Effects of quality grade on the carcass component, and chemico-physical sensory traits of M. *Longissimus dorsi* in Hanwoo (Korean native cattle)

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Abstract

Analyses were conducted to estimate the effect of quality grade on the chemical, physical and sensory traits of *longissimus dorsi* in Hanwoo (Korean native cattle). Total 42,113 carcasses were selected on the basis of sex and live weight to be representative of five quality grades (grade 1^{++}, 1^{+}, 1, 2, 3) and an additional 1,066 carcasses were used to evaluate the traits. Results show that both steer and cow received superior quality grade to bull within the same weight class ($P<0.05$). Marbling score, texture, maturity, and fat color were significantly ($P<0.01$) affected by sex and live weight, whilst only meat color did not affected by live weight. The ultimate quality grade showed significant relationships with marbling score (r=0.97**), meat color (r=0.22**), fat color (r=0.12**), and with texture (r=0.79**), but that had no such a relationship with maturity. WB-shear force was decreased when carcass grade was increased ($P<0.01$) from 3grade to 1^{++} grade, but water-holding capacity was increased when the quality grades increased. The fat percentage of *longissimus dorsi* was increased from 3.6% to 23.8% as increased the quality grade. Objective meat color dimensions in lightness, redness and yellowness were increased for higher quality grade ($P<0.01$). Meat flavor, juiciness and tenderness received higher scores for higher quality grade ($P<0.01$).

Introduction

Korean carcass quality grading system was established in 1992. Many revision have been adaped to meet the demand of the changes of farm production system, for incidence, castration, live weight increasing. The current carcass quality grading system of hanwoo was revise on December in 2004. The quality grade extended from 4 classes (1^{+}, 1, 2, 3) to 5 classes (1^{++}, 1^{+}, 1, 2, 3) according to the curd fat contents of *M. longissimus dorsi*. Intramuscular fat content and maturity are importan, factor since they have directly affect on the beef's tenderness, juiciness, and flavor (Donald and Robert, 1993). Tenderness is considered to be most important factors influencing consumer's percepions of taste and quality grade affected beef tenderness (Gruber et al., 2006) National survey of beef quality grade have been used in a variety of research, education, and business activities as references to what the beef industry was producing (McKenna et al., 2002). Therefore, this study was conducted to determine the effect of quality grade on the chemico-physical and palatability in Korean grade.

Material and methods

Total 42,113 carcasses were selected on the basis of sex and live weight to be representative of national farm base and an additional 1066 carcasses were used to evaluate the quality traits. WB-shear force was determined *m. longissimus dorsi* (LD), which were cooked in a 70□ water bath for 60 and 1.27 cm in diameter. The shear force was measured by using a V-shaped shear blade at 400 mm/min. Cooking loss was calculated as percent of weight changes during cooking for WB-shear force measurement. Objective meat color was determined by using a Minolta Chromameter (CR301, Minolta, Japan) on a freshly cut surface of the WB-shear force block after a 30-min blooming at 1°C. Water-holding capacity was determined by Ryoichi, Degychi, and Nagata (1993). Water-holding capacity was calculated by using a planimeter. Sensory characteristics were determined by 10 semi-trained panelists who were randomly selected from a total of 15 recruits. Tenderness, flavor intensity, juiciness were estimated by using a six-point scale. ANOVA, Duncan-test were determined by using SAS package (1998).

Results and discussions

Table 1 shows the effects of quality grade on carcass traits and quality grade components. Backfat thickness was increased from 7.4mm to 12.2mm and also marbling score was increased as with increasing quality grade (3grade-1^{++}grade). Maturity and texture decreased as with increasing quality grade A lighter

meat color for 1^{++} grade than that of 3grade. Carcass quality grade had a higher correlation relationship with marbling score (r=-097), fasting weight (r=-0.23), but that had a relatively weaker relationship correlation with maturity (r=0.06). These results were similar with those of the previous studies of conducted by Kemp and Koch (1998).

Table 1. Least squares mean for carcass traits within quality grade

Traits	Quality grade					Pooled SE	P-value
	1++	1+	1	2	3		
No. of cattle	5,337	10,311	10,722	9,897	5,846		
Fasting weight (kg)	640.4	637.7	628.4	617.2	577.7	0.37	0.001
Hot carcass weight (kg)	387	637.7	375	367	339	0.25	0.001
Backfat thickness (mm)	12.2	12.1	12.1	11.7	7.4	0.03	0.001
Loineye area (cm2)	84.8	81.9	79.8	78.1	78.3	0.05	0.001
Dressing percentage (%)	65.5	65.3	65.2	65.5	68.8	0.02	0.001
Marbling score	8.31	6.51	4.62	2.60	1.09	0.01	0.001
Meat color	4.67	4.77	4.81	4.88	5.14	0.00	0.001
Fat color	2.85	2.89	2.95	2.95	3.02	0.00	0.001
Texture	1.01	1.03	1.14	1.95	2.03	0.00	0.001
Maturity	2.39	2.33	2.49	2.45	2.77	0.01	0.001

Table 2. Correlation coefficients among quality grade factors

Traits	Fasting weight (1)	Marbling score (2)	Meat color (3)	Fat color (4)	Texture (5)	Maturity (6)	Quality grade (7)
1		0.20	0.07	0.09	0.25	-0.01	-0.23
2			0.19	0.06	0.77	0.01	-0.97
3				0.26	0.23	0.18	0.22
4					0.14	0.35	0.12
5						0.16	0.79
6							0.09

Quality grade(1++grade=1, 1+=2,1=3, 2=4 , 3grade=5)

Table 3 shows the chemical composition of muscle tissue and sensory characteristics. Protein content was decreased with increasing quality grade from 20.2% to 18.5% ($P < 0.01$), while intramuscular fat content was increased from 7.4 to 23.8% ($P < 0.01$). Similarly, moisture content decreased from 70.3% to 57.2% ($P < 0.01$). In addition, the current result was in consistent with that of the previous study (Jones, Savell & Cross, 1990) who reported that intramuscular fat content was increased in parallel with increasing marbling score and carcass quality grade. The results showed that WB-shear force and cooking loss was decreased as quality grade was increased. Water holding capacity was significantly increased ($P < 0.01$) and showed that the water-holding capacity increased from 52.4% to 57.8% from a carcass quality grade of 3 to 1^{++}.

Table 4 shows the effect of quality grade on sensory characteristics. At $P < 0.01$, the results showed that higher fat contents significantly increased that tenderness (from 3.56 to 4.85), flavor (from 4.27 to 4.60), and juiciness (from 4.21 to 4.72) and were significantly ($P < 0.01$) increased for higher fat content from 3.35 to 4.46. These result findings supported the observation that intramuscular fat was the most significant variant that explaining explains approximately 7-15% of meat tenderness (Parrish, 1974). These findings also agree with those of the previous report (Shackelford, Wheeler & Koohmarmie, 1995) which showed significant correlation between marbling score and meat tenderness. In addition like wise, the results agreed with the result those of Lorenzen et al. (2003) who reported that meat flavor and juiciness were improved by 0.3 and 0.4 between low select and top choice. Mckenna et al. (2002) similarly reported that increase in marbling score improved overall sensory characteristics.

Table 3. Chemico-physical traits within quality grade

Traits	Quality grade				
	1^{++}	1^{+}	1	2	3
Moisture, %	57.2	63.7	67.7	70.3	73.2
Curde fat, %	23.8^{a}	14.8^{b}	10.7^{c}	7.4^{d}	3.6^{e}
Protein, %	18.5	19.7	20.2	20.2	21.1
Cooking loss, %	22.9	22.1	20.8	20.3	19.7
Shear force, kg/㎠	3.78^{c}	4.49^{c}	5.83^{b}	7.10^{ab}	8.29^{a}
Water holding capacity, %	57.8	56.8	55.4	53.9	52.4
pH	5.66	5.65	5.65	5.65	5.60

*a,b,c,d,e : p≤0.05

Table 4. Meat color and panel score within quality grade

Traits		Quality grade				
		1++	1+	1	2	3
Meat color CIE	L	42.1^{a}	37.5^{b}	37.5^{b}	35.4^{bc}	33.9^{c}
	a	24.8	20.1	19.4	19.4	18.2
	b	12.4	8.9	8.8	8.5	7.7
Panal score	Juiciness	4.72	4.85	4.64	4.47	4.21
	Tenderness	4.85^{a}	4.65^{a}	4.60^{ab}	4.25^{b}	3.56^{c}
	Flavor	4.60	4.72	4.65	4.52	4.27
	Total	4.73^{a}	4.74^{a}	4.63^{ab}	4.42^{b}	4.02^{c}

*a,b,c : p≤0.05

Conclusions

As quality grade increased, Warner-Bratzler shear force and cooking loss correspondingly decreased, whereas while the water-holding capacity increased ($P < 0.01$). In the panel tests, the scores of tenderness, flavor, and juiciness increased ($P < 0.01$) with increasing quality grade. The shear force values had a negative correlation with the juiciness, tenderness, and flavor. The current results of this study suggested a need for comparative studies on increase in the range of marbling scores based on intramuscular fat content and need to revise current 9 class marbling score to 10 or more marbling class.

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