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Effect of yield and meat quality characteristics on the growing age of Korean native bulls and steers

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Background

The meat quality and cattle performance have been related to the physiological growing age as well as sex and marketing weight. Several reports have shown that bulls grow more rapidly(15～17%), utilize feed more efficiently(10～13%) to an age or weight end point and are leaner than steers (London et al., 1978; Seideman et al. 1982). However, the quality characteristics(tenderness) are either similar or meat from bulls is less tender than steers when slaughtered at the same age (Dikeman et al., 1986). The underlying mechanisms for these facts have not been determined yet. Korean native cattle was originated from the cross-bred of Bos Indicus and Bos Primigenius breeds. According to the data from 1997, Korean native bulls produced only 19.4% of the first quality grade and most of them were the third quality grade (45.5%) for sales on the retail market. If Korean native bulls are castrated at an early stage, thus being steers, they will produce the high percentages of the first quality grade by the production of improved meat quality. At present, there were no practical documentations for Korean native bulls and steers based on the relationship of their physiological changes and meat characteristics during the growth stages.

Objective

The aim was to determine the effect of castration on meat yield, growth performance and meat quality characteristics during the growing period of birth to 24month for Korean native bulls and steers.

Materials and Methods

Animals: Animals to remain bulls or to be castrated were randomly assigned and castration was performed within 3months after birth. Bulls(n=20) and steers(n=32) were fed concentrated feed, rice straw, and water by ad libitum feeding. Animals were housed in an insulated barn in individual stalls. Before slaughtering, animals were deprived of feed and water for 24hr then weighed. They were slaughtered according to the standard procedure at each stage. Carcasses were chilled for 24hr at 1℃.

Table 1. Total numbers of cattle slaughtered for the experimental design.

Treatments	Growing age (month)			
	6	12	18	24
Bulls (T1)	5	5	5	5
Steers (T2)	8	8	8	8

Carcass evaluation: A section of the longissimus muscle (extending from the last thoracic vertebra to the first lumbar vertebra) was removed from the short loin on the left side of each carcass, and hot carcass weight, bone weight, backfat thickness, marbling degree, and longissimus muscle area were recorded. Lean color, fat color and texture were scored on a 7-point scale(7=severe, black, very soft, or very coarse, and 1=none, very light cherry red, very firm or very fine)

Meat quality evaluation: At 24hr postmortem, each carcass was ribbed between the 11th and 13th ribs and the loin muscles were vacuum packaged and stored at 5℃ until determination of chemical compositions (AOAC, 1990), water holding capacity, shear force, cooking loss and sensory evaluation.

Sensory evaluation: Trained sensory panelists evaluated the samples for juiciness, tenderness and flavor using 6-point scales(6=very juicy, very tender, very intense; 1=very dry, very tough, very weak).

Statistical analysis: The data was analyzed using the SAS program(1990). The t-test was used to determine the significant difference between means ($p<0.05$).

Results and discussion

Carcass weight of bulls at 24months was 8.2% heavier than that of steers due to the reduction of the growth rate by castration. Compared to bulls, the development of muscle from steers was slow and the development of fat was fast ($p<0.05$). The ratio of muscle to carcass was lower in steers than bulls after 12months, but the ratio of total separable carcass fat in carcass weights was higher ($p<0.05$). The changes of cattle performance to 24months, ie, carcass weight,

ribeye area and yield index were higher in bulls than steers and the bulls backfat was thinner than that of steers. Marbling was not developed until 12months and it was rapidly increased after that period. Steers had the higher tendency of marbling development than bulls during the growing age. Meat color and texture were improved as the growing age increased. The frequencies of the first quality grade were higher in steers than in bulls (bulls, 40% : steers, 71%). There was no significant difference in moisture content(%) and cooking loss(%) of longissimus muscle between bulls and steers, however, bulls produced high crude protein content(%) after 18months, and low fat content(%) in the muscles up to 12months when compared to those of steers up to 12months($p<0.05$). The longissimus muscles from steers had significantly lower scores in Warner Bratzler shear force values and higher in water holding capacity than those from bulls after 18months of growing age. Trained sensroy panel evaluated that longissimus muscles from steers after 12months were significantly juicier and more tender when compared to those from bulls.

Conclusion

Korean native steers had the better qualities in marbling scores, meat color, cooking loss, shear force value, and sensory characteristics than bulls after 12months although bulls produced high yield of carcass weight and had more muscle with less fat than steers during the growing ages. Therefore, the substitution of Korean native steers for bulls can increase the production level of the first quality grade for marketing.

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Table 2. Means for carcass and longissimus muscle traits of Korean native bulls and steers.

Items	Trt.	Growing age (Month) 6	12	18	24
Carcass Wt. (kg)	T1[1)]	72.36	177.86	283.76	353.06
	T2	73.61	158.57	268.13	338.10
Separable muscle (%)	T1	68.31	64.36^{a}	57.02^{a}	57.93^{a}
	T2	67.44	57.34^{b}	50.00^{b}	50.49^{b}
Total separable carcass fat (%)	T1	9.51	19.11^{b}	28.97^{b}	29.62^{b}
	T2	12.42	27.36^{a}	36.17^{a}	36.19^{a}
Back fat thickness (㎝)	T1	0.00	0.49	0.74^{b}	1.24
	T2	0.00	0.56	1.15^{a}	1.34
Loin-eye area (㎠)	T1	36.42	59.60	78.06	88.62
	T2	33.38	57.37	80.25	83.10
Bone (%)	T1	20.60	15.51	12.49	11.77
	T2	20.37	15.57	12.44	12.70
Marbling score[2)]	T1	1.00	1.80	5.40	8.40
	T2	1.00	2.00	5.13	11.00
Meat color[3)]	T1	2.20	2.00	3.40	3.40^{b}
	T2	2.20	2.75	4.00	4.43^{a}
Fat color[4)]	T1	2.20	2.40	4.00	4.00^{a}
	T2	2.20	2.52	3.75	2.71^{b}
Meat texture[5)]	T1	2.00	2.20	1.60	1.60
	T2	2.00	2.00	1.50	1.57

Table 3. Means for physico-chemical traits of longissimus muscle from Korean native bulls and steers.

Items	Trt.	Growing age (Month) 6	12	18	24
Moisture (%)	T1	75.73	72.86	70.85	69.47
	T2	75.98	72.92	69.81	68.33
Protein (%)	T1	19.28	19.88^{b}	20.20^{a}	21.22^{a}
	T2	19.79	19.43^{a}	19.39^{b}	18.38^{b}
Fat (%)	T1	3.82^{a}	6.16^{a}	7.83	8.35^{b}
	T2	2.26^{b}	5.57^{b}	9.19	12.05^{a}
Ash (%)	T1	1.07	1.04	1.00a	1.03a
	T2	1.00	0.99	0.92b	0.90b
Cooking loss (%)	T1	34.68	33.76	40.60	36.29
	T2	38.76	38.56	38.87	36.48
Shear forces (kg/0.5inch^{2})	T1	9.41	7.60	8.93^{a}	6.30^{a}
	T2	9.88	6.69	3.99^{b}	3.51^{b}
Water holding capacity (%)	T1	64.85^{a}	57.38^{a}	38.94^{b}	56.34
	T2	36.16^{b}	37.21^{b}	47.05^{a}	47.56
Sensory Properties[6)]					
Juiciness	T1	4.90^{a}	4.64	4.33	4.38
	T2	3.65^{b}	4.20	4.48	4.61
Tenderness	T1	4.00	4.36	3.38	4.55
	T2	3.24	4.38	4.37	4.57
Flavor	T1	4.36^{a}	4.68	4.33	4.66
	T2	4.03^{b}	4.39	4.68	4.54

a-bMeans with different superscripts between treatments are significantly different ($P<.05$).
1) T1: Korean native bulls, T2: Korean native steers., 2) Marbling score: 1= None; 15= Very abundant., 3) Beef muscle color: 1= Light pink; 7= Dark red. 4) 1= White; 7= Yellow., 5) Beef texture 6) Sensory properties: 6= Very juicy, tender, intense; 1= Very dry, tough, weak.