71st ICoMST
GIRONA - CATALONIA - SPAIN
3rd-8th August - 2025

IMPACT OF FATTY ACID COMPOSITION ON THE TEXTURAL PROPERTIES OF MEAT AMONG DIFFERENT PIG BREEDS: A COMPREHENSIVE ANALYSIS

Mia Nayeem[1], Jeong-Uk Eom[1], Kang-Jin Jeong [1], Han-Sul Yang[1,2,*]

[1]Division of Applied Life Science (BK21 Four), [2]Institute of Agriculture and Life Science, Gyeongsang National University, Jinjudaero, 501 Jinju, Gyeongnam 52828, Republic of Korea

*Corresponding author email: hsyang@gnu.ac.kr

I. INTRODUCTION

Meat texture is a crucial factor in determining consumer satisfaction and marketability, with attributes such as tenderness, juiciness, and chewiness being heavily influenced by the fatty acid composition of the meat. Fatty acids, categorized into saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), and polyunsaturated fatty acids (PUFA), each play distinct roles in shaping the meat's texture. While SFAs are associated with firmer meat, PUFAs contribute to improved tenderness and juiciness. While previous studies have highlighted differences in fatty acid profiles across pig breeds, the precise relationship between fatty acid composition, breed, and textural qualities remains underexplored. This research aims to fill that gap by examining how fatty acid profiles in three widely raised pig breeds, Duroc, Landrace, and Yorkshire, correlate with their meat's textural properties. By identifying breed-specific fatty acid compositions and linking them to key textural characteristics, this study provides fresh insights into how these profiles influence meat quality. The findings promise practical applications, such as targeted breeding or diet modifications, that could significantly enhance meat tenderness and juiciness, making a valuable contribution to the meat production industry.

II. MATERIALS AND METHODS

In this study, 10 pigs were randomly selected (male or female) from three different breeds (Duroc, Landrace, and Yorkshire), with 10 pigs from each breed. The pigs' ages ranged from 122 to 130 days, and their weights varied between 112 and 120 kg. The study did not specifically consider variations in the pigs' diets and sex. Therefore, the same amount of conventional feeds were used for every breed for this experiment. The fresh pork loin was used for analysis. The fatty acid composition of the meat was analyzed using Gas Chromatography. The meat's tenderness was evaluated following the TPA (Texture Profile Analysis) method. Principal Component Analysis (PCA) was conducted to identify the most significant variables influencing meat texture, followed by correlation analysis and regression analysis to determine the relationship between fatty acid composition and textural properties. All data were analyzed using JMP Pro 17 software, developed by SAS Institute, and Python was used for further statistical processing. Tukey's test was applied at $p < 0.05$. Results are presented as mean ± standard error.

III. RESULTS AND DISCUSSION

The fatty acid profiles and their influence on the textural properties of meat from three pig breeds, Duroc, Landrace, and Yorkshire were analyzed. Significant differences in the concentrations of various fatty acids were observed across these breeds. C16:1 (Palmitoleic acid) and C18:3n-3 (alpha-linolenic acid) had significantly higher concentrations in Duroc compared to Landrace and Yorkshire, while C16:0 (Palmitic acid) showed the highest concentration in Duroc (154.56 mg/100g), but it's not a significant effect. From correlation analysis, we find, the presence of C15:0 (pentadecanoic acid) was positively correlated with Cohesiveness, suggesting that higher concentrations of C15:0 lead to enhanced meat texture, contributing to better meat structure and retention, although it had no significant value among these breeds. C18:3n-3 (alpha-linolenic acid), C18:2 cis (Linoleic acid), C20:2 (Eicosadienoic acid), a polyunsaturated fatty acid (PUFA), and C(20-22) saturated fatty acids exhibited greater variability across breeds. Principal Component Analysis (PCA) and correlation revealed that C18:1 trans, C18:1 cis, and C16:0 were strongly associated with Cohesiveness, Springiness, and brittleness, while C16:1, C18:3n-3, and C22:0 were more related to Hardness, chewiness, and Gumminess, influencing the firmness of the meat. Regression analysis confirmed that C18:1 cis positively correlated with Cohesiveness, C18:2 trans negatively impacted brittleness, and C20:2 was a strong contributor to Hardness, these findings suggest that PUFAs could be leveraged to improve meat tenderness and juiciness, while balancing SFAs like C16:0 can help maintain desirable firmness, (although it has no significant effect among the breed) offering opportunities for selective breeding and dietary modifications to optimize meat quality [1, 2].

Table 1 – Fatty Acid Composition and Its Influence on Meat Texture Across Different Pig Breeds.

Fatty acid (mg/100g tissue)		Concentration (mg/100g)			
		Duroc	Landrace	Yolkshire	Significant level
Saturated Fatty Acids (SFA)	C6:0	0.18±0.02	0.14±0.01	0.17±0.01	ns
	C10:0	0.69±0.07 ^{A}	0.28±0.07^{B}	0.57±0.07^{A}	***
	C12:0	0.81±0.12	0.73±0.11	0.98±0.12	ns
	C14:0	10.49±1.03	7.18±1.03	8.43±0.84	ns
	C15:0	0.43±0.06	0.48±0.06	0.43±0.05	ns
	C16:0	154.56±15.29	118.05±15.29	129.47±14.50	ns
	C17:0	1.54±0.24 ^{A}	0.39±0.26 ^{B}	1.63±0.18 ^{A}	***
	C18:0	88.88±44.57	22.45±44.57	128.78±41.69	ns
	C20:0	1.24±0.13 ^{A}	0.09±0.13^{B}	0.48±0.11 ^{B}	***
	C21:0	1.12±0.10 ^{A}	0.09±0.09 ^{A}	1.12±0.08 ^{B}	***
	C22:0	0.29±0.03 ^{A}	0.03±0.03 ^{B}	0.19±0.02^{C}	***
Monounsaturated Fatty Acids (MUFA)	C14:1	0.31±0.38	0.95±0.39	0.22±0.36	ns
	C16:1	21.73±2.57 ^{A}	2.81±2.82 ^{B}	14.25±1.99 ^{A}	***
	C17:1	0.66±0.55	-	0.57±0.29	ns
	C18:1 trans	53.46±35.42	25.22±11.81	15.08±14.46	ns
	C18:1 cis	56.80±4.68	64.63±4.4	49.79±4.28	ns
	C20:1	2.11±0.23 ^{A}	0.24±0.24 ^{B}	0.93±0.20 ^{B}	***
Polyunsaturated Fatty Acids (PUFA)	C18:2 trans	0.26±0.03	0.13±0.04	0.19±0.03	ns
	C18:2 cis	1.78±0.21 ^{A}	0.19±0.20 ^{B}	1.01±0.15 ^{B}	***
	C18:3 n-3	5.72±0.51 ^{A}	0.48±0.52 ^{B}	3.09±0.40 ^{C}	***
	C20:2	5.70±0.73 ^{A}	0.03±0.75 ^{A}	6.85±0.61 ^{B}	***
	C20:3 n-3	0.63±0.11 ^{A}	0.11±0.10 ^{B}	0.45±0.10 ^{AB}	*

A-C Different letters within different sample groups were significantly different (p<0.05).
ns= not significance, *p<0.05, **p<0.01,***p<0.001.

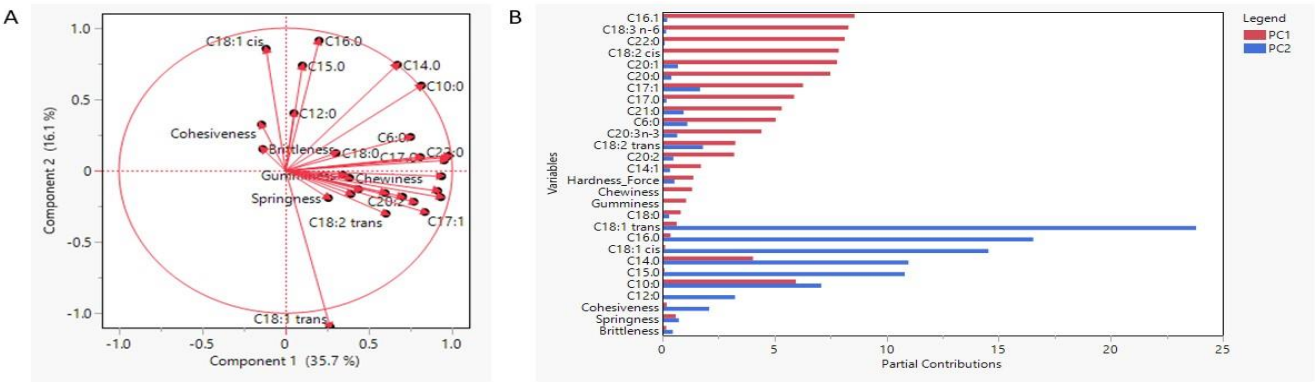


Figure 1. Principal Component Analysis (PCA) of Fatty Acid Composition and Its Impact on Meat Texture

IV. CONCLUSION

This study underscores the critical role of fatty acid composition in determining the textural properties of meat, with PUFAs contributing to tenderness and SFAs influencing meat firmness. Increasing the levels of PUFAs, particularly C16:1, C18:1 trans and C18:1 cis, could enhance meat quality by improving its hardness and cohesiveness, while a careful balance of SFAs like C16:0 may contribute to desirable firmness. These insights could lead to strategies for improving meat quality through selective breeding or dietary adjustments in pork production.

ACKNOWLEDGEMENTS

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science, and Technology (Project No. 2022R1A2C1013013116138211653010 1).

REFERENCES

1. Sampath, V.; Park, J. H.; Kim, I. H. (2023) Synbiotic-Glyconutrient Additive Reveals a Conducive Effect on Growth Performance, Fatty Acid Profile, Sensory Characteristics, and Texture Profile Analysis in Finishing Pig. Foods, 13(1): 105.
2. Seo, J. K.; Lee, Y. S.; Eom, J. U.; Yang, H. S. (2024) Comparing Physicochemical Properties, Fatty Acid Profiles, Amino Acid Composition, and Volatile Compounds in Dry-Cured Loin: The Impact of Different Levels of Proteolysis and Lipid Oxidation. Food Science of Animal Resources, 44(1): 103.