

EFFECTS OF THE CASTRATION TIME ON MEAT QUALITY AND FATTY ACID PROFILES OF KOREAN BLACK GOATS

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Abstract—We examined the effect of the castration time on meat quality and fatty acid composition of Korean Black Goats. Forty five male kids were divided into five groups, including control(without castration) and four groups with the kids castrated at 0.5, 3, 5 and 7 months of age, respectively. Dressing percentage for 0.5 months-castrated group was higher than that for 7 months-castrated group. Retail cut percentages for control was higher ($P<0.05$) than that for the others, but the retail cut percentages did not differ between the castrated groups. The fat percentages gradually increased as castrated earlier. As castrated earlier, moisture contents tended to decrease, whereas crude protein and fat contents tended to increase. The different castration time did not affect physical properties of goat meat (shear force, cooking loss and water holding capacity). Results from panel tests showed that juiciness or tenderness of meats for 5 months-castrated group tended to be higher than those for the other groups. The flavor of meats for 7-months castrated group appeared to be more favorable compared with 0.5- or 3-months castrated groups ($P<0.05$). The proportion of saturated fatty acid was higher for 5-months castrated group and lower for 3-months castrated group as compared to the other castrated groups, whereas the proportion of unsaturated fatty acid was *vice versa* ($P<0.05$). Mono-unsaturated fatty acid contents did not differ between the castrated groups. Present results may indicate that castration at 5 months of age increase goat meat quality.

Index Terms - Korean black goat, Castration, Meat quality, Fatty acid

I. INTRODUCTION

Korean Black goat meat has been mainly consumed as a type of medicine in Korea. However, with growing consumer awareness on well-being and healthy food, the consumption pattern for goat meat is greatly shifted toward general meat cooking such as grilled or broths. The quite peculiar flavor of black goat meat that comes from volatile compounds such as volatile branched-chain fatty acids (Madruga, Stephen Elmore *et al.* 2009), as well as the low juiciness and tenderness due to relatively low subcutaneous and intramuscular fat contents, are disadvantageous for the meat being popular food. These problems could be overcome by research on castration that not only reduces volatile flavor but also enhance juiciness and tenderness by increasing subcutaneous and intramuscular fat contents while increasing unsaturated fatty acid composition. Although most of goat farms practice castration of goat, there still is not enough data on meat quality and fatty acid composition by castration time. This study investigated the effect of castration time of Korean black goat on meat characteristics and fatty acid composition.

II. MATERIALS AND METHODS

Forty five growing crossbred black male goats (Korean native black goat×Nubian) were used in this study and were divided into five groups (nine animals per treatment) according to the time of castration. Animals in four treatment groups were castrated at 0.5, 3, 5 and 7 months of age, respectively. For concentrated feed stuff, we used commercially available formula feed for goat with 14.5% crude protein level. Test was conducted for seven months period (from March 21 to October 31, 2008) at the Animal Genetic Resources Station, National Institute of Animal Science, RDA (Namwon, South Korea). After slaughtered with scaled process methods, Goats were investigated on the carcass characteristics, meat characteristics (chemical composition and physical property determined by sensory evaluation), and fatty acid compositions.

III. RESULTS AND DISCUSSION

A. Carcass characteristics

Carcass characteristics for each treatment was listed in Table 1. Carcass percentages for castration time ranged from 48.1 to 54.2% with 0.5-month castration group as highest and increased with earlier castration time. Meat percentage for castration time ranged from 50.1 to 53.3% with no significant difference while that of noncastration group was 61.1% which is significantly higher than castration groups ($P<0.05$). Fat percentage of 0.5-month castration group (18.8%) was the highest ($P<0.05$) while that of noncastration group (7.39%) was lower than castration group ($P<0.05$).

Castration increases fat contents and decrease meat weight compared to noncastrated animal due to the fact that castration changes hormonal mediation of nitrogen metabolism controlling accumulation of muscle tissue (Galbraith, Dempster *et al.* 1978) and is related to the control and concentrations of growth hormones and metabolites.

Table 1. Effects of the castration time on carcass characteristics of Korean black goat.

Item	Castration time				intact male
	at 15 days	at 3 month	at 5 month	at 7 month	
Slaughter weight (kg)	27.00±1.41	27.50±0.71	28.00±1.41	27.50±0.71	27.50±0.71
Cold carcass weight (kg)	14.63±0.60 ^a	14.13±0.32 ^{ab}	14.13±0.04 ^{ab}	13.23±0.11 ^b	14.63±0.74 ^a
Dressing percentage (%)	54.18±0.61 ^a	51.40±2.48 ^{ab}	50.51±2.68 ^{ab}	48.10±0.85 ^b	53.16±1.33 ^a
Meat weight (kg)	7.65±0.68 ^b	7.08±0.13 ^b	7.53±0.04 ^b	6.94±0.21 ^b	8.95±0.53 ^a
Meat percentage (%)	52.26±2.49 ^b	50.13±0.23 ^b	53.27±0.38 ^b	52.43±1.13 ^b	61.15±0.52 ^a
Fat percentage (%)	18.84±1.84 ^a	18.20±2.54 ^{ab}	16.00±0.54 ^{ab}	14.60±0.76 ^b	7.39±0.28 ^c
Bone percentage (%)	18.02±0.31 ^c	20.79±1.42 ^{ab}	20.57±0.50 ^{ab}	22.04±0.12 ^a	19.64±0.51 ^b

^{a,b,c} Values with different superscripts within same rows are significantly different ($p<0.05$).

B. Meat characteristics

Chemical composition of Korean black goat meat according to castration time in this study is listed in Table 2. Moisture contents of goat meat decreased for earlier castration time while crude protein and crude fat contents increased for earlier castration time. 0.5-month castration group had higher crude protein contents than noncastration ($P<0.05$).

Table 2. Effect of the castration time on chemical compositions of Korean black goat meat.

Item	Castration time				intact male
	at 15 days	at 3 month	at 5 month	at 7 month	
Moisture (%)	74.22±0.99 ^b	75.54±1.31 ^{ab}	74.90±0.35 ^{ab}	74.92±0.39 ^{ab}	76.83±0.49 ^a
Crude protein (%)	20.45±2.47 ^a	17.52±0.40 ^{ab}	17.58±0.45 ^{ab}	17.72±0.06 ^{ab}	17.23±0.08 ^b
Crude fat (%)	2.39±1.51	1.87±1.15	2.31±0.11	2.01±0.39	0.80±0.01
Crude ash (%)	0.93±0.16	0.99±0.02	0.93±0.12	0.89±0.15	1.12±0.25

^{a,b} Values with different superscripts within same rows are significantly different ($p<0.05$).

Physical characteristics of goat meat for each castration time is shown in Table 3. Shear force, cooking loss, and water holding capacity did not show significant difference between castration time groups as well as between castration and noncastration groups. However, 5 and 7-months castration groups showed somewhat lower shear force. Result of sensory evaluation suggested 5 and 7-months castration groups as having better juiciness, tenderness and aroma in their meat.

Table 3. Effect of the castration time on physical properties of Korean black goat meat.

Item	Castrated				intact male
	at 15 days	at 3 month	at 5 month	at 7 month	
Shear force (kg/cm ²)	2.67±0.25	2.58±1.76	2.33±0.78	2.20±0.55	3.79±0.11
Cooking loss (%)	26.22±0.66	21.92±11.09	26.05±5.59	26.99±2.98	33.10±0.28
Water holding capacity (%)	57.63±3.14	56.43±2.10	58.17±0.43	59.70±0.24	56.68±0.33
Juiciness	4.55±0.35	4.35±0.21	4.85±0.49	4.60±0.14	4.50±0.28
Tenderness	4.95±0.35	4.25±0.35	5.45±0.35	4.60±0.14	4.35±0.21
Flavor	4.15±0.21 ^{bc}	3.85±0.49 ^c	4.70±0.00 ^{ab}	4.90±0.14 ^a	4.25±0.07 ^{abc}

^{a,b} Values with different superscripts within same rows are significantly different (P<0.05).

C. fatty acid composition

For total fatty acids, 5-month castration group had highest (44.4%) saturated fatty acid contents while 3-month castration group had highest (59.6%) unsaturated fatty acid contents. Although, among unsaturated fatty acids, there was no difference in monosaturated fatty acid contents for each castration time group, 3-month castration group showed somewhat higher level of monosaturated fatty acid contents (Table 4). Werdi Pratiwi *et al.* reported that the fatty acid contents in Australian Feral goat and Boer goat had lower saturated fatty acid contents an higher monosaturated fatty acid (Werdi Pratiwi, Murray *et al.* 2006) which was similar to our finding.

Table 4. Effect of the castration time on profiles of fatty acids of Korean black goat meat.

Item	Castration ages				intact male
	at 15 days	at 3 month	at 5 month	at 7 month	
C14:0	2.58±0.55	2.07±0.24	2.57±0.43	2.10±0.28	2.50±0.41
C16:0	23.98±1.95	23.04±1.23	23.78±1.97	22.38±1.33	22.15±0.68
C16:1n7	2.45±0.22	2.48±0.13	2.42±0.22	2.27±0.24	2.36±0.06
C18:0	16.76±1.21 ^{bc}	15.29±0.38 ^c	18.09±1.42 ^{ab}	17.24±1.63 ^{abc}	19.49±1.41 ^a
C18:1n9	49.85±2.82 ^{ab}	52.84±1.48 ^a	48.99±0.45 ^{ab}	51.84±1.79 ^{ab}	47.96±3.34 ^b
C18:1n7	0.00±0.00	0.02±0.03	0.00±0.00	0.01±0.02	0.02±0.03
C18:2n6	2.48±0.36	2.68±0.33	2.55±0.77	2.84±0.68	3.58±1.08
C18:3n6	0.10±0.00 ^{bc}	0.09±0.00 ^c	0.09±0.02 ^{bc}	0.11±0.01 ^{ab}	0.13±0.02 ^a
C18:3n3	0.08±0.01	0.08±0.01	0.08±0.02	0.06±0.04	0.08±0.04
C20:1n9	0.10±0.01	0.15±0.05	0.09±0.03	0.13±0.07	0.14±0.03
C20:4n6	1.63±0.01	1.29±0.15	1.34±0.32	1.02±0.86	1.62±0.47
Total	100.00±0.00	100.00±0.00	100.00±0.00	100.00±0.00	100.00±0.00
SFA	43.31±2.39 ^{ab}	40.39±1.10 ^b	44.44±1.61 ^a	41.73±2.67 ^{ab}	44.13±2.43 ^{ab}
USFA	56.69±2.39 ^{ab}	59.61±1.10 ^a	55.56±1.61 ^b	58.27±2.67 ^{ab}	55.87±2.43 ^{ab}
mono	52.40±2.73 ^{ab}	55.48±1.34 ^a	51.50±0.52 ^{ab}	54.25±2.10 ^{ab}	50.47±3.25 ^b
poly	4.29±0.34	4.13±0.29	4.06±1.13	4.02±1.38	5.40±1.49

^{a,b,c} Values with different superscripts within same rows are significantly different (p<0.05).

IV. CONCLUSION

The carcass percentage and fat percentage of Korean black goat increased with earlier castration time while there was no change in meat percentage. For chemical composition of goat meat, the moisture contents tend to decrease with earlier castration time while crude protein and crude fat contents tend to increase. For physical characteristics of meat, there was no difference for each castration time group. The results of sensory evaluation showed best juiciness, tenderness, and aroma in 5-month castration group. The saturated fatty acid contents was highest in 5-month castration

while the unsaturated fatty acid contents was higher in 3-month castration. These differences seems to be closely related to the slaughter weight and hormone concentration between castration and noncastration group.

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