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Effects of dry- and wet-aging on volatile flavor compounds and eating quality of various Hanwoo beef muscles
(#161)

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Introduction
In the meat industry, two the most commonly-applied aging methods which are wet-aging and dry-aging. The nature of wet-aging is placing beef cuts into plastic bags which are vacuum-sealed and stored in refrigerated temperature (Smith et al. 2008), and its advantageous points are increased juiciness and tenderness due to retained meat's moisture (Kim et al. 2019). While, the nature of dry-aging is hanging beef carcasses or quarters in a cold room without any protective packaging materials (Savell, 2008). Previous studies reported that dry-aging results in a beefier and more flavorful beef (Xin et al. 2014). Although these aging techniques generally improves the eating quality of beef as mentioned above, also the huge contributions of aroma compounds to the cooked beef flavor development have been demonstrated (Mottram, 1998), there is no published research detecting and identifying aroma compounds in dry-aged beef. This study aimed at investigating the effects of wet-and dry-aging methods on the volatile flavor compounds and eating quality of various Hanwoo beef muscles.

Methods
Sampling and aging treatmentBeef samples were collected from carcasses (Grade 2) of Hanwoo cows (34-60 mon old). At 24 h postmortem, hindquarters and bone-in loins were obtained from the carcass sides and used for dry-aging. While, for the wet-aging treatment, 3 cuts (boneless): Loin, top-round and rump were obtained from the carcasses. For dry-aging, the samples were aged by direct exposure to aging environment (2~4℃ & 65-85% humidity) without any package. The samples assigned to wet-aging were individually vacuum-packaged in a Nylon/PE vacuum bag, and aged at 1℃. The aging was carried out in the aging rooms for 0, 20, 40 and 60 d. At the end of each aging period, 3 muscles: Longissimus thoracis(LT), semimembranosus(SM) and glutaeusmedus(GM) (n=3 each) were collected from the corresponding cuts and used for analyses.Flavor compounds analysisVolatile flavor compounds were extracted using solid-phase micro-extraction and analyzed using our previously-standardized method (Ba et al. 2010).Sensory evaluationSensory evaluation was carried out using trained panels as described by Cho et al. (2016).Statistical analysis The obtained results were analyzed using Statistic Analysis System package (SAS Institute, USA, 2010). Significance among the treatments was verified at the 5% level by Student-Newman-Keul multiple test.

Results
The changes in total amounts of classes of flavor compounds in cooked beef muscles by different aging methods and times are presented in Fig 1 & 2. The total amounts of lipids-derived compounds such as, aldehydes and alcohols were significantly ($p<0.05$) higher in most dry-aged muscles than those in the wet-aged ones (Fig 1A, B). Similarly, the total amounts of Maillard reaction products such as, pyrazines and nitrogen-and sulfur-containing compounds were significantly higher in all muscles aged under the dry-aging condition compared to those aged under the wet-aging condition (Fig 2A, C & D). Especially, under the same dry-aging condition the GM and SM muscles had higher total amounts of pyrazines and sulfur-containing compounds compared to LT muscle ($p<0.05$). It well known that eating quality attributes, specifically tenderness and flavor are the most important factors affecting the purchasing decision by consumers for beef. Result (Fig 3) showed that both aging methods improved tenderness and flavor as the scores were significantly increased with increased aging time for all the muscles. Noticeably, compared to the wet-aging the dry-aging resulted in significantly higher flavor scores for GM and SM muscle after 20 or 40 and 60 d aging ($p<0.05$). This could be attributed to the significantly higher amounts of flavor compounds (e.g., pyrazines, nitrogen-and sulfur-containing compounds) in these dry-aged muscles (Fig 1 & 2).

Conclusion
It may be concluded that postmortem aging especially dry-aging could be used to improve eating quality attributes especially the flavor of low grade carcasses-derived beef muscles (GM and SM). Further study in characterizing more descriptive flavor attributes by using a larger number of sensory panels is necessary.

Acknowledgement
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Reference
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Notes

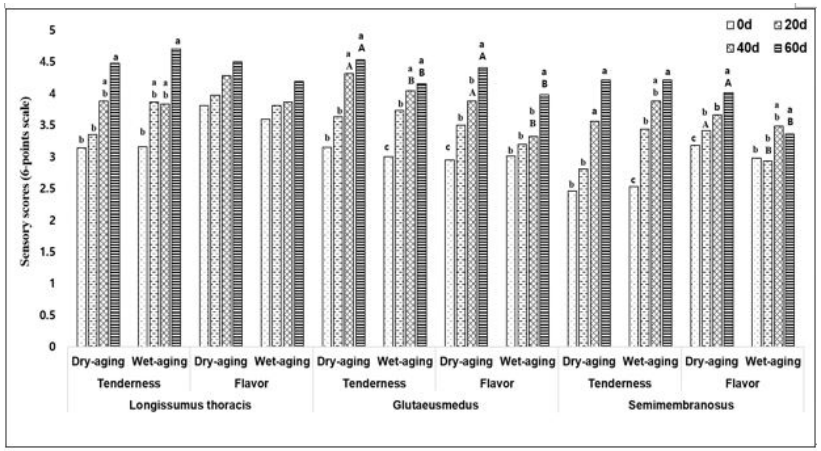

Fig. 2. Sensory properties of beef *Longissmus thoracis*, *Glutaeusmedus* and *Semimembranosus* muscles as affected by different aging methods and durations. The means were calculated using 6-points scale (6=extremely like; 5=like very much; 4=like moderately; 3=neither like nor dislike; 2=dislike very much and 1=dislike extremely). Means within each aging method and sensory attribute with different letters (a-c) differ significantly ($p<0.05$). Means within each muscle, sensory attribute and aging time with different letters (A-B) are significantly different ($p<0.05$).

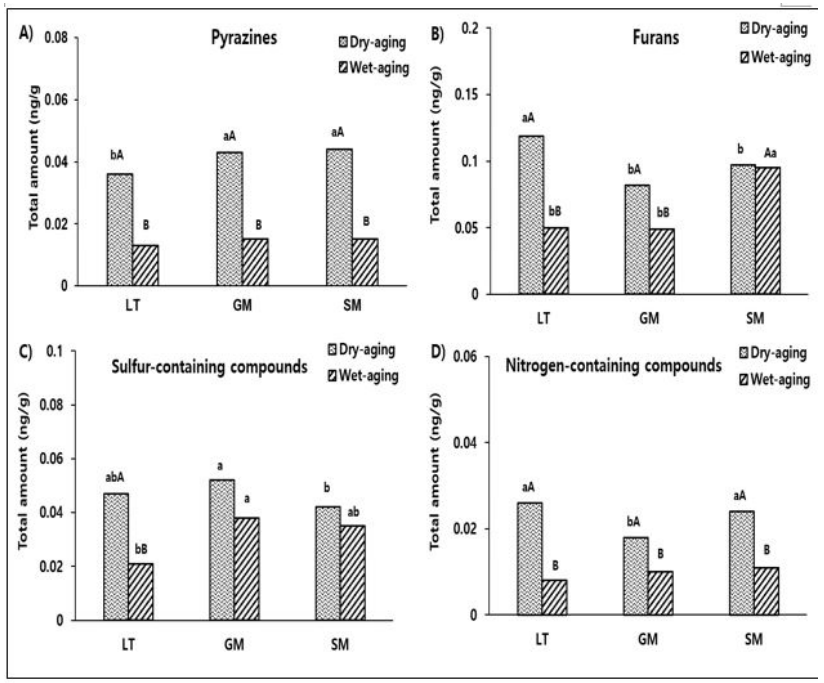

Fig. 2. Total amount (averaged from 0, 20, 40 and 60 d aging) of pyrazines (A), furans (B), sulfur-containing compounds (C) and nitrogen-containing compounds (D) during aging periods (0, 20, 40 and 60 d). ST: *Longissimus thoracis*; GM: *glutaeusmedus*; SM: *semimembranosus*.

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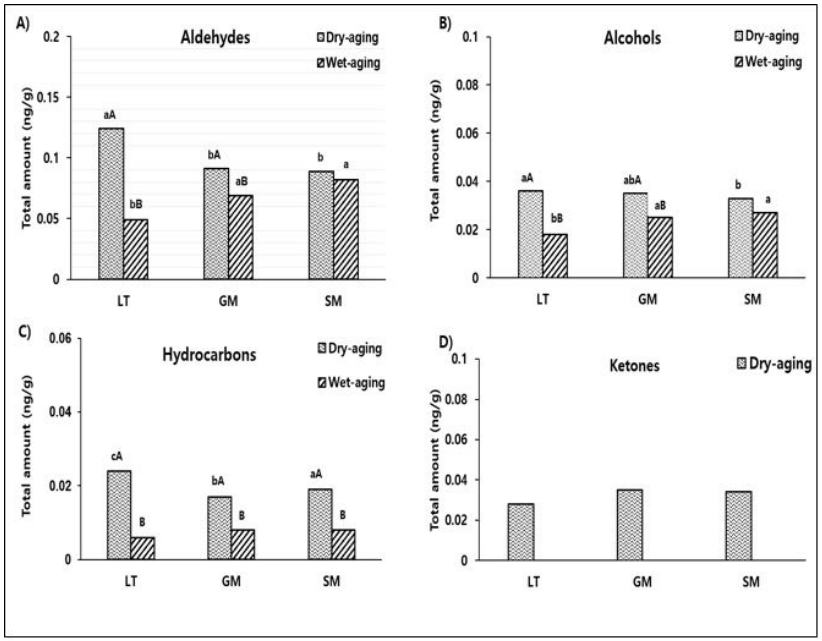

Fig. 1. Total amount (averaged from 0, 20, 40 and 60 d aging) of aldehydes (A), alcohols (B), Hydrocarbons (C) and ketones (D). ST: *Longissimus thoracis*; GM: *glutaeusmedus*; SM: *semimembranosus*.

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