POLYVINYLCHLORIDE-PACKAGED LOIN STRIP STEAKS FROM VACUUM-PACKAGED BEEF STRIP LOINS DECONTAMINATED WITH LACTIC ACID AND STORED FOR UP TO 126 DAYS

L. E. Mease[1], D. H. Kropf, R. K. Prasai, P. B. Kenney[2], L. R. Vogt[3], D.Y.C. Fung, and C. L. Kastner

Summary

Aerobic plate counts (APCs), presence/absence of *Listeria monocytogenes* and *Salmonella* spp., and visual color evaluations were used to determine the microbiological and display quality of steaks fabricated from beef strip loins sprayed with lactic acid (1.5% v/v) or water before, after, or both before and after vacuum storage (14, 28, 56, 84, or 126 days) at either 30° or 36°F compared to nonsprayed or nonstored controls. Lactic acid applied pre- and poststorage (126 days) at 30°F reduced APCs of steaks up to 2 log (99%). *L. monocytogenes* and *Salmonella* spp. were absent from all steaks. Lactic acid caused slightly more rapid color deterioration, resulting in slightly shorter display-life for steaks.

(Key Words: Decontamination, Lactic Acid, Beef Steaks, Display, Color, Bacteria.)

Introduction

Contamination of beef during slaughter and processing is inevitable. In addition to affecting food safety, high numbers of bacteria can degrade sensory qualities of retail beef. Organic acids, such as lactic and acetic acids, reduce microbial loads when sprayed on carcasses. However, microbial reductions from spraying acid on carcasses do not carry through to fabricated subprimal cuts. Therefore, treatment of subprimals may be more effective than treating carcasses.

The objectives of this study were to determine the effects of lactic acid or water sprays applied to vacuum-stored beef strip loins at different points during processing and effects of temperature of strip loin storage on microbiological and display quality of retail steaks.

Experimental Procedures

A total of 36 strip loins in each of three replicates were taken from a commercial processing line. Each loin had two treatments, one for each half loin strip. Each replicate was treated as follows: I). Twelve loins were vacuum packaged and stored at 30°F (6 loins) or 36°F (6 loins) for 14, 28, 56, 84, or 126 days or not stored (0 days). On each specified day, a 1.5% lactic acid solution (approx. 725 ml per loin) was sprayed on one half of each loin as a second treatment. II). Another group of 12 loins was sprayed with acid solution prior to vacuum packaging followed by storage and a second treatment with acid in the same manner as described in I. III). The last group of 12 loins was treated the same way as in II except that the second treatment applied to the other half of each loin was sprayed with water instead of acid. These three treatment groups yielded these different treatment combinations: vacuum packaged control (C), acid treatment only after vacuum

[1]Viskase Inc., Chicago, IL.
[2]Div. of Anim. and Veterinary Sci., West Virginia University, Morgantown, WV.
[3]Excel, Dodge City, KS.

storage (0-A), acid treatment before vacuum storage (A-0), acid treatment before and after vacuum storage (A-A), and acid treatment before storage and sprayed with water after storage (A-W).

An 8.5 liter hand-held sprayer was used to apply lactic acid (1.5% v/v, pH 2.4) and water sprays at a rate of 725 ml/min for 1 min (30 sec per side).

Strip loins were vacuum packaged in B-620 oxygen-barrier shrink bags (oxygen transmission rate 30-50 ml/m^2/24 h/atm at 73°F; water vapor transmission rate .5 to .6 g/100 in^2/24 hr in 100% relative humidity at 100°F) using a Cryovac 8300 series packaging machine at the processor location.

On the specified day of storage (0, 14, 28, 56, 84, or 126 days), a strip loin from each treatment pair was selected randomly from each storage-temperature treatment and processed in a refrigerated (48±2°F) fabrication room. The vacuum bag was opened with a sterile scalpel, and the strip loin was "faced" by removing a steak of sufficient thickness. Strip loins and steaks were handled aseptically.

The three steaks fabricated, 1 in. thick from each loin half, were assigned to one of three retail display periods (0, 3, and 5 days). Steaks were placed individually on an absorbent pad in a styrofoam tray and overwrapped with polyvinylchloride (PVC) film (high oxygen permeability) as used in retail meat counters. Steaks were displayed in open-top retail cases at 36°F under continuous 100-foot candle Warm White Deluxe fluorescent lighting.

On the specified day, steaks were sampled for microbiological analysis. Aerobic plate counts (APCs) were obtained by pour plate and/or spiral plate methods from two cores per steak. A modified USDA-FSIS procedure for isolation and identification of *Listeria monocytogenes* was followed. We also tested for the presence of *Salmonella*.

Color measurements and evaluations were conducted only on the loin eye muscle of steaks assigned to 5-day retail display. On days 0 (before exposure to light), 3, and 5 of display, a seven-member experienced panel visually scored "average" and "worst point" color to .5 point increments on a 5-point scale.

Results and Discussion

Data from day 3 of display are reported and best show the results. Microbial APCs were influenced by storage time, temperature, and their interaction. The lower temperature (30°F) resulted in lower counts, especially for steaks from cuts vacuum-stored for 28 days and longer, because of an extended lag growth phase through 28 days of storage. Storage for 56 days resulted in higher numbers of microbes than for 28 days (Figure 1).

Treatment also affected APCs, especially at 28 days for steaks from loins treated with lactic acid before vacuum packaging. Microbial reductions of 2 logs (99%) were shown for the most effective treatments. No microbial counts for steaks displayed for 3 days were unreasonably high. No *Listeria monocytogenes* or *Salmonella* were detected on steaks, even after 5 dats of display.

Average color score was affected primarily by storage time (Figure 2), because steaks from longer stored subprimal cuts were more discolored (higher score). A color score of 3.5 or higher is considered marginally unacceptable. At the higher storage temperature, the average color score for treatments exceeded this point after storage for 126 days. After vacuum storage for 14 and 28 days, steaks from loins treated with lactic acid were slightly darker in appearance. Instrumental color readings confirmed visual evaluations.

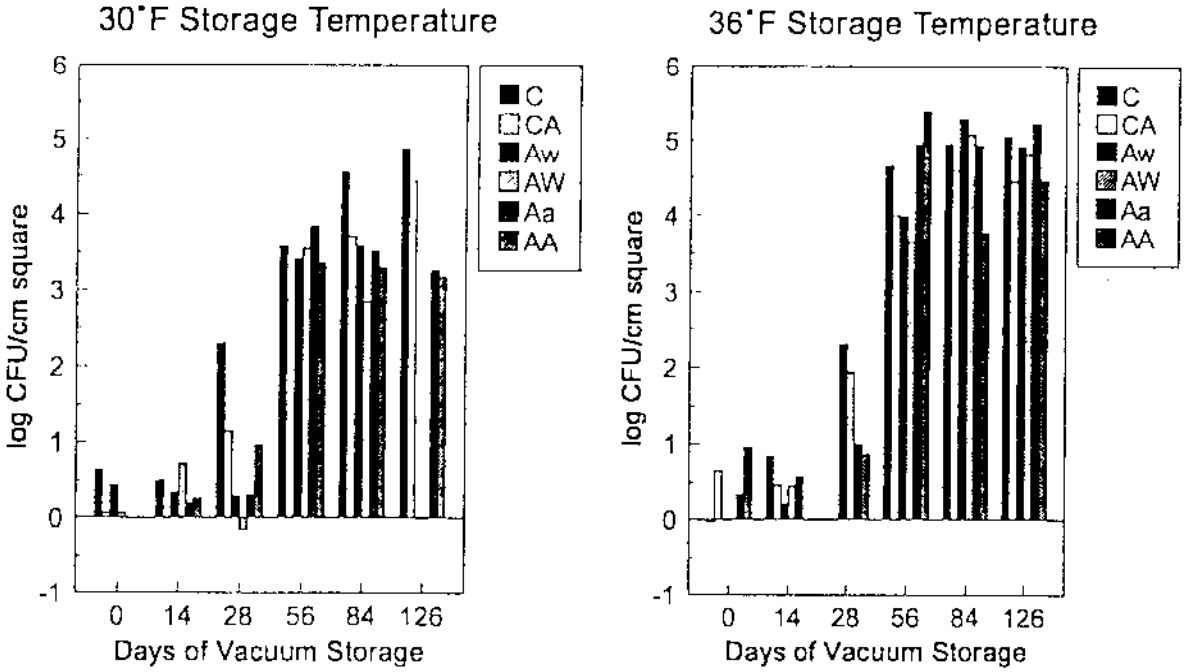

Figure 1. Aerobic Plate Counts of PVC-Packaged Steaks at 3 Days. of Retail Display.

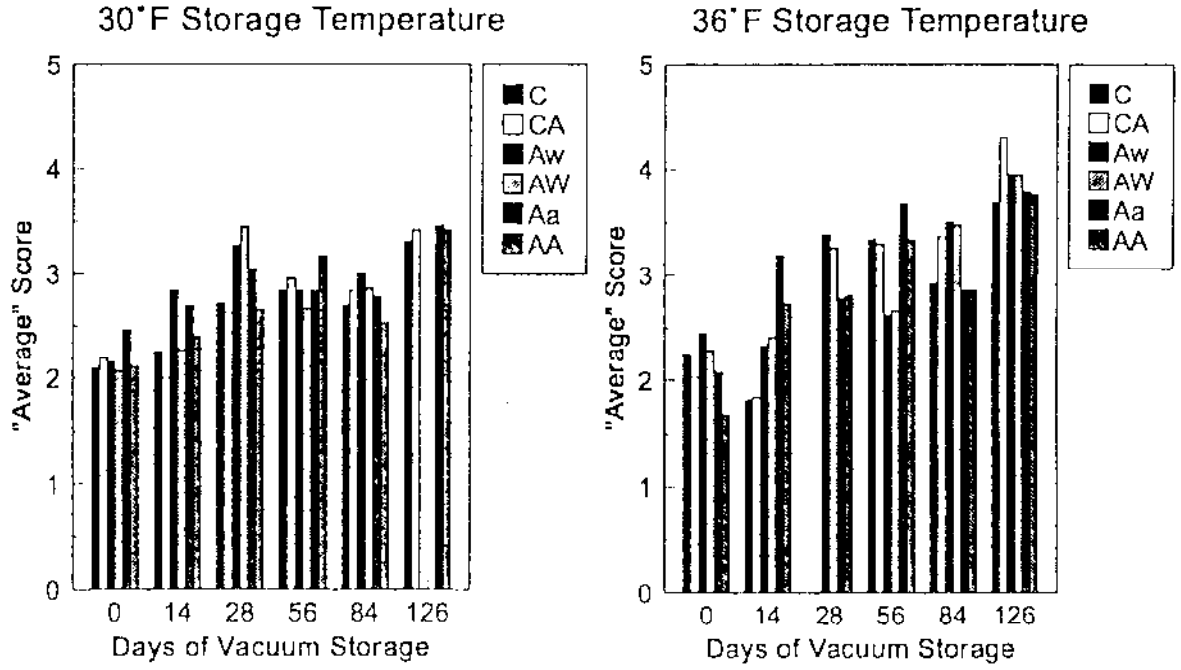

Figure 2. Average Visual Color Score [a] of PVC-Packaged Steaks at 3 Days of Retail Display. [a] 1=Bright Red, 2=Dull Red, 3=Slightl y Dark Red or Brown, 4=Dark Red or Brown, and 5=Very Dark Red or Brown.