

# MEAT QUALITY OF HANWOO STEERS FED WITH DOMESTIC FORAGE BARLEY SILAGE IN KOREA

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**Abstract**— The livestock industry of Korea is still primarily carrying out feeding method using the concentrates and rice straw. Recently, the supply of domestic good quality forages increases rapidly, particularly in Italian ryegrass, forage barley and so on. This study was carried out to investigate the feeding effect of forage barley silage on the beef carcass grade and meat quality of Korean native Hanwoo steers. The steers were divided into three treatment groups which fed rice straw only, forage barley silage, and fresh rice straw silage plus forage barley silage during overall period *ad libitum*. Meat quality with forage barley silage was higher than that of control. Frequency rate(%) of 1 and/or 1<sup>+</sup> quality grade, and marbling score of feeding with forage barley were 62.5% and 4.38, while those of control were 37.5% and 2.75, respectively. The results of the sensory evaluation showed that Hanwoo beef fed with forage barley were better than that of control. In conclusion, feeding of forage barley silage as domestic forage was desirable to improve the beef quality and palatability of Hanwoo steers.

**Index Terms**—beef quality, forage barley, sensory evaluation, whole crop silage

## I. INTRODUCTION

The livestock industry in Korea is dependent on the feeding method with concentrates and rice straw. Also, over 700,000 MT of forages was recorded to be imported per year. The important fields for forage production are upland, paddy land, grassland and forest areas. Rice straw is also one of the most important roughages. Recently, however, the production and utilization of forage barley and Italian ryegrass (IRG) for cattle increase rapidly, and research on forage barley and IRG as domestic forages is carrying actively out since 1998 (Seo & Yook, 2002 ; MIFAFF, 2009 ; Seo, 2009). MIFAFF steadily tries to make the policies about the plans and supports for cattle research and extension of forages such as barley, IRG, corn, and so on. High quality and high safety Hanwoo beef is greatly required to consumers, nowadays. Therefore, this study was carried out to investigate the effect of feeding forage barley silage produced in domestic area on the carcass grade, beef quality and sensory evaluation of Korean native Hanwoo steers.

## II. MATERIALS AND METHODS

This study was carried out to investigate the effect of feeding forage barley silage on the beef carcass grade and meat quality of Korean native Hanwoo steers in Jeongub, Jeonbuk, 2001. Twenty one steers were allocated and divided into three treatment groups which fed rice straw only, forage barley silage, and fresh rice straw silage plus forage barley silage during overall period *ad libitum*, and allowed free access to water. Concentrates were fed at 1.5% level of live body weight during growing stage, 4~12 months old at 1.8% level of live body weight during early fattening stage, 13 ~ 18 months of age, and *ad libitum* after late fattening stage, 19 ~ 27 months of age. Forage barley was harvested at dough to early yellowish stage for round bale silage manufacture (Seo *et al.*, 2002).

Hanwoo beef was analyzed quality-grade factor (marbling score, meat color, fat color, texture, maturity), and quantity-grade factor (carcass weight, back fat thickness, *longissimus* muscle loin area). The contents of moisture, crude protein, crude fat, and crude ash were analyzed by AOAC (1990) with *longissimus lumborum* muscles (striploin), and water holding capacity was measured by Laakkonen, Wellington & Skerbon (1970). WB-shear force was measured on cooked steaks (2.54 cm thick) in a pre-heated water bath for 60 min until the core temperature reached 70 °C and then cooled in running water (ca. 18°C) for 30 min to reach a core temperature below 30°C. Eight cores of 1.27-cm diameter were made for each sample, and peak force was determined using a V-shaped shear blade with a cross-head speed of 400 mm/min (Wheeler, Shackelford & Koohmaraie, 2000). Cooking loss was calculated as percent of weight changes during cooking for WB-shear force measurement. Non-trained eight panelists evaluated sensory characteristics of tenderness, juiciness and flavor intensity on a 6-point scale from very unacceptable to very acceptable.

### III. RESULTS AND DISCUSSION

The most important factor is beef quality grade in Hanwoo steers (Table 1). The marbling score of Hanwoo beef fed with forage barley (4.38) was higher than rice straw (2.75) and fresh rice straw+forage barley (2.86) ( $p<0.05$ ). Meat color score, fat color score, and texture score of Hanwoo beef were not significantly different among treatments. General grading levels were 1.13 for forage barley treatment, and then 1.71 for fresh rice straw+forage barley and 1.75 for rice straw ( $p<0.05$ ). The appearance percentage of over first and/or first+ grade quality was high in forage barley silage as a 62.5% than those of rice straw (37.5%) and fresh rice straw+forage barley (42.9%). This result was very similar with that of Cho, Cho, Hong, Chung, Lee & Yoon (2000). However, the quality grading levels were lower when compared with average national beef quality (MIFAFF, 2009), because of continuing silage feeding until late fattening stage and/or assuming low genetic factor of experimental Hanwoo.

In the quantity grade factor of Hanwoo beef (Table 2), no significant differences were found in back fat thickness, carcass weight, meat quantity index, and meat quantity grade among three treatments. But *longissimus* muscle area tends to high in forage barley silage. The grade of beef quantity was 2.13 in rice straw, 2.25 in forage barley silage, and 2.43 in fresh rice straw+forage barley silage. Cho *et. al.* (2000) reported that *longissimus* muscle area would be high when feeding with high quality forage of Italian ryegrass during growing stage and fattening stage of Japanese black cattle (Wagyu) in Japan. However, digestible energy, fat cover and dressing percent of barley silage were lower than those of corn silage (Mowat & Slumskie, 1971).

The content of moisture, crude protein, and crude ash were similar among treatments (Table 3). However, the content of crude fat was significantly high in feeding with forage barley silage as 16.3%. Juiciness, tenderness, and flavor of sensory evaluation of Hanwoo beef also good in forage barley silage than those of rice straw, and fresh rice straw+forage barley silage feeding treatment (Table 5).

Table 1. Characteristics of beef quality grading factors of Hanwoo beef

Treatment	Beef marbling score	Meat color score	Fat color score	Texture	Maturity	Quality grade*	% of over 1 grade
Control	2.75 b	4.75 a	3.00 a	1.63 a	1.00 b	1.75	37.5
Forage barley silage	4.38 a	5.00 a	3.00 a	1.38 a	1.00 b	1.13	62.5
Fresh rice straw + Forage barley silage	2.86 b	5.00 a	3.14 a	1.57 a	1.57 a	1.71	42.9

\* Beef marbling score: 1 = devoid, 7 = very abundant ; Meat color: 1 = bright red, 7 = dark red ; Fat color: 1 = creamy white, 7 = yellowish ; Texture(firmness): 1 = firm, 3 = soft ; Maturity: 1 = young, 9 = mature)

Table 2. Characteristics of beef yield grade factors of Hanwoo beef

Treatment	Back fat thickness (mm)	<i>Longissimus</i> muscle area (cm <sup>2</sup> )	Carcass weight (kg)	Yield index	Yield grade*	% of yield grade
Control	12.9 a	75.8 a	345.4 a	66.68 a	2.13	B 87.5, C 12.5
Forage barley silage	14.0 a	79.9 a	366.0 a	66.44 a	2.25	A 12.5, B 62.5 C 25.0
Fresh rice straw + Forage barley silage	13.3 a	76.6 a	363.3 a	66.45 a	2.43	B 57.1, C 42.9

\* A: score 1, B: score 2, C: score 3

Table 3. Proximate composition of Hanwoo beef

Treatment	Moisture (%)	Protein (%)	Fat (%)	Ash (%)
Control	66.6 ab	19.4 a	12.4 ab	0.78 a
Forage barley silage	62.5 b	19.6 a	16.3 a	0.84 a
Fresh rice straw + Forage barley silage	68.6 a	20.5 a	9.2 b	0.86 a

Table 4. Physical characteristics of Hanwoo beef

Treatment	Cooking loss (%)	WB-shear force (kg/cm <sup>2</sup> )	Water holding capacity (%)
Control	27.93 a	3.07 a	54.58 a
Forage barley silage	24.04 b	3.18 a	57.47 a
Fresh rice straw + Forage barley silage	26.72 ab	3.77 a	48.98 b

Table 5. Sensory evaluation of Hanwoo steer beef

Treatment	Juiciness (1 ~ 6)	Tenderness (1 ~ 6)	Flavor (1 ~ 6)
Control	4.45 b	5.15 a	5.00 a
Forage barley silage	5.23 a	4.90 ab	5.25 a
Fresh rice straw + Forage barley silage	4.00 c	3.85 b	4.45 b

\* 6-point scale from 1(very unacceptable) to 6(very acceptable)

#### IV. CONCLUSION

Beef quality factors are very important to consumers and farmers. Feeding of forage barley silage as domestic high quality forage was very desirable for improving beef quality and palatability of Hanwoo steers. Feeding with good quality forage (forage barley, Italian ryegrass, corn, oats, and so on) should be applicable greatly to beef cattle farmers during growing and early-middle stage of Hanwoo steers.

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