MUSCLE FIBER CHARACTERISTICS AND MEAT QUALITY TRAITS OF THE 8 MAJOR MUSLCES FROM HANWOO STEERS

Sung-Hyun Joo[1], Eun-Young Lee[1], Kyu-Won Lee[2], Young-Hwa Hwang[1] and Seon-Tea Joo[2*]

[1]Department of Animal Science, College of Agriculture and Life Science, Gyeongsang National University, Jiniu, Korea

[2] Division of Applied Science (BK21+), Graduated School, Gyeongsang National University, Jiniu, Korea

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

Abstract – To investigate the relationship between muscle fiber characteristics and meat quality, eight muscles were separated from Hanwoo steers, and muscle fiber composition and meat quality traits were measured. *Superficialis flexor* (SF) had a significantly higher fiber type I percentage, whereas the type II percentage was higher in *Longissimus thoracis* (LT), *Longissimus lumborum* (LL), and *Gluteus medius* (GM) muscles. LT muscle had significantly higher intramuscular fat (IMF) content, whereas the myoglobin (Mb) content was higher in *Psoas major* (PM) and SF muscles. IMF content was negatively correlated with fiber type I percentage and positively correlated with type IIB percentage. Results imply that the correlations are dependent on number of muscle kinds investigated.

Key Words – Muscle fiber characteristics, Hanwoo steers, Beef quality.

I. INTRODUCTION

Variations of meat quality exist because the quality traits are affected by various intrinsic and extrinsic factors. The beef quality is directly related to muscle fiber characteristics because skeletal muscles mainly consist to muscle fibers [1]. However, the relationship between quality traits and fiber characteristics is yet to be fully established. Moreover, the Korean beef industry as well as other developed countries is showing trends toward marketing individual muscle cuts to improve the value of retail beef cuts [2]. Therefore, the objective of this study was to investigate the relationship between muscle fiber characteristics and meat quality in 8 major muscles of Hanwoo steers.

II. MATERIALS AND METHODS

Six Hanwoo carcasses were selected randomly from a commercial slaughterhouse at 24 h postmortem, and eight muscles including LT, LL, PM, GM, SF, *Biceps femoris* (BF), *Triceps brachii* (TB), and *Abdominal oblique* (AO) were separated to investigate muscle fiber characteristics including total number of fibers and cross-sectional area of fibers. Also, the 8 muscles were used to measure meat quality traits such as IMF and moisture content, Mb and collagen content, meat color (CIE L*a*b*), drip loss, cooking loss, sarcomere length, Warner-Bratzler shear force (WBSF). Data were analyzed by SAS (2002). Duncan's multiple range test was used to determine the significant differences and Pearson correlation coefficients were evaluated.

III. RESULTS AND DISCUSSION

The muscle fibers in eight muscles obtained from Hanwoo cattle were divided into type I, IIA, and IIB (Fig. 1). A clear difference in fiber type composition was observed among the muscles. SF muscle had a significantly higher number percentage of fiber type I, whereas the number percentage of fiber type IIB was higher in LT, LL, and GM muscles (Table 1). Also, the number percentage of fiber type IIA was significantly higher in TB, AO, and SF muscles. Similar results were observed for the area percentage of fiber types among the muscles. In addition, many differences in meat quality traits were observed among the 8 muscles. LT muscle had significantly higher IMF content, whereas the Mb content was higher in PM and SF muscles. PM muscle had significantly longer sarcomere length and lower WBSF, while SF muscle had higher collagen content and WBSF. The lowest collagen content was observed in LT muscle.

The type I and type IIB fibers were inversely correlated to meat quality traits (Table 2). IMF content was negatively correlated with number percentage of type I ($r = -0.54$) and positively correlated with type IIB percentage ($r = 0.47$). This is exact opposite result with our previous study that investigated 3 muscles from highly marbled Hanwoo beef [3]. The type I percentage was also negatively correlated with L* value, but positively correlated with Mb content. Collagen content was negatively correlated with type IIB percentage and positively correlated with type IIA percentage. These results imply that the correlations are dependent on number of muscle kinds investigated.

Table 1 Muscle fiber characteristics and meat quality traits for 8 major muscles of Hanwoo steer.

Traits	LT	LL	PM	BF	GM	TB	AO	SF
Type I number (%)	20.83^{EF}	18.83^{F}	28.17^{B}	22.33^{DEF}	23.5^{CDE}	26.67^{BCD}	27.67^{BC}	32.83^{A}
Type IIA number (%)	14.17^{C}	18^{BC}	25^{AB}	25.33^{AB}	15.17^{C}	30.33^{A}	31^{A}	28.33^{A}
Type IIB number (%)	65.17^{A}	63.33^{A}	47.17^{BC}	52.33^{B}	61.33^{A}	43^{C}	41.17^{C}	38.83^{C}
Type I area (%)	26.67^{BCD}	27.67^{BC}	29.33^{B}	21.17^{D}	25.33^{BCD}	22.67^{CD}	29.5^{B}	36^{A}
Type IIA area (%)	10.67^{B}	13^{B}	22^{B}	35.17^{A}	9.33^{B}	20.5^{B}	39.67^{A}	14^{B}
Type IIB area (%)	62.67^{AB}	59.5^{AB}	49.17^{BC}	43.33^{CD}	65.17^{A}	56.83^{ABC}	31^{D}	50.17^{ABC}
Fat content (%)	14.84^{A}	12.5^{B}	8.66^{C}	5.05^{D}	8.15^{C}	5.83^{D}	11.61^{B}	4.47^{D}
Moisture content (%)	62.94^{C}	63.94^{C}	65.82^{B}	70.78^{A}	65.8^{B}	71.08^{A}	64.25^{C}	70.53^{A}
Drip loss (%)	1.32	1.38	1.33	1.69	1.75	1.80	1.34	1.48
Cooking loss (%)	24.01	25.01	23.31	29.38	28.87	30.32	27.25	27.46
L* value	38.9^{A}	38.48^{AB}	36.89^{BC}	35.42^{C}	35.62^{C}	35.11^{C}	35.91^{C}	33.14^{D}
a* value	20.8^{ABC}	20.68^{ABC}	22.47^{A}	18.88^{BC}	19.74^{ABC}	22.01^{AB}	21.92^{AB}	18.52^{C}
b* value	7.28^{AB}	7.19^{AB}	9.1^{A}	8.48^{AB}	8.55^{AB}	8.81^{AB}	8.96^{AB}	7.03^{B}
Myoglobin	8.98^{CD}	8.91^{CD}	13.02^{A}	7.91^{D}	8.35^{CD}	9.84^{BC}	11.06^{B}	13.86^{A}
Sarcomere length	2.02^{B}	2.15^{B}	2.52^{A}	1.89^{B}	1.85^{B}	1.92^{B}	2.02^{B}	1.94^{B}
WBSF	3.09^{BC}	3.12^{BC}	2.69^{C}	5.07^{A}	5.19^{A}	5.14^{A}	3.81^{B}	5.74^{A}
Collagen	1.11^{B}	1.14^{B}	1.32^{B}	1.41^{B}	1.43^{B}	1.5^{B}	1.54^{AB}	1.94^{A}

$^{A-F}$ Means with different superscripts in the same row are significantly different ($p<0.05$).

Table 2 Correlation coefficients between muscle fiber characteristics and meat quality traits for 8 muscles of Hanwoo steer.

	Fiber number (%)			Fiber area (%)		
	Type I	**Type IIA**	**Type IIB**	**Type I**	**Type IIA**	**Type IIB**
IMF (%)	-0.54^{***}	-0.27	0.46^{***}	-0.04	-0.08	0.10
CIE L*	-0.41^{**}	-0.47^{***}	0.58^{***}	-0.07	-0.15	0.18
Myoglobin (%)	0.67^{***}	0.24	-0.49^{***}	0.58^{***}	-0.02	-0.20
Collagen (%)	0.13	0.38^{**}	-0.37^{**}	0.17	0.07	-0.14

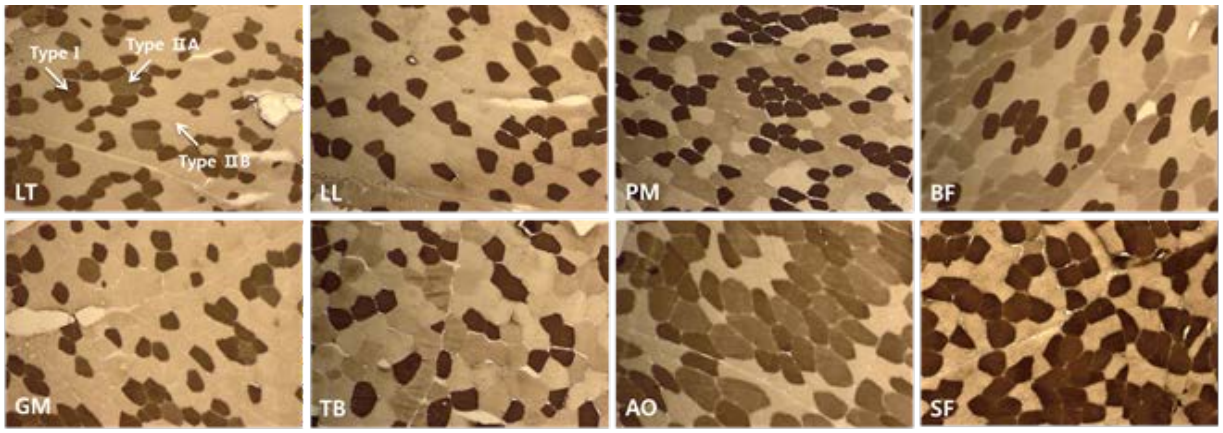

Figure 1. Serial sections of 8 major muscles stained for myosin ATPase reactivity after pre-incubation at pH 4.6.

IV. CONCLUSION

There are significant differences in fiber type composition and meat quality among the 8 major muscles from Hanwoo steers. The correlations between muscle fiber characteristics and meat quality traits are strongly affected by number of muscle kinds investigated.

REFERENCES

1. Joo, S. T., Kim, G. D., Hwang, Y. H. & Ryu, Y. C. (2013). Control of fresh meat quality through manipulation of muscle fiber characteristics. Meat Science 95: 828-836.
2. Jung, E. Y., Hwang, Y. H. & Joo, S. T. (2016). Muscle profiling to improve the value of retail meat cuts. Meat Science 120: 47-53.
3. Hwang, Y. H., Kim, G. D., Jeong, J. Y., Hur, S. J. & Joo, S. T. (2010). The relationship between muscle fiber characteristics and meat quality traits of highly marbled Hanwoo (Korean native cattle) steers. Meat Science 86: 456-461.