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CHILLER AGEING IS MORE IMPORTANT THEN INTRAMUSCULAR FAT ON CONSUMER TENDERNESS FOR HIGH MARBLING BEEF

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I. INTRODUCTION

Consumers evaluate overall satisfaction when consuming beef, considering tenderness, flavor, and juiciness, among other factors. Among these, tenderness is known to have the most significant impact [1-3]. For general consumers or untrained panels, the evaluation of beef taste/satisfaction is influenced by societal culture and previous experiences [4]. For example, Korean and Japanese consumers prefer tender beef with fine marbling, while European consumers prefer beef with less marbling for health reasons [5,6]. The tenderness of beef is determined by various mechanisms, both inherent and acquired, such as muscle fiber density, characteristics of connective tissue, level and distribution of marbling, post-slaughter processing, and aging [7]. In Korea's carcass grading system, the amount of marbling is evaluated according to the Beef Marbling Standard (BMS) on a scale from 1 (devoid) to 9 (very abundant) [8]. Marbling in beef refers to the distribution of fat within the muscle in a specific pattern, whereas fat content represents the proportion of fat within the entire meat. Although finer marbling tends to correlate with an increase in fat content, fat content itself does not fully represent marbling [9]. This study was conducted with Korean consumers to compare the effects of aging and marbling levels on the tenderness evaluation of beef in different marbling level groups.

II. MATERIALS AND METHODS

From 2007 to 2020, data on Hanwoo beef analyzed at Jeonbuk National University and the National Institute of Animal Science were collected. The analysis results for the Longissimus thoracis (LT) muscle from a total of 231 heads (29 bulls, 57cows, 24 heifers and 121 steers) generated across four projects were utilized. All animals were conventionally raised in feedlots and slaughtered according to the regulations set forth by the Korea Animal Plant Quarantine Agency of the Ministry of Agriculture, Food and Rural Affairs for beef slaughter at commercial abattoirs. And then immediately moved to a chilling room and stored at 4 °C, after 24 h in the chilling room, all carcasses were graded according to the Korean Beef Carcass Grading System included intramuscular fat grade (include marbling sore) [11]. Aging was initiated 24 hours post-slaughter, designated as Day 0 of aging, and data were collected up to Day 21. The sensory-tenderness evaluation methods used in the analysis were consistent across all projects. For sensory evaluation of tenderness, a 100mm line scale method was used, with the item scale ranging from very tough (0) to very tender (100). The level of marbling score was classified into low marbling group (score 1-5) and high marbling group (score 6-9), the average fat contents(%) were 11.57% and 17.85%, respectively. The statistical analysis was conducted using IBM SPSS Statistics (version 27.0, SPSS Inc., Chicago, IL, USA). The comparison of the impact of intramuscular fat level and aging on tenderness was conducted using multiple regression analysis.

III. RESULTS AND DISCUSSION

To compare the degree of influence of aging and marbling levels on beef tenderness evaluation in different marbling level groups of Hanwoo, multiple linear regression analysis was conducted, and the results are shown in Tables 1 and 2. In the low marbling group (Table 1), both aging days and marbling score showed a significant positive correlation ($\beta = 0.649$, $p < 0.001$; $\beta = 0.181$, $p < 0.01$). The regression model was found to be appropriate with $F = 64.504$ ($p < 0.01$), and the adjusted R^2 was 0.458, indicating approximately 42% explanatory power. On the other hand, in the high marbling group (Table 2), aging days had a significant effect on consumer tenderness evaluation ($\beta = 0.376$, $p < 0.001$), whereas marbling score did not show any significant influence. The regression model was still appropriate with $F = 6.407$ ($p < 0.01$); however, the adjusted R^2 was 0.120, showing a very weak explanatory power.

Table 1 – Comparison of the effects of aging days and marbling on consumer sensory-tenderness evaluation in LT muscle of low marbling group.

Variations	Unstandardized coefficient		standardization coefficient	t(p)	TOL	VIF
	β	SE	β			
(Coefficient)	44.758	2.421		18.490		
Aging days	1.486	0.138	0.649	10.789***	0.997	1.003
Marbling score	1.971	0.656	0.181	3.004**	0.997	1.003
F(p)			64.504**			
Adj.R^2			0.458			

***P<0.001; **P<0.01

Table 2 – Comparison of the effects of aging days and marbling on consumer sensory-tenderness evaluation in LT muscle of high marbling group.

Variations	Unstandardized coefficient		standardization coefficient	t(p)	TOL	VIF
	β	SE	β			
(Coefficient)	61.736	8.869		6.961		
Aging days	0.882	0.248	0.375	3.551***	0.998	1.002
Marbling score	0.758	1.227	0.065	0.618	0.998	1.002
F(p)			6.407**			
Adj.R^2			0.120			

***P<0.001; **P<0.01

IV. CONCLUSION

According to the results, in the low marbling group, both aging and marbling score showed a significant positive effect. These findings suggest that beyond a certain level of marbling, the significance of marbling score (related marbling fineness) in tenderness evaluation by consumers may diminish. Furthermore this suggests that improving tenderness through aging may be more effective than enhancing the marbling score.

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