Effects of castration and high pressure reaction on fatty acid compositions and volatile compounds in Korean native goat meat

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Abstract— **The objective of this study was to investigate the effects of castration and a high pressure (HP) reaction on fatty acid compositions and volatile compounds in Korean native goat (KNG) meat. A total of five KNG were selected at a meat plant. The carcasses were chilled for 24 hrs in refrigerator at a temperature of 2±2℃, then the *longissimus* muscle was obtained. The KNG meat treated at 2℃ for 18 hrs was subjected to a HP reaction at 100 MPa. The samples were then analyzed after HP treatment. Based on the results the analysis, the order of fatty acids in all treatments were as follows: vaccenic acid (C18:1n7) > palmitic acid (C16:0) > stearic acid (C18:0) > linoleic acid (C18:3n3). Fatty acid compositions of the KNG meat were not significantly (p>0.05) different between the control and HP treatment. The relative amounts of the major volatile compounds from normally castrated KNG meat as assessed using gas chromatography-mass spectroscopy were as follows: benzene > 2,5-cylohexadien-1-one > xylene > ethylbenzene > indole. In contrast, the major volatile compounds from abnormally castrated KNG meat were mostly lauric acid. Specially, the 9,12-octadecadienoic acid and octadecanoic acid were detected, which is the well known to produce off-flavors. A difference between the control and HP treatment was observed in the discriminated function analysis of the data obtained using an electronic nose. Therefore, these results suggested that the volatile compound compositions of KNG meat were affected by the castration method and HP reaction.**

Keywords— **Korean native goat meat, volatile compounds, fatty acid, castration, high pressure reaction**

I. INTRODUCTION

Goats are widely distributed around the world and a very important protein source (Biswas, Das, Banerjee, & Sharma, 2007). Goat meat is without a doubt one of the staple red meats in human diets. Goat meat is almost acceptable, but with cultural traditions, social and economic conditions influencing consumer preference (Casey, Van Niekerk, & Webb, 2003).

In Korea, milk goat production has been used mostly for goat milk production whereas KNG has been used for meat production. Also, most of the KNGs were castrated then normally slaughtered in the autumn. However, KNG meat production is limited because of Korean consumers were less prefer odour flavour of those. It is well known that the perception of consumers in the western world is not in flavour of goat meat (Teh, 1992).

Goat meat composition and quality are well known to be influenced by genotype (Tshabalala, Strydom, Webb, & de Kock, 2003), age (Todaro et al., 2002), sex (Todaro et al., 2004), diet, and production methods (Johnson & McGowan, 1998; Marinova, Banskalieva, Alexandrow, Tzvetkova, & Stanchev, 2001). These factors influence the volatile composition of goat meat and, hence, its characteristic and easily perceived smell which the consumer associates with goat meat (Webb, Casey, & Simela, 2005).

Therefore, the objective of this study was investigated the effects of castration and high pressure reaction on volatile compounds in KNG meat.

II. MATERIALS AND METHODS

A total of five Korean native goats (KNG) were selected at a meat plant. The carcasses were chilled for 24 hrs in refrigerator at a temperature of 2±2℃, then the *longissimus* muscle was obtained. The KNG meat treated at 2℃ for 18 hrs was subjected to a high pressure (HP) reaction at 100 MPa. Fatty acid compositions between control and HP treatment were measured using gas chromatography (CP-3800, Varian, Netherlands). And discriminate function data was obtained from electronic nose (SMart Nose 300, Smart Nose®, Switzerland) based on mass. Difference volatile compounds between control and HP treatment were analyzed using gas chromatography-mass spectroscopy (4000 MS, Varian, Netherlands).

III. RESULTS AND DISCUSSION

Table 1 showed those changes in fatty acid compositions between control and high pressure reaction from KNG meat. Changes in fatty acid compositions were not significantly ($p>0.05$) different between control and HP reaction. However, we seemed in previously study that fatty acid concentrations were more increasing in HP reaction than control from milk goat tissues (Kang et al., 2010).

Volatile compounds using electronic noise were showed difference patterns between control and HP reaction (Fig. 1). In other words, flavour materials observed stronger in HP treatment than control. It was presented results of chromatograms and components from KNG meat using gas chromatography-mass spectroscopy, respectively Fig. 2 and Table 2. The 9,12-octadecadienoic acid and octadecanoic acid were detected only from castrated KNG meat. However, indole peak was detected from all treatments.

Table 1 Effect of high pressure (HP) reaction on fatty acid compositions in Korean native goat meat

Fatty acids	Control	HP reaction	SEM
Myristic (C14:0)	3.21	3.16	0.15
Palmitic (C16:0)	23.24	23.24	0.43
Palmitoleic (C16:1)	3.29	3.20	0.14
Stearic (C18:0)	15.18	15.41	0.70
Oleic (C18:1 n-9)	2.57	2.36	0.17
Vaccenic (C18:1 n-7)	41.49	41.05	0.56
Linoleic (C18:2 n-6)	7.58	8.02	0.61
γ-linolenic (C18:3 n-6)	0.17	0.17	0.004
Linolenic (C18:3 n-3)	0.19	0.19	0.01
Arachidonic (C20:4 n-6)	3.10	3.21	0.38
Total SFA	41.63	41.81	1.12
Total UFA	58.39	58.19	1.12
Total MUFA	47.35	46.61	0.63
Total PUFA	11.04	11.59	0.99
Total n-6	10.85	11.40	0.98
Total n-3	0.19	0.19	0.01
MUFA/SFA	1.16	1.14	0.04
PUFA/SFA	0.28	0.30	0.03
n-6/n-3	55.17	56.60	2.65

Means were not significantly ($p<0.05$) different within a same row. SFA, total saturated fatty acids; UFA, unsaturated fatty acids; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids; n-6, fatty acid with the last double bond at 6th carbon from the methyl end; n-3, fatty acid with last double bond at 3rd carbon from the methyl end.

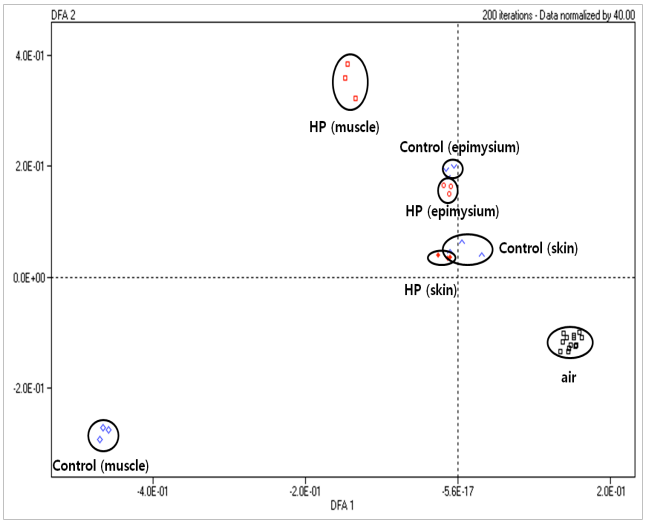

Fig. 1 Discriminate function analysis of the data obtained from electronic nose based on mass spectrometer. Korean native goat meat samples were treated with different condition and different region. HP, high pressure reaction; DF1, (R^2= 0.9978, F=1841.1); DF2, (R^2= 0.9952, F=831.89).

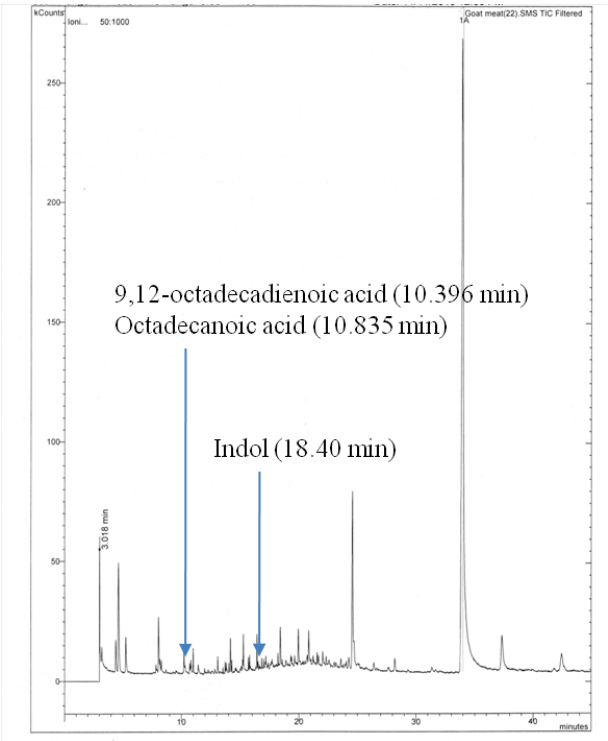

Fig. 2 GC-MS Chromatograms of volatiles extracted *M. longissimus* of non-castrated Korean native goat meat.

Table 2 Area (%) of the volatile compounds identified in Korean native goat meat with castration and non castration

Volatile compounds	RT (min)	Castration	Non castration
Octadecane	3.02	1.11	0.32
Trans-z-hexenyl formate	3.21	4.66	0
Ethylbenzene	4.41	10.57	1.61
Benzene	4.64	46.42	6.17
Xylene	5.29	15.57	5.94
1-Undecyne	8.06	tr	0.90
2,6-Nonadienal	10.23	0	1.28
9,12-Octadecadienoic acid	10.39	0	tr(0.1>)
Octadecanoic acid	10.83	0	tr(0.1>)
1-Undecyne	10.99	4.05	0
Benzene	13.53	1.66	0
Cycloheptasiloxane	14.16	4.44	0.49
1,3-Dioxane	15.25	0	2.43
Cycloheptasiloxane	16.41	0	037
Indole	18.4	8.07	0.68
Oleyl alcohol	19.95	0	0.69
Cyclononasiloxane	20.84	0	0.62
2,5-Cylohexadien-1-one	24.58	26.15	4.98
Lauric acid	33.92	3.60	44.16
Hexadecanoic acid	37.33	0	4.86

RT, retention time; tr, trace.

Generally associated with hexanal and 2,4-heptadienal are the smells of oxidate and cod-liver oil, as well as the typical smell of grass and plants (Ólafsdòttir et al., 1997).

Branched chain fatty (BCFA) have been specifically implicated in sheep and goat species related flavour (Wong et al., 1975; Johnson et al., 1977; Ha and Lindsay, 1990). The 4-ethyloctanoic acid is associated with a powerful goaty odour and has been detected in goat meat, lamb and mutton (Han and Lindsasy, 1990; Madruga et al., 2000). Other BCFA implicated in goat-like flavour are 4-methyloctanoic, 4-methylnanoic (Wong et al., 1975; Brennand et al., 1989) and 4-ethylheptanoic (Ha and Lindsasy, 1990). Alkaloids, pyridines and sulphur containing compounds are other notable flavour compounds that have been identified in goat meat and mutton, but are unlikely to play a major role in the development of goat flavout (Ha and Lindsay, 1991).

Also, Paleari et al (2008) were demonstrated that 9,12-Octadecadienoic acid and octadecanoic acid were derived from goat meat.

IV. CONCLUSIONS

This result suggested that castration methods from Korean native goat (KNG) were affected volatile compounds such as 9,12-octadecadienoic acid or octadecanoic acid. High pressure (HP) reaction was observed difference volatile compounds patterns of KNG meat by electronic nose whereas fatty acid compositions were no difference between control and HP reaction.

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