EFFECT OF MATURATION ON THE MEAT COLOR IN BEEF FROM HANWOO (KOREAN CATTLE) COWS OF VARIOUS AGES

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Abstract – The effect of maturation (Maturity score : 4 ~9) on the meat color in beef from Hanwoo (Korean cattle) cow (83 heads; 1.4 ~ 11.5 years-aged) was investigated. Maturation degree was increased by increasing age in cow. By increasing maturity score, total myoglobin content was increased and CIE L^* was decreased in beef from cow. Therefore, more matured Hanwoo cow had the darker meat color.

Key Words – Age, Cow, Hanwoo, Maturity, Meat color, Myoglobin

- INTRODUCTION

In Korea, the price of Hanwoo (Korean cattle) beef depends on its carcass grade (Particularly, quality grade), that is, the high grade beef is sold at a high price. Korean beef carcasses are graded by classifying largely as two categories: yield and quality. The quality grade is rated as 1^{++} (Best), 1^{+}, 1, 2, or 3 (Worst) through two rating processes. Primarily, it is rated by marbling score (1 = avoid ~ 9 = abundant; 8, 9 = 1^{++}; 6, 7 = 1^{+}; 4, 5 = 1; 2, 3 = 2; 1 = 3) and then finally decided by meat color, fat color, firmness, and maturity (Bone maturity) scores. However, if the beef carcass is scored as 1 or 7 for meat color (1 = brightly cherry-red ~ 7 = extremely dark-red) or 7 or 8 for fat color (1 = white ~ 7 = dark yellow) or 3 for firmness (1 = firm ~ 3 = soft) or 8 or 9 for maturity (1 = very youthful ~ 9 = very mature), final quality grade is rated with downgrading of primary quality grade.
The age of cattle influences meat color in beef. In a previous study of Boccard *et al*. [1], it has been reported that older age lead to darker color in beef. This is due to increase of myoglobin content with increase of age [2].

The cow meat usually sold in meat market is not only older but has also a variety of ages when compared with bull and steer. Thereby, in our scientific experience, the scores of meat color and maturity in cow meat have tended to be high and non-uniform.

Therefore, we estimated the meat color score, myoglobin content, and instrumental color in beef from Hanwoo (Korean cattle) cows of various ages, in order to investigate the effect of maturation on the meat color.

- MATERIALS AND METHODS

Animals and raw materials

A total of 83 heads of 1.4 ~ 11.5 years-aged Hanwoo (Korean cattle) cows were slaughtered and their carcasses were chilled overnight. For this research, the striploins were collected and divided into 6 treatments by maturation degree (Maturity score of 4 : 13 heads; 5 : 14; 6 : 12; 7 : 14; 8 : 15; 9 : 15).

Maturation degree and meat color score evaluation

Following chilling of carcasses, maturation degree and meat color score were evaluated by an animal products grader according to MAFRA [3]. The grade standards are as follows.

Maturation degree (Maturity)
: 1 = very youthful ~ 9 = very mature
Meat color score
: 1 = brightly cherry-red ~ 7 = extremely dark-red

Total myoglobin measurement

Total myoglobin content was analyzed following the procedure described by Sammel *et al*. [4]. Five grams of samples were homogenized (T25 Digital Ultra-Turrex, Ika Werke GmbH & Co., Staufen, Baden-Wüttenberg, Germany) with 20 mL of deionized water for 30 sec, centrifuged (Avanti J-20XP Centrifuge, Beckman Coulter, Inc., Palo Alto, CA, USA) for 30 min at 30,000 × g at 2℃, and then filtered through 0.45 μm syringe filter. The absorbance values of supernatants were measured at 525 nm (ProteomeLab DU-800, Beckman Coulter, Inc., Fullerton, CA, USA) and calculated as mg per g meat through MW (16,110; 5) and millimolar extinction coefficient (7.6 $mM^{-1}cm^{-1}$; 6) of myoglobin.

Instrumental color determination

Immediately after blooming, CIE L^* (Lightness), a^* (Redness), and b^* (Yellowness) at the surfaces of samples was determined using a chroma meter (CR-400, Konica Minolta Sensing, Inc., Osaka, Kansai, Japan). CIE C^* (Chroma) and H^o (Hue-angle) were calculated as $(a^{*2} + b^{*2})^{1/2}$ and $\tan^{-1}(b^*/a^*)$, respectively, by a data processor (DP-400) connected to a chroma meter.

Statistical analysis

All data were analyzed by the analysis of variance (ANOVA) in SPSS [7] program. Duncan's multiple range tests were conducted to compare the significant differences among means of treatments at $P < 0.05$. Pearson's correlation coefficient was estimated for variables.

- RESULTS AND DISCUSSION

The slaughter age by maturation in Hanwoo cow was presented in Figure 1. Except maturation degree of 6, increasing maturation degree significantly (P <0.05) increased the age in Hanwoo cow. This result means old-aged Hanwoo cow has the high degree of maturation.

Figure 1. Slaughter age by maturation in Hanwoo (Korean cattle) cow.
[a-e]Means±S.E. among treatments with different letters differ significantly ($P < 0.05$).

Meat color score by maturation in beef from Hanwoo cow was presented in Figure 2. There were not significant differences for meat color score among treatments.

Figure 2. Meat color score by maturation in beef from Hanwoo (Korean cattle) cow.
[a-b]Means±S.E. among treatments with different letters differ significantly ($P < 0.05$). Meat color score : 1 = brightly

cherry-red ~ 9 = extremely dark-red.

Total myoglobin content (Fig. 3) in beef from Hanwoo cow showed the tendency to increase with increase of maturation degree. Particularly, it was significantly ($P < 0.05$) higher in beef of maturation degree of 6 and 9 compared with degree of 4. This result is because of high myoglobin content in beef from cattle of high age as reported previously by Lawrie [2].

Figure 3. Total myoglobin content by maturation in beef from Hanwoo (Korean cattle) cow.
[a-c]Means±S.E. among treatments with different letters differ significantly ($P < 0.05$).

All CIE values (Figure 4) were tended to decrease by increasing maturation degree. In particular, the L^* was significantly ($P < 0.05$) decreased in beef from cow of maturity 7 and 8 scores compared with 4 score. The a^* and b^* were significantly ($P < 0.05$) decreased in beef from cow matured in degrees of 5 and 9 compared with degree of 4. Thus, higher myoglobin content lead to darker color in beef from cow.

Figure 4. CIE values by maturation in beef from Hanwoo (Korean cattle) cow.
[a-d]Means±S.E. among treatments with different letters differ significantly ($P < 0.05$).

Correlation coefficient among maturation degree and other variables was presented in Table 1. Maturation degree was positively correlated with cow age (r = 0.733; $P < 0.01$), meat color score (r = 0.236; $P < 0.05$), and total myoglobin content (r = 0.459; $P < 0.01$) and negatively correlated with CIE L^* (r = -0.237; $P < 0.05$). However, it did not have significantly ($P > 0.05$) correlation with CIE a^* and b^*.

Table 1 Correlation coefficient among maturation degree, slaughter age, meat color score, myoglobin content, and CIE values

Items	Coefficient	*P* value[1]
Age	0.733	**
Meat color score	0.236	*
Myoglobin	0.459	**
L^*	-0.237	*
a^*	-0.173	N.S.
b^*	-0.147	N.S.
[1]N.S. : Not significant ($P > 0.05$); * : $P < 0.05$; ** : $P < 0.01$.		

- CONCLUSION

Maturation causes the dark meat color with increase of myoglobin content in Hanwoo cow. This may be because high maturity results from old age.

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