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COMPARATIVE ANALYSIS OF FATTY ACIDS, AMINO ACIDS, AND BIOACTIVE METABOLITES IN KOREAN NATIVE CATTLE AND IMPORTED BEEF

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I. INTRODUCTION

Meat consumption per capita in Korea has steadily increased over decades [1]. Following the COVID-19 pandemic, public interest has expanded from general nutritional needs to functional foods that support immunity, especially those rich in protein, essential amino acids, zinc, and iron. This shift has driven demand for high-quality, health-oriented meat products. While Hanwoo remains central to Korea's beef market, native breeds such as Chikso, Black cattle, and Black Hanwoo are gaining renewed attention. These breeds are not only part of Korea's livestock biodiversity but are also considered valuable resources in the context of consumer interest in breed origin and sustainable meat production. However, research on their nutritional and functional characteristics remains limited, as most existing studies focus on Hanwoo and marbling traits. This study compares the fatty acid composition, amino acid profile, and bioactive metabolites of native Korean cattle and imported beef. Findings aim to support the development of value-added, breed-specific meat products for health-conscious and aging populations.

II. MATERIALS AND METHODS

The Korean native cattle used in this study included six castrated Chikso steers (average age: 30 months), twelve Black Cattle steers (average age: 33 months), and twelve Black Hanwoo steers (average age: 31 months). All animals were slaughtered at the experimental slaughterhouse of the National Institute of Animal Science, and *Longissimus lumborum M., Psoas major M.*, and *Adductor M.* muscles were collected after chilling (18–24 h) until the internal temperature dropped below 5°C. Imported beef samples included five U.S. Angus (Choice grade) and five Australian Wagyu (MB2 and MB5 grades), which were purchased within 20 days post-slaughter via air transportation, and the same muscle parts were collected for analysis.

Fatty acid composition was analyzed using gas chromatography (GC), and free amino acids were quantified using HPLC. Metabolites were analyzed without extraction using HR-MAS 600 MHz NMR, and spectral data were processed using the Chenomx NMR Suite 7.1. Statistical analysis was performed using SAS (2005), and significance between groups was determined using the Student-Newman-Keuls multiple comparison test ($p<0.05$).

III. RESULTS AND DISCUSSION

Korean native cattle exhibited significantly lower SFA/UFA (saturated/unsaturated fatty acid) ratios and higher levels of unsaturated fatty acids than imported beef, indicating better lipid quality. A lower SFA/UFA ratio corresponds to a higher proportion of unsaturated fatty acids associated with a reduced risk of cardiovascular disease [2]. Ponnampalam et al. [3] reported that a lower SFA/UFA ratio improves the lipid quality of beef. Korean native cattle demonstrate this favorable trait, suggesting potential health benefits. Although Korean native cattle showed higher ω-6/ω-3 ratios than imported beef (e.g., Chikso 32.6, Heugu 23.1, Black Hanwoo 16.8 vs. U.S. 18.5, Australia 8.8), they still retain their value as health-promoting meat due to their functional metabolite profiles and balanced fatty acid composition. Chikso and Black Hanwoo had higher levels of valine and threonine, which were functionally associated with protein synthesis and immune function, showing statistically significant differences. These findings are consistent with Kwon and Choi [4], who reported that Hanwoo beef contains a higher proportion of essential amino acids to total free amino acids, as well as significantly higher levels of anserine and carnosine compared to imported beef, indicating superior protein quality and bioactivity. Additionally, Korean native breeds showed higher concentrations of taurine, carnosine, carnitine, and creatine, highlighting their potential as functional meat sources with enhanced nutritional and physiological properties.

Table 1 – Comparison of fatty acids, amino acids, and metabolites by breed.

Trait			Breed				
			Chikso	Black Cattle	Black Hanwoo	Angus (USA)	Wagyu (Australia)
Fatty acid (%)	SFA		43.83^{CD}	43.44^{D}	45.88^{C}	48.77^{B}	51.51^{A}
	UFA		56.17^{AB}	56.56^{A}	54.12^{B}	51.23^{C}	48.49^{D}
	SFA/UFA		0.78^{A}	0.77^{A}	0.85^{A}	0.95^{B}	1.06^{C}
	ω-6/ ω-3		32.60^{A}	23.13^{B}	16.77^{B}	18.47^{B}	8.81^{C}
Amino acid (%)	Essential	Leucine	8.82^{B}	3.04^{C}	6.80^{B}	15.15^{A}	16.69^{A}
		Valine	4.88^{A}	2.24^{B}	3.84^{A}	1.15^{B}	1.37^{B}
		Threonine	3.83^{B}	2.63^{C}	3.90^{B}	7.74^{A}	8.49^{A}
		Isoleucine	2.59^{CD}	1.77^{D}	3.12^{C}	5.14^{B}	6.47^{A}
		Lysine	4.45^{A}	3.59^{AB}	5.19^{A}	2.15^{B}	2.26^{B}
		Phenylalanine	4.41^{B}	2.82^{C}	5.14^{B}	8.44^{A}	8.52^{A}
		Histidine	2.62^{B}	1.91^{C}	2.68^{B}	6.54^{A}	6.78^{A}
Metabolic profiles (mM)	Flavor	Taurine	17.66*	15.04	16.13	7.71	11.74
		Carnosine	33.39^{A}	34.63^{A}	33.80^{A}	28.54^{AB}	20.49^{B}
	Functionality	Carnitine	13.88^{A}	13.94^{A}	13.52^{A}	6.33^{B}	7.57^{B}
		Creatine	69.61^{A}	80.70^{A}	75.03^{A}	73.20^{A}	56.92^{B}
		Acetate	2.67^{AB}	1.87^{C}	2.89^{BC}	6.25^{A}	3.22^{B}
		Lactate	271.10^{A}	270.18^{A}	263.54^{A}	201.73^{B}	136.07^{C}

$^{A-D}$ Means within a row with different superscript letters differ significantly (P<0.05).

IV. CONCLUSION

Korean native cattle possess superior functional and nutritional profiles, indicating their potential as raw materials for personalized, value-added meat products targeting aging and health-conscious populations.

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