Correlation between Tenderness and Other Carcass Characteristics of Hanwoo (Korean Native) Steers

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ABSTRACT : This experiment was carried out to evaluate the tenderness of meat and it's correlation with other carcass traits of Hanwoo steers. The significantly ($p<0.01$) higher mastication and shearing were observed in boiled meat than in the raw meat but the coefficient of variations were greater in raw meat than in boiled meat. The correlation between raw and boiled meat for shearing and penetration were positive and significant ($p<0.01$). Negative and significant correlations were observed between mastication and eye muscle area ($p<0.05$) and also between shearing and cooking loss ($p<0.01$) in raw meat whereas, penetration in raw meat was positively and significantly ($p<0.05$) correlated with age of the steers. Shearing in boiled meat negatively and significantly correlated with age ($p<0.05$), carcass weight ($p<0.01$), back fat thickness ($p<0.01$) as well as muscle score ($p<0.01$). The pH was not significantly correlated with tenderness in both raw and boiled meat. There were possibilities that the tenderness of boiled meat could be predicted from the raw meat. ***(Asian-Aust. J. Anim. Sci. 2002. Vol 15, No. 12 : 1677-1679)***

Key Words : Carcass Weight, Eye Muscle Area, Back Fat, Cook Loss, Tenderness, Correlation

INTRODUCTION

According to the liberalization of trade between countries, the farmers raising Hanwoo historically known as a unique breed have made a great effort to distinguish Hanwoo from other beef cattle breed as production of high quality meat (Kim et al., 1998). In Korea, carcass value is determinedon the basis of meat quality, especially, degree of marbling (intra- muscular fat). The tenderness of meat depends on several factors. Meat with high pH is more susceptible to bacterial spoilage and has reduced flavor. Nevertheless, this meat is associated with a higher rate of tenderization (Watanabe et al., 1996) or with a better tenderness (Bouton et al., 1973).

It is well known that the first step in animal improvement for high quality meat is the evaluation of the trait by precise and accurate tools. Currently, slaughtered beef evaluation is conducted on the basis of visual evaluation by the meat graders. To select high quality beef genetically, as well as to provide price determination base in the beef auction, mechanical evaluation of meat quality is necessary. The estimation of genetic parameters in body weights of Hanwoo was made (Shin and Park, 1990; Son et al., 1997). Despite the endeavor to improve Hanwoo, the information on the merit of carcass with the measurement by mechanical instruments are limited. In this study, mechanical evaluation of tenderness in terms of mastication, shearing and penetration of Korean native cattle were attempted in raw and boiled meat by rheometer and also to find out the correlation between tenderness and other carcass traits.

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MATERIALS AND METHODS

This experiment was undertaken at the laboratory of Animal Resources and Biotechnology, Chonbuk National University, Korea. A total of 161 samples were collected from Hanwoo steers aged between 657-753 days (average 717 days). Samples were collected between 13th-14th rib of the steers within 24 h of slaughter when the meat quality is evaluated by professional graders. The traits studied were carcass weight, eye muscle area (EMA), back fat thickness (BF), pH, cooking loss (CL), muscle score (MS), mastication, shearing and penetration. Fudoh Rheo Meter was used to measure the tenderness values for the raw meat expressed in the mastication, shearing and penetration within 36 h postmortem. The pH was measured directly in the raw muscle using pH meter. The samples were also boiled at the 65°C for 30 min to obtain the 2nd measurements. The CL was calculated by the weight differences between raw and boiled meat and the MS were ranked from 1 to 7 on the basis marbling by visual assessment. Collected data were analyzed by using SAS statistical package (SAS, 1991) program. For the meaningful comparison of sub-class mean Least Significant Difference (LSD) test was performed.

RESULTS AND DISCUSSION

Carcass traits

Means along with their standard errors of carcass traits of Hanwoo steers are presented in Table 1. The mean

Table 1. Means with standard deviations of carcass characteristics of Hanwoo steers

Parameters	Mean	SD	Min	Max
Carcass wt. (kg)	314.80	31.18	226	398
EMA (cm^2)	81.60	8.42	57	104
BF (cm)	0.84	0.312	0.20	1.8
pH	5.87	0.090	5.69	6.11
Cooking loss (%)	6.50	2.39	1.97	17.28
MS (1-7)	2.84	1.57	1	7

EMA=Eye muscle area; BF=Back fat; MS=Muscle score.

carcass weight and CL of steer were 314.80±31.18 kg and 6.50±2.39% respectively. Silva et al. (1999) conducted an experiment with 1, 6 and 13 days post mortem beef samples and heated all the samples at 70°C. They found that the CL were 14.5, 20.0 and 20.5% for the samples of 1, 6 and 13 days post mortem respectively. These results are higher than the present experiment may be due to the cooking temperature differences. According to the reports of Wolf et al. (1980), a greater EMA is associated with a higher production of lean in the carcass. The EMA was 81.60±8.42 cm^2 in the present experiment. The BF and pH were 0.84±0.31 cm and 5.87±0.09 respectively (Table 1). Silva et al. (1999) noted that pH of bovine meat varied from 5.56 to 6.70, which supports the present study.

Correlation of traits between raw and boiled meat

The means, standard deviations, coefficient of variations of mastication, shearing and penetration, and the correlation between raw and boiled meat for these traits are shown in Table 2. The greater variations were observed in the raw meat than in the boiled meat for the mastication and the shearing. The significantly ($p<0.01$) higher mastication and shearing were observed in the boiled meat than in the raw meat. Concomitant comparisons of these traits between raw and boiled beef are not found in literature to compare the facts of this study. From Table 2, it was also found that the correlation between raw and boiled meat for shearing and penetration were positive and significant ($p<0.01$). It may be due to presence of high amount of heat insoluble collagen in the steers.

Table 2. Mastication, shearing and penetration and their correlations between raw and boiled meat

Tenderness	Condition	Mean	SD	CV	Corr.
Mastication	Raw	43.3^a	26.15	60.4	
(g/cm^2)	Boiled	378.4^b	189.5	50.1	-0.085
Shearing	Raw	$3,858^a$	1,275	33.10	
(g/cm^2)	Boiled	$6,347^b$	1,533	24.20	0.410**
Penetration	Raw	5,434	1,959	36.10	
(g/cm^2)	Boiled	5,801	2,227	38.40	0.525**

Means with different superscripts in the same traits differ significantly ($p<0.01$).
** $p<0.01$.

Correlation between traits of raw meat

Correlation coefficients of tenderness in raw meat with age, carcass weight, EMA, BF, pH, CL and MS are presented in Table 3. Significant and negative correlations between mastication and EMA ($p<0.05$) and between shearing and CL ($p<0.01$) in raw meat were observed. But penetration in raw meat positively and significantly ($p<0.05$) correlated with age of steers in the present experiment. These results are partially similar to those of Silva et al. (1999) who showed that tenderness significantly ($p<0.01$) correlated with CL. Bouton et al. (1973) considered that the higher water holding capacity of meat with high pH contributes to their high tenderness. The pH insignificantly and negatively correlated with shearing and positively correlated with mastication and penetration in raw meat (Table 3). Dransfield (1981) stated that tenderness was not related to pH in raw meat.

Correlation between traits of boiled meat

Correlation coefficients of tenderness in boiled meat with age, carcass weight, EMA, BF, pH, CL and MS are presented in Table 4. Shearing in boiled meat negatively and significantly correlated with age ($p<0.05$), carcass weight ($p<0.01$), BF ($p<0.01$) and MS ($p<0.01$) of steers. The relationship between pH and tenderness was insignificant but positive in boiled meat (Table 4). However, the relationship between pH and tenderness is controversial; some authors (Bouton et al., 1973; Guignot et al., 1994) found a linear relationship between these parameters whereas others (Jeremiah et al., 1991; Purchas, 1990; Purchas and Aungsupakon, 1993) found a curvilinear relationship, with minimum tenderness between 5.8 and 6.2 pH values.

As a conclusion, the relationship between raw and boiled meat for shearing and penetration were high which indicates that there are possibilities that the physical characteristics of meat after boiling could be predicted from the raw meat.

Table 3. Correlation coefficients among tenderness and other carcass traits in raw meat

Tenderness	Age	Carcass weight	EMA	BF	PH	CL	MS
Mastication	-0.082	- 0.067	-0.210*	-0.057	0.030	- 0.081	0.167
Shearing	-0.094	- 0.144	- 0.040	0.007	- 0.125	- 0.240**	- 0.060
Penetration	0.211*	0.094	- 0.020	-0.054	0.068	0.158	0.141

EMA=Eye muscle area; BF=Back fat; CL=Cooking loss; MS=Muscle score.
* $p<0.05$; ** $p<0.01$.

Table 4. Correlation coefficients among tenderness and other carcass traits in boiled meat

Tenderness	Age	Carcass weight	EMA	BF	PH	CL	MS
Mastication	0.123	0.121	0.157	0.054	0.123	0.072	-0.154
Shearing	-0.202*	-0.246**	-0.048	-0.232**	0.106	-0.121	-0.293**
Penetration	0.160	0.129	-0.026	0.044	0.059	0.127	0.151

EMA=Eye muscle area; BF=Back fat; CL=Cooking loss; MS=Muscle score.
* $p<0.05$; ** $p<0.01$.

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