INVESTIGATION OF LIPID OXIDATION MARKERS IN HANWOO *DEEP PECTORALIS* COOKED USING DIFFERENT METHODS

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Abstract – This study was aim to investigate the formation of lipid-oxidation related markers, such as hexanal, heptanal, malondialdehyde and free iron in Hanwoo (Korean native cattle) *deep pectoralis* muscles cooked in boiling water or oven roasted at 180 °C to final core temperature of 77 °C. Oven roasted samples had higher malondialdehyde content and released more free iron, hexanal and heptanal than the boiled samples did. Free iron and heptanal were positively associated with malondialdehyde content with Pearson's correlation coefficients of 0.92 ($p<0.001$) and 0.70 ($p<0.05$), respectively. Oven roasting required longer cooking time than boiling to reach desired final core temperature thus increased the occurrence of lipid oxidation.

Key Words – free iron, heptanal, malondialdehyde.

I. INTRODUCTION

Lipid oxidation promotes off-flavor formation and quality deterioration of meat products, causes the loss of nutritional and functional value and generates compounds that have negative effects on human health. Thus, it can diminish the sensory properties that are the main factors in consumer meat purchasing [1]. Different thermal treatments or cooking methods influenced malondialdehyde, free iron and lipid oxidation-related aldehydes content as markers in foal meat [2]. Therefore, this study aimed to investigate the effect of two cooking methods (dry and moist heat) on the formation of lipid oxidation-related markers in beef brisket of Hanwoo.

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 time was recorded and samples were ground for determining the malondialdehyde content using 2-thiobarbituric acid reactive substances (TBARS) assay, free iron content [3], hexanal and heptanal. Volatiles were identified using solid phase microextraction-gas chromatography-mass spectrometry and the peak area was measured [4]. Data were subjected to one-way analysis of variance (ANOVA) and Pearson's correlation coefficients were also determined using R-version 3.3.2 with "Agricolae" library (The R-foundation for Statistical Computing, Austria).

III. RESULTS AND DISCUSSION

Samples that were oven-roasted at 180 °C required longer time to cook (50.50 min) than did samples that were boiled (22.83 min) to reach the final core temperature of 77 °C. A greater lipid oxidation occurred in oven-roasted samples ($p<0.05$) than in boiled samples (Figure 1a). This suggests that prolonged heat exposure accelerates the oxidation of polyunsaturated fatty acids, thus accumulate higher malondialdehyde content than shorter heat exposure to the beef samples. The free iron content of oven-roasted group was higher than that of the boiled group (Figure 1b). Moreover, the concentration of free iron in cooked samples had a positive correlation with the TBARS value ($r=0.92$, $p<0.001$) as shown in Table 1. This evidence agrees with previous finding that free ionic iron released from heme pigments and ferritin is considered one of the major catalysts in lipid oxidation [1,3].

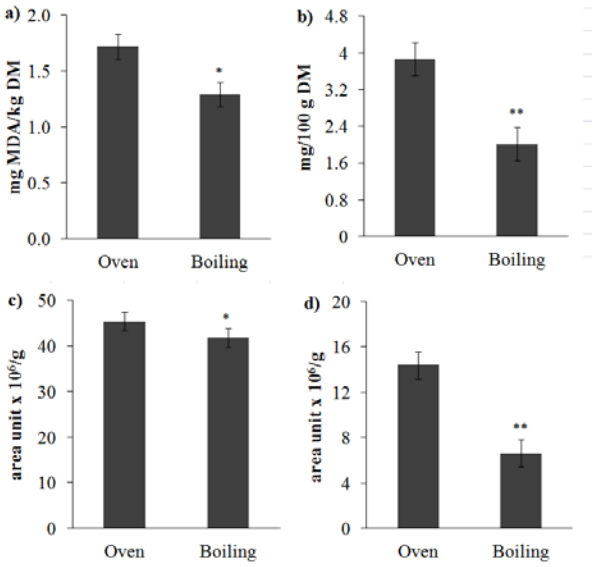

Figure 1 Effect of different cooking methods on the content of malondialdehyde (MDA) (a) and free iron (b), and the peak area of hexanal (c) and heptanal (d) of Hanwoo *deep pectoralis*

Other lipid oxidation markers that used in previous studies are hexanal and heptanal [5]. In this study, however, only heptanal showed positive correlation ($r = 0.70$, $p<0.05$) with TBARS value. Hexanal ($p<0.05$) and heptanal ($p<0.01$) were significantly higher in oven roasted samples than in boiled samples as shown in Figure 1c and Figure 1d, respectively. The formation of heptanal was positively associated with the formation of hexanal ($r = 0.86$, $p<0.001$) and the formation of heptanal also had positive association with the release of free iron in cooked beef brisket.

Table 1 Pearson correlation coefficients between lipid oxidation markers (pooled means, n = 12)

Item	Free iron	Heptanal	Hexanal
TBARS	0.92***	0.70*	0.52
Hexanal	0.48	0.86***	-
Heptanal	0.67*	-	-

IV. CONCLUSION

Prolonged heat exposure in oven roasting method increased the occurrence of lipid oxidation. TBARS value along with free iron and heptanal content can be used as marker for lipid oxidation study in beef brisket.

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