Review on Agriculture and Rural Development 2023 vol. 12 (1-2) ISSN 2677-0792
DOI: 10.14232/rard.2023.1-2.15-21

THE IMPACT OF LACTIC ACID AND ASCORBIC ACID MIXTURE ON QUALITY PARAMETERS OF WILD BOAR MEAT

Munkhnasan Enkhbold[1]*, Attila Lőrincz[2], Majd Elayan[1], László Friedrich[1], Attila Solymosi[1], Balázs Wieszt[1], Kornél Jáni[1], Adrienn Tóth[1]

[1] Doctoral School of Food Science, Department of Livestock and Food Preservation Technology, Hungarian University of Agriculture and Life Sciences, 1118 Budapest, HUNGARY

[2] VADEX Mezőföldi Erdő- és Vadgazdálkodási Zrt., 8123 Soponya, HUNGARY

*corresponding author: munkhnasan.e@gmail.com

Abstract: The objective of the current research was to evaluate effect of organic acids in the European wild boar (*Sus scrofa L.*) meat and to investigate the ageing procedure in vacuum packaging. Wild boar meat is reported to contain a lower concentration of fat and cholesterol than the meat from the domestic pig. Therefore, recent increases in natural populations, as well as the possibility of farming wild boars have stimulated interest in this species as a meat producer. In this study, the effect of lactic acid and the ascorbic acid mixture was evaluated in wild boar meat on meat quality parameters like pH, water holding capacity, water activity, and microbiological evaluation. Certain parameters are considered as indicators of fresh meat shelf life. Lactic acid 2% and ascorbic acid 2% were mixed and sprayed on wild boar meat samples. The meat samples were immediately vacuum packaged after treatment and stored at 4 ± 1°C for 21 days of display. Quality parameters were measured on 1, 7, 14, and 21 days. The results indicate that the use of lactic acid and the ascorbic acid mixture could be an alternative to extend meat shelf life.

Keywords: wild boar meat, lactic acid, ascorbic acid, pH, water holding capacity, microbiological evaluation

1. Introduction

Wild boar (*Sus scrofa L.*) is a wild animal species that is widely distributed in many parts of the world, including Europe, Asia, and North Africa (Massei et al., 2009). In recent years, there has been growing interest in the use of wild boar meat as a potential alternative to the meat of domestic pigs due to its reported lower concentration of fat and cholesterol (Barone et al., 2014). This has led to an increase in both the hunting of wild boars and the possibility of farming them for meat production. Meat quality is a key factor in the acceptance of wild boar meat as a viable alternative to domestic pig meat. However, wild boar meat has a shorter shelf life than domestic pork due to its lower pH, higher drip loss, and higher microbial load (Martín et al., 2020). Therefore, strategies need to be investigated to extend the shelf life of wild boar meat.

One promising approach to extend the shelf life of meat products is the use of organic acids, which have been shown to inhibit microbial growth and improve the quality of meat products (Knochel & Ganzle, 2011). Lactic acid and ascorbic acid are two commonly used organic acids in the food industry that have been shown to

improve the quality and safety of meat products (Zhao et al., 1998; Yang & Lee, 2005). Lactic acid is a naturally occurring organic acid that is produced by lactic acid bacteria during fermentation. It is widely used as a food preservative due to its ability to inhibit the growth of pathogenic bacteria and spoilage organisms. Ascorbic acid, also known as Vitamin C, is an essential nutrient for humans and many other animals. It is commonly used as a food additive due to its antioxidant properties, which help to prevent oxidative damage in food products. Ascorbic acid can also enhance the color, flavor, and texture of food products, and inhibit the growth of pathogenic bacteria. Lactic acid is known to reduce bacterial growth and improve the water-holding capacity of meat, while ascorbic acid has antioxidant properties that can help prevent oxidation and maintain color stability (Santos et al., 2019).

In the context of meat products, lactic acid and ascorbic acid have been shown to improve the quality and safety of meat by reducing microbial growth and extending shelf life. Several studies have investigated the use of lactic acid and ascorbic acid in various types of meat, including beef, pork, and poultry. However, there is limited research on the use of these acids in wild boar meat specifically. The objective of this study is to evaluate the effect of lactic acid and ascorbic acid mixture on the quality parameters of wild boar meat, including pH, water holding capacity, water activity, and microbiological evaluation. In addition, the effect of ageing in vacuum packaging will be investigated. This study aims to contribute to the development of strategies to extend the shelf life of wild boar meat and improve its overall quality and safety.

2. Materials and methods

2.1. Sample preparation

Fresh wild boar meat samples were obtained from a local processing plant, and transported to the laboratory in a chilled state. Samples were cut into similar-sized steaks. The samples were then randomly divided into two groups: a control group and a treatment group. The control group was vacuum-packed in polyethylene bags and stored in a refrigerated cabinet, while the treatment group was sprayed with a 2% lactic acid and 2% ascorbic acid solution on both the top and bottom surfaces at room temperature. The acid solution was prepared by diluting lactic acid and ascorbic acid in distilled water. After treatment, the samples were vacuum packaged and stored at 4 ± 1°C for 21 days. Quality parameters were measured on 1, 7, 14, and 21 days.

2.2. pH measurement

The pH of the treated and non-treated wild boar meat samples was measured using a one-hand pH meter. The pH meter was calibrated using pH 4.0 and pH 7.0 buffer solutions prior to measurements. The pH meter electrode was inserted into the meat sample, and the pH value was recorded.

2.3. Water holding capacity measurement

The water-holding capacity of the meat samples was determined using the filter paper press method (Honikel, 1998). Briefly, a 200 mg meat sample was placed between two filter papers, and a 0,5 kg weight was applied for 5 min. The filter papers were then weighed, and the water holding capacity was calculated as a percentage of the initial weight of the meat sample.

2.4. Water activity measurement

The water activity of the meat samples was measured using a water activity meter. The meat samples were cut into small pieces and placed in a sample cup. The cup was then inserted into the water activity meter, and the measurement was recorded.

2.5. Microbiological evaluation

10 g of wild boar meat samples was aseptically weighed and homogenized with 90 mL of buffered peptone water. The homogenate was serially diluted, and 0.1 mL of the appropriate dilution and subjected to the Aerobic Plate Count (APC) using nutrient agar through the pour plate method with duplicate plates. The APC plates were incubated at 37°C for 48 h. The colonies were counted, and the results were expressed as colony-forming units per gram of meat (CFU/g).

2.6. Statistical analysis

To evaluate the impact of treated and non-treated methods on the quality of wild boar meat samples, a statistical analysis was performed using IBM SPSS27 (Armonk, NY 2020) as a tool for statistical evaluation. A two-way analysis of variance (ANOVA) and Tukey's HSD post hoc test were conducted, and differences were considered significant at a $P < 0.05$.

3. Results

3.1. pH measurement

The pH of meat is an important parameter that affects its quality and safety. In this study, the pH values of treated and non-treated wild boar meat samples were measured over a period of 21 days.

The results (Table 1) showed that the pH of the treated samples was slightly lower than the pH of the non-treated samples on day 1, which could be due to the use of the lactic acid and ascorbic acid mixture solution, which has a pH=2.8 lower than the meat. On day 21, the pH of the treated samples was slightly higher than the pH of the non-treated samples, indicating that the treated samples may have had a better shelf life compared to the non-treated samples.

Table 1: Effect of lactic acid and ascorbic acid mixture and vacuum packaging on pH values of wild boar meat samples during retail display at 4 ± 1 °C.

Day	Treatment	pH
1	Treated	5.60±0.04[b]
	Non-treated	5.67±0.03[b]
7	Treated	5.38±0.16[b]
	Non-treated	5.51±0.10[b]
14	Treated	5.12±0.02[a]
	Non-treated	5.13±0.04[a]
21	Treated	5.02±0.12[a]
	Non-treated	4.99±0.17[a]

[ab]*Different letters are for significantly different groups (Tukey, $p < 0.05$).*
Data are recorded as Mean ± Standard Error.
Treated (sprayed with 2% lactic acid and 2% ascorbic acid mixture)

3.2. Water holding capacity (WHC) measurement

The results (Figure 1) showed that the WHC of the treated samples was lower than the WHC of the non-treated samples on day 1. This could be due to the use of the lactic acid and ascorbic acid mixture solution, which may have caused some initial dehydration of the meat.

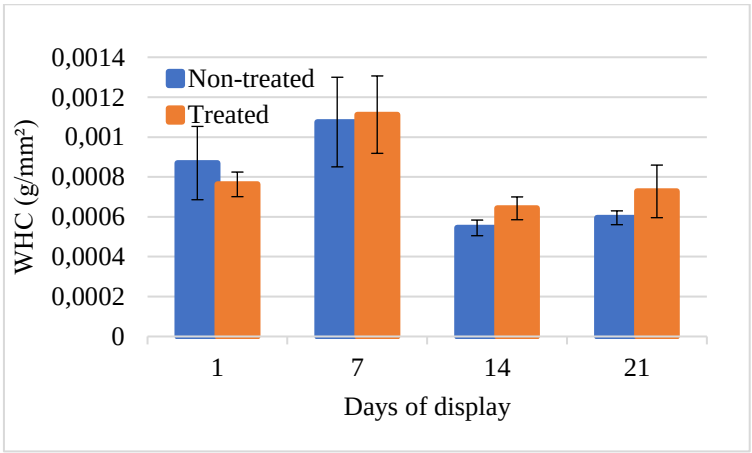

Figure 1: Effect of lactic acid and ascorbic acid mixture and vacuum packaging on WHC values of wild boar meat samples during retail display at 4 ± 1 °C.

However, on day 7, both treated and non-treated samples showed an increase in WHC, which could be due to the accumulation of moisture in the meat as a result of the natural postmortem changes. Both treated and non-treated samples showed a decrease in WHC on day 14, which could be due to the breakdown of the muscle fibers and the release of water from the meat. On day 21, both treated and non-treated samples showed a slight increase in WHC, which could be due to the reabsorption of moisture in the meat.

Interestingly, the treated samples showed a slightly higher WHC than the non-treated samples on day 21, indicating that the lactic acid and ascorbic acid mixture solution may have had a positive effect on the WHC of the meat. This is consistent with previous studies that have shown that the use of organic acids can improve the WHC of meat by altering the protein structure and increasing the ionic strength of the meat (Barbut, 1996).

3.3. Water activity (a_w) measurement

The results (Figure 2) showed that the a_w of the treated samples was slightly lower than the a_w of the non-treated samples on day 1, which is consistent with the WHC results.

The increase in a_w values on day 7 for both treated and non-treated samples may be attributed to the natural postmortem changes in the meat, which can cause a release of water and an increase in a_w. However, on day 21, both treated and non-treated samples had higher aw values, but the treated samples had a significantly higher a_w value compared to the non-treated samples.

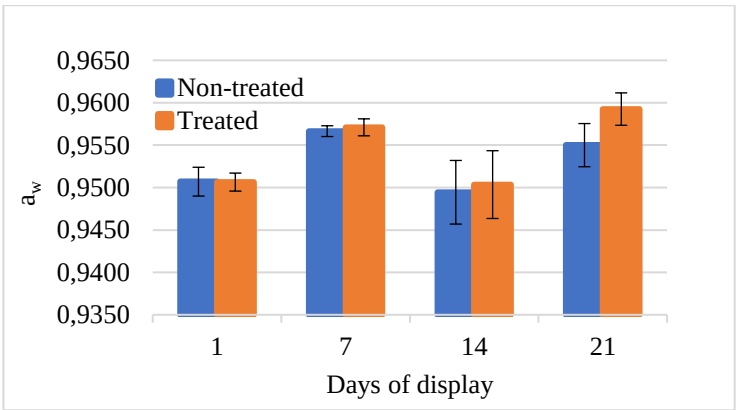

Figure 2: Effect of lactic acid and ascorbic acid mixture and vacuum packaging on a_w values of wild boar meat samples during retail display at 4 ± 1 °C.

3.4. Microbiological evaluation

The use of lactic acid and ascorbic acid mixture solution in this study appeared the positively affecting the microbial shelf life of the wild boar meat samples (Figure 3). The reduction in APC on days 14 and 21 of the treated samples suggests that the mixture solution may have inhibited the growth of aerobic bacteria.

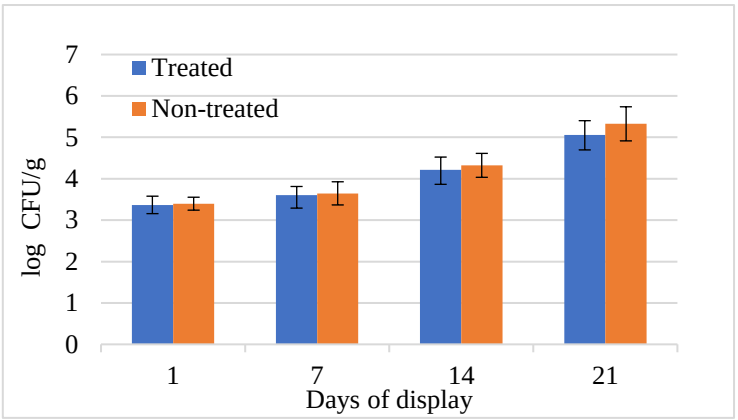

Figure 3: Effect of lactic acid and ascorbic acid mixture on aerobic plate count (log cfu/g) of vacuum-packed wild boar meat samples during 21 days of retail display at 4 ± 1 °C.

4. Discussion

The application of a lactic acid and ascorbic acid mixture solution on wild boar meat samples had a positive impact on their quality and safety during 21 days of retail display at 4 ± 1 °C. The pH of the treated samples decreased slower than the non-treated samples, indicating that the lactic acid and ascorbic acid mixture solution may have had a protective effect on the meat. Additionally, the treated samples showed a slightly higher water holding capacity and water activity than the non-treated samples on day 21, indicating that the lactic acid and ascorbic acid mixture solution may have had a positive effect on the water-binding properties of the meat. Moreover, the treated samples had a lower microbial count on days 14 and 21 compared to the non-treated samples, indicating the potential antimicrobial activity of the lactic acid and ascorbic acid mixture solution.

Therefore, the application of the lactic acid and ascorbic acid mixture solution on wild boar meat samples can improve their quality and safety during retail display. Further studies are needed to optimize the concentration and application of the lactic acid and ascorbic acid mixture solution in the meat industry.

Acknowledgements

The research was supported by the Doctoral School of Food Science of Hungarian University of Agriculture and Life Sciences and Capriovus Kft.

References

Barbut, S. (1996). The effects of organic acids on meat quality. Food Research International, 29(7), 729-737. https://doi.org/10.1016/S0963-9969(96)00063-9

Barone, F., Marangon, A., Pasquali, F., & Dalla Costa, E. (2014). Nutritional characteristics and safety aspects of wild boar meat. Meat Science, 98(3), 544-550.

Honikel, K.O. (1998). Reference methods for the assessment of physical characteristics of meat. Meat Science, 49(4), 447-457.

Knochel, S., & Ganzle, M. (2011). Food preservation with organic acids and their salts. In Organic acids in food preservation (pp. 129-170). CRC Press.

Martín, B., Prieto, M., López, M., Alonso-Calleja, C., & Capita, R. (2020). Microbiological quality of wild boar meat during post-mortem ageing. Journal of Food Safety, 40(2), e12719.

Massei, G., Kindberg, J., Licoppe, A., & Gačić, D. (2009). Wild boar populations up, numbers of hunters down? A review of trends and implications for Europe. Pest Management Science, 65(7), 773-781.

Santos, E. M., Fernandes, R. P. P., Trindade, M. A., Gandra, E. A., Franco, R. M., & Rodrigues, L. F. (2019). Impact of sodium lactate, sodium ascorbate and chitosan on quality of refrigerated pork sausages. Meat Science, 148, 117-124.

Yang, H. S., & Lee, E. J. (2005). Effects of lactic acid and ascorbic acid on color, residual nitrite and nitrosamine formation in cooked pork sausages during storage. Meat Science, 69(4), 759-766.

Zhao, Y., Xiong, Y. L., & Chen, J. (1998). Physicochemical and microbial changes of vacuum-packaged pork steaks during refrigerated storage as affected by lactic acid bacteria culture. Journal of Food Science, 63(4), 671-674.