COMPARISON OF PHYSICOCHEMICAL TRAITS OF HANWOO, HOLSTEIN AND DOMESTIC-FED ANGUS BEEF

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***Abstract*— The objective of the study is to compare the physicochemical characteristics of three beef breeds raised in Korea. pH of loin from Holstein breed was significantly (p<0.05) higher than that of Hanwoo on 7 days of storage and that of Angus beef on 14 days of storage at 4□. Hanwoo beef had significant (p<0.05) higher CIE L* value than those of Angus and Holstein beef. Angus beef was significantly (p<0.05) higher in cooking loss than Holstein beef when stored for 7 days. Drip loss of Hanwoo beef was significantly (p<0.05) lower than Holstein beef during the storage. Angus and Holstein beef had significantly (p<0.05) longer sarcomere length than Hanwoo beef on the storage of 14 days. Myofibril fragmentation index of Angus beef was significantly (p<0.05) higher than that of Hanwoo beef when measured on day 14. Total collagen contents in Hanwoo and Angus beef were significantly (p<0.05) higher than Holstein beef when measured on 7 days, wherese Holstein beef had significantly (p<0.05) higher contgent of soluble collagen than Hanwoo and Angus beef. Therefore, this study will provide the basic data regarding of meat quality of Hanwoo, Angus and Holstein beef raise in Korea.**

***Index Terms*— Angus, Hanwoo, Holstein, meat quality**

I. INTRODUCTION

The change in the world meat markets over the past decades and improvement in the educational and economical conditions of most consumers have increased the demands for meat quality. As a consequence, consumers are searching for meat that has characteristics that differ from the most commonly consumed meat (Vieira et al., 2007). To produce a high quality meat, it is necessary to evaluate variables related to animal production, such as genetic and management properties, as well as variables associated with the processing of meat (Short et al., 1999).

Breed is an important factor that can influence on the beef quality(Ramsey et al., 1963). Beef production in Korea has been shared mostly with Hanwoo, Holstein and Angus beef. Hanwoo were originated from a hybrid of Bos taurus×Bos zebu which was transmitted and settled in the Korean peninsula in BC 4,000 (Han, 1996). The Korean cattle breed, Hanwoo, is of particular importance in Korea because of its favorable meat quality although its productivity is relatively low in general (Yeo et al., 2002). It has been regarded as a premium beef in Korea and is partly due to its high palatability and desirable chewiness. On the contrary, Holstein breed is the premier dairy breed with a high potential for milk production (Petit and Liénard, 1998). These animals genetically evolved into the efficient, high producing black-and-white dairy cow, known as the Holstein-Friesian (Yoon, 1990). At present, Korean government allows Angus beef, which was imported from Australia and raised for 6 months in domestic, to produce in Korea as domestic beef (MAF, 2001). Although sensory and physico-chemical properties have been compared between Hanwoo and Holstein (Oh, 1990), there is little information on comparison of the meat quality of Hanwoo, Holstein and domestic-fed Australian Angus beef. A comparative study of the most common breeds raised in Korea is needed. Therefore, the objective of the study is to compare of three common breeds raised in Korea, in order to reveal differences on physicochemical characteristics.

II. MATERIALS AND METHODS

Animals, treatment, and sample preparation A total of 4 Hanwoo, Holstein and domestic-fed Australian Angus steers were used to determine meat quality traits. Hanwoo and Holstein cattles were raised in Korea and Angus beef was imported from Australia and raised for 6 months in Korea. The steers were approximately 24 months old. M. *longissimus lumborum* from the left side of each animal composing of carcass quality grade 2 were sampled from a commercial abattoir. Carcass traits for loin muscles of Hanwoo, Angus and Holstein breeds were evaluated by an official meat grader at Korean Animal Products Grading Service (APGS) and are presented in Table 1. The samples were transported to the National Institute of Animal Science and stored at 4℃ for 7 days until analysis. Proximate composition, pH, water-holding capacity, cooking loss, shear force value and myoglobin contents were measured at

postmortem 48 h.

Fatty acid analysis : 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 (2000) and means were separated by the Duncan's multi test. The level of significance was $p<0.05$.

III. RESULTS AND DISCUSSION

Quality trraits of *M. longissimus lumborum* from Hanwoo, Augus and Holstein breeds are presented in Table 1. There were not significantly different on among breeds. CIE a^* and b^* values were significantly higher ($p<0.05$) in Hanwoo compared to that from the other breeds at storage of 7 d.. Contents of oximyoglobin and metmyoglobin were not significantly different during storage 7 d . Hanwoo beefhad significantly ($p<0.05$) lower cooking loss whereas Angus beef had higher ($p<0.05$) cooking loss compared to the other breeds at storage 7 d. But, it was not significantly different at storage 14 d. Shear force values were not significantly different among breeds at storage 7 and 14 d. Sarcomere length was significantly ($p<0.05$) shorter in Hanwoo compared to Angus or Holstein at storage 14 d. That result, myofibrillar fragmentation index was also significantly ($p<0.05$) lower in Hanwoo compared those breeds at storage 14 d. As ruslts form fatty acids (Table 2), Hanwoo beef was significantly ($p<0.05$) higher content of oleic acid compared the other breeds. Flavor and overall acceptability scores from sensory evaluation, Hanwoo beef was significantgly ($p<0.05$) higher when comared to those from the Angus or Holstein beef after 14 days of storgae(Table 3). Cooking loss was significantly higher for Angus beef (27.16%) than that of Hanwoo (23.66%) and Holstein beef (22.15%). WB-shear force value of Hanwoo beef was 4.53kg/0.5inch^2 and it was higher than 3.62kg/0.5inch^2 4.39kg/0.5inch^2. There were no significantly differences in sarcomere length among the breeds ($p>0.05$). In fatty acid compositons, total contents of SFAs such as myristic acid(C14:0), palmitic acid(C16:0), stearic acid(C18:0) were 43.60% when compared to those of 42.34% for Holstein and 39.34% for Hanwoo beef. Hanwoo beef contained significantly higher oleic acid (52.86%) when compared to those of Angus (49.11%) and Holstein beef (48.98%). From the results of sensory evaluation, tenderness scores were not significantly different among the breeds. However, juciness, flavor-likeness and overall likeness scores were significantly higher for Hanwoo (8.45, 8.18, 8.50) and Angus (8.18, 8.25, 8.25) beef than those of Holstein beef (6.55, 6.75, 6.73) ($p<0.05$). This would be due to the difference of fat contents and fatty acid composition among the breeds. There are many studies showed that breed, gender, age and feeding regine influence animal growth rate, meat yield and composition (Boles & Swan, 2002; Vestergaard, Therkildsen, Henckel, Jensen, Andersen & Sejrsen, 2000). These factors, together with slaughter and post-slaughter conditions will influence tenderness and flavour attributes of meat (Vieira, Cerdeno, Serrano, Lavin, and Mantecon, 2007). Boles & Swan (2002) showed that sensory evaluations with US consumer panel indicated only slight sensory differences due to country of origin and breed but a significant effect from storage regime. These results suggested that oleic acid is related meat flavor of among beef breeds.

IV. CONCLUSION

Overall total contents of saturated fatty acids (SFA) were significantly lower and higher MUFA and PUFA in Hanwoo beef than those in Angus beef ($p<0.05$). Overall, these results implied that difference among beef breeds are meat flavor. Drip loss (%) was significantly lower for Hanwoo beef than Angus and Holstein beef ($p<0.05$). There was not significantly different from sacoreme length ($p>0.05$) and MFI of Angus beef was significantly higher than Hanwoo beef ($p<0.05$). Hanwoo beef contained significantly higher unsaturated fatty acids especially, oleic acid than the other breeds($p<0.05$). In sensory properties, juiciness, flavor-likeness and overall acceptability scores were significantly higher than the other breeds ($p<0.05$).

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Table 1. Carcass traits for loin muscles of Hanwoo, Augus and Holstein breeds

Items	Hanwoo*	Angus**	Holstein*
Carcass weight (㎏)	378.50±24.95^{b}	464.75±12.70^{a}	417.50±7.59^{ab}
Backfat thickness (㎜)	16.25±4.57^{a}	17.00±0.71^{a}	5.75±0.85^{b}
Loin eye area (㎠)	76.25±4.03^{b}	89.25±4.99^{a}	71.75±1.03^{b}

$^{a-b}$ Means having different letters in the same row are significantly different (p<0.05).
* Hanwoo, Holstein : Raised in Korea.
** Angus : Imported from Australia and raised for 6 months in Korea.

Table 2. Quality traits of *M. longissimus lumborum* from Hanwoo, Angus and Holstein breeds during storage at 4℃ for 7 d

	Hanwoo*	**Angus****	**Holstein***
pH	5.33±0.02^{b}	5.37±0.02^{ab}	5.45±0.03^{b}
WHC (%)	52.90±0.39	53.12±1.40	54.50±0.65
Cooking loss (%)	23.66±0.43^{b}	27.16±0.50^{a}	22.15±0.94^{b}
Shear force (N)	4.53±0.47	3.62±0.21	4.39±0.57
Sarcomere length (㎛)	1.83±0.04	1.94±0.06	1.91±0.06
MFI	89.21±1.05^{b}	101.91±3.85^{a}	93.39±3.17^{ab}

$^{a-b}$ Means having different letters in the same row are significantly different (p<0.05).
* Hanwoo, Holstein : Raised in Korea.
** Angus : Imported from Australia and raised for 6 months in Korea.

Table 3. Fatty acid composition of *M. longissimus lumborum* from Hanwoo, Augus and Holstein beef during storage at 4℃ for 7 d

Fatty acid (%)	Hanwoo*	Angus**	Holstein*
Myristic acid	0.91±0.07[b]	2.23±0.81[ab]	3.26±0.22[a]
Palmitic acid	26.76±1.41	29.12±0.64	27.35±0.22
Palmitoleic acid	4.58±0.12	4.47±0.36	4.87±0.38
Stearic acid	11.67±0.64	12.24±0.76	11.73±0.41
Oleic acid	52.86±1.76[a]	49.11±0.62[b]	48.98±0.37[b]
Vaccenic acid	0.21±0.02[b]	0.27±0.01[a]	0.06±0.01[c]
Linoleic acid	1.86±0.10[b]	1.60±0.11[b]	2.77±0.08[a]
Linoleic acid	0.09±0.02	0.11±0.03	0.00±0.00
Linolenic acid	0.15±0.00[b]	0.14±0.01[b]	0.20±0.02[a]
Eicosenoic acid	0.47±0.03[a]	0.41±0.02[a]	0.13±0.02[b]
Eicosadienoic acid	0.08±0.00[b]	0.05±0.01[b]	0.31±0.02[a]
Eicosatrienoic acid	0.12±0.01[ab]	0.10±0.01[b]	0.14±0.01[a]
Arachidonic acid	0.26±0.03	0.19±0.01	0.29±0.05
SFA	39.34±1.83[b]	43.60±0.70[a]	42.34±0.48[ab]
USFA	60.67±1.83[a]	56.41±0.70[b]	57.67±0.48[ab]
MUFA/SFA	1.49±0.12[a]	1.25±0.04[b]	1.28±0.02[ab]
PUFA/SFA	0.07±0.00[b]	0.05±0.00[c]	0.09±0.00[a]

[a~c] Means having different letters in the same row are significantly different($p<0.05$).

[*] Hanwoo, Holstein : Raised in Korea.

[**] Angus : Imported from Australia and raised for 6 months in Korea.

Table 4. Sensory properties of *M. longissimus lumborum* from Hanwoo, Angus and Holstein beef during storage at 4℃ for 7d.

Items	Hanwoo*	Angus**	Holstein*
Tenderness[1)]	8.55±0.29	8.53±0.27	7.80±0.58
Juiciness[2)]	8.45±0.34[a]	8.18±0.20[a]	6.55±0.50[b]
Flavor[3)]	8.18±0.16[a]	8.25±0.40[a]	6.75±0.30[b]
Overall acceptability[4)]	8.50±0.14[a]	8.25±0.38[a]	6.73±0.44[b]

[a~b] Means having different letters in the same row are significantly different($p<0.05$).

[*] Hanwoo, Holstein : Raised in Korea.

[**] Angus : Imported from Australia and raised for 6 months in Korea.

[1)] Tenderness : 1 = extremely tough, 10 = extremely tender.

[2)] Juiciness : 1 = extremely dry, 10 =Extremely juicy.

[3)] Flavor : 1 = extremely bland, 10 = extremely intense.

[4)] Overall acceptability : 1 = extremely unacceptable, 10 = extremely acceptable.