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Comparison of Fatty Acid Profiles for Subcutaneous Fat and Intramuscular Fat of Korean Native Pigs

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Introduction

The fatty acid composition is known to influence the nutritional, technological and sensory qualities of both fresh meat and processed meat products. Variation in fatty acid composition, in particular in saturation affects firmness of fat, which in turn affects the economics of meat processing and consumer acceptance of meat[(1)]. The ratio of C18:0 to C18:2 was found to provide the best firmness[(2)]. Studies have been shown that cohesiveness is closely related to water, collagen, C18:0 to C18:2 fatty acid compositions, just as is firmness[(3)]. As subcutaneous fat tissue develops and changes in composition, it becomes more cohesive ie. is less easily separated within itself layer by layer. The problem of fat tissue separation is unsightly in fresh pork and particularly in bacon or ham. Campo et al.(2004) found that odor scores were often higher for C18:3 than for C18:2, ie. C18:3 produces more intense odors. Although Korean Native Black Pigs(KNBP) have been characterized with more redness of meat color and higher palatability than other breeds. there were not enough information available and many studies conducted so far. The aim of this experiment was to determine the properties of fatty acid profiles extracted from different fat sources(intramuscular fat and subcutaneous fat) of sows and boars

Materials and Methods

Forty Korean native black pigs(KNBP, 21 sows, 19 boars) which average live weight and age for 72kg and 192 days, were transported to the National Livestock Research Institute and conventionally slaughtered over two consecutive days with an electronic stunner (230 volts for 2.5 sec). The carcasses were placed in a 1℃ chiller until the following day. Loin muscle and subcutaneous fat layer from 40 Korean Native Black Pigs(KNBP) were separated and total lipids were extracted using chloroform-methanol (2:1, v/v) according to the procedure of Folch et al.[(4)]. An aliquot of the lipid fraction was methylated as described by Morrison and Smith[(5)]. Fatty acid methylesters were analyzed by a gas chromatograph (Varian 3400) fitted with a fused silica capillary column, Omegawax (205, 30 m × 0.32 mm I.D., 0.25㎛ film thickness), The injection port

was at 250℃ and the detector was maintained at 260℃. Nitrogen was used as the carrier gas. Resuts were expressed as percentages based on the total peak area.

Result and Discussion

Comparison of fatty acid profiles for subcutaneous fat and intramuscular fat

Fatty acid composition in the subcutaneous fat had a higher degree of saturation when compared with the intramuscular fat($P<0.05$)(Table 1). The major fatty acids of subcutaneous fat were C18: 1n-9, C16:0, C18:2n-6, C18:0, C16:1n-7, and C14:0 and the major fatty acids of intramuscular fat were C18:1n-9, C16:0, C18:0, C18:2n-6, C16:1n-7 and C14:0 in decreasing order. The level of polyunsaturated fatty acids(PUFA) was approximately 17.57% in the subcutaneous fat, compared with 14.43% in the intramuscular fat. By contrast, the level of monounsaturated fatty acids(MUFA) and saturated fatty acids (SFA) were approximately

Table 1. Comparison of fatty acid profiles for subcutaneous fat and intramuscular fat of Korean Native Pigs

	Intramuscular fat	Subcutaneous fat	Overall Mean
C14:0	1.16(0.02)^{a*}	1.08(0.03)^{b}	1.12(0.02)
C16:0	25.04(0.13)^{a}	23.72(0.57)^{b}	24.38(0.30)
C18:0	14.84(0.18)	14.54(0.22)	14.69(0.14)
C16:1n7	2.27(0.06)^{a}	1.83(0.03)^{b}	2.05(0.04)
C18:1n7	0.05(0.00)^{a}	0.02(0.00)^{b}	0.04(0.00)
C18:1n9	42.02(0.52)	40.27(0.77)	41.14(0.47)
C18:2n6	12.76(0.49)^{b}	15.50(0.33)^{a}	14.13(0.33)
C18:3n3	0.67(0.03)^{b}	0.81(0.03)^{a}	0.74(0.02)
C18:3n6	0.62(0.04)^{b}	0.83(0.02)^{a}	0.73(0.03)
C20:1n9	0.20(0.02)	0.26(0.05)	0.23(0.02)
C20:4n6	0.11(0.01)^{a}	0.09(0.01)^{b}	0.10(0.00)
C20:5n3	0.12(0.01)	0.11(0.02)	0.11(0.01)
C22:4n6	0.15(0.02)	0.16(0.02)	0.15(0.01)
SFA	41.04(0.19)^{a}	38.46(1.00)^{b}	9.75(0.53)
USFA	58.96(0.19)^{b}	60.63(0.48)^{a}	59.80(0.27)
MUFA(mono)	44.53(0.57)^{a}	43.06(0.42)^{b}	43.80(0.36)
PUFA(poly)	14.43(0.54)^{b}	17.57(0.37)^{a}	16.00(0.37)
MUFA/SFA	1.09(0.02)	1.11(0.03)	1.10(0.02)
PUFA/SFA	0.35(0.01)^{b}	0.45(0.02)^{a}	0.40(0.01)
n3	0.79(0.03)^{b}	0.92(0.03)^{a}	0.85(0.02)
n6	13.64(0.52)^{b}	16.66(0.36)^{a}	15.15(0.36)
n6/n3	18.43(1.21)	19.40(1.47)	18.91(0.95)

43.06% and 38.46% in the subcutaneous fat, but approximately 43.53% and 44.04% in the intramuscular fat. A higher PUFA level in porcine the subcutaneous fat led to a softer fat[6]. Davenel et al.[6] have shown that the solid fat content of pigs decreased as the level of unsaturation rose. However, PUFA, despite its negative effect on technological and sensory qualities, can have a positive impact on human health, and is essential for growth and development throughout the human life cycle[7]. The present study showed that significantly higher levels of total PUFAs including n-3 and n-6 fatty acids, and lower levels of total contents of SFA and MUFA in the subcutaneous fat($P<0.05$). The ratio of PUFA to SFA (P:S) were 0.35 and 0.45 in the intramuscular fat and subcutaneous fat, respectively.

Comparison of fatty acid profiles for subcutaneous fat and intramuscular fat

When fatty acid compositions were analyzed by gender, MUFAs were significantly higher for female than males in the intramuscular fat as well as the subcutaneous fat(Table 2). There were not significantly different

Table 2. Comparison of fatty acid profiles for subcutaneous fat and intramuscular fat of Korean Native Pigs by gender

	Intramuscular fat		Subcutaneous fat	
	Female	Male	Female	Male
C14:0	1.20(0.02)*	1.11(0.03)	1.08(0.05)^{a}	1.08(0.03)^{b}
C16:0	25.41(0.15)	24.64(0.17)	24.49(0.15)^{a}	22.87(1.17)^{b}
C18:0	14.59(0.25)^{b}	15.12(0.26)^{a}	14.13(0.21)	15.00(0.38)
C16:1n7	2.45(0.08)^{a}	2.07(0.06)^{b}	1.87(0.05)	1.78(0.04)
C18:1n7	0.04(0.00)^{b}	0.05(0.01)^{a}	0.02(0.00)	0.03(0.00)
C18:1n9	43.68(0.50)^{a}	40.17(0.76)^{b}	40.63(1.35)	39.88(0.67)
C18:2n6	10.84(0.48)^{b}	14.89(0.57)^{a}	14.40(0.35)^{b}	16.72(0.43)^{a}
C18:3n3	0.65(0.04)	0.70(0.06)	0.79(0.04)	0.84(0.05)
C18:3n6	0.59(0.03)	0.64(0.08)	0.80(0.03)	0.87(0.03)
C20:1n9	0.24(0.01)^{b}	0.15(0.03)^{a}	0.12(0.00)^{a}	0.43(0.08)^{b}
C20:4n6	0.07(0.01)^{b}	0.16(0.02)^{a}	0.08(0.01)	0.11(0.01)
C20:5n3	0.13(0.02)	0.10(0.02)	0.14(0.02)^{a}	0.07(0.02)^{b}
C22:4n6	0.10((0.02)^{b}	0.21(0.03)^{a}	0.12(0.03)^{b}	0.20(0.03)^{a}
SFA	41.20(0.26)	40.86(0.28)	39.75(0.29)	37.04(2.07)
USFA	58.80(0.26)	59.14(0.28)	60.25(0.29)^{a}	61.05(0.95)
MUFA(mono)	46.41(0.56)^{a}	42.44(0.78)^{b}	43.92(0.40)^{a}	42.11(0.70)^{b}
PUFA(poly)	12.39(0.53)	16.70(0.66)	16.33(0.40)	18.94(0.47)
MUFA/SFA	1.13(0.02)^{a}	1.04(0.02)^{b}	1.11(0.01)	1.11(0.06)
PUFA/SFA	0.30(0.01)^{b}	0.41(0.02)^{a}	0.41(0.01)^{b}	0.50(0.03)^{a}
n3	0.78(0.03)	0.80(0.06)	0.93(0.02)	0.90(0.05)
n6	11.61(0.51)^{b}	15.89(0.63)^{a}	15.40(0.39)^{b}	18.04(0.47)^{a}
n6/n3	15.11(0.58)^{b}	22.10(2.20)^{a}	16.64(0.35)^{b}	22.45(2.96)^{a}

$^{a-b}$ Means with same row having the same superscripts are not different($p>0.05$).

from total SFA in the intramuscular fat when compared with those in the intramuscular fat. In the compositions of fatty acids boar had significantly higher levels of C18:0, C18:2n-6, C22:4n-6, C20:4n-6, and C20:1n-9 in the intramuscular fat, and C18:2n6, C22:4n6 in the subcutaneous fat than those of sows($P<0.05$). Whereas sows had significantly higher levels of C18:1n-9, C16:1n-7 in the intramuscular fat, and of C16:0, C14:0, C20:5n-3, C20:1n-9 in the subcutaneous fat than those of boars($P<0.05$). Sows had significantly higher levels of total MUFA contents than boars. However, boar had high contents of PUFA n-6 when compared with that of sows($P<0.05$). The ratios of PUFA to SFA (P:S) of boar were 0.41 in the intramuscular fat and 0.50 in the subcutaneous fat, were significantly higher than those of sows which were 0.30 in the intramuscular fat and 0.41 in the subcutaneous fat($P<0.05$).

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