Proximate composition and physico-chemical meat quality of Korean Hanwoo beef by different quality grade and cut

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Abstract

High quality grade (1^{++}) of Hanwoo beef cuts had significantly higher intramuscular fat contents (7.81~24.74%) and significantly lower pH (5.47-5.64), protein (16.94-21.15%), moisture (58.17-70.08%) and ash contents (0.60-0.79%) than low quality grade beef cuts ($p<0.05$). CIE *L* value of loin in the high quality grade was highest ($p<0.05$). Cooking loss (%) was lowest for short plate (26.97%) of the low quality grade and striploin (21.44%) of the high quality grade. Water holding capacity (WHC) was higher in loin (55.85%) and lower in chuck tender (51.99%) among 10 cuts of the low quality grade, but it was not significantly different among 10 cuts of high quality grade ($p>0.05$). Warner-Bratzler shear force (WBS) values were significantly lower in all cuts of high quality grade when compared to the same cuts of low quality grade ($p<0.05$). Short plate in high quality grade and chuck tender in low quality grade had the highest WBS among 10 cuts in the same quality grade, respectively ($p<0.05$).

Introduction

In Korea, beef quality was evaluated by the carcass grading system based on meat color, fat color, texture, and maturity of loin muscle and intramuscular fat contents and there were 5 quality grades such as 1^{++}, 1^{+}, 1, 2, 3. According to the statistics data of 2007, 47.3% Hanwoo produced high quality grade beef (above grade 1) when compared to the other breed (AGPS, 2008). Especially, 71.5% Hanwoo steers produced 1^{++} grade when compared to 59.7% Hanwoo cow and 2.9% bulls. The objective of this study was to investigate the chemical composition and meat quality properties of Hanwoo beef by different quality grade and cut.

Materials and methods

Sample preparation : 10 cuts (short plate, top sirloin, striploin, loin, chuck tender, eye of round, chuck roll, bottom round, top round and brisket) were selected and prepared from 10 Hanwoo bulls (24-26months old, Korean quality grade 3) for low quality grade beef and 10 Hanwoo steers (28-30months old, Korean quality grade 1^{++}) for high quality grade beef, respectively.

Analytical methods **:** Chemical compositions were analyzed by using methods of Association of Official Analytical Chemists (AOAC) (1996). Water-holding capacity (WHC) was measured by using the method of Kristensen and Purslow (2001). Warner-Bratzler shear force (WBS) was measured on cooked steaks (25-mm thick) according to the method described by Wheeler et al.(2000). Color values on freshly cut surface of the WBS 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 1℃. Cooking loss was calculated as a percent for the weight changes during cooking for WBS measurement. Total lipids were extracted by using chloroform-methanol (2:1, v/v) according to the procedure of Folch et al.(1957). An aliquot of the lipid fraction was methylated as described by Morrison and Smith(1964). Fatty acid methylesters were analyzed by a gas chromatograph (Varian 3400) fitted with a fused silica capillary column, Omegawax (205, 30 m × 0.32 mm I.D., 0.25 ㎛ film thickness). The injection port was at 250℃ and the detector was maintained at 260℃. Nitrogen was used as the carrier gas. Results were expressed as percentages, based on the total peak area.

Statistical analysis : Data were analyzed by using the SAS program (1996) and means were separated by the Student-Newman-Keuls' test. To determine the breed effect on samples, data were analyzed as one-factor randomized block experiments with treatments. The level of significance was $p<0.05$.

Results and discussion

High quality grade (QG 1^{++}) of Hanwoo beef cuts had significantly higher intramuscular fat contents (7.81~24.74%) and significantly lower pH (5.47-5.64), protein (16.94-21.15%), moisture (58.17-70.08%) and ash contents (0.60-0.79%) than low quality grade beef cuts (QG 3) ($p<0.05$). In each quality grade, the intramuscular fat contents (%) of loin muscles were significantly high whereas those of eye of round muscles

were significantly low among 10 cuts. CIE L value (42.67) of loin in the high quality grade was highest whereas that of short plate muscle was highest in the low quality grade ($p<0.05$). Most cuts in the high quality grade had significantly higher *L*, *a* and *b* values when compared to the same cuts of low quality grade ($p<0.05$). Cooking losses (%) of high quality grade beef were significantly lower in top sirloin, striploin, loin and chuck tender than those of low quality grade beef ($p<0.05$). WHC was higher in loin (55.85%) and lower in chuck tender (51.99%) among 10 cuts in the low quality grade, but it was not significantly different in the high quality grade ($p>0.05$). WBS values were significantly lower (3.45-6.24 inch^2/kg) in all cuts of high quality grade when compared to the same cuts of low quality grade (6.94-8.22 inch^2/kg). Loin had the significant lower WBS values than the other cuts for both quality grade beef ($p<0.05$). Short plate in the high quality grade and chuck tender in the low quality grade had the highest WBS when compared to the other cuts in the same quality grade ($p<0.05$).

Table 1. pH and chemical composition of Hanwoo beef by different quality grade and cut

Cut	pH		Protein		Moisture		Fat		Ash	
	1^{++}	3	1^{++}	3	1^{++}	3	1^{++}	3	1^{++}	3
Short plate	5.58^{*abcY} (0.03)	5.69^{*X} (0.05)	17.77^{deY} (0.57)	21.66^{bcX} (0.33)	61.35^{cY} (1.35)	74.78^{bX} (0.72)	19.55^{bX} (1.86)	2.09^{abY} (0.82)	0.67^{abY} (0.03)	0.89^{cdX} (0.02)
Top sirloin	5.49^{cdY} (0.02)	5.65^{X} (0.06)	19.69^{abcY} (0.44)	22.19^{abcX} (0.19)	65.95^{abY} (1.19)	75.08^{abX} (0.35)	13.31^{cdX} (1.66)	1.04^{bY} (0.25)	0.76^{aY} (0.03)	0.94^{abcX} (0.01)
Strip loin	5.46^{d} (0.01)	5.72 (0.12)	17.84^{deY} (0.45)	22.35^{abX} (0.22)	59.36^{cY} (1.19)	74.13^{bX} (0.57)	20.95^{abX} (1.59)	1.75^{bcY} (0.43)	0.7^{abY} (0.03)	0.93^{abcX} (0.01)
Loin	5.57^{abcY} (0.03)	5.71^{X} (0.07)	16.94^{eY} (0.54)	21.32^{cX} (0.35)	58.17^{cY} (0.89)	74.03^{bX} (0.64)	24.74^{aX} (0.85)	2.85^{aY} (0.05)	0.60^{bY} (0.03)	0.85^{cdX} (0.02)
Chuck tender	5.64^{aY} (0.04)	5.70^{X} (0.04)	19.49^{abcdY} (0.34)	21.47^{cX} (0.26)	70.08^{aY} (0.47)	75.79^{aX} (0.54)	9.32^{dX} (0.44)	1.19^{bY} (0.73)	0.72^{ab} (0.02)	0.80^{d} (0.05)
Eye of round	5.51^{bcdY} (0.02)	5.73^{X} (0.08)	21.15^{aY} (0.37)	22.49^{abX} (0.23)	69.75^{aY} (0.93)	75.65^{aX} (0.46)	7.81^{dX} (0.99)	0.65^{cY} (0.39)	0.76^{aY} (0.04)	1.01^{aX} (0.03)
Chuck roll	5.59^{abY} (0.02)	5.75^{X} (0.05)	18.80^{cdY} (0.35)	21.38^{cX} (0.30)	64.93^{bY} (1.49)	75.86^{aX} (0.46)	15.52^{cX} (1.93)	1.23^{bY} (0.27)	0.69^{abY} (0.02)	0.87^{cdX} (0.02)
Bottom round	5.50^{bcdY} (0.02)	5.62^{X} (0.06)	19.50^{abcdY} (0.39)	22.24^{abcX} (0.20)	66.38^{abY} (1.25)	74.63^{bX} (0.85)	12.50^{cdX} (1.53)	1.52^{bcY} (0.79)	0.72^{abY} (0.03)	0.94^{abcX} (0.03)
Top round	5.47^{dY} (0.02)	5.63^{X} (0.08)	20.57^{abY} (0.37)	22.80^{aX} (0.23)	68.43^{abY} (0.98)	74.50^{bX} (0.61)	9.21^{dX} (1.37)	0.98^{bY} (0.38)	0.79^{aY} (0.04)	0.99^{abX} (0.03)
Brisket	5.50^{bcdY} (0.02)	5.67^{X} (0.05)	19.08^{bcdY} (0.33)	21.35^{cX} (0.28)	66.96^{abY} (0.72)	75.82^{aX} (0.43)	12.88^{cdX} (0.97)	1.06^{bY} (0.33)	0.72^{abY} (0.03)	0.91^{bcX} (0.01)

$^{a-d}$Means within the same column having the different superscript were significantly different($p<0.05$)
$^{X-Y}$Means within the same row having the different superscript in the same catergory were significantly different ($p<0.05$)
*Mean(standard error)

Table 2. Meat color(CIE Lab), cooking loss(CL), water holding capacity(WHC), Warner-Bratzler shear force (WBS) of Hanwoo beef by different quality grade and cut

Cut	CIE						CL (%)		WBS ($inch^2$/kg)		WHC (%)	
	L		*a*		*b*							
	1^{++}	3	1^{++}	3	1^{++}	3	1^{++}	3	1^{++}	3	1^{++}	3
Short plate	39.18^{*b} (0.38)	40.28^{a} (1.62)	24.49 (1.55)	20.78^{ab} (1.16)	11.30 (0.87)	11.11^{a} (0.51)	27.70^{ab} (1.61)	26.97^{b} (1.24)	6.24^{aY} (0.39)	7.90^{abX} (0.46)	55.16 (1.28)	52.56^{bc} (0.62)
Top sirloin	39.13^{b} (0.50)	37.22^{abc} (1.31)	23.22^{X} (0.74)	17.88^{abcY} (0.56)	10.82^{X} (0.55)	8.77^{abcY} (0.72)	27.65^{abY} (1.21)	30.71^{abX} (0.68)	4.64^{bcY} (0.41)	7.30^{abX} (0.48)	56.38 (0.56)	54.32^{abc} (1.02)
Strip loin	40.85^{bX} (0.67)	33.53^{cY} (0.92)	22.65^{X} (0.96)	16.16^{cY} (0.70)	11.53^{X} (0.52)	6.71^{cY} (0.53)	21.44^{dY} (0.59)	27.23^{bX} (1.52)	3.50^{cY} (0.32)	7.08^{abX} (0.39)	57.07 (1.00)	55.35^{ab} (1.20)
Loin	42.67^{aX} (0.94)	36.47^{bcY} (1.00)	23.21^{X} (1.41)	18.98^{abcY} (0.93)	12.35^{X} (0.60)	9.50^{abY} (0.67)	23.44^{cdY} (0.93)	27.43^{bX} (0.85)	3.45^{cY} (0.27)	6.94^{bX} (0.32)	57.41 (0.89)	55.85^{a} (1.42)
Chuck tender	39.36^{bX} (0.35)	35.55^{bcY} (0.61)	24.95^{X} (0.64)	20.03^{abcY} (0.27)	11.83^{X} (0.44)	8.44^{abcY} (0.32)	30.56^{a} (0.60)	32.61^{a} (0.91)	5.05^{abY} (0.33)	8.22^{aX} (0.44)	55.82^{X} (1.01)	51.99^{cY} (0.89)
Eye of round	40.19^{b} (0.42)	37.27^{abc} (1.98)	23.30^{X} (0.59)	21.08^{aY} (1.41)	11.70^{X} (0.45)	9.06^{abcY} (1.28)	29.57^{a} (0.63)	28.39^{ab} (2.35)	5.15^{abY} (0.16)	7.51^{abX} (0.86)	55.87 (0.35)	54.66^{abc} (1.29)
Chuck roll	39.81^{bX} (0.53)	35.95^{bcY} (0.65)	24.32^{X} (0.65)	19.40^{abcY} (1.09)	11.30^{X} (0.45)	8.86^{abcY} (0.60)	25.64^{bcY} (0.92)	28.44^{abX} (1.03)	4.68^{bcY} (0.41)	7.59^{abX} (0.33)	55.27 (1.20)	54.81^{abc} (1.08)
Bottom round	38.78^{b} (0.34)	36.77^{abc} (1.15)	23.71^{X} (0.93)	17.74^{abcY} (1.31)	11.56^{X} (0.61)	9.07^{abcY} (0.89)	28.42^{ab} (0.68)	28.44^{ab} (0.66)	4.90^{abY} (0.35)	7.59^{abX} (0.29)	56.07 (1.03)	54.81^{abc} (1.16)
Top round	38.51^{bX} (0.22)	34.99^{bcY} (1.27)	23.64^{X} (0.63)	16.89^{bcY} (1.06)	11.22^{X} (0.39)	8.12^{bcY} (0.87)	29.85^{a} (0.72)	29.73^{ab} (1.54)	5.34^{abY} (0.29)	7.31^{abX} (0.28)	55.09 (0.67)	54.11^{abc} (1.21)
Brisket	40.25^{bX} (0.75)	38.04^{abcY} (0.69)	23.29 (1.30)	18.60^{abc} (0.86)	11.83^{X} (0.50)	9.69^{abY} (0.70)	30.08^{a} (0.89)	29.44^{ab} (1.18)	5.21^{abY} (0.35)	7.53^{abX} (0.41)	54.21 (1.26)	53.40^{abc} (0.90)

$^{a-c}$Means within the same column having the different superscript were significantly different ($p<0.05$)
$^{X-Y}$Means within the same row having the different superscript in the same catergory were significantly different ($p<0.05$).
*Mean(standard error)

Conclusions

In the comparison of Hanwoo beef by the Korean quality grade, grade 1^{++} Hanwoo beef had significantly higher contents (%) of intramuscular fat whereas significantly lower protein, moisture and ash than grade 3 beef ($p<0.05$). Also, grade 1^{++} Hanwoo beef had significantly higher *L* and *a* values, and WBS than those of grade 3 beef. However, there was no significantly different in WHC among 10 cuts in the high quality grade beef ($p>0.05$)

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