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IMPACT OF ACETIC ACID ON pH AND MICROBIAL POPULATIONS ON PORK LOINS DURING STORAGE

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I. INTRODUCTION

Pork is one of the most widely consumed meats worldwide, serving as a rich source of high-quality protein and essential nutrients while playing a vital role in a wide range of culinary traditions [1]. However, due to its high moisture content and nutrient-rich composition, pork is particularly susceptible to microbial contamination and spoilage, which can significantly compromise both its safety and quality [2]. As such, the development of effective preservation and storage technologies remains a key focus within the meat industry. Among various preservation strategies, washing carcasses with water or sanitizing agents has been widely adopted to physically remove surface microorganisms, thereby improving the microbiological quality of fresh meat [3]. In some countries, organic acids such as acetic acid, citric acid, and lactic acid are frequently employed to promote hygienic meat production practices [4, 5]. These acids are generally recognized as safe (GRAS) and are approved for use in slaughterhouses as microbial inhibitors [6]. Organic acids serve as natural preservatives by inhibiting the growth of pathogenic microorganisms, thereby enhancing the microbial safety of meat products [7]. Numerous studies have been conducted to evaluate the microbiological and physicochemical effects of organic acid treatments on meat. However, there is a lack of comprehensive research focusing specifically on the microbial quality changes in pork loin treated with acetic acid during storage. Thus, this study was carried out to evaluate the impacts of acetic acid on pH and microbial characteristics of pork loins.

II. MATERIALS AND METHODS

The pork samples were obtained from a slaughterhouse located in Gyeongbuk, South Korea. Within 3 hours post-slaughter, the samples were transported to the laboratory under refrigerated conditions (3 ± 1°C) in an icebox. Approximately 100 g of each prepared sample was exposed to ultraviolet (UV) light for 30 min on a clean bench to sterilize the surface microorganisms. Acetic acid (glacial, food grade, J.T. Baker Chemical Co., Phillipsburg, NJ, USA) was diluted to 2.5% (v/v), 5% (v/v) with distilled water. For the immersion treatment, samples were divided into the following groups: a control group with no washing treatment, a water-washed group (sterile water), and a treatment group immersed in a 2.5%, 5% acetic acid solution. Each sample was immersed in the respective solution for 10 minutes and then air-dried at room temperature for 20 min. All samples, including controls, were vacuum-packaged after treatment. The packaged samples were stored at 5 ± 1°C for 12 days. Samples were collected on days 6 and 12 of storage for analysis. All experiments were conducted in triplicate. The pH values of samples were measured in the homogenized meat slurry by a pH meter with a glass electrode (Model 5985 Digi-Sense pH meter, Cole-Parmer Instrument Co., USA). To analyze microbial counts, 10 g of each sample was mixed with 90 mL of sterile saline solution (0.85% NaCl) and homogenized for 120 sec using a BagMixer® (Model 400, Interscience, France). The homogenates were serially diluted using a ten-fold dilution method. One milliliter of each dilution was plated on Plate Count Agar (Difco™, Laboratories, MI) and incubated at 37°C for 48 hours. *Escherichia coli* (E. coli), coliforms, and *Staphylococcus* spp. were quantified using Petrifilm (3M, USA) and incubated at 37°C for 48 hours. Microbial counts were expressed as colony-forming units per gram of sample (CFU/g). Duncan's multiple range test was used to compare treatments using the SPSS (2023) program.

III. RESULTS AND DISCUSSION

The pH values of 2.5% and 5% (v/v) acetic acid were 3.71 and 3.65, respectively. Throughout the storage period, pH levels were lower in the organic acid-treated samples compared to the control. On day 0, total aerobic bacteria were detected in the control and distilled water (DW) groups but not in the acetic acid-treated groups. By day 6, the DW group showed the highest bacterial count, while the 5% acetic acid group had the lowest. Higher acetic acid concentrations led to lower microbial counts, indicating effective inhibition of bacterial growth. Coliform and *Staphylococcus aureus* were also significantly reduced in the treated groups, confirming the antimicrobial effect of acetic acid.

Table 1. pH values on vacuum-packaged pork loins immersed with acetic acid during storage

Treatment	Storage period (days)		
	0	6	12
Control	5.50±0.03[a]	5.52±0.05[a]	5.57±0.05[a]
Distilled water	5.46±0.07[a]	5.61±0.05[a]	5.46±0.01[a]
Acetic acid 2.5%	5.31±0.10[b]	5.08±0.01[b]	5.17±0.03[b]
Acetic acid 5%	4.97±0.06[c]	4.88±0.08[c]	5.10±0.03[b]

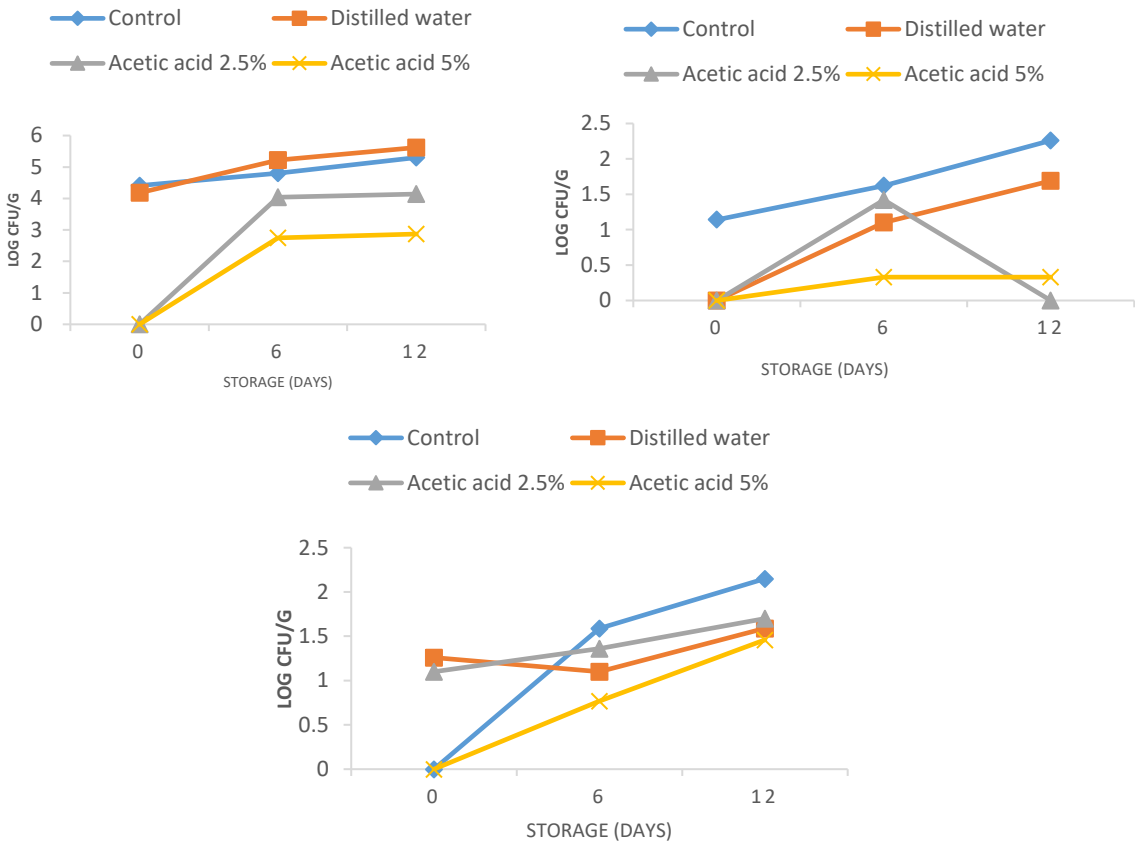


Figure 1. Total aerobic bacterial count (A; upper left), Coliform (B; upper right), *Staphylococcus aureus* count (C; lower middle) on vacuum-packaged pork loins immersed with acetic acid during storage

IV. CONCLUSION

This study confirmed that acetic acid treatment, among various organic acids, significantly affected the microbiological quality of pork loin during storage. In particular, treatment with 5% acetic acid demonstrated the most effective microbial inhibition compared to other treatments. These results suggest that organic acid treatment is a promising method for preserving the freshness of pork during storage.

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