FLAVOR CHARACTERISTICS OF HANWOO BEEF FED RICE BRAN AND ROASTED SOYBEAN DURING FINISHING PERIOD

Sung Il Kim[1], Keun Ki Jung[1], Duck Young Kim[2], Kyung Hoon Baek[1], Seul Gi Jung[1], Sang Oug Lee[1], Jin Yeol Kim[3], and Chang Bon Choi[1*]

[1]Department of Animal Science, Graduate School, Yeungnam University, 214-1, Dae-dong, Gyeongsan, 712-749, South Korea

[2]Jeil Feed Company, 40-36 Daehwa-Dong-Dong, Daeduk-Gu, Daejeon 306-801, South Korea

[3]Gunwi Livestock Cooperative, Seobu-Ri, Gunwi-Eup, Gunwi 716-804, South Korea

[*]Corresponding author (phone: +82-53-810-3023; fax: +82-53-810-4769; e-mail: cbchoi@yu.ac.kr)

***Abstract*—This study was conducted to understand flavor characteristics of Hanwoo beef by supplementing rice bran and roatsed soybean into concentrates. Thirty-six Hanwoo steers (average 20.9 months old/599.9kg) were assigned into either Control (C), Rice bran (RB), or Roasted soybean (RS) group (12 steers/group) and fed for 314 days. Final body weight were 754.6, 783.3 and 755.7 kg for C, RB and RS group, respectively. Intake of crude protein/head/day was significantly($P<0.05$) high in RS (1.70 kg) group comparing to C (1.43 kg) or RB (1.40 kg) group. No significant differences were found in backfat thickness, area of M. Longissimus dorci and yield grade by supplementing RB or RS. Marbling score and texture were improved, and therefore quality grade by supplementing RB and RS. Amino acids are classified into basic taste categories, and the composition for sweet taste was higher in RB group and for umami taste was higher in RB and RS groups than C group. Conjugated linoleic acid (CLA) composition was increased ($P<0.05$) in RS (0.21%) group comparing to C (0.16%) and RB (0.17%) groups. No significant changes in the other fatty acids including oleic acid and monounsaturated : saturated fatty acid were found by supplementing RB or RS. Melting point of lipid extracted from M. Longissimus dorci of experimental animals were numerically decreased in RB and RS groups. The results of panel test for tenderness, juiciness, flavor, off-flavor, umami and overall palatability showed significant ($P<0.05$) improvement in RB and RS groups. From the results obtained in the current study, it is concluded that both RB and RS were beneficial to improve flavors of Hanwoo beef. The results, furthermore, imply that supplementation of RS in the concentrates of beef cattle would increase health related compounds such as CLAs in beef.**

***Index Terms*—Hanwoo, flavors, rice bran, roasted soybean.**

I. INTRODUCTION

The tastes of beef would be enriched by combination of three major factors, tenderness, juiciness, and flavor. The amount of lipids as well as its quality, concentrations and composition of free amino acids and nucleic acids are also known to be related with beef tastes. Recently, in Korea, the consumers tend to purchase beef considering safety and tastes as well as considering marbling fat and prices. These tendencies imply that Korean consumers are willing to pay more for safe and high quality beef. In addition, the needs for health beneficial compound containing beef are also increasing. It is necessary for producers to establish environment-friendly sustainable beef producing systems to fulfill these recent consumer's demands. In this aspect, objective of the current study was to define flavor characteristics of Hanwoo beef and to develop flavor enriched finishing diets for Hanwoo steers.

Rice bran is a by-product of rice, and, in Korea, only about 20 to 30 % of rice bran is used to extract oil and the others are used for animal feed or fertilizers (Lee et al., 2006). Rice bran is an excellent source of protein, energy and minerals for animals (White and Hembry, 1985). Recently, nutritional and physiological function of rice bran is acknowledged and researches to use rice bran into various foods are under process (Hwang and Jung, 1996). On the other hand, cautions should be given to use rice bran because it is easy to be rancid under high temperature and free fatty acids composition after hulling increases rapidly because of lipolytic enzymes in it (Ferrell, 1994). Rice bran oil contains high amount of unsaturated fatty acids and enriches flavor of food (Taira, 1989). Composition of amino acids of rice bran is in the order of glutamic acid, aspartate, arginine and leucine (INRA, 2004).

Soybean is the most important and representative legume through the world and soybean meal and oil is used widely as animal feeds (Lee, 2006). Unsaturated fatty acids such as linoleic acid and oleic acid are abundant in soybean oil. Soybean protein contains high concentrations of lysine and histidine (Santos et al., 1998), but low concentrations of methionine (NRC, 2001). Because of protease inhibitors in unprocessed soybean, it is recommended to feed soybean after processing to animals (Slinger, 1973; Cuaron, 1984; Mitaru et al., 1984). Processed full-fat soybean and soybean meal are main protein sources for animal feeds. Leucine (27.7%), arginine (26.3%) and lysine (23.4%) are the most abundant amino acids, and linoleic acid and oleic acid represent 50% and 20%, respectively, of fatty acids in full-fat soybean (INRA, 2004).

The current study was designed under speculations that supplementation of rice bran and processed (roasted) soybean containing high unsaturated fatty acids into diets may cause changes in fatty acid composition in the carcass of Hanwoo steers and hence flavor characteristics.

II. MATERIALS AND METHODS

A. Experimental animals and design

Thirty-six (36) Hanwoo steers (average 20.92 months old, 599.89kg) in experiment station of Gunwi Livestock Cooperative, Gunwi, Gyeongsangbuk-do, Korea, were assigned into control (C), rice bran (RB) and roasted soybean (RS) groups (12 steers/group). Each group was consisted with two pens (6 steers/pen). The animals were fed for 314 days (until 31.2 months old).

B. Experimental diets and feeding managements

Basal concentrates were Brand 750 produced from Jeil Feed Co., Daejeon, Korea, and rice straw was used as a sole roughage source. For C group, Brand 750 was fed, and rice bran and roasted soybean was supplemented to Brand 750 for RB and RS group, respectively. The amount of supplementing rice bran and roasted soybean was determined to meet total 5% crude fat (as fed) in the concentrates. And the ingredients were fed by top-dressing method. Concentrates for all groups were allowed ad libitum. For RB and RS group, the amount of supplementing ingredients was determined based on feed intake for one weeek prior to the experiment. This procedures were repeated every week until the end of the experiment.

C. Carcass grading

The animals were slaughtered at lacal abattoir at the end of the experiment. Cold carcass weight, yield index (backfat thickness, area of M. Longissimus dorci) and quality index (marbling degree, meat color, fat color, texture, maturity) were measured. Final yield and quality grade of Hanwoo steers were determined by Korean Beef Carcass Grading Standard.

D. Analytical items

1) Performances

Body weight gain, feed intake, crude protein intake, TDN intake were determined.

2) Physico-chemical characteristics of carcass

Moisture, crude fat, crude protein, meat color (L, a, b, chroma, hue values), cooking loss, drip loss, and melting point of lipid extracted from various fat depots of carcass were determined.

3) Composition of fatty acid and amino acid

Fatty acid composition was determined by gas chromatography for subcutaneous, perirenal and M. Longissimus dorci lipids. And free amino acid was composition of M. Longissimus dorci was determined by HPLC based on modified method (Henderson et al., 2000).

4) Panel test

M. longissimus dorci with same degree of marbling were selected for panel test and aged for 14 days by dry-aging method. Panelists were trained for their ability to discriminate basic tastes, sweet, sour, salty and umami, and were also trained to evaluate beef tenderness, juiciness, flavor and overall palatability. A mouthful beef piece was supplied to each panelist and evaluated for each item on the scale of 1 through 8.

5) Statistical analysis

The data obtained in the study was analyzed for variances using GLM of SAS (2002), and statistical significance was determined at 5% level using Duncan’s multiple range test.

III. RESULTS AND DISCUSSION

Table 1. Performances of Hanwoo steers fed rice bran (RB) and roasted soybean (RS).

Items	C	RB	RS	P
No. of heads	12	12	12	
Total weight gain	157.75	178.83	157.33	0.1682
Daily gain	0.50	0.57	0.50	0.1870
Feed intake, kg/hd/day	11.0	10.7	10.8	
Feed conversion, kg/kg	21.98	18.79	21.55	

Table 2. Carcass yield and quality grade of Hanwoo steers fed rice bran (RB) and roasted soybean (RS).

Items	C	RB	RS	P
Cold carcass wt., kg	453.92	470.00	457.00	0.5078
Yield traits:				
Backfat thickness, mm	14.50	15.17	14.42	0.9479
Longissimus muscle area, cm^2	92.50	90.17	92.17	0.7338
Yield grade[1)]	2.17	2.25	1.92	0.4564
Quality traits				
Marbling score[2)]	5.92	6.00	7.25	0.2722
Texture[5)]	1.33	1.33	1.08	0.3788
Maturity[6)]	2.33	2.42	2.58	0.4780
Quality grade[7)]	0.76	0.63	0.28	0.2410

[1)] converted to numeric value: grade A = 1, B = 2, and C= 3; [2)] 9 = the most abundant, 1 = devoid; [3)] 7 = dark red, 1 = bright; [4)] 7 = yellowish, 1 = white; [5)] 3 = Coarse, 1 = fine; [6)] 9 = mature, 1 = youthful; [7)] converted to a numeric value : grade 1^{++} = 0.01, 1^{+} = 0.1, 1 = 1, 2 = 2.

Table 3. Classification of free amino acids in M. longissimus dorci of Hanwoo steers fed rice bran (RB) and roasted soybean (RS).

Tastes	C	RB	RS	P-value
Sweet	34.40	42.82	35.48	0.0758
Sour	2.00	2.39	2.04	0.2029
Bitter	20.27	20.20	12.87	0.0017
Umami	24.26	27.62	26.09	0.8953

Table 4. Composition of conjugated linoleic acid (CLA, $C_{18:2}$-cis_9, $trans_{11}$) in M. longissimus dorci of Hanwoo steers fed rice bran (RB) and roasted soybean (RS).

	C	RB	RS	P-Value
CLA, %	0.16	0.17	0.21	0.0441

Table 5. Fatty acid composition of M. longissimus dorci of Hanwoo steers fed rice bran (RB) and roasted soybean (RS).

Fatty acid, %	C	RB	RS	P
$C_{14:0}$	3.99	3.23	3.06	0.3742
$C_{16:0}$	24.91	25.18	24.55	0.5787
$C_{16:1}$	5.70	5.97	5.99	0.6583
$C_{18:0}$	9.00	9.36	8.91	0.6020
$C_{18:1}$	49.28	49.73	50.39	0.6485
$C_{18:2}$	0.19	0.18	0.19	0.5877
c_9,t_{11}-$C_{18:2}$	0.16	0.17	0.21	0.0441
t_{10},c_{12}-$C_{18:2}$	0.01[a]	0.005	0.003	0.0252
$C_{18:3}$	2.00	2.07	2.44	0.3743
SFA	39.87	39.60	38.47	0.3821
MUFA	57.16	57.80	58.46	0.5406
M/S	1.43	1.47	1.52	0.5542

Table 6. Results of panel test for M. longissimus dorci of Hanwoo steers fed rice bran (RB) and roasted soybean (RS).

Items	C	RB	RS	P
Tenderness[1)]	4.78	5.27	5.04	0.5561
Juiceness[2)]	4.54	5.38	5.29	0.0367
Beefy taste[3)]	4.50	5.13	5.08	0.0987
Off-flavor[4)]	5.33	5.67	5.63	0.5098
Umami[5)]	4.57	5.04	5.00	0.3813
Overall palatability[6)]	4.67	5.29	5.04	0.0370

[1)] 1(extremely hard) ~ 8(extremely soft), [2)] 1(extremely dry) ~ 8(extremely wet), [3)] 1(extremely absent) ~ 8(extremely exist), [4)] 1(extremely abundant) ~ 8(extremely rare), [5)] 1(Extremely absent) ~ 8(extremely exist), [6)] 1(extremely bad) ~ 8(extremely good).

IV. CONCLUSION

From the results obtained in the current study, it is concluded that both rice bran and roasted soybean were beneficial to improve flavors of Hanwoo beef. The results, furthermore, imply that supplementation of roasted soybean in the concentrates of beef cattle would increase health related compounds such as CLAs in beef.

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