ALTERNATIVE TECHNOLOGY FOR SODIUM NITRITE: EFFECT OF ATMOSPHERIC PRESSURE PLASMA ON MANUFACTURING OF PORK JERKY

Hae In Yong, Sang Hui Lee, So Yeon Kim, Jeong Yeon An and Cheorun Jo*

Department of Agricultural Biotechnology, Seoul National University, Seoul 08826, Korea.

*Corresponding author email: cheorun@snu.ac.kr

Abstract – The objective of this study was to evaluate the effect of atmospheric pressure plasma (APP) on pork jerky as an alternative method for sodium nitrite addition. Pork slices were marinated with brines added with or without sodium nitrite. The brines consisted of 10% water, 0.15% salt, and 0.03% ascorbic acid (w/w). The cured pork without sodium nitrite was exposed by APP for 0, 20, 40, and 60 min, respectively. All groups were dried to produce pork jerky. In general, a^* value, nitroso-heme pigments, and residual nitrite content of pork jerky were significantly increased as increasing of APP treatment time. Compared to jerky added with sodium nitrite, jerky treated with APP for 40 and 60 min showed similar (P>0.05) and significantly higher values in a^* and nitroso-heme pigments, respectively. Moreover, pork slices treated with sodium nitrite had similar value (P>0.05) in residual nitrite compared to group treated with APP for 60 min. In conclusion, APP could be used effectively as an alternative to sodium nitrite in cured pork jerky due to similar values in a^*, nitroso-heme pigment, and residual nitrite.

Key Words – alternative of sodium nitrite, cured meat product, non-thermal plasma

I. INTRODUCTION

Plasma is ionized gas which is literally defined as the fourth state of matter along with solids, liquids, and gases. Plasma devices operated under atmospheric pressure, called atmospheric pressure plasma (APP), had a number of attentions in recent years [1]. A number of studies were reported that high concentrations of reactive oxygen and nitrogen species (RONS) generated by APP led to reduction in microbial counts in food [2]. However, there were limited studies about utilization of APP in curing process [1]. In this study, it is hypothesized that RONS generated by APP could be used in curing process as alternative of sodium nitrite. Therefore, the objective of this study was to evaluate the effect of APP treatment on physicochemical characteristics including a^* value, nitroso-heme pigments, and residual nitrite content of pork jerky manufactured with or without sodium nitrite.

II. MATERIALS AND METHODS

Sample preparation and APP treatment

Raw pork (*M. biceps femoris*) slices were marinated with two different brines for 16 hours, respectively. The brines contain sodium nitrite with 0 or 0.007%, respectively, based on water (10.0%), salt (0.15%), and ascorbic acid (0.03%). Then, pork cured with nitrite-free brine was treated with APP for 0, 20, 40, and 60 min, respectively. A schematic diagram and conditions of utilized APP device was shown in previous study [2]. All cured meat samples were dried at 75°C for 150 min, at 65°C for 90 min, and at 55°C for 90 min.

Physicochemical properties

a^* value of pork jerky was measured using a colorimeter (CM-5, Konica Minolta Co., Ltd., Japan). Nitroso-heme pigments and residual nitrite levels were conducted based on the method of Ahn *et al*. [3].

Statistical analysis

Statistical analysis was performed by one-way analysis of variance and significant differences were identified with the Tukey's multiple range test using SAS software (SAS 9.3, SAS Institute Inc., USA).

III. RESULTS AND DISCUSSION

In general, a^* value and nitroso-heme pigment content of pork jerky gradually increased with increasing APP treatment time (P<0.05; Fig. 1). The enhancement in redness of APP treated sample may be due to the formation of nitroso-heme pigment which is generated by reaction of nitric oxide (NO) and myoglobin in meat product [3]. In present study, NO, N_2, and N_2^+ molecular were observed in the emission spectrum of APP (data not shown) and it can affect the curing possibility in cured pork jerky without sodium nitrite.

Compared to pork jerky with sodium nitrite, APP treatment for 40 min showed similar a^* value and nitroso-heme pigment content, while lower residual nitrite content in pork jerky (Fig. 1). The residual nitrite plays an important role for preventing toxin production by *Clostridium botulinum*. However, nitrite in cured meat also has health risk due to the potential formation of carcinogenic nitrosamines [1, 2]. Thus, low residual nitrite content in meat products may have both risks and benefits.

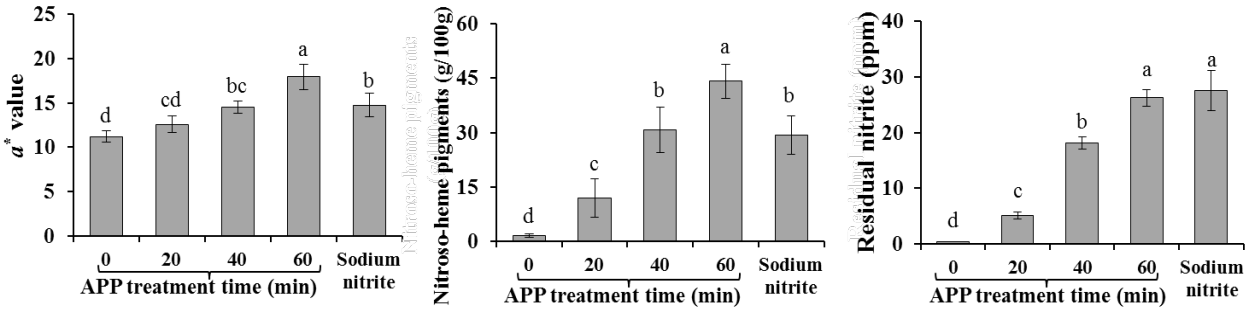

Figure 1. Physicochemical properties of pork jerky treated with APP (0, 20, 40, and 60 min) or added with sodium nitrite. [a-d]Different letters within the same treatments were significantly different (P<0.05).

IV. CONCLUSION

Overall, treatment of APP for 60 min in pork jerky increased a^* value and nitroso-heme pigment with similar residual nitrite content to pork jerky with sodium nitrite. Thus, APP can be used with indicating enhancement in color intensity of pork jerky production as a replacement to sodium nitrite.

ACKNOWLEDGEMENTS

This research was carried out with the support of Cooperative Research Program for Agriculture Science & Technology Development (Project No.011617) and National Research Foundation Grant funded by the Korean Government (NRF-2015H1A2A1034708).

REFERENCES

1. Jung, S., Lee, J., Lim, Y., Choe, W., Yong, H. I. & Jo, C. (2017). Direct infusion of nitrite into meat batter by atmospheric pressure plasma treatment. Innovative Food Science & Emerging Technologies, 39: 113-118.
2. Jung, S., Kim, H. J., Park, S., Yong, H. I., Choe, J. H., Jeon, H. J., Choe, W. & Jo, C. (2015). The use of atmospheric pressure plasma-treated water as a source of nitrite for emulsion-type sausage. Meat Science, 108: 132-137.
3. Ahn, H. J., Jo, C., Lee, J. W., Kim, J. H., Kim, K. H. & Byun, M. W. (2003). Irradiation and modified atmosphere packaging effects on residual nitrite, ascorbic acid, nitroso-myoglobin, and color in sausage. Journal of Agricultural and Food Chemistry 51: 1249-1253.