INOSINIC ACID, INOSINE AND HYPOXANTHINE CONTENT OF HANWOO *DEEP PECTORALIS* SUBJECTED TO DIFFERENT COOKING METHODS

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Abstract – This study was performed to observe the effects of two cooking methods on inosinic acid, inosine and hypoxanthine content in the brisket (*deep pectoralis*) of Hanwoo (Korean native cattle). Samples were either oven-roasted at 180°C (dry heat) or cooked in boiling water (moist heat) to a final core temperature of 77 °C. No significant differences were found on cooking loss. The concentration of inosinic acid, inosine and hypoxanthine was higher in oven-roasted samples than in boiled samples ($p<0.001$). These results suggest that cooking beef brisket in boiling water, extracts water-soluble taste precursors, which is advantageous in the preparation of beef stock, and oven-roasting remains higher level of hypoxanthine that may contribute to the bitter taste of roast beef.

Key Words – beef, nucleotides, thermal process.

I. INTRODUCTION

Among five basic tastes, umami has been associated with the pleasure of eating meat and meat products. Inosinic acid, or inosine-5'monophosphate (IMP), is a 5'-nucleotide that has been shown to enhance the umami intensity of glutamic acid [1]. Postmortem aging plays a role in enhancing, reducing or converting umami-related taste precursors [2]. However, the scientific evidences regarding the effect of different cooking methods on inosinic acid content in beef are still limited. It is thus necessary to investigate the effects of dry and moist heat cooking methods on inosinic acid content and its derivatives such as inosine and hypoxanthine content in Hanwoo beef brisket.

II. MATERIALS AND METHODS

Vacuum-packed beef brisket (*deep pectoralis*) was purchased from local market (Chuncheon, Korea) on day seven after slaughtered. The samples (8.65% of fat) were obtained from the quality grade 1^+ carcass of Hanwoo steers finished on grain-based diet. Samples (n=6) were sliced into 2.5 cm-thick and all external fat was trimmed, subsequently cooked to final core temperature of 77 °C by oven-roasting at 180 °C (dry heat) using an electric oven (Hauzen, Samsung Electronics Co., Ltd., Suwon, Korea) or cooked in boiling water (moist heat). Prior to cooking, oven was set on at 180 °C for 15 min and water was boiled. Core temperature was monitored using a handheld thermometer (HCP2, Habor Precise Industries Co., Ltd., Zhejiang, China). After reaching the desired core temperature, samples were taken out and cooled for 10 min. Cooking losses were recorded and part of the samples was frozen at -24 °C for further analysis. The method reported by Jayasena et al. [3] using high-performance liquid chromatography (HPLC) was used for nucleotides measurement with modification on HPLC instrument, mobile phase and linear gradient. Mobile phase A was 0.04% (v/v) triethylamine in phosphate buffer (58.72 mM Na_2HPO_4, 40 mM KH_2PO_4, pH 7.02 at 22°C), and mobile phase B was a mixture of HPLC-grade distilled water and acetonitrile (40:60 v/v). The linear gradient was 0-15% mobile phase B for 17 min and 15-100% mobile phase B for 3 min (maintained for another 5 min) followed by re-equilibration with 100% mobile phase A for 10 min before the next injection. Data were subjected to one-way analysis of variance (ANOVA) using R-version 3.3.2 with "Agricolae" library (The R-foundation for Statistical Computing, Austria).

III. RESULTS AND DISCUSSION

Inosinic acid is associated with umami taste, whereas hypoxanthine is associated with a cured meat taste [1,4]. Free ribose (a reducing sugar) and phosphate are released from the degradation of the remaining inosinic acid into the purine base hypoxanthine. Prolonged aging and elevated pH levels decrease the level of inosinic acid but increase the level of hypoxanthine [2]. The concentration of inosinic acid in the *deep pectoralis* muscle of Hanwoo steers was observed to be relatively high. Previous study has shown that the content of inosinic acid and its derivatives, i.e., inosine and hypoxanthine, is higher in chicken breast muscle (*deep pectoralis*) than in meat from other parts [3]. This

explains that use of beef brisket in preparing beef stock is more suitable than meat from other parts such as rump. Different cooking methods had no significant effects on cooking loss (Figure 1A) although the lower trend was found on boiling method. As water was used as the medium of heat transfer in boiling method, it slows the loss of moisture during cooking. As expected, these attributes affected the concentration (dry matter basis) of inosinic acid and its derivatives. In this study, the concentration of water-soluble taste precursors was higher in oven-roasted samples than in boiled samples ($p<0.001$). Oven roasting remained higher content of inosinic acid (Figure 1 B), inosine (Figure 1 C) and hypoxanthine (Figure 1 D) in beef brisket as no water was used as medium of heat transfer during cooking.

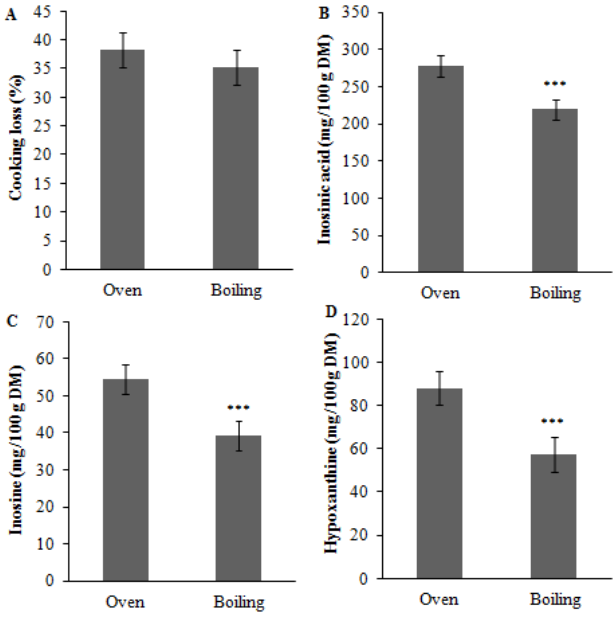

Figure 1. Cooking loss (A), inosinic acid content (B), inosine content (C) and hypoxanthine content (D) of Hanwoo brisket (*deep pectoralis*) subjected to different thermal processes

IV. CONCLUSION

The effects of different cooking methods on the concentration of water-soluble taste precursors from 5'-nucleotide (inosinic acid) and its derivatives were investigated in this study. These evidences can be used to explain scientifically that cooking in boiling water (moist heat method) extracts umami-related compounds to the water for further use to enhance the taste of beef stock.

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REFERENCES

1. Zhang, F., Klebansky, B., Fine, R. M., Xu, H., Pronin, A., Liu, H., Tachdijan, C. & Li, X. (2008). Molecular mechanism for the umami taste synergism. Proceedings of the National Academy of Sciences of the United States of America 105: 20930-20934.
2. Tikk, M., Tikk, K, T., Tørngren, M. A., Meinert, L., Aaslyng, M. D., Karlsson, A. H. & Andersen, H. J. (2006). Development of inosine monophosphate and its degradation products during aging of pork of different qualities in relation to basic taste and retronasal flavor perception of the meat. Journal of Agriculture and Food Chemistry 54: 7769-7777.
3. Jayasena, D. D., Jung, S., Kim, H. J., Bae, Y. S., Yong, H. I., Lee, J. H., Kim, J. G. & Jo, C. (2013). Comparison of quality traits of meat from Korean native chickens used in two different traditional Korean cuisines. Asian-Australasian Journal of Animal Science 26: 1038-1046.
4. Ichimura, S., Nakamura, Y., Yoshida, Y. & Hattori, A. (2016). Hypoxanthine enhances the cured meat taste. Animal Science Journal 88: 379-385.