

EFFECT OF ORGANIC ACIDS ON MICROBIAL CHARACTERISTICS AND *Salmonella typhimurium* IN PORK LOINS

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Background

Spoilage microorganisms and pathogenic bacteria such as *Salmonella*, *Campylobacter*, and *Listeria*, are contaminated during slaughter and subsequent processing to produce retail cuts from live animals. Application of organic acids to carcass surfaces has been reported to reduce populations of spoilage bacteria and pathogens, and thus has potential to extend shelf-life and reduce food borne illness in pork (Fu et al., 1994), beef and lamb (Osthold et al., 1984) and poultry (Tamblyn and Conner, 1997). However, acids treatment of beef carcasses had little or no effect on the microbiological quality of meat cuts after fabrication (Prasai et al., 1991). In pork, Fu et al.(1994) reported that organic acids treatments were of relatively limited effectiveness for long term storage. On the other hand, an acid spray immediately prior to packaging can reduce some species of bacteria without adversely affecting the physical properties of beef (Goddard et al., 1996)

Objective

The objective of this study was to evaluate the effects of various organic acids including lactic acid, citric acid and acetic acid on microbial characteristics and *Salmonella typhimurium* in pork loins.

Methods

Fresh pork loins were sprayed with various organic acids such as lactic acid, citric acid and acetic acid (0.5, 1, 1.5 and 2%) for 15 sec at 30°C with hand sprayer. The control samples were sprayed with sterilized distilled water. After spraying, the samples were packaged by HDPE film under air and stored at 4°C for 14 days, and analyzed for total plate counts and coliforms. In another experiment, fresh pork loins were inoculated with *Salmonella typhimurium* ATCC 14028 (from Veterinary Microbiology Lab, College of Veterinary Medicine, Seoul National University) and then sprayed with organic acids in the same way as in the first experiment. After spraying, the samples were packaged and stored at 1°C. For microbial measurements each sample was stomached in distilled water for 1 min. The stomached water was diluted serially. Aerobic and coliform bacteria were enumerated on Petrifilm(Microbiology Products 3M Health Care, USA) for 2 days at 37°C, while *Samonella typhimurium* was on SS agar as a *Salmonella* selective medium (Difco Lab, ML, U.S.A.) with spreading method and incubated for 24hr at 37°C. Duncan's multiple range test was used to compare among treatments using SAS(1995) program.

Results and discussion

Results showed that organic acids treatments reduced the total plate counts of pork in aerobic package after a day of storage at 4°C. The counts of treatment samples at 0.5% were 0.7 - 1.1 log unit lower than that of the control (Figure 1). With each organic acid, the antimicrobial effect increased as the concentration increased. The effect with the storage period varied with the kind of organic acid, showing lactic and citric acid showed a decreasing trend while acetic acid an increasing one except at 0.5 % level (Fig. 1). The results of Figure 2 on coliform bacteria revealed a similar pattern to those on total plate counts. The bactericidal effect increased with the concentration. Citric acid above 1% was the most effective in keeping the count low during the storage. Fu et al.(1994) reported that 1.5% of acetic acid and citric acid showed some initial effect on decreasing aerobic plate counts and coliform count of pork loins, but did not continue beyond 14 days storage under vacuum packaging, while lactic acid had no effect on inhibiting them at any point of storage. Ouattara et al.(1997) suggested that on a weight basis, acetic acid was found to be the most inhibitory, followed by lactic and citric acid.

The numbers of *Salmonella typhimurium* on the fresh pork loins sprayed with organic acids were lower than that of the control with distilled water sprayed (Figure 3). The lactic acid spray reduced *S. typhimurium* by 0.4 to 1.4 log unit, citric acid 0.6 to 1.5 unit and acetic acid 0.5 to 1.5 unit. The bactericidal activity was the highest at 2% of all acids. Among acids, citric acid was found to have most inhibitory effect at all concentrations and acetic acid was the second. Tamblyn and Conner (1997) reported that bactericidal activity of organic acids increased linearly with increasing concentration and the activity of organic acids depended on concentration and method of application. Acetic acid was found to have most inhibitory effect against salmonellae, whereas lactic acid exhibited intermediate activity, and citric acid was least inhibitory (Chung and Goepfert, 1970). Effective use of an acid depends upon the dissociation constant (pKa) or the pH at which 50% of the total acid is dissociated(Doores, 1993).

Conclusions

Microbial deterioration of pork loins during the aerobic cold storage was delayed by organic acid spray. The bactericidal

effect of acids increased with the increasing concentration. However, the inhibitory activity of organic acids during the storage varied with the kind and concentration of the acid. For total plate counts, acetic acid was found to have the highest bactericidal activity, whereas citric acid was the most inhibitory for coliform and *S. typhimurium*. Therefore, it can be concluded that organic acid spray could be utilized to enhance the shelf-life of pork loins and safety as well.

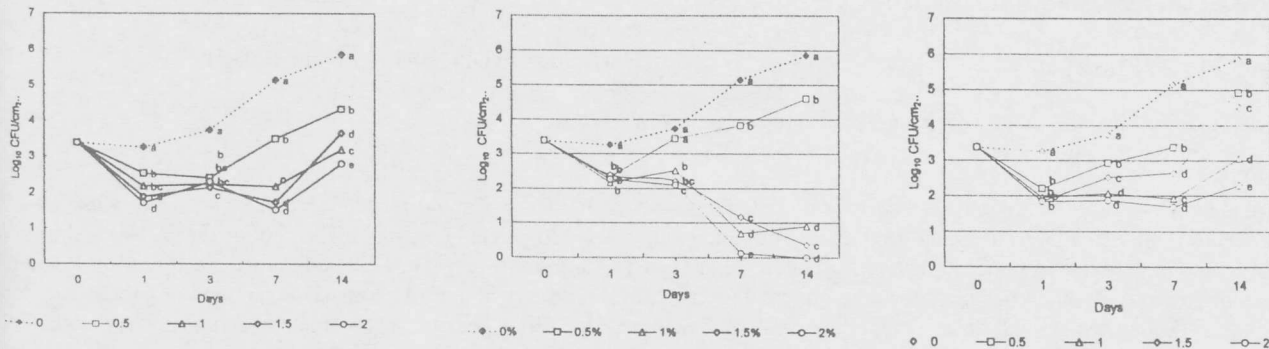


Figure 1. Total plate counts on aerobic-packaged pork loins sprayed with lactic acid, citric acid, acetic acid (from left side) during storage at 4°C. Zero percentage samples were controls. Means with the different letter in the same day are significantly different. (P<0.05)

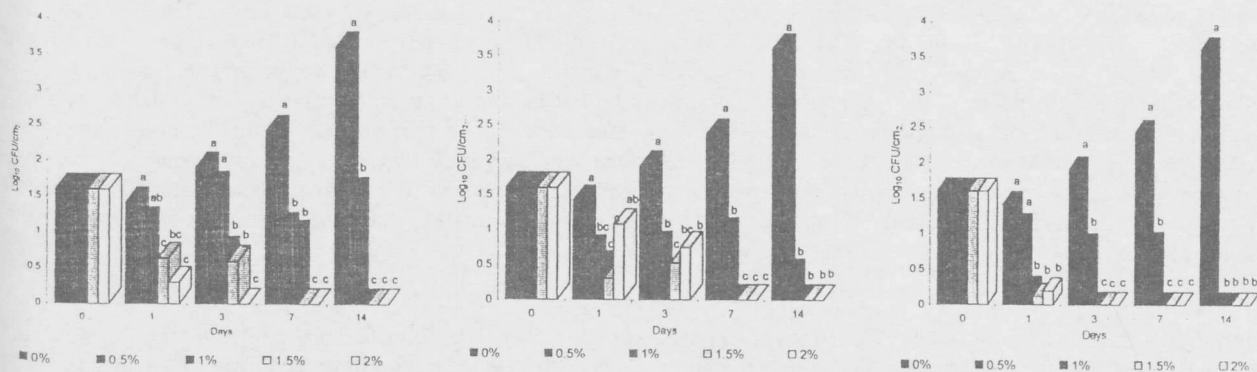


Figure 2. Coliform counts of aerobic-packaged pork loins sprayed with lactic acid, citric acid, acetic acid (from left side) during storage at 4°C. Zero percentage samples were controls. Means with the different letter in the same day are significantly different. (P<0.05)

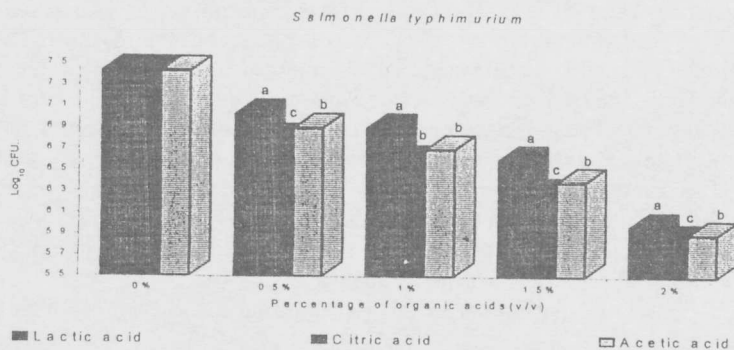


Figure 3. *Salmonella typhimurium* of aerobic-packaged pork loins sprayed with organic acids after 24 hr at 4°C. Zero percentage samples were controls. Means with the different letter in the same percentage of organic acids are significantly different. (p < 0.05)

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