FATTY ACID COMPOSITION OF INTRAMUSCULAR FAT IN THREE MUSCLES OF SIMMENTAL AND BROWN BULLS

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Background

Variability in intramuscular fatty acid composition may arise from differences in breed of cattle, feed type or lipid level in muscle (Itoh *et all.*,1999) and it can be also changed by sex, growth and muscle type or anatomical location (Mojto *et all.*, 1996; Web *et all.*, 1998; Ender *et all.*, 2000; Laborde *et all.*, 2001). A substantial majority of beef production in Slovenia represents Simmental (60%) and Brown (30%) cattle (Ferčej *et all.*, 1989). A specific breeding and feeding of animals influence on the specific carcass quality what means less subcutaneous fat and leaner meat compared with many literature data about beef produced in Europe and elsewhere. Lower intramuscular fat content in beef leads to higher proportion of polar lipids (phospholipids) and to higher levels of unsaturated fatty acids (Itoh *et all.*, 1999). We also expect the same trends in Slovenian beef, depending on cattle breed and anatomical location or muscle.

Objective

The objective of this study was to determine the fatty acid composition of intramuscular fat in three different muscles of Simmental and Brown bulls of Slovenian origin.

Methods

The lumbar part of *longissimus dorsi* muscle (LD), the *triceps brachii* (*caput longum)* muscle (TB) and the *semitendinosus* muscle (ST) of eight Brown (B) and eight Simmental (S) bulls, each aged approximately 18 months, live weight 540-620 kg, were taken 24 h *post mortem* from commercially-slaughtered animals. Sixteen LD, TB and ST muscles with trimmed subcutaneous fat were homogenized and immediately frozen at -35 °C till analysis. The fatty acid composition of 48 muscles was determined by the method *in situ* transesterification modified after Park and Goins (1994) and by the capillary Gas-Liquid Chromatography. The data were analysed by the method of the least squares using the GLM procedure (SAS, 1990). The statistical model for fatty acid composition of young beef included the effects of breed (B_i; i = Brown, Simmental), muscle (M_j; j = TB, LD, ST) and repetition (R_k; k = 1 – 8): $y_{ijk} = \mu + B_i + M_j + R_k + e_{ijk}$

Results and discussion

Table 1. Intramuscular fat content (g / 100 g) of three muscles in Simmental (S) and Brown (B) bulls

Breed-muscle	LSM[a]	SEM[b]	Differences between groups (significancy)[c]				
			S – ST	S – TB	B – LD	B – ST	B – TB
S – LD	4.43	0.247	0.84*	0.02	-1.13**	-0.09	-2.74***
S – ST	3.59	0.238		-0.82*	-1.97***	-0.93**	-3.58***
S – TB	4.41	0.238			-1.15**	-0.11	-2.76***
B – LD	5.56	0.247				1.04**	-1.61***
B – ST	4.52	0.238					-2.65***
B – TB	7.17	0.238					

[a]LSM=least square mean, [b]SEM= standard error of mean; [c] * statistically significant (P≤0.05); ** & *** statistically highly significant (P≤0.01)

Intramuscular fat content

Intramuscular fat content (IMF) of three muscles was ranging from 4.43 to 7.17% (Table 1). ST muscle contained significantly the lowest IMF, but there were no differences between LD and TB muscle of Simmental bulls. IMF of all muscles of Brawn bulls was significantly higher and differences between the three muscles were also significant (ST 4.52 %: LD 5.56 %: TB 7.17 %).

Fatty acid composition of IMF

Breed differences. Results in Table 2 showed that almost all differences in fatty acid composition between two breeds were highly significant with exception of 11:0, 12:0 and 18:1 (Tω-9) fatty acids (FA). The share of saturated fatty acids (SFA) were nearly equal in both breeds (S= 43.86 % vs. B=43.03 %), but Simmental breed contained highly significant lower share of monounsaturated fatty acids (MUFA) (46.70 % vs. 51.5 %), higher share of polyunsaturated fatty acids (PUFA) (8.24 % vs. 6.34 %), higher total ω-3 and ω-6 FA and also slightly higher P/S index, what is positive from human nutrition viewpoint. Better FA composition (more PUFA) of Simmental breed is a consequence of lower IMF content and higher share of polar lipids in all analysed muscles what is in accordance with findings of other researchers (Webb *et all.*, 1998; Itoh *et all.*, 1999). IMF fatty acid composition of Slovenian lean

Table 2 Fatty acids composition of intramuscular fat of two cattle breeds and three muscles (LSM values as percents of total fatty acids)

Fatty Acids	Breed			Muscle			
	Simmental	Brown	sig.[c]	LD	ST	TB	sig.
10:0	1.58	1.15	***	1.37	1.48	1.24	ns
11:0	0.15	0.13	ns	0.12	0.16	0.13	ns
12:0	1.11	1.01	ns	1.17	1.06	0.95	ns
13:0	2.10	2.51	***	2.41^{b}	2.10^{a}	2.42^{b}	*
14:0	0.46	0.40	*	0.45	0.44	0.40	ns
14:1 ω-5	0.58	1.11	***	0.92	0.78	0.82	ns
15:0	0.83	0.65	***	0.69	0.71	0.81	ns
15:1 ω-5	0.42	0.3	***	0.35	0.34	0.39	ns
16:0	21.67	23.79	***	23	22.58	22.61	ns
16:1 C ω-7	4.32	5.94	***	5.53^{b}	4.80^{a}	5.06^{a}	**
17:0	0.84	0.7	***	0.78^{b}	0.64^{a}	0.88^{b}	***
17:1 T ω-7	0.67	0.31	***	0.56	0.42	0.48	ns
17:1 C ω-7	0.66	0.77	***	0.71^{abc}	0.66^{ab}	0.78^{bc}	*
18:0	14.55	11.96	***	13.33	12.72	13.71	ns
18:1 T ω-9	2.10	2.08	ns	1.61^{ab}	1.27^{a}	3.39^{b}	ns
18:1 C ω-9	37.54	40.63	**	40.87^{bc}	37.59^{ab}	38.79^{abc}	ns
18:2 CC ω-6	5.42	4.66	**	4.49^{ab}	5.38^{bc}	5.25^{abc}	ns
20:0	0.56	0.74	***	0.64^{abc}	0.60^{ab}	0.70^{bc}	*
20:1 C ω-9	0.41	0.37	**	0.41^{b}	0.35^{a}	0.42^{b}	***
20:3 ω-6	0.34	0.2	***	0.24	0.30	0.28	ns
20:4 ω-6	2.23	1.32	***	1.64	1.87	1.81	ns
22:6 ω-3	0.25	0.15	**	0.18	0.24	0.18	ns
SFA	43.86	43.03	ns	43.99	42.49	43.85	ns
MUFA	46.70	51.5	***	50.95^{b}	46.22^{a}	50.13^{b}	**
PUFA	8.24	6.34	***	6.56^{ab}	7.79^{bc}	7.52^{abc}	ns
ω-3	0.25	0.15	**	0.18	0.24	0.18	ns
ω-6	7.99	6.19	***	6.37^{ab}	7.55^{bc}	7.35^{abc}	ns
P/S[a]	0.19	0.15	***	0.15^{ab}	0.18^{bc}	0.17^{abc}	ns
IA[b]	0.50	0.50	ns	0.50	0.49	0.51	ns

[a] P/S = PUFA/SFA;

[b] IA = atherogenic index = (C12 + 4 C14 + C16 + Trans FA) / (PUFA + C18:1 + other MUFA) (Ulbricht *et all.*, 1991);

[c] *LSM*, least square means; levels of significance: ns, P>0.05; * P<0.05; ** P<0.01; *** P<0.001; *LSM* with different superscripts within the same row differ significantly (P<0.05).

beef showed lower degree of saturation (43 %) compared with many literature data (near 50 % and more) for another or the same cattle breeds and muscles (Chow, 1992; Mojto *et all.*, 1996).

Muscle differences. IMF of three muscles differed significantly in MUFA with higher share in LD muscle (50.95 %) and lower in ST muscle (46.22 %). There were no significant differences between muscles in SFA (about 43 %) and PUFA (about 7 %) but it was tendency of lower PUFA in LD muscle. Higher share of MUFA led to lower percentage of PUFA in all three muscles.

Conclusions

Simmental bulls have leaner musculature than Brown one and ST muscle contains significantly lower IMF than LD and TB muscles. IMF fatty acid composition of Simmental bulls is nutritionally more favourable than Brown one because of relative higher percentage of PUFA and higher P/S index. Muscles differ significantly only in MUFA with the highest share in LD and lowest in ST muscle.

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