Influence of Composition of Muscle Fiber Type on Meat Quality Characteristics of Hanwoo Cattle

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Background and objective:

The beef quality of fresh meat is an important characteristic influencing the consumer's purchase decision. The three sensory properties affecting the preferences of consumers for meat quality are appearance, texture, and flavor. Ashmore(1974) suggested that meat quality are influenced by skeletal muscle fiber characteristics. The variation in muscle oxidative, glycolytic and contractile properties can be assessed using biochemical techniques, since the concentration, activities and ratios of different enzymes used for contraction and energy metabolism differ in the various types of muscle (Pette and Staron, 1990). Isolation of different heavy and light chain myosin isoforms by electrophoretic techniques is one of the ways of muscle typing. Three different single myosin heavy chain (MHC) isoforms have been identified in ATPase based on fiber types: MHC I in type I, MHC IIa in type IIa and MHC IIb in type IIb (Picard et al., 1995). Picard et al., (1999) reported that the classification of bovine muscle fibers is of particular interest for the food industry because meat quality depends in part on the proportion of the different types of fibers. Muscle comprises a heterogeneous population of fibers differing in their speed of contraction and their metabolism. Therefore, the objective of the study was to investigate influence of muscle fiber type on meat quality characteristics of Hanwoo (Korean native cattle) major muscles.

Materials and methodology:

Commercial 9 carcasses of Hanwoo were selected randomly at 24h postmortem, and the muscles were used to make steaks (3 cm thickness). Carcasses were dissected into the following individual muscles*: M. Longissimus dorsi* (LD), *M. Psoas major* (PM), *M. Semimemebranosus* (SM). Steaks from each muscle were measured for meat color (CIE L*, a*, b*), pH, myoglobin concentration, total fat concentration, muscle fiber types, cooking loss, drip loss, WHC(water holding capacity), shear force, and sarcomere length.

Results and discussion:

Results from Table 1 showed that the moisture content of SM muscle was significantly higher than LD and PM muscles. However, the myoglobin concentration was not significantly different among the muscle samples, although high value was found in PM muscle ($p>0.05$). The crude fat content was significantly ($p<0.05$) higher in LD and lower in SM. A typical SDS-PAGE band of muscle fiber type and their intensity for the three major muscles of Hanwoo cattle were showed in Figure 1. There were no significant differences in composition of muscle fiber types among three muscles ($P>0.05$). However, as myoglobin concentration, PM muscle had more type I muscle fiber compared to those of LD and SM muscles (Table 1). No significant differences were found in muscle pH between LD, PM, and SM muscles (Table 2). The lightness (L*) was significantly lower in SM, while hue (ΔH) value was significantly lower in PM muscle ($P<0.05$). No significant differences were found in redness (a*), yellowness (b*) and croma value (ΔC) among 3 major muscles of Hanwoo cattle. Although a* values were not significantly different among three muscles ($P>0.05$), hue value of PM muscle was significantly ($P<0.05$) lower than those of LD and SM muscles. These results suggested that the lower hue value and high a* value of PM muscle might be due to more type I and less type IIb muscle fibers compared to LD and SM muscles.

Meat quality characteristics of three major muscles of Hanwoo cattle were related with composition of muscle fiber type. There were significant ($P<0.05$) differences in cooking loss, drip loss, shear force and sarcomere length between LD, PM and SM samples (Table 3). However, water-holding capacity of three muscles was not significant differ among three muscles ($P>0.05$). Cooking loss was significantly higher in SM muscle, while drip loss was significantly lower LD muscle ($P<0.05$). Although PM muscle had more type I muscle fibers (Table 1), PM muscle showed significant ($P<0.05$) longer sarcomere length and lower shear force compared to LD and SM muscles. These differences in meat quality characteristics might be related with different composition of muscle fiber type in three major muscles of cattle. Further research, under strictly controlled conditions may be necessary to explain the relationship between composition of muscle fiber types and meat quality characteristics of major muscles of Hanwoo cattle.

Conclusions:

Although no significant differences were found among 3 major muscles of Hanwoo cattle in their muscle fiber types, variation

was found in some meat quality characteristics. Contents of moisture and crude fat, lightness and hue values, cooking and drip loss, sarcomere length and shear force varied among three muscles. Besides no significant differences in muscle fiber types found in three major muscles of Hanwoo cattle, the significant differences in meat quality characteristics suggested that the meat quality might be related to composition of muscle fiber types.

Table1. The contents of moisture, crude fat, myoglobin and composition of muscle fiber types of Hanwoo major muscles (Mean±S. D)

Muscles	Measurements			Muscle fiber types		
	Moisture	Crude fat (%)	Mb con.	Type Ⅱa	Type Ⅱb	Type Ⅰ
LD [1)]	69.23±2.33 [B]	14.91±1.97 [A]	6.98±2.01	49.07±0.31	27.83±0.44	23.08±0.25
PM	69.46±1.45 [B]	11.15±1.23 [B]	9.12±1.94	48.77±0.16	25.31±0.71	25.91±0.70
SM	72.44±1.52 [A]	8.25±1.99 [C]	8.89±2.24	46.25±3.19	29.23±1.48	24.50±1.73

[1)] LD*: Longissimus dorsi*, PM: *Psoas major*, SM: *Semimemebanosus*.

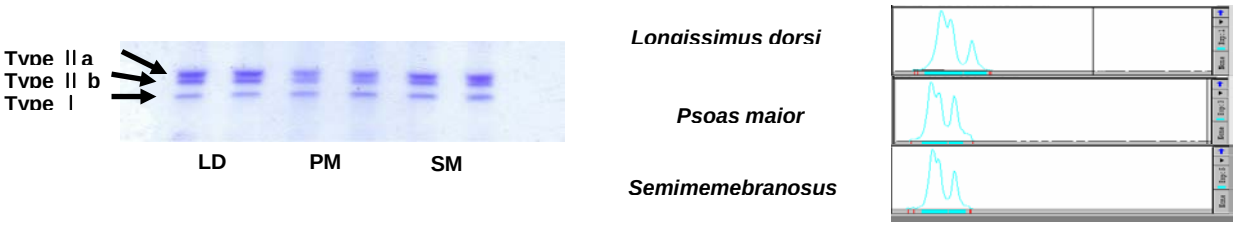

Figure 1. SDS-PAGE band(left) and band intensity(right) of muscle fiber types of Hanwoo major muscles.

Table 2. Comparison in surface meat color and pH of Hanwoo major muscles (Mean±S. D)

Muscles	CIE values					pH
	L*	a*	b*	ΔC	ΔH	
LD [1)]	42.82±2.80 [A]	26.78±2.45	13.76±1.36	30.11±2.74	27.13±1.17 [A]	5.431±0.047
PM	41.55±1.86 [AB]	27.34±2.43	13.17±1.01	30.34±2.61	25.67±0.76 [B]	5.418±0.019
SM	39.92±2.71 [B]	25.29±3.21	12.72±1.69	38.30±3.62	26.65±0.64 [A]	5.453±0.103

[1)] LD*: longissimus dorsi*, PM: *Psoas major*, SM: *Semimemebanosus*.
[A,B] Means with same letter in the same column are not significantly different ($p<0.05$).

Table 3. Characteristics of meat quality of Hanwoo major muscles (Mean±S. D)

Muscles	Item				
	Cooking loss	Drip loss	WHC	Shear force	Sarcomere length
LD [1)]	39.98±1.49 [B]	2.37±0.20 [B]	66.18±10.91	8.11±1.09 [B]	2.16±0.13 [B]
PM	41.39±1.17 [B]	3.04±0.66 [A]	66.99±1.53	5.01±0.64 [C]	3.99±0.63 [A]
SM	43.29±1.87 [A]	3.26±0.58 [A]	68.11±1.26	10.90±1.89 [A]	2.07±0.69 [B]

[1)] LD*: longissimus dorsi*, PM: *Psoas major*, SM: *Semimemebanosus*.
[A,B] Means with same letter in the same column are not significantly different ($p<0.05$).

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