EFFECT OF LACTIC ACID SPRAYS ON SHELF LIFE AND MICROBIOLOGICAL SAFETY OF BEEF SUBPRIMALS

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Summary

Beef loins were sprayed with 1.5% lactic acid either before or after vacuum storage, both before and after vacuum storage, and before vacuum packaging followed by a water spray after storage. We stored treated loins at either 30°F or 36°F for up to 126 days in vacuum packages. Nonsprayed or nonstored loins served as controls. Total aerobic plate counts (APCs) and tests for presence/absence of two importa nt foodborne pathogens, *Salmonella* spp. and *Listeria monocytogenes*, were conducted during storage. Acid spraying prior to vacuum packaging was more effective in reducing bacterial contamination than spraying after storage. However, counts were reduced ($P<.05$) for only 28 days of storage. Most loins stored at 30°F had lower APCs than those stored at 36°F. *Salmonella* was not detected in any samples. Twenty-eight percent of nonacid treated and 4 percent of acid-treated loins were positive for *Listeria* spp. with *L. monocytogenes* found from one nonacid-treated loin. No change in visual color was observed in acid-treated loins. Appropriate timing of acid s praying in combination with lower storage temperature can improve the keeping quality and microbial safety of meat.

(Key Words: Lactic Acid, Beef, Bacteria, Safety.)

Introduction

Initial numbers and types of microorganisms and storage temperature are major factors determining the s helf life and safety of meat. According to USDA, the annual cost of foodborne illness in the U.S ranges from $5.2 to $6.1 billion with $3.9 to $4.3 billion attributable to meat and poultry products. Organic (lactic and acetic) acid sprays effectively reduce microbial contamination of carcasses but have little or no effect in improving the microbiological quality of resultant fabricated cuts. Secondary contamination can occur during fabrication and mask effects of lactic acid decontamination. This study determine d if the microbiological quality of meat can be improved by spraying lactic acid directly on subprimal cuts rather than on carcasses.

Experimental Procedures

A total of 36 strip loins in each of three replicates were taken from a commercial processing line. Each loin re c eived 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 eac h loin as a second treatment. II). Another group of 12 loins was sprayed with acid solution prior to vacuum packagin g followed by storage and a

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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 water spray instead of acid. These three treatment groups yielded these different treatment combinations: vacuum packaged control (C), acid treatment only after vacuum 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).

On prespecified days of storage (0, 14, 28, 56, 84, and 126 days), one strip loin from each treatment group and storage temperature was selected randomly and one half of that loin was cored (surface) for microbiological analysis. The other half of the loin received a second treatment (either acid, or water spray) and was then sampled.

Microbiological samples obtained from two halves of each loin were analyzed separately for total aerobic plate count (APC) and for the presence or absence of *Salmonella* spp. and *Listeria monocytogenes*.

Results and Discussions

Mean (log_{10}/cm^2) APCs of subprimals as affected by treatments, storage temperatures, and length of storage are summarized in Table 1. Acid spray on loins prior to vacuum packaging (A-0) reduced bacterial contamination with counts being lower than those of controls (C) for all storage periods. The average reductions in mean log_{10} APCs ranged from .4 to 1.9 (1 log equals 90% reduction, 2 log equals 99% reduction), with the initial mean log_{10} APC in control loins ranging from 3.1 to 7.3.

Microbial reduction by acid spray generally was successful for loins stored for up to 28 days. After 28 days, few differences occurred between any of the treatments and controls. Loins treated with acid after storage (0-A) had microbial counts most similar to those of controls, indicating that acid application after storage was less useful than acid applied before storage. Generally, the mean reduction in APC of AW or A-A loins was slightly greater than that of A-0 loins.

Although not significant (P>.05), almost all loins stored at 30°F had numerically lower counts than those stored at 36°F, indicating the role of storage temperature as a major hurdle to control outgrowth of microorganisms. *Salmonella* was not detected in any samples. Twenty-eight percent of nonacid-treated and 4 percent of acid-treated loins were positive for *Listeria* spp., with *L. monocytogenes* found from one non-acid treated loin. We saw no change in visual color with acid treatment.

Appropriate time of application of acid at the subprimal level in combination with lower temperature of storage can improve the safety and shelf life of meat.

Table 1. Mean[a] Aerobic Plate Counts (lo g_{10}/cm^2) of Control and Acid-Treated Beef Subprimals Stored in Vacuum Packages at 30 and 3 6°F for up to 26 Days

Sampling Time (days)	Storage Temp. (°F)	Treatments[b]					
		C	0-A	A-0	A-W	A-0	A-A
0	30	3.12[c]	2.07	2.50[c]	2.02[c]	1.92	2.36[c]
	36	3.09[c]	2.80[c]	2.16[c]	1.89	2.42[c]	2.20[c]
14	30	3.46[c]	3.40[c]	2.50[c]	2.26	2.23	2.16
	36	4.30[c]	4.16[c]	3.26[c]	2.26	2.35	2.10
28	30	4.20[c]	4.26[c]	2.36	2.83[c]	2.26	1.96
	36	4.76[c]	5.41[c]	3.06	2.34	3.50	3.66[c]
56	30	5.10[c]	5.60[c]	4.80[c]	5.13[c]	4.35[c]	4.83[c]
	36	6.16[c]	5.29	5.63[c]	5.42[c]	5.92[c]	5.89[c]
84	30	6.16[c]	6.22[c]	4.94[c]	4.56	5.48[c]	4.95
	36	7.25[c]	6.66[c]	6.77[c]	5.90	6.39[c]	5.65
126	30	6.59[c]	5.98[c]	5.69[c]	5.50[c]	5.72[c]	5.48[c]
	36	7.20[c]	7.08[c]	6.56[c]	6.22[c]	7.16[c]	6.65[c]

[a]Individual means in each treatment are based on three samples from three loin halves in three replicate experiments. Each sample was taken from four different locations (two per side) of a loin half and then combined.

[b]C = no treatment (Control); 0-A = acid sprayed after vacuum storage; A-0 = acid sprayed before vacuum packaging; A-W = acid sprayed before vacuum packaging followed by water spray after storage; A-A = acid sprayed before and after vacuum storage.

[c]Means within a row with same superscript as C are not different (P>.05) from control.