Journal of Animal and Veterinary Advances 11 (20): 3776-3780, 2012
ISSN: 1680-5593

Muscle Fatty Acid Profile of Thai Native x Anglo-Nubian Meat Goats of Different Ages and Methods Castration

[1]T. Phonmun, [1]P. Paengkoum, [2]S. Paengkoum and [1]S. Traiyakun
[1]School of Animal Production Technology, Institute of Agricultural Technology,
Suranaree University of Techonlogy, Muang, 30000 Nakhon Ratchasima, Thailand
[2]Silpakorn University, Phetchaburi IT Campus, Cha-am, 76120 Petchaburi, Thailand

Abstract: This research was conducted to compare the fatty acid composition of the goat meat to investigate the relationship between goat meat different ages and method of castration. The experimental design used Completely Randomized Designed (CRD) in a 2×2 factorial arrangement of treatments. Twenty four male Thai native x Anglo-Nubian crossbred goats were randomly allocated to receive four treatments. The experiment was conducted for 4 months and slaughtered that the Longissimus dorsi muscle was collected for fatty acid analysis. The results conclude that either castrated method or ages had no significantly different on Monounsaturated Fatty Acid (MUFA) ($p>0.05$) except erucic acid (C22:1n9). Interaction between castrated method and ages had significantly different in MUFA ($p<0.01$). Although, the effect of castration method and age are not difference on fatty acid composition, it contributed to known that difference Castration Method and age (surgical and budizzo) no effect on accumulation fatty acid in meat goats.

Key words: Thai native goats, fatty acid, Castration Method, age, goat meat

INTRODUCTION

Small ruminant animals have an important in developing country particularly goat due to goat meat production were produced not sufficient the consumption demands. Carcass fat is one factor used to classify the quality or grade of goat. The characteristics goat meat have a strong demand for the healthy market food that highly demands consumers, cause of it has a low fat content when compared other meat such as pork, fish and poultry (Wood and Enser, 1997) and it has a high unsaturated fatty acid in addition to being a source of conjugated linoleic acid (Webb *et al*., 2005).

In addition, meat and meat product qualities can be seriously affected by the fatty acid composition of the muscle and adipose tissues. Fat improves meat quality especially C18:1 and C18:3 also influence meat flavor (Melton *et al*., 1982). The knowledge management productions goat intended to be produce meat quality meet to demand of consumers which depends on several factors such as breed of goats, nutritional management and production process. The fat composition of the goat is highly variable (Warmington and Kirton, 1990) depend on many factors such as gender, body weight, age, management condition and animal activity.

Castration is one of many factors in animal production for several reasons including the ease of controlling, removal of undesirable odour. In addition castration can influence on lean meat, fat deposit in the carcass (Babiker *et al*., 1985; Arnold and Meyer, 1988; Koyuncu *et al*., 2007; Kebede *et al*., 2008) but there have also been reports representing no significant effect of castration on fat accumulation in animals (Tichenor *et al*., 1970; Tahir *et al*., 1994; Madruga *et al*., 2001). Some research shown that the castration by surgical method had effect to fatty acid composition in rat (Cinci *et al*., 1993). However, the effect of castration on most parameters of goat performance and carcass characteristics especially meat composition are limited and unclear.

This study was investigated to determine effect of Castration Method (Surgical and Burdizzo) and age of castrated on fatty acid composition in Thai native x Anglo Nubian male goats.

MATERIALS AND METHODS

This objective of research was evaluated the effect of different ages and castrate methods on fatty acid composition in muscle of Thai native x Anglo Nubian male crossbred goats. There were four treatments (T1-T4) with

Corresponding Author: P. Paengkoum, School of Animal Production Technology, Institute of Agricultural Technology, Suranaree University of Techonlogy, Muang, 30000 Nakhon Ratchasima, Thailand

Table 1: Chemical composition (% of DM) of experiment diet

Items (%)	Concentrate	Roughage (Rice strew)
Crude protein	16.26	3.21
Ether extract	4.01	0.66
Ash	6.89	15.34
Neutral detergent fiber	43.89	66.46
Acid detergent fiber	27.60	49.95

initial weight of 13±1.50 kg as T1 = Castrate at 3 months age by Surgical Method as T2 = Castrate at 8 months age by Surgical Method as T3 = Castrate at 3 months age by Burdizzo Method as T4 = Castrate at 8 months age by Burdizzo Method.

Six male goats in each treatment were randomly assigned to an individual pen and water was available all the time in experimental period (16 weeks). The experiment period started after goats in 8 months castration group were castrated and recovery from castration procedure that all goat had initial weight 17.0 kg. Animal were offered *ad libitum* daily with rice straw and concentrate diet at 1.5% of BW (16% CP) throughout four mounts.

The chemical compositions of the experiment diet are shown in the Table 1. The content of concentrate diet consisted of 16.26% crude protein, 4.01% ether extract, 6.89% ash, 43.89% neutral detergent fiber and 27.60% acid detergent fiber. The proportion of chemical composition of roughage (rice strew) diet consisted of 3.21 crude protein, 0.66 ether extract, 15.34 ash, 66.46 neutral detergent fiber and 49.95% acid detergent fiber. Six goats were slaughtered at final weight 19 kg on the same day and kept meat sample from longissimus muscle for analyses fatty acid composition after being stored at 4°C for 24 h.

Extraction and preparation of sample: Meat sample were extraction from Longissimus dorsi muscle was according to Enser, meat sample (approximately 15 g) was homogenize with 90 mL chloroform-methanol (2:1 v/v) solution for 2 min and homogenize for 2 min after added 30 chloroform. The mixtures solutions of solvent and meat sample were filtrated by using Whatman filter paper No.1 in to separate flask that protect light by aluminium foil. The deionized water 30 and 5 mL 0.58% NaCl were added to it and leave overnight according to Hara and Radin (1978). The mixture was dividing in to two layers and the top layer (methanol aqueous fraction) was discarded while the bottom layer containing fatty acids was transferred into erlenmeyer flask and evaporated to remove chloroform. Keep the extracted fat sample at -20°C for prepare sample for analysis fatty acid by GC.

The fatty acid extraction (Metcalfe and Schmitz, 1961) was weight approximately 25 mg into screw capped culture tube and added 1.5 mL of 0.5 methanolic NaOH after that heated for 2 min at 100°C in water bath after flush with nitrogen gas. The BF_3 (boron trifluoride in 14% methanol) reagent 2 mL (Morrison and Smith, 1964) was added into cool sample tube and flash with nitrogen gas. The sample tube was caped tightly and heated for 30 min at 100°C in water bath. About 1 mL of iso-octane was added after cool mixture to 30-40°C and flash with nitrogen gas, cap and shake vigorously while still warm for 30 sec then added 5 mL saturated NaCl solution. The iso-octane layer was carefully transferred with a pasteur pipette into a screw cap glass vial and stored at -20°C until used for gas chromatography mass spectrophotometry.

Determination of fatty acid by GC: The fatty acid composition of the FAME was determined on a Hewlett Packard 6890 Model Gas Chromatograph (GC), equipped with a Flame Ionization Detector (FID) and fitted with a SP-2560, 100 m × 0.25 mm × 0.20 μm capillary column (Supelco), 7673 controller and split injection (Agilent Technologies Inc., Santa Clara, CA). The initial oven temperature was 70°C, held for 4 min. There after, the temperature increased at a rate of 13°C/min to 175°C. Helium was used as the carrier gas at a flow rate of 1.0 mL min^{-1}. Both the injector and the detector were set at 250°C. Fatty acids were identified by comparing their retention times with the fatty acid methyl standards from Supelco, USA.

Statistic analysis: Data were analyzed using SPSS 10.0 for windows in 2×2 factorial arrangement in CRD. The variances were 2 animal age (3 and 8 months) ×2 methods (Surgical and Burdizzo) were computed and tested for differences the data of fatty acid at 0.05 significance level. The model consisted of animal age, method of castration and their interaction. All data are reported as means±standard error that compared with Duncan test.

RESULTS AND DISCUSSION

This experiment was considered effect of two types of Castrated Method (Surgical and Budizzo) and different ages (3 and 8 months) on fatty acid profile in goats. The fatty acid compositions of Longissimus dorsi from the all treatment groups are shown in Table 2. There was no significant difference either castrated method or ages on content of the saturated fatty acids or unsaturated fatty acid ($p>0.05$). These result are difference to those by Teye, who reported that increasing age resulted in significantly with increased concentrations Saturated Fatty Acids (SFA) ($p<0.01$). There was no interaction between Castration Method and age for fatty acids composition ($p>0.05$). The goats were castrated by

Table 2: Fatty acid profile as percentage of total fatty acid±SE from castrated goats by Surgical and Budizzo Method at 3 and 8 monthss

	Surgical Method		Budizzo Method			p-value		
Fatty acid	3 months	8 months	3 months	8 months	SEM	Method	Age	Method x Age
Saturated Fatty Acid (SFA)								
Capric acid (C10:0)	0.12±0.100	0.11±0.0050	0.10±0.030	0.11±0.010	0.009	0.512	0.821	0.652
Lauric acid (C12:0)	0.87±0.051	0.82±0.0610	0.79±0.143	0.86±0.122	0.051	0.843	0.934	0.615
Tridecanoic acid (C13:0)	0.03±0.002	0.04±0.0010	0.04±0.010	0.03±0.029	0.003	0.811	0.572	0.256
Myristic acid (C14:0)	6.41±0.125	6.96±0.3570	6.92±0.157	6.67±0.509	0.163	0.740	0.645	0.255
Pentadecanoic acid (C15:0)	0.64±0.020	0.64±0.0440	0.57±0.006	0.62±0.014	0.013	0.145	0.322	0.368
Palmitic acid (16:0)	25.41±0.793	26.41±0.4300	25.37±2.920	25.55±0.616	0.780	0.781	0.713	0.798
Heptadecanoic acid (C17:0)	1.53±0.109	1.40±0.0080	1.75±0.248	1.42±0.036	0.068	0.411	0.132	0.510
Stearic acid (C18:0)	24.18±0.562	24.79±0.4810	24.17±0.942	25.03±1.390	0.463	0.903	0.449	0.900
Arachidic acid (C20:0)	0.15±0.012	0.20±0.0170	0.44±0.233	0.16±0.024	0.059	0.308	0.341	0.196
Behenic acid (C22:0)	0.04±0.007	0.06±0.0190	0.06±0.004	0.06±0.012	0.006	0.383	0.523	0.280
Tricosanoic acid (C23:0)	0.05±0.014	0.06±0.0160	0.04±0.010	0.06±0.003	0.006	0.953	0.373	0.848
Lignoceric acid (C24:0)	0.04±0.003	0.05±0.0060	0.06±0.008	0.05±0.006	0.003	0.083	0.875	0.279
Total SFA	59.45±0.846	61.54±1.1760	60.32±2.871	60.6±0.1920	0.805	0.989	0.480	0.595
Monounsaturated Fatty Acid (MUFA)								
Myristoleic acid (C14:1)	0.20±0.027	0.15±0.0360	0.17±0.035	0.21±0.006	0.014	0.582	0.856	0.166
Pantadecenoic acid (C15:1)	0.06±0.009	0.06±0.0060	0.06±0.007	0.05±0.006	0.004	0.430	0.778	0.838
Palmitoleic acid (C16:1)	2.26±0.131	2.03±0.2990	2.17±0.445	2.26±0.031	0.138	0.815	0.811	0.585
Heptadecenoic acid (C17:1)	1.27±0.067	1.58±0.1580	1.40±0.166	1.51±0.217	0.081	0.849	0.228	0.544
Elaidic acid (C18:1n9t)	0.41±0.109	0.63±0.3000	0.30±0.067	0.31±0.027	0.082	0.223	0.507	0.547
Oleic acid (C18:1n9c)	32.54±0.452	28.04±2.5840	31.37±3.289	31.18±0.471	1.058	0.654	0.300	0.339
Eicoenioic acid (C20:1)	0.08±0.008	0.12±0.0370	0.08±0.010	0.09±0.016	0.011	0.648	0.351	0.424
Erucic acid (C22:1n9)	0.05±0.005	0.05±0.0040	0.08±0.004	0.05±0.003	0.002	0.001	0.019	0.008
Nervonic acid (C24:1)	0.04±0.007	0.05±0.0060	0.04±0.003	0.04±0.008	0.003	0.589	0.253	0.863
Total MUFA	36.89±0.476	32.70±2.4500	35.67±2.987	35.70±0.270	0.976	0.662	0.317	0.311
Polyunsaturated Fatty Acid (PUFA)								
Linolelaidic acid (C18:2n6t)	0.05±0.012	0.015±0.031	0.15±0.072	0.10±0.057	0.024	0.619	0.637	0.166
Linoleic acid (C18:2n6c)	1.48±0.194	1.40±0.0350	1.25±0.047	1.41±0.120	0.059	0.361	0.714	0.323
Gamma-Linolenic acid (C18:3n6)	0.03±0.005	0.04±0.0030	0.12±0.136	0.03±0.007	0.020	0.338	0.338	0.253
Alpha-Linolenic acid (C18:3n3)	0.07±0.015	0.08±0.0120	0.08±0.020	0.07±0.010	0.007	0.879	0.998	0.615
Eicosedienoic acid (C20:2)	0.07±0.005	1.71±1.3590	0.07±0.012	0.06±0.004	0.340	0.259	0.264	0.256
Eicosatrienoic acid (C20:3n6)	0.07±0.014	0.06±0.0080	0.08±0.016	0.06±0.010	0.006	0.769	0.336	0.441
Eicosatrienoic acid (C20:3n3)	0.11±0.004	0.13±0.0410	0.05±0.007	0.08±0.050	0.019	0.236	0.534	0.899
Arachidonic acid (C20:4n6)	0.66±0.145	0.66±0.1390	0.70±0.128	0.56±0.089	0.064	0.815	0.600	0.600
Eicosapentaenoic acid (C20:5n3)	0.09±0.018	0.09±0.0200	0.08±0.017	0.09±0.018	0.009	0.661	0.747	0.976
Docosadienoic acid (C22:2)	0.35±0.057	0.44±0.1210	0.42±0.049	0.36±0.057	0.038	0.953	0.828	0.355
Docosahexaenoic acid (C22:6n3)	0.27±0.060	0.45±0.0780	0.40±0.083	0.43±0.076	0.037	0.498	0.184	0.380
Conjugated linoleic acid isomers								
cis-9, trans-11 CLA (C18:2)	0.23±0.031	0.32±0.0570	0.23±0.067	0.23±0.019	0.024	0.353	0.375	0.427
trans-10 cis-12 CLA (C18:2)	0.06±0.008	0.06±0.0060	0.05±0.003	0.05±0.003	0.003	0.126	0.554	0.812
cis-9, cis-11 CLA (C18:2)	0.04±0.013	0.05±0.0050	0.07±0.014	0.06±0.016	0.006	0.142	0.937	0.463
trans-9, trans-11 CLA (C18:2)	0.10±0.011	0.14±0.0240	0.13±0.038	0.10±0.012	0.012	0.981	0.862	0.193
Total PUFA	3.66±0.568	5.77±1.4310	3.86±0.184	3.68±0.408	0.401	0.274	0.262	0.193
PUFA/SFA	0.06±0.007	0.09±0.0220	0.06±0.005	0.06±0.007	0.006	0.273	0.304	0.208

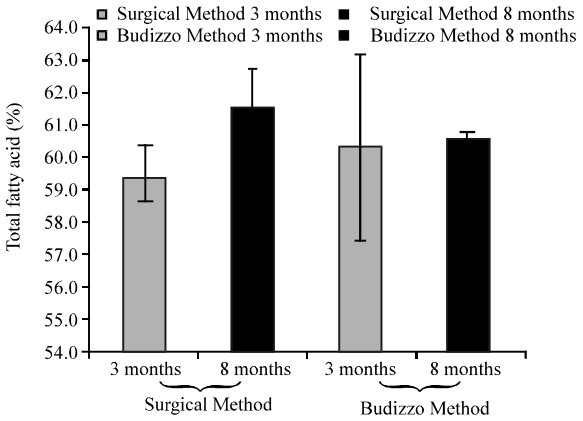

Fig. 1: Effect of different ages and method of castration on SFA in goat meat

Surgical Method had amount of total SFA approximately 59.4 and 61.54% at 3 and 8 months, respectively. While the goats were castrated by Budizzo Method had amount of total SFA approximately 60.32 and 60.60% at 3 and 8 months, respectively (Fig. 1).

In addition, either castrated method or ages had no significantly different on Monounsaturated Fatty Acid (MUFA) ($p>0.05$) that shown in Fig. 2 except erucic acid (C22:1n9) opposite with Cinci *et al.* (1993) who report that the fatty acid composition decrease after castration in rats. Interaction between castrated method and ages had significantly different in MUFA ($p<0.01$). Erucic acid content of the goats were castrated by budizzo method at 3 months had higher (0.08%) than other groups (Table 2) difference from report of Teye that increate age had effect to the lowered the concentrations of linoleic acid

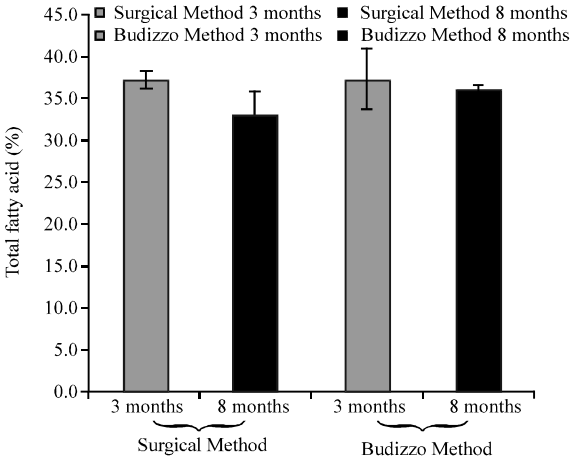

Fig. 2: Effect of different ages and method of castration on MUFA in goat meat

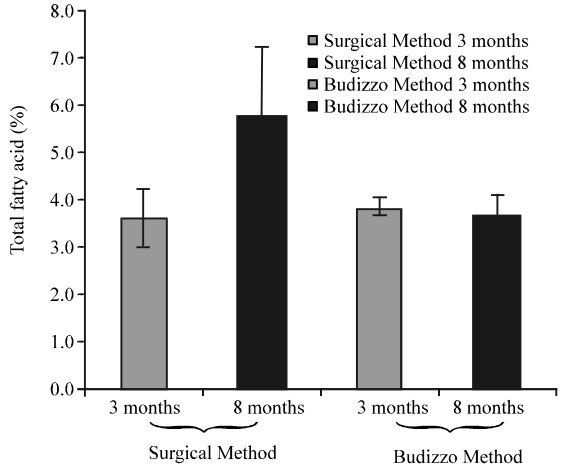

Fig. 3: Effect of different ages and method of castration on PUFA in goat meat

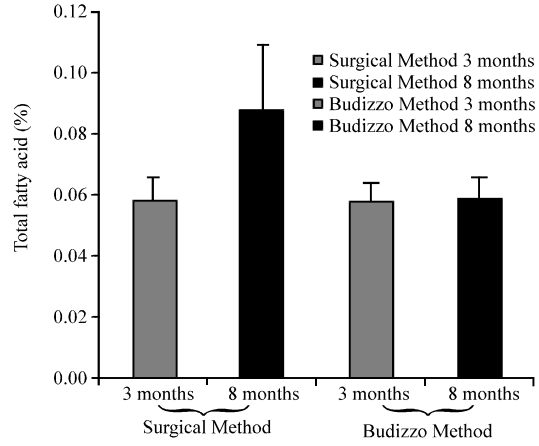

Fig. 4: Effect of different ages and method of castration on PUFA/SFA ratio of goat meat

(18:2), linolenic (18:3) and total polyunsaturated Fatty Acids (pUFA) ($p<0.001$). However, in this investigate the concentration polyunsaturated Fatty Acid (pUFA) and conjugated fatty acid isomer were not significantly different either castrated method or ages ($p>0.05$) (Fig. 3).

Beside the goats were castrated by Surgical Method at 8 months had slightly higher amount of total PUFA (5.77%) and PUFA/SFA ratio (0.09) than other groups that shown in Fig. 4.

CONCLUSION

This research was conducted to compare the fatty acid composition of the goat meat to investigate the relationship between goat meat different ages and method of castration. The result shows that the castrated method and ages had no effect on fatty acid composition while many reported of tissue fatty acid composition being changed via the diet. Although, the effect of Castration Method and age are not difference on fatty acid composition, it contributed to known that difference Castration Method and age (Surgical and Budizzo) no effect on accumulation fatty acid in meat goats.

ACKNOWLEDGEMENTS

This research was supported by Suranaree University of Technology and by the Higher Education Promotion and National Research University Project of Thailand (NRU), Office of the higher Education Commission.

REFERENCES

Arnold, A. and H. Meyer, 1988. Effects of gender, time of castration, genotype and feeding regimen on lamb growth and carcass fatness. J. Anim. Sci., 66: 2468-2475.

Babiker, S.A., M. Maglad and M.E. Koudoda, 1985. Effect of castration on performance and carcass characteristics of male Sudan desert goats. World Rev. Anim. Prod., 21: 11-13.

Cinci, G., R. Pagani, M.L. Pandolfi, B. Porcelli, M. Pizzichini and E. Marinello, 1993. Effects of testosterone on cholesterol levels and fatty acid composition in the rat. Life Sci., 53: 91-97.

Hara, A. and N.S. Radin, 1978. Lipid extraction of tissues with a low-toxicity solvent. Anal. Biochem., 90: 420-426.

Kebede, T., T. Lemma, H. Dinka, M. Guru and A. Sisay, 2008. Growth performance and carcass characteristics of Arsi-Bale goats castrated at different ages. World Applied Sci. J., 4: 545-553.

Koyuncu, M., S. Duru, S.U. Kara, S. Ozis and E. Tuncel, 2007. Effect of castration on growth and carcass traits in hair goat kids under a semi-intensive system in the South-Marmara region of Turkey. Small Rumin. Res., 72: 38-44.

Madruga, M.S., N. Narain, J.G. Souza and R.G. Costa, 2001. Castration and slaughter age effects on fat components of Mestico goat meat. Small Rumin Res., 42: 75-80.

Melton, S.L., M. Amiri, G.W. Davis and W.R. Backus, 1982. Flavor and chemical characteristics of ground beef from grass-, grain- and grain-finished steers. J. Anim. Sci., 55: 77-87.

Metcalfe, L.D. and A.A. Schmitz, 1961. The rapid preparation of fatty acid esters for gas chromatographic analysis. Anal. Chem., 33: 363-364.

Morrison, W.R. and L.M. Smith, 1964. Preparation of fatty acid methyl esters and dimethylacetals from lipids with boron trifluoride-methanol. J. Lipid Res., 5: 600-608.

Tahir, M.A., A.F. Al-Jassim and A.H.H. Abdulla, 1994. Influence of live weight and castration on distribution of meat, fat and bone in the carcass of goats. Small Rumin Res., 41: 219-223.

Tichenor, D.A., J.D. Kemp, J. Fox, W. Moody and W. Deweese, 1970. Effect of slaughter weight and castration on ovine adipose fatty acids. J. Anim. Sci., 31: 671-675.

Warmington, B.G. and A.H. Kirton, 1990. Genetic and non-genetic influences on growth and carcass traits of goats. Small Rumin. Res., 3: 147-165.

Webb, E.C., N.J. Casey and L. Simela, 2005. Goat meat quality. Small Rumin. Res., 60: 153-166.

Wood, J.D. and M. Enser, 1997. Factors influencing fatty acids in meat and the role of antioxidants in improving meat quality. Br. J. Nutr., 78: S49-S60.