STUDY ON PRESERVATION OF RAW MEAT BY ORGANIC ACIDS SEPARATELY AND COMBINATION

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Abstract – Raw meat material has always been considered as one of ten foods having highest risk of contamination. In Vietnam, the slaughtering, transportation and storage conditions are still manual and the status of not being guaranteed food hygiene and food safety is still very popular. Organic acids in foods have been known for a long time for their high antimicrobial effect and are quite safe to use. Nisin is an antibacterial agent that is of natural origin and it has been used in many countries around the world. The application of nisin in food preservation especially meat and meat products has been well documented [1,4,5]. However, in Vietnam this application is rather limited. This study demonstrates the effects of organic acids, separately and combination with nisin to inhibit the growth of microorganisms on the surface of meat, with the aim to extend shelf life and food safety for consumers.

Key Words – nisin, organic acid, raw meat.

I. INTRODUCTION

Currently, the consumption of hot fresh meat after slaughterhouse is widespread in Vietnam. The meat industry in Vietnam, including slaughterhouse, transportation, and storage and processing, is at its infancy.

The safety of meat as raw material is really a concern due to its microbiological quality. Among 735 raw meat samples been analyzed in 2011, 450 samples (makes up 61%) did not meet requirements by Vietnamese standards (TCVN-7046: 2009) due to high prevalence of coliforms, *Escherichia coli, S. aureus* and *Salmonella* [6].

The bacteria inhibiting role on the meat surface by organic acids has been reported in many studies [2,3]. However there are a few drawbacks as in high concentrations they could alter unwanted sensory properties of materials meat. Combined organic acids with safe biological products such as nisin will be a useful solution to overcome the above disadvantages.

II. MATERIALS AND METHODS

2.1. Materials

The raw meat samples (pork) were collected at 6-7 am from some markets after separation into pieces (2-3 h after slaughter). Nisin was obtained as the commercial preparation Nisaplin (1050 IU/mg; Danisco, Thailand). Acetic acid with a purity of ≥ 99.5% (liquid); Lactic acid ≥ 85% (liquid) were obtained from Sigma. Baird Parker media was used for isolation and enumeration *S. aureus*. Violet red bile glucose agar was used for the isolation and enumeration of *Enterobacteriaceae*. Plate Count agar was used for isolation and enumeration of total aerobic microorganisms. Oxytetracycline–glucose-yeast extract agar was used for isolation and enumeration of yeast and molds.

2.2. Methods

Isolation and enumeration of *Staphylococcus aureus* done according to TCVN 4830-1: 2005. Isolation and enumeration of *Enterobacteriaceae* was done according to international standard method F18-1 (UK, 2005). Isolation and enumeration of total aerobic microorganisms was done according to the TCVN 7928:2008. pH was determined according to the TCVN 4835:2002 (ISO 2917: 1999) and determination of NH_3 was done according to the TCVN 3706:1990. Determination of water holding capacity (area

liquid) was done by the Filter Paper Press method (Grau and Hamm, 1957; Honikel, 1987). Solutions of organic acids and nisin were prepared aseptically and sprayed onto the surface of the meat with a pressure of 5.4 kg/cm$_2$ and volume of 20 mL/per kg meat.

III. RESULTS AND DISCUSSION

1. *To preserve raw meat with individual organic acids*

Raw meat samples were treated with solutions of lactic acid, acetic acid in concentrations ranging from 2 to 3% (w/w). The results of quality evaluation of raw meat samples through physico-chemical and microbial indicators are shown in Figures 1 to 4.

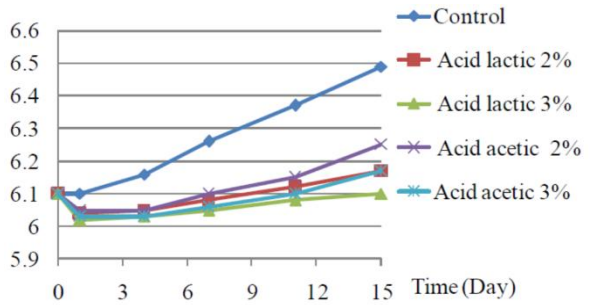

Figure 1. The pH of raw meat treated with organic acids

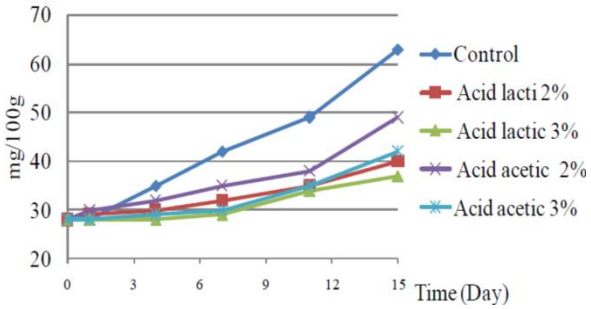

Figure 2. The NH_3 content of raw meat treated with organic acids

The pH assesses the stability of raw meat, and NH_3 content indirectly assesses the decay of raw meat.

Both types of organic acids sprayed onto the surface of raw meat with a concentration from 2% to 3% have antibacterial effects and significantly reduced the number of microorganisms as compared to the control sample. The inhibitory effects of lactic acid against total aerobic microorganisms and Gram positive bacteria is

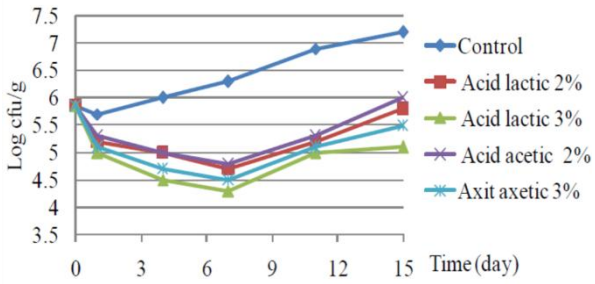

Figure 3. Number of total of aerobic bacteria on meat treated with organic acids

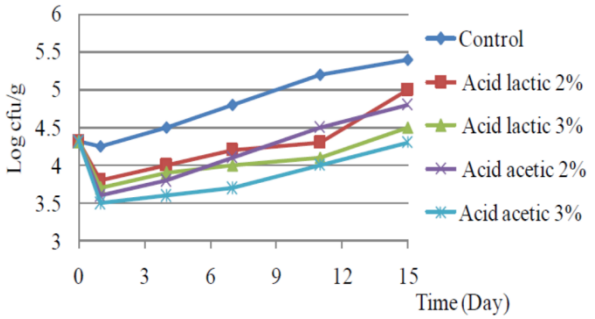

Figure 4. Number of *Enterobacteriaceae* on the raw meat

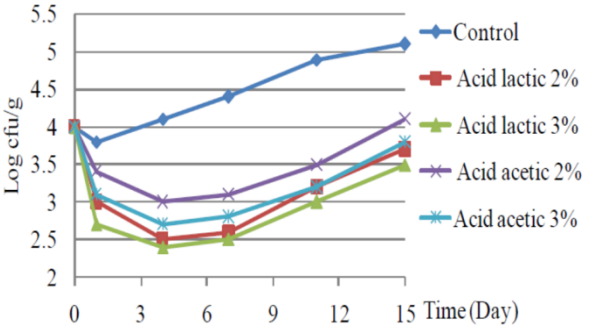

Figure 5. Number of *S. aureus* on the raw meat treated with organic acids

better than acetic acid. However, acetic acid has better inhibitory ability against *Enterobacteriaceae* and Gram negative bacteria. This result is in accordance with data reported by Beyar, D. et al [1] and Jamilah, M. B. et al [2]. Sensory evaluation showed that at the concentration of 3%, the acids had negatively affected the sensory quality including the color, smell and drip loss. At a concentration of 2% these acids may not inhibit enough to ensure quality of raw meat as desired.

Therefore, was necessary to study the combination of these acids with nisin to extend shelf life and ensure the quality of raw meat [3].

2. To preserve raw meat by organic acids combined with nisin

Raw meat samples were treated with organic acids combined with a solution of nisin at concentrations of organic acids from 1-1.5 to 3% and nisin concentrations of 1000 -700 - 500 IU/ mL. The data for raw meat qualities evaluated by physico-chemical and microbiological targets are shown in Figures 6 to 12.

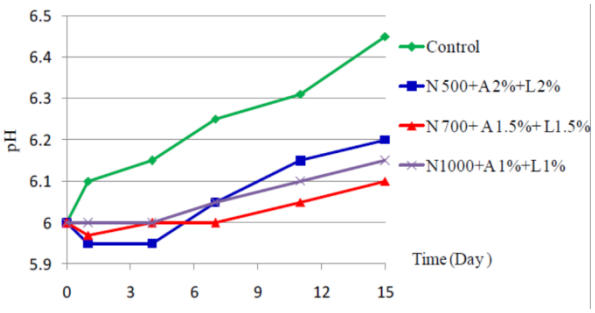

Figure 6. The pH of raw meat treated with a combination of organic acids and nisin

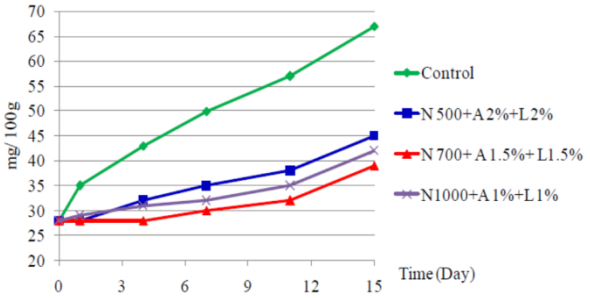

Figure 7. The NH_3 content of meat treated with combinations of organic acids and nisin

The pH indicates the stability of raw meat, and NH_3 content indirectly indicates the decay of raw meat. Samples with the lowest nisin concentration of 500 IU/ mL when combined with the two acids in highest concentration of 2% had the worst effects, showing the most umstable pH, sharply dropping in four days in samples with the highest concentration of acid, but then the pH is not stable and increased after 7 d of storage. Samples were treated with solution with concentrations of nisin 700 IU/mL and 1.5% lactic acid and 1.5% acetic acid had stable values for pH and NH_3, showing that the combination is quite effective and best for shelf life extension.

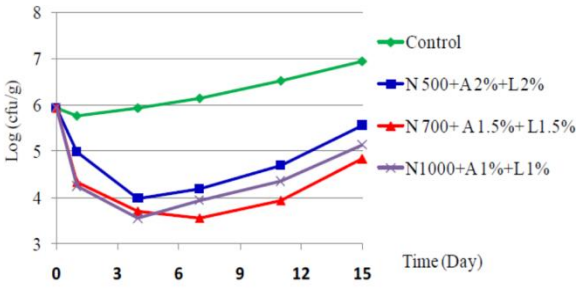

Figure 8. Number of total of aerobic bacteria on raw meat treated with a combination of organic acids and nisin

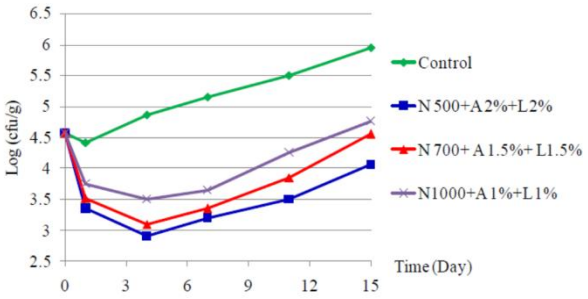

Figure 9. Number of *Enterobacteriaceae* on raw meat treated with a combination of organic acids and nisin

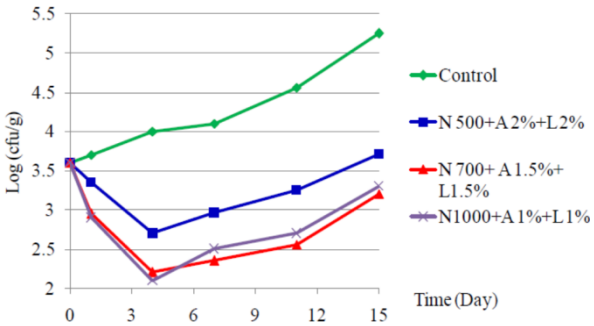

Figure 10. Number of *S. aureus* on raw meat treated with a combination of organic acids and nisin

The raw meat before treatment was contaminated with high microbial levels because of manual slaughtering, transportation and storage processes. When the meat surface was treated with mixture of organic acids and nisin, it demonstrated much better antibacterial activity as compared with organic acids alone. Nisin effectively suppressed Gram (+) bacteria as well as *S. aureus.* It reduced > 1.5 - 2log CFU/g as compared with the control sample. Two samples with nisin concentration of 700 IU/ mL and 1000 IU/mL in combination with organic acids showed significant antibacterial effect. Mixture of nisin 700 IU/ mL and 1.5% lactic acid and 1.5% acetic acid resulted in the best

inhibition activity for broader group of microorganisms, particularly *Enterobacteriaceae* group and the total number of microorganisms. This result is in accordance with data reported by Martinez, Y. B. et all [3].

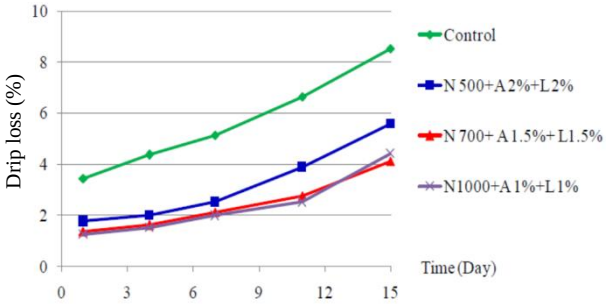

Figure 11. The drip loss of raw meat treated with a combination of nisin and organic acids

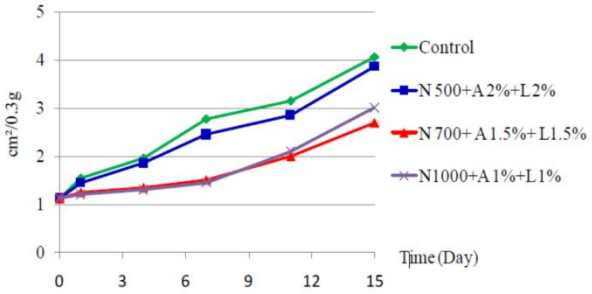

Figure 12. The liquid area of raw meat treated with a combination of organic acids and nisin

The drip loss and water holding capacity (Liquid area) of raw meat samples with other sensory properties such as color, smell, also showed that samples with the mixture of 700 IU/ mL nisin, 1.5% lactic acid and 1.5% acetic acid were the most stable.

IV. CONCLUSION

Organic acids can significantly reduce the numbers of microorganisms on the surface of meat; however; the sensory properties such as color, smell, drip loss does not meet requirements for extended storage life. The combination of organic acids with nisin overcame the above disadvantages. The results showed that concentrations of the combination: 700 IU/mL nisin, 1.5% lactic acid and 1.5% acetic acid showed the best result. The shelf life extended 7 days greater than that of the control sample when samples were stored 0-4°C. The stored meat reaches the standards for meat materials in Vietnam (TCVN-7046).

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