METABOLOMICS PROFILING AND CHEMICAL ANALYSES TO IDENTIFY COMPOUNDS ASSOCIATED WITH PALATABILITY ATTRIBUTES OF DRY-AGED BEEF LOINS

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I. INTRODUCTION

Dry-aging is a traditional process, where whole carcass or primal/sub-primal sections are stored without packaging material under a controlled refrigerated conditions. Improved eating quality attributes (flavor in particular) through dry-aging have been documented in scientific articles [1-2]. However, chemical compounds that positively affect meat quality attributes of dry-aged beef have not been fully established. Therefore, the objective of this study was to identify chemical compound associated with the dry-aged flavor utilizing a metabolomics approach coupled with other chemical analyses and consumer descriptive sensory comments. This study was a further investigation of our previous study [3], where significant improvement in palatability traits, such as tenderness, juiciness, and flavor, were found in low marbled/grass-fed beef loins through dry-aging.

II. MATERIALS AND METHODS

Paired beef loins (*M. longissimus lumborum*) from 9 beef carcasses were obtained at 7 d postmortem, cut into two sections and randomly assigned to three different aging methods: conventional dry-aging (DA), vacuum packaged wet-aging (WA) and dry-aging in a high water permeable bag (DW) for 28 d at 2ºC as previously reported [3]. After aging, multiple steaks from each section were collected for consumer panel sensory evaluation, chemical analyses and metabolomics analysis. The consumer panelists (n=120) were asked to evaluate the palatability traits as well as provide additional comments on each trait. The frequency of similar descriptive comments was then quantified for the statistical analysis. The 2-thiobarbituric acid reactive substances (TBARS), carbonyl protein oxidation, volatile compounds and fatty acid were measured. UPLC-ESI-MS metabolomics was conducted and the relative abundance of metabolites was quantified and normalized for the statistical analyses. Data were analyzed by split-plot ANOVA using PROC MIXED and PROC LOGISTIC from SAS, and LS means were separated ($P<0.05$). Principal component analysis (PCA) was performed on the metabolites using the R software.

III. RESULTS AND DISCUSSION

A total of 1666 metabolites were detected, in which 125 metabolites were found to be significantly responsive to aging treatments ($P<0.05$). The PCA analysis result exhibited distinct clusters of metabolites between dry-aged and wet-aged treatments (Fig 1.). Higher abundance of compounds possibly related to flavor, such as thiamine thiazole, thymidine monophosphate and pyroglutamic acid were observed in DA and DW compared to WA ($P<0.05$). Multiple glutamine containing dipeptides as well as adenosine monophosphate were also observed to be higher in DW and DA ($P<0.05$). No significant difference in carbonyl oxidation between the treatments was observed ($P>0.05$). However, significant differences in lipid oxidation (TBARS) were found between different aging treatments, where DA and DW beef samples had slightly higher MDA levels (0.62 and 0.65 mg/kg, respective) as compared to WA beef samples (0.55 mg/kg). For volatile compound analysis, methanethiol and ethanol were found to be higher in DA compared to DW and WA ($P<0.05$). 2-Heptanone was observed to be higher in both DA and DW compared to WA ($P<0.05$). No significant difference in fatty acid profile was observed except for docosapentaenoic acid, where the content in DW was higher than the other treatments ($P<0.05$). Based on the consumer comment analysis, higher frequency rates were found in beef samples from

DA and DW compared to WA for flavor and juiciness (P<0.05), which were in agreement with our previous sensory results [3]. Higher counts of "Very Juicy" and "Very Tender" comments were also observed in DW compared to the other treatments. From the comments provided by the consumer, descriptive flavor comments (e.g. beefy, smoky) were expressed more frequently in DA samples compared to WA counterparts.

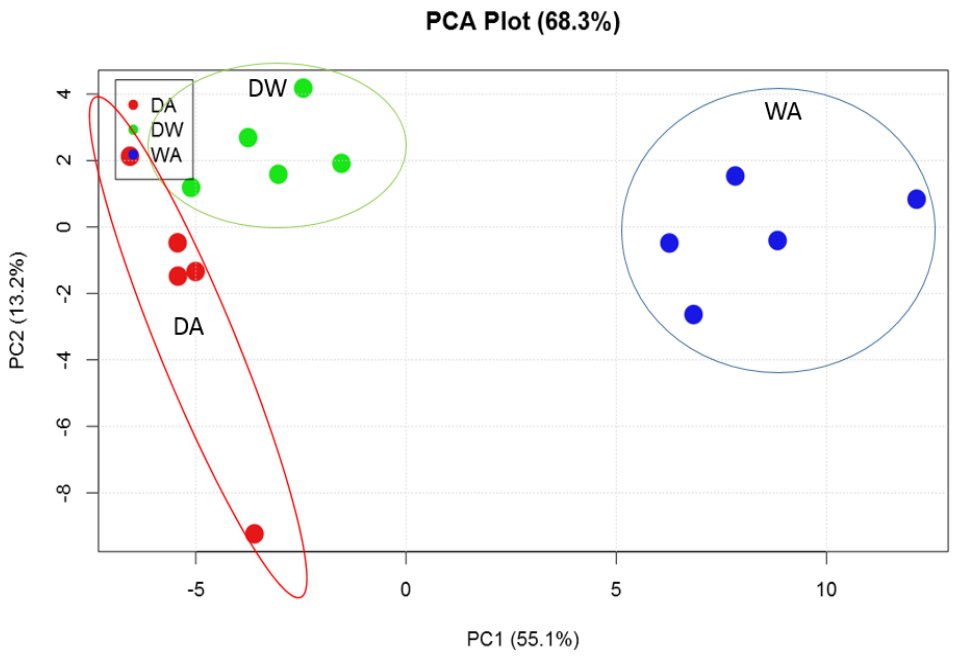

Figure 1. PCA analysis of identified metabolites (P<0.05) in samples from different treatments (DA: Dry-aging, DW: Dry-aging in high permeable bag, WA: Wet-aging).

IV. CONCLUSION

The results from the current study found that some flavor-related metabolites and chemical compounds were more liberated through dry-aging compared to the wet-aging counterpart, which could be possibly attributed to the dry-aged taste/flavor of beef loins. Descriptive comments from non-trained consumer panelists were in good agreement with the results of consumer sensory evaluation as well as flavor-related chemical analyses for dry-aged beef. Further research on identifying potential biomarkers for dry-aged flavor/taste by correlating those metabolites, volatile chemical compounds, and sensory results is currently underway.

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