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Ki-choon Choi

National Institute of Animal Science, South Korea

Won-ho Kim

National Institute of Animal Science, South Korea

Soundarrajan Ilavenil

National Institute of Animal Science, South Korea

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Effect of feeding whole crop barley silage on growth performance, carcass trait and meat quality of Hanwoo steer

Ki Choon Choi*, Won Ho Kim, Soundarrajan Ilavenil

Grassland and forage division, National Institute of Animal Science, RDA, Cheonan, Republic of Korea

*Corresponding author e-mail: Choiwh@korea.kr

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Introduction

Hanwoo steers are one of the major sources of meat, required for increasing consumer demands in Korea, Japan, and China. Beef contained high levels of saturated fat, and it contains appreciable quantities of linolenic acid, eicosapentaenoic acid and docosahexaenoic acid. Optimum growth can obtain with appropriate combination of concentrate and forage. Fattening of Hanwoo on concentrate-based feeds resulted in faster, more efficient growth and heavier carcasses. However, feed costs represent the largest single variable in beef production in Korea and Japan. The grass is generally the cheapest source of feed available for beef production, which provides high yields with quality herbage. Grass-feed based production systems are low-input methods that are particularly suitable to meet the demand of meat retailers and consumers. Therefore, in Korea, the combination of roughage and concentrates are commonly available in the market is used for rearing Hanwoo. Especially, the study of manufacturing silage using whole crop barley or whole crop rye was carried out to expand the usage of roughage. Barley is an important crop cultivated for the production of high-quality forage in Korea and Japan. However, the benefits of feeding diet combinations of concentrate and barley silages from growing period to finishing the period of Hanwoo steer have not been evaluated. The objectives of this study were to compare the growth performance, meat quantity and quality characteristics in Hanwoo steers fed barley silage/concentrate and rice straw/concentrate diet.

Materials and Methods

This experiment was conducted according to the Hanwoo care and user guidelines of the National Livestock Research Institute of Korea. The calves of Hanwoo steers were obtained upon weaning and maintained in the individual feeding barn of livestock farms located in Korea. 24 Hanwoo steers were used in this experiment that lasted for 739 days. Hanwoo steers were randomly allotted to two treatments. *Lactobacillus plantarum* was procured from Chung-Mi Bio Co., Korea. All animals were fed with concentrate for each growing period. After feeding the roughage or silage, the concentrate was offered each feeding time. After experimental periods, all steers were slaughtered for the examination of marbling score, meat color and maturity on the basis of the Animal Products Grading Service (APGS) manual (2007). The cooking loss was performed as described by Honikel (1998).

Results and Discussion

The effects of feeding WCB on growth performance and feed intake of Hanwoo steers during growing, first, middle and finish fattening period were shown in Table 2. In the growing period and the initial fattening period, the initial body weight of the group fed BCW were slightly higher than those of the control group (CON), although in the middle and in the finish fattening period, the body weight of WCB groups was similar to CON. In the whole periods, the final body weights were not different between WCB and CON diet. The daily weight gain of steers fed with WCB was significantly higher (0.98 kg) than that of CON diet in the growing period, whereas no significant difference was found in the period of middle and finish fattening stage. As whole periods, the daily weight gain in WCB fed animal was slightly higher than that of CON (Table 1). This result indicated that the increase in daily weight gain of the growing period was clear as compared with other periods ($p < 0.05$). We suggest that the whole period of the daily weight gain was mainly affected by the growing and first fattening period in Hanwoo steer. The total feed intake of treatment was significantly higher ($p < 0.01$) than that of CON in all the periods, although in the middle and the finish fattening period, the feed efficiency of WCB groups decreased as compared to CON. It clearly confirmed that Hanwoo steer had much interest for eating WCB diet.

The effect of WCB diet on carcass yield and quality traits of Hanwoo steer were shown in Table 2. It is indicated that the carcass fed WCB diet increased back-fat thickness ($p < 0.05$) and slaughter weight of Hanwoo steer as compared with the CON diet. However, rib-eye area, dressing percentage and quantity grade was comparatively lesser. The marbling score was higher in WCB diet, whereas meat colors, fat color, texture, mature and quality grade were slightly higher in CON

diet. However, the profit was higher in Hanwoo steers fed WCB diet than the CON diet, according to decreased feed cost of Hanwoo steer fed WCB diet.

Table 1. Growth performance and feed intake of Hanwoo steers during different period

Items	Growing period				First fattening period				Middle fattening period			
	CON ¹	T ²	SEM ³	Pr<F ⁴	CON	T	SEM	Pr<F	CON ¹	T ²	SEM ³	Pr<F ⁴
Initial body weight (kg)	212.08	201.25	3.78	0.09	359.5	367.42	8.1	0.52	444.75	455.3	10.12	0.49
Final body weight (kg)	359.5	367.42	8.1	0.52	444.75	455.25	10.12	0.49	555	560.4	14.9	0.8
Daily weight gain (kg) ⁵	0.87	0.98	0.03	0.05	0.71	0.73	0.02	0.52	0.63	0.6	0.04	0.62
Feed intake (kg) ⁶	5.36	11.16	0.11	0.01	11.98	20.68	0.11	0.01	12.06	16.82	0.27	0.01
Concentrate (kg) ⁷	2.98	2.6	0.02	0.01	7.33	5.09	0.11	0.01	9.17	7.36	0.22	0.01
Rice straw (kg) ⁸	2.37	0	0.04	0.01	4.65	0	0.06	0.01	2.89	0	0.02	0.01
WCB silage (kg) ⁹	0	8.56	0.09	0.01	0	15.58	0.06	0.01	0	9.47	0.08	0.01
Feed efficiency	0.16	0.09	0	0.01	0.06	0.035	0	0.01	0.05	0.04	0	0.01
Feed conversion ration	6.2	11.47	0.4	0.01	16.9	28.37	0.9	0.01	19.13	28.34	1.77	0.01

Items	Finish fattening period				Whole period			
	CON	T	SEM	Pr<F	CON	T	SEM	Pr<F
Initial body weight (kg)	555	560.42	14.9	0.8	212.08	201.25	3.78	0.09
Final body weight (kg)	696.25	698.75	26.74	0.94	696.25	698.75	26.74	0.94
Daily weight gain (kg) ⁵	0.88	0.86	0.09	0.88	0.77	0.8	0.04	0.71
Feed intake (kg) ⁶	14.86	16.58	0.3	0.01	10.94	15.96	0.1	0.01
Concentrate (kg) ⁷	13.17	11.6	0.27	0.01	8.16	6.72	0.07	0.01
Rice straw (kg) ⁸	1.69	0	0.02	0.01	2.78	0	0.02	0.01
WCB silage (kg) ⁹	0	4.98	0.02	0.01	0	9.24	0.05	0.01
Feed efficiency	0.06	0.05	0	0.35	0.07	0.05	0	0.01
Feed conversion ration	17.84	19.63	1.96	0.01	14.25	20.18	0.86	0.01

¹ CON: Rice straw concentrate, ²T: WCB silage concentrate. ³Standard error of the mean. ⁴Probability levels. ⁵Total weight gain and daily weight gain calculated for each animal per a day that it received the test diets. ⁶⁻⁹Feed intake, concentrate and rice straw/ WCB silage calculated for each animal for each period that it received the test diets (kg/head/day, DM basis).

Table 2: Carcass yield and quality traits of Hanwoo steer

Carcass yield traits	CON ¹	T ²	SEM ³	Pr <F ⁴
Back fat thickness (cm)	9.92	13.50	1.10	0.05
Rib-eye area (cm ²)	89.83	89.10	2.43	0.66
Slaughter weight (kg)	417.67	419.20	11.41	0.64
Dressing percent (%)	66.86	64.50	0.84	0.11
Quantity grade	6.42	5.90	0.17	0.09
Quality traits				
Marbling score	5.42	5.90	0.55	0.54
Meat color	5.08	4.90	0.10	0.08
Fat color	2.92	2.80	0.10	0.51
Texture	1.17	1.10	0.10	0.93
Mature	2.08	1.90	0.11	0.17
Quality grade	2.58	2.00	0.08	0.31
Total Price (₩)	7,001,696	7,387,892	395,693	0.37

¹CON: Hanwoo steer fed rice straw + concentrate, ²T: Hanwoo steer fed WCB silage+ concentrate. ³Standard error of the mean. ⁴Probability levels.

The chemical composition and meat qualities of *M. longissimusdorsi* (LM) of Hanwoo steer fed WCB were shown in Table 3. The contents of moisture and crude protein in LM were significantly higher (P<0.05) in WCB, although the crude

fat was comparatively lower than those of CON ($p < 0.05$). In addition, surface colors in LM and sensory evaluation were comparatively higher in barley silage/concentrate.

Table 3: Chemical composition and meat qualities of *M. longissimus dorsi*.

	C ¹	T ²	SEM ³	Pr <F ⁴
Chemical composition				
Moisture	65.57	61.72	1.08	0.04
Crude fat	12.51	17.72	1.42	0.03
Crude protein	21.02	19.66	0.38	0.04
Ash	0.89	0.90	0.01	0.85
Meat qualities				
Cooking loss (%)	26.09	24.98	0.76	0.33
Shear force (kg)	3.41	3.47	0.17	0.80
Water holding capacity	55.50	56.92	0.65	0.16
pH	5.67	5.65	0.01	0.32
Surface Color				
L*	40.28	42.30	1.53	0.37
a*	22.86	23.05	0.56	0.82
b*	10.93	11.29	0.42	0.57
Sensory evaluation				
Juiciness	4.92	5.10		0.44
Tenderness	4.90	5.04		0.45
Flavour	5.06	5.12		0.61

¹CON: Hanwoo steer fed rice straw+ concentrate, ²T: Hanwoo steer fed WCB silage +concentrate. ³Standard error of the mean. ⁴Probability levels.

Conclusion

Substituting a proportion of the concentrate diet with WCB diet enhances the body weight, meat color and sensory evaluation of the meat of Hanoo steers.

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