Carcass Traits and Their Relationships in Hanwoo (Korean Native) Steers

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한우 거세우의 도체 형질간의 관계

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ABSTRACT

This experiment was prosecuted to estimate the carcass traits and their relationships in Hanwoo steers. The mean carcass weight(CWT), back fat thickness (BFT), meat, bone, intra- muscular fat (IMF) and eye muscle area (EMA) of steers were 300.27 kg, 9.23 mm, 58.99%, 12.92%, 28.08% and 74.00 cm^2, respectively. The pH_B(before aging), pH_A(after aging), cook loss before aging(CL_B) and cook loss after aging (CL_A) were 5.32, 5.60, 16.43% and 19.21%, respectively. It was also found that the MS and FC were 3.67 and 3.17, respectively. The EMA and quantity index (QIX) were positively correlated with CWT, meat% and bone% but negatively correlated with IMF%. The BFT was positively correlated with CWT and meat% but negatively correlated with bone% and IMF%. The pH (both before and after aging) was negatively correlated with CL (both before and after aging), water loss during freezing (WLF) and FC. The muscle score(MS) was negatively correlated with CL but positively correlated with WLF and FC. The ARM, HRD, CHW and CTM increased with the increasing of fat% and sharply decreased with the increasing of meat% in the carcass.

(**Key words**: Carcass traits, Eye muscle area, Back fat, Steer, Cook loss)

I. INTRODUCTION

The Korean cattle breed, Hanwoo, is of particular importance in Korea because of its high quality meat production (Yeo et al., 2002; Kim et al. 1998). The carcass value is determined on the basis of meat quality, especially, degree of marbling (intra-muscular fat, IMF) in Korea. Quality of beef products and quantity of edible portion are the basic factors used to judge carcass merit. The hardness 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.

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1996) or with a better tenderness (Bouton et al. 1973).

The value of a beef carcass of a given weight is largely determined by the lean meat yield, which is a function of carcass fat percent and carcass muscle to bone ratio. Thus, lean meat yield will increase when there is an increase in meat to bone ratio, a decrease in fat% or any combination of these. For carcass classification purposes, estimates of carcass fat% can be made reasonable satisfactorily from measures of fat depths or subjective assessments of overall fat cover (Fisher, 1988).

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. Carcass evaluation is the technique by which the components of quality and the quantity are measured. Currently, slaughtered beef evaluation is conducted on the basis of visual evaluation by the meat gradersormula. Quality, and ratio of lean to fat and bone are the main considerations in carcass merit. The aim of this study was to estimate the carcass traits and to find out the correlation between different carcass traits of Hanwoo steers.

II. MATERIALS AND METHODS

This experiment was carried out at the laboratory of Animal Resources and Biotechnology, Chonbuk National University, Korea. A total of 30 Hanwoo steers were slaughtered and meat samples were collected between 13th-14th ribs of the slaughtered steers within 24 hours of slaughter. The traits studied were carcass weight (CWT), back fat thickness (BFT), meat%, bone%, fat%, eye muscle area (EMA), quantity index (QIX), pH, cook loss (CL), water loss during freezing (WLF), muscle score (MS), fat color (FC), meat aroma (ARM), hardness (HRD), chewness (CHW) and chew time (CTM). The CWT were obtained by weighing the weight of slaughtered steers after the removal of the lungs, heart, liver, intestines and ancillary organs, bladder, reproductive organs and blood. The BFT was measured at the 12th and 13th vertebra and the IMF was estimated by Perchloric-Acetic acid method according to Lee & Sung (1989). Five pairs of isolated tracing of the muscle *longissimus dorsi* or 'eye muscle' were made on a transparent acetate sheet to determine the cross section area of the muscle. Each acetate paper was copied onto a plane white paper of known area and the weight. The demarcated areas on to a white paper for eye muscle were separated. From the area-weight relationship the eye muscle area was determined by simple calculation. The QIX of individual steers were calculated using the following formula according to NFCF (2000):

QIX = 65.834 − [0.393 back fat (mm)]+[0.088 EMA (cm^2)] − [0.008 CWT (kg)]+2.01

The MS were ranked from 1 to 7 on the basis marbling by visual assessment. The FC was scored on a scale of 1 to 7, where, 1 = white and 7 = very yellow. The samples were aged at 15.6℃ for 7 days. The pH was measured directly in the muscle before (pH_B) and after (pH_A) aging using pH meter. The CL was also estimated before (CL_B) and after (CL_A) aging. The CL_B was calculated as percentage based on the weight differences between before aging and after boiling the samples at 65℃ for 30 minutes and the CL_A was calculated as percentage based on the weight differences between after aging and after boiling the samples at 65℃ for 30 minutes. The WLF was calculated as percentage based on the weight differences between before and after freezing. The ARM, HRD, CHW and CTM were estimated by panel test of 5 girls and 3 boys with 2 replications of each sample. Collected data were analyzed by using SAS statistical

package (SAS, 1995) program.

Ⅲ. RESULTS AND DISCUSSIONS

1. Quantitative traits :

The least-squares means with their standard errors of quantitative carcass traits of Hanwoo steers are presented in Table 1. The mean CWT and BFT were 300.27±5.45 kg and 10.23±0.60 mm, respectively. Kim et al. (2002) conducted an experiment with Hanwoo steers fed four dietary treatments of 0, 3, 5 and 10% of the rice straw with equal weights of dried wormwood in the basal diet. They found CWT to be 352.7, 367.5, 375.8 and 390.4 kg for 0, 3, 5 and 10% rice straw based diets, respectively and BFT to be 14.0, 13.0 16.3 and 12.7 mm for 0, 3, 5 and 10% rice straw based diets, respectively. The reason that these results are higher than the present findings may be due to the effect of diet. Baik et al. (2002) conducted an experiment with 161 progeny from 23 sire groups and found that CWT and BFT to be 314.84 kg and 0.80 cm, respectively for Hanwoo steers. The meat, bone and IMF of steers were 58.99±0.86%, 12.92±0.48% and 28.08±0.98%, respectively (Table 1). 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 and QIX were 74.00±1.10cm^2 and 68.38±1.47, respectively in the present experiment. Baik et al. (2002) noted that the EMA ranged from 57.00 to 104.00 cm^2 for different progeny groups of 23 sires.

2. Qualitative traits :

The least squares means with their standard errors of qualitative carcass traits of Hanwoo steers are presented in Table 2. From Table 2 it has been observed that the pH_B and pH_A were 5.32±0.13 and 5.60±0.16, respectively. Silva et al. (1999) noted that pH of bovine meat varied from 5.56 to 6.70, which supports the present study. The CL_B and CL_A were 16.43±0.58% and 19.21±0.64%, respectively (Table 2). These results are in close agreement with those of Silva et al. (1999), who conducted an experiment with 1, 6 and 13 days post mortem beef samples and heated all the samples at 70℃. They found that the CL was 14.5, 20.0 and 20.5% for the samples of 1, 6 and 13 days post mortem, respectively. However, 23.03% water was lost from meat during freezing in the present study. From Table 2, it has also been found that the MS and FC were 3.67±0.35 and 3.17±0.07, respectively. Kim et al. (2002)

Table 1. Least-squares means and their standard errors of quantitative traits of meat in Hanwoo steers

Parameters	LS Mean	Std. error	Minimum	Maximum
CWT (kg)	300.27	5.45	249.00	390.00
BFT (mm)	10.23	0.60	4.00	17.00
Meat (%)	58.99	0.86	49.10	70.20
Bone (%)	12.92	0.48	9.10	18.60
IMF (%)	28.08	0.98	17.90	35.90
EMA (cm^2)	74.00	1.10	60.00	86.00
QIX	68.38	1.47	65.38	70.69

CWT=carcass weight; BFT=back fat thickness; IMF=intra-muscular fat; EMA=eye muscle area; QIX=quantity index.

Table 2. Least-squares means and their standard errors of qualitative traits of meat in Hanwoo steers

Parameters	LS Mean	Std. error	Minimum	Maximum
pH_B	5.32	0.13	5.13	5.91
pH_A	5.60	0.16	5.47	6.27
CL_B (%)	16.43	0.58	9.30	22.00
CL_A (%)	19.21	0.64	12.80	26.10
WLF (%)	23.03	0.67	28.09	44.25
MS	3.67	0.35	1.00	7.00
FC	3.17	0.07	2.00	5.00

pH_B=pH before aging; pH_A=pH after aging; CL_B=cook loss based on before aging; CL_A=cook loss based on after aging; MS=muscle score; FC=fat color; WLF=water loss during freezing.

found FC to be 2.7, 3.0, 3.0 and 2.7 for 0, 3, 5 and 10% rice straw based diets, respectively. They also noted that the feed in their study had no effect on meat fat color.

3. Correlation between different quantitative traits:

The correlation coefficients between different quantitative traits are presented in table 3. The EMA and QIX were positively correlated with CWT (0.48 and 0.37, respectively), meat% (0.20 and 0.53, respectively) and bone% (0.03 and 0.02, respectively) but negatively correlated with IMF (−0.16 and −0.05, respectively). Baik et al. (2002) noted that the phenotypic correlation between EMA and CWT of Hanwoo steers was 0.52. From Table 3, it has also been observed that the BFT was positively correlated with CWT (0.44), meat% (0.46) and IMF% (0.44) but negatively correlated with bone% (−0.09).

4. Correlation between different qualitative traits:

The correlation coefficients between different qualitative traits are presented in table 4. The pH (both before and after aging) was negatively correlated with CL (both before and after aging), WLF and FC. However, Bouton et al. (1973) considered that the higher water holding capacity of meat with high pH contributed to their high meat hardness. The MS was negatively correlated with CL (−0.04 and −0.27 for CL_B and CL_A, respectively) but positively correlated with WLF (0.42) and FC (0.13) in the present study.

5. Relationships of fat% and meat% with organoleptic traits :

Relationships of different organoleptic traits with fat% and meat% of the carcass are shown

Table 3. Correlation between different quantitative traits of meat in Hanwoo

Parameters	CWT	Meat	Bone	IMF
EMA	0.48	0.20	0.03	-0.16
QIX	0.37	0.53	0.02	-0.05
BFT	0.44	0.46	-0.09	0.44

CWT=carcass weight; IMF=intra-muscular fat; EMA=eye muscle area QIX=quantity index; BFT=back fat thickness.

Table 4. Correlation between different qualitative traits of meat in Hanwoo

Parameters	CL_B	CL_A	WLF	FC
pH_B	-0.07	-0.37	-0.20	-0.11
pH_A	-0.03	-0.25	-0.24	-0.04
MS	-0.04	-0.27	0.42	0.13

pH_B=pH before aging; pH_A=pH after aging; MS=muscle score; CL_B=cook loss based on before aging; CL_A=cook loss based on after aging; FC=fat color.

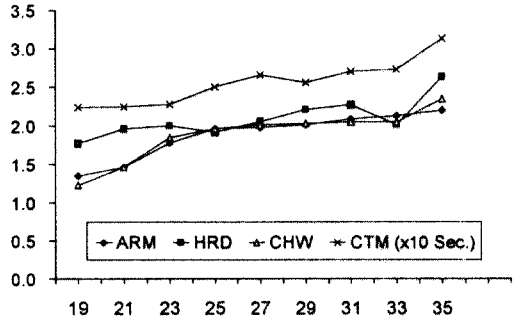

Fig. 1. Relationship between fat% and organoleptic traits of meat in Hanwoo steers.
(ARM = meat aroma; HRD = hardness; CHW = chewness; CTM = carcass weight).

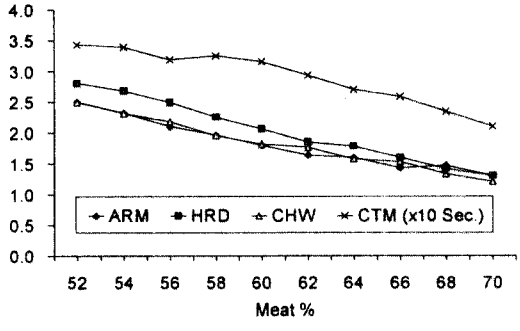

Fig. 2. Relationship between meat% and organoleptic traits of meat in Hanwoo steers.
(ARM = meat aroma; HRD = hardness; CHW = chewness; CTM = carcass weight)

in Fig. 1 and Fig. 2, respectively. The ARM, HRD, CHW and CTM increased with the increasing of fat% in the carcass (Fig. 1). Concomitant comparisons of the relationship between these traits are not found in literature to compare the facts of this study. However, the reason that the ARM, HRD, CHW and CTM decreased sharply with the increasing of meat% in the carcass (Fig. 2) may be due to the fact that meat is more tender and less aromatic than fat.

Ⅳ. CONCLUSIONS

The results of this study showed that the amount of fat in the carcass has a vital role to control ARM, HRD, CHW and CTM. The correlations of EMA and BFT with CWT and meat% were high and positive, which indicates that there are possibilities that the selection for EMA and BFT also leads to increase for CWT and meat% in the carcass.

Ⅴ. 요 약

이 연구는 한우에 있어서 몇 가지 도체형질의 특성을 파악하고 각 형질들 간의 관계를 추정하기 위하여 수행되었다. 도체중, 등지방두께, 살코기 비율(meat %), 뼈 비율(bone %), 근내지방% 및 배장근단면적의 평균치는 각각 300.27kg, 9.23mm, 58.99%, 12.92%, 28.08% 및 74.00cm^2 이었다. 숙성 전 (pH_B) 및 숙성 후 (pH_A)의 산도와 조리손실(숙성 전 및 숙성 후)은 각각 5.32, 5.60, 16.43 및 19.21 이었다. 근육의 평점과 지방색은 3.67 및 3.17을 나타내었다. 배장근 단면적과 육량등급은 도체중, 적육% 및 뼈%와 극히 미약한 正의 상관이 존재

하는 반면에 근내 지방도와는 負의 상관을 보였다. 등지방두께는 도체중 및 적육량과 正의 상관이었으나 뼈의 % 및 근내지방 %와는 負의 상관을 나타내었다. 酸度는 調理 損失과 숙성전후에 관계없이 負의 상관을 보였다.

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