EFFECT OF YUZA PROBIOTICS ON THE MEAT QUALITY CHARACTERISTICS OF HANWOO STEERS

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Abstract – An experiment was conducted to develop Yuza probiotics (YP) as a functional feed additive for beef cattle and to evaluate its effect on carcass characteristics, meat composition, cholesterol content and fatty acid profile of Hanwoo steer. Sixteen Hanwoo steers were supplemented with a basal diet (Control) and basal diet with 1.0% YP (YP 1.0%). After feeding the experimental diets for 6 months, the steers were slaughtered and graded for quality and yield factors by trained carcass evaluator. Taken together, dietary YP had no effects on carcass characteristics except meat quality grade which showed lower score compared to control ($P < 0.05$). Meat proximate compositions remain unaffected by dietary YP. However, cholesterol content was lower in YP supplemented group than control ($P < 0.05$). There was no effect of YP supplementation on meat fatty acid profile, except n-3 polyunsaturated fatty acid (PUFA), which showed significant elevation compared to control ($P < 0.05$). Overall, although Yuza probiotics had no significant effect on carcass characteristics and meat composition of Hanwoo steer, it reduced the cholesterol content and increase n-3 PUFA. Therefore, it can be used as a functional feed additive for beef cattle.

Key Words – Carcass characteristics, Hanwoo steer, Yuza probiotic

I. INTRODUCTION

Hanwoo beef is enthusiastically preferred by Korean consumers despite its high price. The thin muscle fiber and highly marbled fat make Hanwoo more tender, juicy and palatable than the imported one. However, a positive correlation of marbling fat with saturated fatty acid (SFA) content of meat was reported by many authors. Again, it is widely acknowledged that the incidence of cardiovascular diseases (CVD) is closely related to dietary intake of cholesterol and SFA contents. The meat industry is, therefore, looking for ultimate dietary strategies to modulate cholesterol and SFA and also to enrich the meat with bioactive compounds, such as antioxidants, to improve product quality and protect consumers' health from oxidant-mediated diseases.

Citrus Junos Siebold ex Tanaka also known as Yuza in Korean is a citrus fruit of the Rutaceae family commonly used as preserved tea or in tablet form as an herbal antioxidant. This fruit is well known for its antioxidative and anti-carcinogenic properties, which is a result of the combined activity of various antioxidants including vitamin C and phenolics compounds [1]. Fermentation of feed silage for ruminants utilizing beneficial bacteria has been practiced for many years. Citrus byproduct has been reported having characteristics required for use as substrate for the growth of probiotics during fermentation [2]. The beneficial effects of probiotics fermented feedstuffs have been reported by many authors. However, combining the effect of citrus oil and probiotics may be a new approach. Therefore, this study was carried out to investigate the beneficial effects of fermented yuza inoculated with beneficial probiotics bacteria on carcass characteristics, meat composition, cholesterol content and fatty acid profile of Hanwoo beef.

II. MATERIALS AND METHODS

The use and care of animals were carried out in accordance with the guidelines of Animal Care and Use Committee of Sunchon National University. A three-step fermentation method was carried out using a commercial fermenter (W-1000; Wonbalhyo Industry Co., Icheon, South Korea) to develop Yuza probiotic. *Saccharomyces cerevisiae, Lactobacillus acidophilus, Enterococcus faecium and Bacillus subtilis* were used as probiotic strains at 0.5% level and the fermentation was carried out for 3 days at 35°C. The concentration of microorganisms in YP was as follows:

Saccharomyces cerevisiae: 2.0×10^9 CFU/kg
Lactobacillus acidophilus: 2.0×10^8 CFU/kg
Enterococcus faecium: 2.0×10^{10} CFU/kg
Bacillus subtilis: 2.0×10^7 CFU/kg

A total of 16 homogenous Hanwoo steers (22 month old) were randomly allotted to two dietary treatments. The experimental diets were control and YP 1.0%. A commercially available TMR diet was used as the basal diet. After six months feeding trail steers were slaughtered and graded for quality and yield factors by a trained carcass evaluator. Grading of carcasses was carried out in accordance with Korean beef carcass grading standards [3]. The quality of each beef carcass was graded into one of five quality grades (1++, 1+, 1, 2 or 3) primarily based upon marbling score. One of three yield grades (A, B, or C) was determined by assessing live weight, carcass weight, back fat thickness, ribeye area, etc. For all analytical processes loin eye meats from selected Hanwoo steers were excised and grinded with a meat grinder. The moisture, crude protein, crude fat, and crude ash contents of the samples were determined according to the Official Methods of analysis, AOAC (17^{th} edn.). Cholesterol content was determined according to the methodology of King [4]. Meat fatty acids were determined by the methyl ester extraction methods according to Yang *et al.* [5] and fatty acids were identified by matching their retention times with those of their relative standards (polyunsaturated fatty acid-2, Animal Source, SUPELCO, Bellefonte, PA). For all response criteria, individual steer served as the experimental unit. Data were analyzed by SAS Inst. Inc., (version 9.1) and level of significance was preset at $P<0.05$.

III. RESULTS AND DISCUSSION

The effects of Yuza probiotics (YP) on carcass characteristics of Hanwoo steer are shown in Table 1. YP had no significant effects on carcass characteristics except meat quality grade which showed a lower score compared to control ($P < 0.05$). Moisture, protein, fat and ash contents of carcasses remain unaffected ($P > 0.05$) by dietary YP in relation to control (Table 2). However, cholesterol content was shown significant reduction ($P < 0.05$) by dietary YP supplementation compared to control (Table 2). Dietary YP had no significant effects on fatty acid composition of Hanwoo steers, except n3 PUFAs, which showed a higher concentration ($P < 0.05$) in YP fed group compared to control. A reduced ratio of n6/n3 was found in the CP supplemented group, although not differ from control ($P > 0.05$).

Table 1 Effects of Yuza probiotics on carcass characteristics of Hanwoo steers

Items	Treatments	
	Control	YP 1.0%
Carcass weight (kg)	435.50 ±14.13	434.50±11.53
Dressing %	60.55 ± 1.23	62.65 ± 1.08
Meat quality grade[1]	3.75^a ± 0.25	2.50^b ± 0.50
Carcass yield grade[2]	1.25 ± 0.16	1.38 ± 0.26

[a,b]Within a row, mean values without a common superscript differ ($P < 0.05$)
[1]Meat quality grade: 1++=5, 1+=4, 1=3, 2=2, 3=1
[2]Carcass yield grade: A=3, B=2, C=1

Table 2 Effect of Yuza probiotics on the proximate composition and cholesterol content of Hanwoo beef

Meat composition (%)	Treatments	
	Control	YP 1.0%
Moisture	61.67 ± 2.05	60.67 ± 1.25
Crude Protein	20.80 ± 0.71	19.18 ± 0.38
Crude fat	16.64 ± 2.79	19.27 ± 1.53
Crude Ash	0.89 ± 0.04	0.88 ± 0.02
cholesterol	66.26^a ± 2.02	52.00^b ± 3.68

[a,b]Within a row, mean values without a common superscript differ ($P < 0.05$)

The carcass quality grade is an important carcass characteristics primarily determined by age and intramuscular fat deposition. The observed low carcass quality grade in YP supplemented group indicates a negative effect of probiotic preparation on intramuscular fat deposition. In consistence with our result, Meng *et al.* [6] also found negative effect of probiotic on intramuscular fat in pig carcass. There were no significant effects of YP on carcass weight, dressing % and yield grade which is consistent with the findings of Henrique *et al*. [7].

Hesperidin (a citrus flavonoid) was identified as potential antioxidants in in-vitro studies and has been documented to decrease cholesterol level by inhibiting the synthesis of both apolipoprotein B and triglycerides [8]. Plant flavonoids are also found to positively alter the fatty acid profile of meat by increasing the ratio of PUFA to SFA and n-3 to n-6 fatty acids [9]. On the other hand, dietary probiotics have been reported to be

effective in control of serum cholesterol levels in human and mice [10]. There are some evidences proposing that *Lcctobacillus* and *Saccharomyces* feed supplementation reduces the cholesterol contents and ratio of n-6/n-3 fatty acid whereas, increase PUFA/SFA ratio in broiler and goat [11]. The lower cholesterol content and improved fatty acid profile in YP supplemented group may due a synergism of probiotic strain with Yuza byproducts.

Table 3 Effect of Yuza probiotic on the meat fatty acid profile of Hanwoo beef

Fatty acid (% of total)	Treatment	
	Control	YP 1.0%
∑ SFA	41.31 ± 0.18	44.33 ± 2.43
∑USFA	59.39 ± 0.50	55.54 ± 2.13
∑MUFA	56.43 ± 0.56	52.23 ± 2.43
∑PUFA	2.96 ± 0.08	3.31 ± 0.41
∑n-3 PUFA	0.46 ± 0.02 [b]	0.61 ± 0.01[a]
∑n-6 PUFA	2.49 ± 0.08	2.71 ± 0.41
USFA/SFA	1.44 ± 0.02	1.27 ± 0.11
MUFA/SFA	1.37 ± 0.02	1.20 ± 0.11
PUFA/SFA	0.07 ± 0.01	0.08 ± 0.01
n-6/n-3	5.39 ± 0.27	4.48 ± 0.73

[a,b]Within a row, mean values without a common superscript differ ($P < 0.05$)

∑ = Sum, SFA = saturated fatty acid, USFA = unsaturated fatty acid, MUSFA = monounsaturated fatty acid, PUFA= polyunsaturated fatty acid

IV. CONCLUSION

Taken together, although yuza probiotics had no positive effects on carcass characteristics and meat proximate composition, it positively affects the meat cholesterol and fatty acid profile. Therefore, it can be used as functional feed additives for Hanwoo beef to improve health aspect of beef.

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