

EFFECTS OF BYPASS VITAMIN C SUPPLEMENT ON BEEF QUALITY IMPROVEMENT IN HANWOO STEERS

Sun Sik Jang^{*}, Hyeong Cheol Kim, Eung Gi kwon, Byung Ki Park, Sang Min Lee, Tae Il Kim,
Byoung Soo Jeon, Meing Joong Kim, Young Moo Cho and Seong Koo Hong

National Institute of Animal Science, RDA, Pyeongchang, Gangwon, 232-952, South Korea

^{*}Corresponding author (phone: +82-33-330-0615; fax: +82-33-330-0660; e-mail: jangsc@korea.kr)

Abstract — This experiment is carried out to study the effects of a bypassed vitamin C supplement and appropriate supplement type in Hanwoo steers. The 50 Hanwoo steers were allotted to study a appropriate period and dosage. Experimental animals were grouped 5 allotment, control as non-supplement, T1 as fed vitamin C 40 mg per BW 1 kg per head daily from 13 to 29 months of age, T2 as fed vitamin C 80 mg per BW 1 kg per head daily from 13 to 29 months of age, T3 as fed vitamin C 40 mg per BW 1 kg per head daily from 16 to 29 months of age, and T4 as fed vitamin C 80 mg per BW 1 kg per head daily from 16 to 29 months of age. The BW of experimental animals were 374.1 ~ 385.4 kg at initial, and the final BW were 651.1, 683.3 kg in T3,4 heavier than, Control and T1. The marbling score was 5.6, 6.3 of T2, T4 individually in vitamin C 80 mg fed groups. However a feeding cost was more expensive as 760 thousand won.

Index Terms—Hanwoo steers, Vitamin C, quality beef, texture grade,

I. INTRODUCTION

Vitamin C is one of strongest anti oxidant in the nature, and especially an essential nutrient in the human and fish(McDowell, 1989), but not important in the ruminant as cattle because of synthesis in the liver(Cappa, 1958). It constitutes collagen protein that strengthens each muscles and blood vessel walls. Meanwhile, Professor Yano team of Kyoto Univ. Japan reported that Vitamin C increase activity of the adipose synthesis enzyme and promotes differentiation of intramuscular fat precursor cell. And because the ruminants can synthesize basically Vitamin C requirement in body, Vitamin C has to be supplied from 12 age of month to accumulate intramuscular fat rather than all period (Takahashi, 1999).

The all water soluble vitamins activity disappears by microbes in the rumen, therefore need to process for passage of rumen. The fat coating is one of most popular methods, in addition to ethyl-cellulose (EC) binding and chitosan adhesion methods to delay a solution.

The Japanese researchers reported that improved intramuscular fat, meat color and texture grade in case of supplement bypass vitamin C from 12 to 24 months of age(Kyoto Univ. 2002). Thus, the present study was designed to investigate effects of supplement bypass vitamin C dosage and term on the growth performance, carcass characteristics and meat properties in Hanwoo steers.

II. MATERIALS AND METHODS

Animals and diets

Fifty Hanwoo steers, 12months of age and weighing an average of 379.8 ± 12.8 kg, were distributed into 5 groups of 10 steers. The steers were assigned to 2 different dosages and fattening periods, which lasted for 16 months from 13 to 29 months of age, respectively. Experimental animals were grouped 5 allotment, control as non-supplement, T1 as fed vitamin C 40mg per BW 1kg per head daily from 13 to 29 months of age, T2 as fed vitamin C 80mg per BW 1kg per head daily from 13 to 29 months of age, T3 as fed vitamin C 40mg per BW 1kg per head daily from 16 to 29 months of age, and T4 as fed vitamin C 80mg per BW 1kg per head daily from 16 to 29 months of age. In the treatments, 10 pens (5' 10 m) which had concrete floors with sawdust bedding were arranged with 5 steers per pen. Animals were offered a commercial concentrate at 1.8% of BW, and rice straw was fed *ad libitum*. Experimental steers had free access to fresh water and mineral block during the whole period.

Sampling, measurements and analyses

Steers were weighed every month during the experiment period. Rice straw was fed at 09:00 h daily, and the concentrates in two equal portions at 08:00 and 16:00 h. Dietary refusals were collected and weighed every day. Feed conversion ratio was expressed as average feed intake per daily body weight gain.

Carcass characteristics such as yield and quality grades were assessed at 24 h *post-mortem* by a carcass grader of the Animal Products Grading Service (APGS, 2005), Korea. Quality (marbling score, meat color, fat color, texture and maturity) and yield (cold carcass weight, back fat thickness and rib eye area) characteristics were recorded. After a 24-h chill, cold carcass weights were measured and then the left side of each carcass was cut between the last rib and the first lumbar vertebrae to determine quality grade. The quality grade was determined by assessing the degree of marbling and firmness in the cut surface of the rib eye, in relation to the maturity, meat color and fat color of the carcass. The rib eye area was measured from *longissimus dorsi* taken at the 13th rib and back fat thickness was also measured at the 13th rib. Yield index was calculated as follows: Yield index: $68.184 - (0.625 \times \text{back fat thickness (mm)}) + (0.130 \times \text{rib eye area (cm}^2\text{)}) - (0.024 \times \text{dressed weight amount (kg)}) + 3.23$. The degree of marbling was evaluated with the Korean Beef Marbling Standard, and the scores of meat color and fat color were made using the color standard (APGS, 2003). The scores for texture and maturity were made using the APGS reference index (APGS, 2005). The grading ranges were 1 to 9 for marbling score with higher numbers for better quality (1 = devoid, 9 = abundant); meat color (1 = brightly cherry red, 7 = extremely dark red); fat color (1 = white, 7 = dark yellow); texture (1 = soft, 3 = firm); maturity (1 = youthful, 9 = mature).

Statistical analysis

Comparisons of growth performance, carcass characteristics and meat properties between each groups were analyzed by t-test to compare between the groups.

III. RESULTS AND DISCUSSION

Body weight and average daily gain (ADG) were not different between treatments, although final BW tended to be higher in T1 and T2 (Table 1). Concentrate and rice straw were similar in steers on different fattening period. Also, feed conversion ratio was not affected by supplemental vitamin C. Therefore, fattening period had no positive effects on ADG, and feed conversion ratio,

Table1. Effect of fattening period on growth performance of Hanwoo steers

Item	Control	T1	T2	T3	T4
		13mo.-40mg	13mo.-80mg	16mo.-40mg	16mo.-80mg
Body weigh gain (kg)					
Initial BW(13mon.)	375.4	380.8	374.1	385.4	383.4
22 months of age	574.8	599.3	600.6	550.3	547.5
Final BW (29 mon.)	684.4	707.6	709.1	651.1	683.3
Average daily gain	0.72	0.74	0.76	0.67	0.76
Feed intake (kg)					
Concentrate	9.08	9.38	9.38	8.83	8.74
Rice straw	1.93	1.91	1.94	1.70	1.72
Feed conversion ratio	14.37	14.41	14.03	13.61	11.96
Vit. C intake(kg)		46.9	93.8	41.1	95.3
(cost, 1,000won)	-	(385)	(780)	(328)	(762)

In carcass yield traits, rib eye area, back fat thickness, yield index were similar between each groups (Table 2). In the yield grades of T1, incidence of A, more fed supplemental vitamin C than control In carcass quality traits, marbling score, meat color, fat color, texture and maturity were similar in steers on the different treatments. The appearances of desirable high quality grade (1⁺⁺, 1⁺ and 1) of beef based on consumers demand in fed supplemental vitamin C groups were higher 88.9~100% than 30% of control. And firmness tended to similar.

Table2. Effect of fattening period on carcass characteristics of Hanwoo steers

Item	Control	T1	T2	T3	T4
		13mo.-40mg	13mo.-80mg	16mo.-40mg	16mo.-80mg
Fasting weight(kg)	696.7 ^{ab}	727.3 ^a	709.8 ^a	647.7 ^b	680.3 ^a
Carcass weight (kg)	409.9 ^{abc}	433.9 ^a	709.8 ^a	386.4 ^c	399.1 ^{bc}

Dressing rate (%)	58.8	59.7	59.7	59.6	58.7
Yield traits ¹					
Back fat thickness (mm)	12.5	11.5	9.6	11.5	10.0
Rib eye area (cm ²)	83.1	91.6	92.4	85.0	91.1
Yield index	64.6	65.8	67.3	66.0	67.6
Yield grade (A:B:C, head)	3:5:2	6:2:2	6:3:0	3:7:0	6:3:1
Quality traits ²					
Marbling score	3.9	6.3	6.3	5.6	6.3
Meat color	4.9	4.9	4.9	4.8	5.0
Fat color	3.0	3.0	3.0	3.0	3.0
Texture	1.7 ^a	1.2 ^b	1.4 ^{ab}	1.1 ^b	1.1 ^b
Maturity	2.2	2.3	2.3	2.0	2.1
Quality grade (1 ⁺⁺ :1 ⁺ :1:2:3, 1:2:0:7:0		4:2:4:0:0	3:2:3:1:0	2:4:3:0:1	2:5:2:1:0

¹ Area was measured from *longissimus* muscle taken as 13th rib and back fat thickness were also measured at 13th rib; Yield index was calculated using the following equation: $68.184 - (0.625 \times \text{back fat thickness (mm)}) + (0.130 \times \text{rib eye area (cm}^2\text{)}) - (0.024 \times \text{dressed weight amount (kg)})$; Carcass yield grades from C (low yield) to A (high yield).

² Grading ranges are 1 to 9 for marbling score with higher numbers for better quality (1 = devoid, 9 = abundant); meat color (1 = brightly cherry red, 7 = extremely dark red); fat color (1 = white, 7 = dark yellow); texture (1 = soft, 3 = firm); maturity (1 = youthful, 9 = mature); quality grades from 3 (low quality) to 1⁺⁺(very high quality).

Table3. Economical analysis of supplemental bypass vitamin C in Hanwoo steers (Unit: 1,000won)

Item	Control	T1	T2	T3	T4
		13mo.-40mg	13mo.-80mg	16mo.-40mg	16mo.-80mg
Total income	6,694	7,805	7,485	6,904	6,682
Total cost	3,973	4,425	4,753	4,167	4,576
Starter steer	2,566	2,603	2,557	2,635	2,621
Concentrate ¹	1,210	1,249	1,249	1,049	1,038
Rice straw ²	197	197	197	156	156
Supplement ³	0	375	750	329	762
Net income	2,721	3,380	2,731	2,736	2,106

¹ 300won/kg, ² 230won/kg, ³ 1,000won/kg

IV. CONCLUSION

The present findings indicated that different feeding periods and dosage of supplemental vitamin C resulted in similar growth performance, and feed efficiency, but better vitamin C fed groups than control on marbling score, texture and quality grade of characteristics and meat properties in Hanwoo steers. Especially, T2 had positive effect on the appearances of desirable high quality grade of beef based on consumers demand. Therefore, the present results indicated that optimal feeding period was 13~29 months of age and dosage was 40mg/kg of BW. in Hanwoo steers.

V. REFERENCES

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