

PHYSICO-CHEMICAL MEAT QUALITY PROPERTIES OF LOIN AND TOP ROUND MUSCLES FROM HANWOO (KOREAN NATIVE CATTLE) HEIFER AND COW BEEF

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Abstract – The physico-chemical properties of loin (*m. longissimus dorsi*, LD) and top round (*m. semimembranosus*, SM) from Hanwoo heifer and cow beef were investigated. They were divided into 4 groups depending on age and parity conditions; G1 (24-36 months old and parity 0), G2 (24-60 months old and parity 1-3 times), G3 (61-107 months old and parity 4-6 times) and G4 (108-194 months old and parity >7 times). The G1 had significant higher intramuscular fat contents for loin (14.74%) and SM (12.70%) muscles than the other groups ($p < 0.05$). In the meat color of LD muscles, L^* and a^* values were significantly lower and b^* values were significantly higher for the G4 than those of the other groups. The a^* values were significantly higher in the G1 than those of the other groups for LD and SM muscles ($p < 0.05$). The G2 had the lower cooking losses (%) and WB-shear force (kg) (WB-shear force) values than G4 for the LD and SM muscles ($p < 0.05$). The water holding capacity (WHC) (%) of SM muscles were significantly higher in the G1 and G2 (56.38 and 55.45%) when compared to those of the G4 ($p < 0.05$).

Key Words – Hanwoo heifer, Hanwoo cow, meat quality, chemical composition.

I. INTRODUCTION

Mature Hanwoo cows represent a significant meat source for the Korean beef industry and they accounted for 51.8% of the total beef cattle slaughtered in Korea (KAPE, 2012). Several factors influence the quality attributes of mature cows in the beef cattle group. Beef from physiologically old carcasses is generally less tender than that from young animals because of the chemical nature of muscle-fiber fragmentation and connective tissue collagen (Shorthose and Harris, 1990). Boccard *et al.* (1979) reported that increased chronological age in cattle resulted in dark-colored lean meat. The lack of literature showing the potential differences in post-

mortem muscles from mature cows of various parity and ages. The objective of the present study was to investigate the physicochemical meat quality and compositional properties of loin (*m. longissimus dorsi*, LD) and top round (*m. semimembranosus*, SM) from Hanwoo heifer and cow beef.

II. MATERIALS AND METHODS

A. Sample preparation

Hanwoo cows ($n = 45$; age, 24–194 months old; live weight, 270–500 kg) were finished at the Daekwanryung experimental station of National Institute of Animal Science (NIAS) of RDA. Animals were transported to the NIAS abattoir, Suwon, Korea, and fasted for approximately 12 h but with access to water prior to slaughter. After slaughter, the left side of each carcass was deboned and trimmed to domestic fabrication. The LD and SM muscle samples were collected from each carcass and they were vacuum packaged and stored at -20°C until the analysis was conducted. They were divided into 4 groups and their slaughter age and parity numbers were shown in Table 1.

B. Analytical methods

Chemical compositions were analyzed by using methods of Association of Official Analytical Chemists (AOAC) (2002). Color values on freshly cut surface of the WB-shear force block were measured by a chroma meter (Minolta Co. CR 301) for lightness (L^*), redness (a^*) and yellowness (b^*) of CIE after a 30-min blooming at 2°C (Commission Inter-nationale de Leclairage, 1986). Warner Bratzler-shear force (WBS) was measured on cooked steaks (25-mm thick) according to the method described by Wheeler *et al.* (2000). Cooking loss was calculated as a percent for the weight changes during cooking for WB-shear force measurement. Water-holding capacity (WHC)

was measured by using the method of Ryoichi et al. (1993).

C. Statistical analysis

Data were analyzed by using the SAS program (2005) and means were separated by the Student-Newman-Keuls' test. The level of significance was $p < 0.05$.

III. RESULTS AND DISCUSSION

For LD samples, there were not significant differences in the moisture and protein contents (%) among 4 groups ($p > 0.05$). The intramuscular fat contents were significantly lower in the G4 than those in the G1 ($p < 0.05$). For SM samples, the G1 had significantly lower moisture contents and significantly higher intramuscular fat contents than the G2 ($p < 0.05$). Visible intramuscular fat (IMF) or marbling is an important meat characteristic that is appreciated by the consumer because of its positive effects on taste, juiciness, and tenderness (Platter *et al.*, 2005). Galli *et al.* (2008) reported that 12-year-old cows had the least amount of intramuscular fat of Hereford cows for 3-12 years old. The protein contents of the G1 were the lowest among the 4 groups ($p < 0.05$). There were not significantly different among the 4 groups ($p > 0.05$). In the meat color of LD muscles, L^* values were significantly lower and b^* values were significantly higher in the G4 than those of the other groups ($p < 0.05$). The a^* values were significantly higher in the G1 than those of the other groups for LD and SM muscles ($p < 0.05$). The cooking losses (%) were significantly higher in the LD and SM muscles and they were significantly lower in the G2 than the other groups ($p < 0.05$). The G2 had significant lower WBS values, whereas G4 had the highest WBS values for LD and SM muscles among 4 groups ($p < 0.05$). Huff-Lonergan *et al.* (1995) postulated that LD samples from old cattle probably contained higher calpastatin activity that inhibited calpain-mediated protein degradation in post-mortem beef. Xiong *et al.* (2007) postulated that older cows exhibited increased toughness because they probably had reduced calpain activity in muscles with greater oxidative stress compared to younger cattle. The water holding capacity (WHC) (%) were not significantly different among the 4 groups for LD muscles, however, the G1 and G2 had significant higher WHC than the G4 for SM muscles ($p < 0.05$).

Table 1. Distribution of analysis sample numbers for experiment (n=45)

	Groups			
	1	2	3	4
Animals (heads)	10	15	15	5
Parity (times)	0	1-3	4-6	>7
Age (months)	24-36	24-60	61-107	108-194

Table 2. Chemical compositions (%) for LD and SM muscles of Hanwoo cow beef by different age and parity groups

Cut	Group	Moisture (%)	Protein (%)	Fat (%)	Collagen (%)
LD	1	65.95 ±0.33	19.56 ±0.27	14.74 ^a ±0.99	1.89 ±0.06
	2	64.05 ±1.23	20.24 ±0.29	13.72 ^{ab} ±1.35	1.90 ±0.06
	3	64.55 ±0.89	20.34 ±0.27	11.29 ^{ab} ±0.77	1.82 ±0.05
	4	65.37 ±0.58	20.77 ±0.37	8.95 ^b ±1.04	1.89 ±0.07
SM	1	64.23 ^b ±0.95	19.72 ^b ±0.25	12.10 ^a ±1.04	1.93 ±0.06
	2	69.88 ^a ±0.98	21.48 ^a ±0.34	5.89 ^b ±1.34	1.84 ±0.06
	3	67.51 ^{ab} ±0.82	20.87 ^a ±0.44	6.75 ^{ab} ±1.05	1.74 ±0.04
	4	66.76 ^{ab} ±1.71	21.39 ^a ±1.04	6.97 ^{ab} ±2.95	1.74 ±0.16

*Mean ± S.E.

^{a-b}Means in the same row within the same category with different letters are significantly different ($p < 0.05$).

Table 3. Meat color for LD and SM muscles of Hanwoo cow beef by different age and parity groups

Cut	Group*	CIE		
		L	a	b
LD	1	34.46 ^a ±0.99	21.31 ^a ±0.40	8.07 ^b ±0.24
	2	32.13 ^a ±0.79	19.02 ^b ±0.35	7.80 ^b ±0.30

SM	3	36.02 ^a	19.11 ^b	8.91 ^b	±1.08	±0.32	±0.64
		±1.67	±0.51	±0.45			
	4	27.00 ^b	19.02 ^b	10.16 ^a	±1.55	±0.24	±0.81
		±0.73	±0.29	±0.78			
	1	34.65	21.45 ^a	8.61	±0.93	±0.67	±0.30
		±0.93	±0.67	±0.30			
	2	34.79	19.74 ^{ab}	8.57	±0.42	±0.67	±0.42
		±0.42	±0.67	±0.42			
	3	33.05	19.97 ^{ab}	9.23	±0.84	±1.17	±0.64
		±0.84	±1.17	±0.64			
	4	32.72	17.01 ^b	9.91	±1.56	±0.81	±1.35
		±1.56	±0.81	±1.35			

*Mean ± S.E.

^{a-b}Means in the same row within the same category with different letters are significantly different (p<0.05).

Table 4. Cooking loss, Warner-Bratzler shear force (WBS) and Water holding capacity (WHC) for LD and SM muscles of Hanwoo cow beef by different age and parity groups

Cut	Group	Cooking loss (%)	WBS (kg)	WHC (%)
LD	1	24.12 ^b	3.86 ^{ab}	52.61
		±0.06	±0.16	±0.96
	2	24.17 ^b	2.99 ^b	54.27
		±0.40	±0.17	±0.75
	3	26.71 ^{ab}	3.75 ^{ab}	53.78
		±0.75	±0.32	±0.75
	4	28.71 ^a	4.43 ^a	51.00
		±0.89	±0.19	±0.63
SM	1	26.89 ^{ab}	4.66 ^{ab}	56.38 ^a
		±0.61	±0.16	±0.48
	2	25.59 ^b	4.05 ^b	55.45 ^a
		±0.80	±0.19	±0.59
	3	27.42 ^{ab}	4.92 ^{ab}	54.31 ^{ab}
		±0.80	±0.19	±0.59

*Mean ± S.E.

^{a-b}Means in the same row within the same category with different letters are significantly different (p<0.05).

IV. CONCLUSION

The Hanwoo heifer beef group (24-36 months old) had the higher intramuscular fat contents, L^* values and a^* values than Hanwoo cow groups. The Hanwoo cow group, G2 (24-60 month old, parity 1-3 times) had significant low cooking loss and WB-shear force, whereas the Hanwoo cow group, G4 (108-194 months old, parity >7times) had the highest cooking loss and WB-shear force among the groups.

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