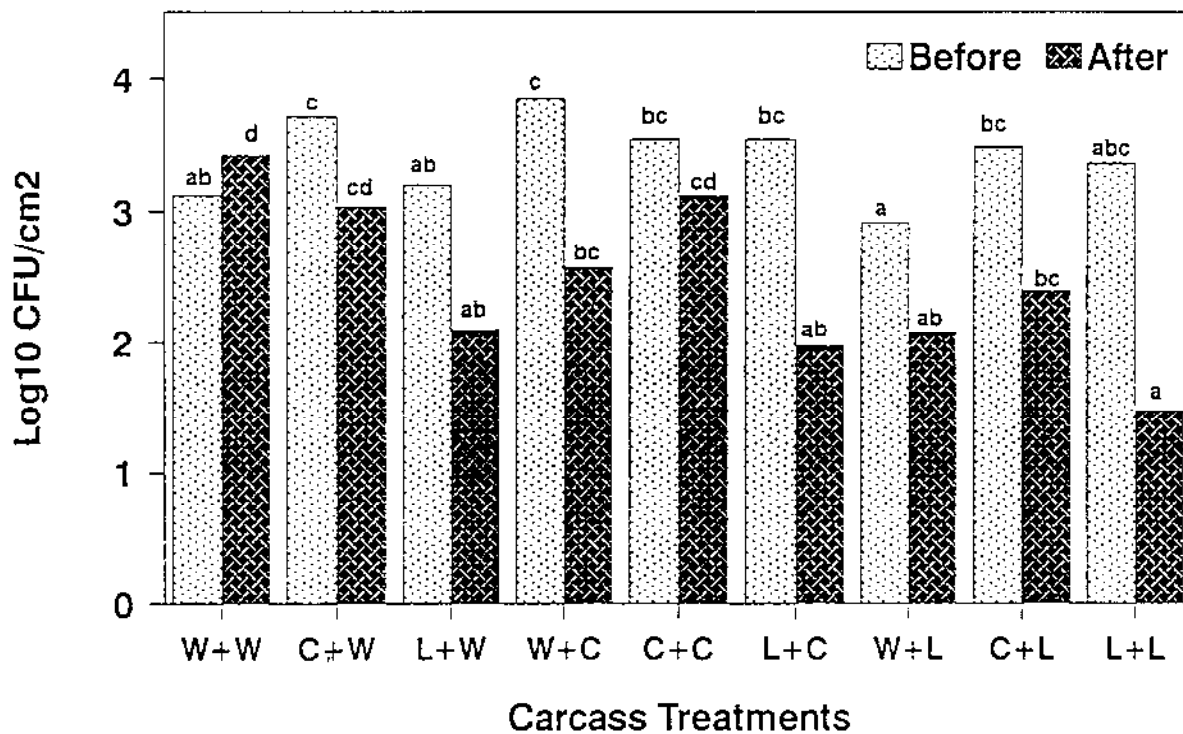


Figure 1. Effect of Water (W), Chlorine (C), and Lactic Acid (L), either Alone or in Combination, on Mean Carcass Aerobic Plate Counts. Means of before and after Treatment Groups with Same Letter Are Not Different ($P > .05$).

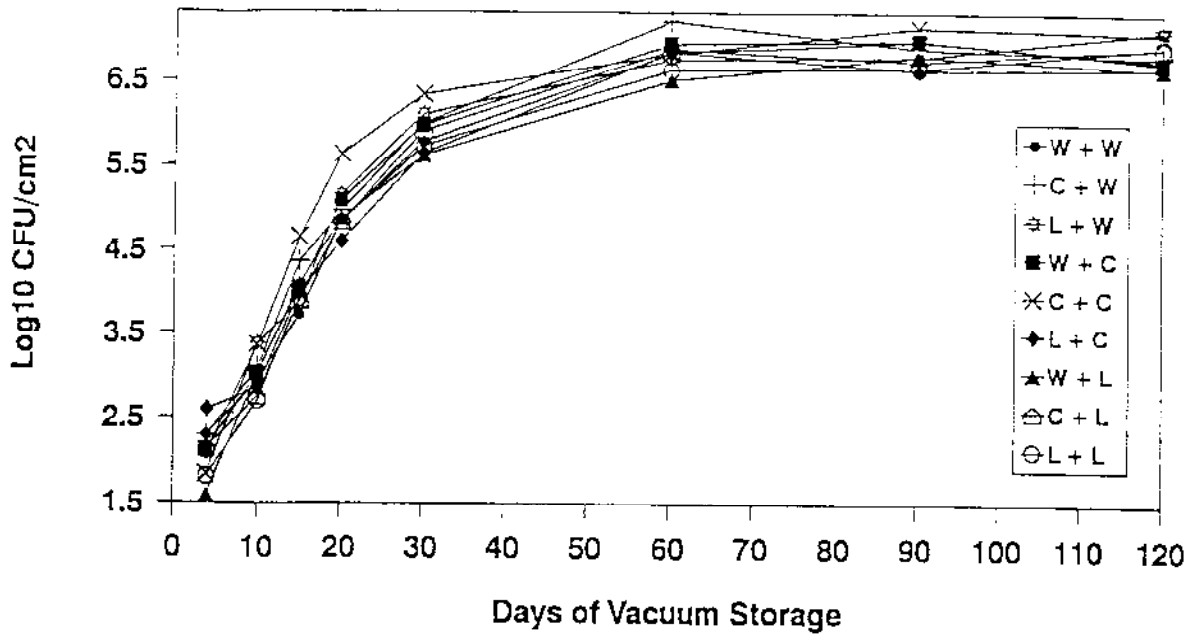


Figure 2. Aerobic Plate Counts of Subprimal Cuts as Affected by Length of Storage and Carcass Treatment (W=Water, C=Chlorine, and L=Lactic Acid).

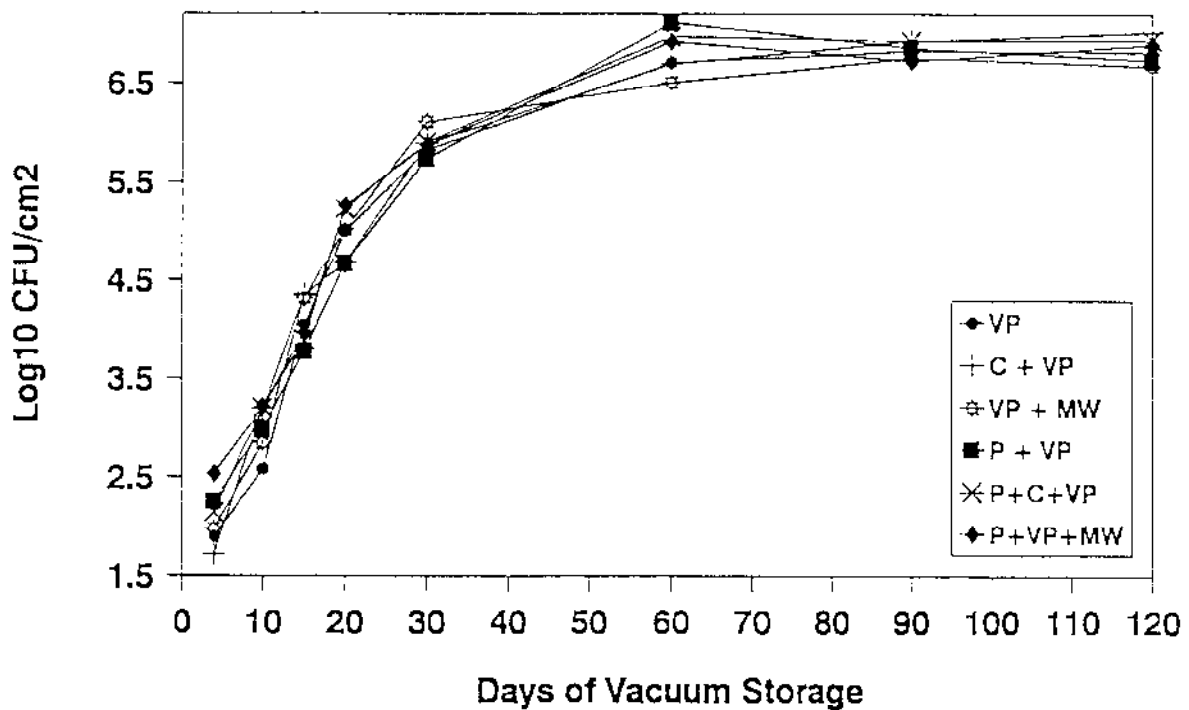


Figure 3. Aerobic Plate Counts of Subprimal Cuts as Affected by Length of Storage and Subprimal Treatment (VP=Vacuum Packaged, C=200 ppm Chlorine Spray, MW=Microwaved, and P=Pathogen Added).