REPLACEMENT OF PHOSPHATES BY WINTER MUSHROOM POWDER IN EMULSION-TYPE SAUSAGES

Kyung Jo[1], Jeehwan Choe[1], Juri Lee[1], Cheorun Jo[2, 3], Minho Song[1], and Samooel Jung[1*]

[1]Division of Animal and Dairy Science, Chungnam National University, Daejeon 34134, Korea

[2]Department of Agricultural Biotechnology, Center for Food and Bioconvergence, and Research Institute of Agriculture and Life Science, Seoul National University, Seoul 08826, Korea

[3]Institute of Green Bio Science and Technology, Seoul National University, Pyeongchang 25354, Korea

*Corresponding author email: samooel@cnu.ac.kr

ABSTRACT

This research evaluated the utilization of winter mushrooms for replacement of phosphates in emulsion-type sausages. Winter mushroom powder (WMP) was added to the sausages at 0, 0.5, 1.0, 1.5, and 2.0% (w/w), and phosphate was added at 0.3% as a positive control. The WMP addition above 1.0% increased the pH of meat batter and efficiently inhibited the exudation of fat from the sausages. Lipid oxidation of sausages was inhibited by the addition of WMP. Therefore, this research indicates that WMP can effectively replace phosphate in meat products, and that the most effective addition level may be 1.0% WMP.

Keywords: winter mushroom, phosphate, replacement, antioxidant, pH

I. INTRODUCTION

Various ingredients and additives are used to improve the quality and shelf life of meat products. Phosphates are widely used additive for manufacturing meat products [1]. In meat processing, one of the most beneficial functions of phosphates is the improvement of water holding capacity by raising the pH of meat batter. This results in improved cooking yield, texture, and eating quality, including improved tenderness and juiciness [1]. However, phosphates are a synthetic additive, and consumer's demand for replacing synthetic additives with natural additives have increased. Thus, there is a requirement to find natural ingredients for the replacement of phosphates. Winter mushrooms are the most popularly consumed mushrooms in South Korea, China, and Japan [2]. Winter mushrooms have high levels of nutrients and several biological benefits, such as antioxidant, antitumor, and antiinflammation properties [2]. Moreover, some studies have shown that mushrooms can increase the pH of meat [3]. Therefore, the aim of this study was to evaluate the potential use of winter mushrooms as an alternative to phosphates in emulsion-type sausages.

II. MATERIALS AND METHODS

Winter mushrooms were lyophilized and pulverized to prepare winter mushroom powder (WMP). Ground pork (1.6 kg) was mixed with back fat (0.4 kg), ice (0.4 kg), sodium chloride (1.5%), L-ascorbic acid (0.02%), and sodium nitrite (0.01%). Six treatments were made by adding sodium pyrophosphate (0.3%) or different level of WMP (0, 0.5, 1.0, 1.5, and 2.0%). The pH of the meat batter, the proportion of jelly and melted fat, and lipid oxidation of sausages were measured with three replicates per treatment. The data from this study was analyzed using the PROC GLM procedure in a randomized complete block design (batch as a block). Specific comparisons were performed by Tukey's multiple range test when the main effect was significant. Results are reported as standard error of the least-square mean. Statistical significance was considered for $p < 0.05$.

III. RESULTS AND DISCUSSION

The pH of meat batter was the lowest in WMP 0 and the addition of WMP significantly increased its pH (Table 1, $p < 0.05$). The meat batters with the addition of more than 1.0% WMP had similar pH values to phosphate group. The previous study showed that the addition of winter mushroom extracts to beef and fish meat slightly increased the pH of their products [3]. This result might be related to the high levels of basic amino acids such as histidine and arginine in the winter mushroom [4]. The amount of exuded jelly and melted fat form sausages was the highest in WMP 0 and significantly decreased with the addition of increasing amounts of

WMP (Table 1, $p < 0.05$). This result was closely related to the increase in pH of the meat batters containing WMP. In addition, the dried winter mushroom contained 50.30% of dietary fibers [5]. The previous study has reported improvements in water and fat retention in meat products with the addition of dietary fiber sources [6].

Table 1 pH of the meat batter, separation of jelly and melted fat from sausages, and the malondialdehyde content (mg/kg) of sausage added with phosphate or WMP

Treatments	pH	Exuded jelly and melted fat	Malondialdehyde (mg kg-1)
Phosphate	6.30^{a}	7.37^{cd}	0.35^{ab}
WMP 0	6.08^{c}	21.37^{a}	0.28^{bc}
WMP 0.5	6.13^{b}	15.27^{b}	0.45^{a}
WMP 1.0	6.31^{a}	8.45^{c}	0.19^{c}
WMP 1.5	6.31^{a}	6.59^{cd}	0.18^{c}
WMP 2.0	6.33^{a}	5.39^{d}	0.22^{c}
SEM[1]	0.012	0.538	0.028

[1]Standard error of the mean (n = 18).
[a-d]Different letters within the same column represent significant differences ($p < 0.05$).

The malondialdehyde (MDA) content of sausages with added phosphate was not significantly different from that of those without WMP (Table 1). Sausages with the addition of more than 1.0% WMP showed lower MDA contents than those with the phosphate group ($p < 0.05$). Winter mushrooms contain phenolic compounds, flavonoids, and ergothioneine, which are well-known antioxidants [3]. The previous study has reported the practical antioxidant effects of winter mushrooms when winter mushroom extracts were added to beef and fish products [3].

IV. CONCLUSION

The addition of more than 1.0% WMP to sausages inhibited the exudation of fat from sausages and increased the pH of meat batter. In addition, lipid oxidation of sausages was inhibited with the addition of more than 1.0% WMP. Therefore, this research indicates that WMP could effectively replace phosphate in meat products, and that 1.0% WMP addition may be the most effective level. The effect of WMP on the microbiological safety and shelf life of sausages should be addressed in future studies.

ACKNOWLEDGEMENTS

This study was financially supported by research project (PJ012254) for Development of Advanced Core Technology for Agriculture, Rural Development Administration, Republic of Korea.

REFERENCES

1. Sebranek, J. G. (2009). Basic curing ingredients, In R. Tarte (Ed.), Ingredients in meat products. Wisconsin, USA: Springer.
2. Dong, Y., Cheng, S., Qi, G, Yang, Z., Yin, S., & Chen, G. (2017). Antimicrobial and antioxidant activities of *Flammulina velutipes* polysacchrides and polysacchride-iron (III) complex. Carbohydrate Polymers, 161: 26–32.
3. Bao, H. N. D., Ushio, H., & Ohshima, T. (2008). Antioxidative activity and antidiscoloration efficacy of ergothioneine in mushroom (*Flammulina velutipes*) extract added to beef and fish meats. Journal of Agricultural and Food Chemistry, 56: 10032–10040.
4. Ito, H., Ueno, H., & Kikuzaki, H. (2017). Construction of a free-form amino acid database for vegetables and mushrooms. Integrative Food, Nutrition and Metabolism, 4: 1-9.
5. Ulziijargal E, & Mau JL. (2011). Nutrient compositions of culinary-medicinal mushroom fruiting bodies and mycelia. International journal of medicinal mushrooms, 13: 343-349.
6. Han, M., & Bertram, H. C. (2017). Designing healthier comminuted meat products: Effect of dietary fibers on water distribution and texture of a fat-reduced meat model system. Meat Science, 133: 159–165.