CONJUGATED LINOLEIC ACID IN RAW ROUND BEEF AND BEEF PRODUCT

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Background

The term „conjugated linoleic acid" (CLA) refers to a mixture of positional and geometric *cis* and *trans* isomers of octadecadienoic acid (C18:2) with conjugated unsaturated bonds. Growing body of evidence indicates that CLA exerts multidirectional physiological effects (e.g. it prevents chemically induced carcinogenesis and induced *via* alimentary tract atherosclerosis, counteracts body fat deposition). For these reasons the interest of nutritionists and food technologists is focused on the content of CLA in foods, estimation of daily CLA intake and possibilities to increase the content of CLA in food products. The formation of CLA *in vivo* occurs through the microbiological hydrogenation of dietary unsaturated fatty acid, particularly linoleic acid in the rumen. The first step in this metabolic pathway is the isomerization of linoleic acid to CLA, particularly with configuration c9, t11 (rumenic acid); this intermediate is hydrogenated further to mainly vaccenic acid (C18:1, t11), and stearic acid (C18:0) is the product of complete biohydrogenation. Consequently, CLA is found primarily in ruminant and milk fat, and rumenic acid (C18:2. c9, t11) predominates among isomers of CLA in milk and ruminant fat.

Objective

The main objective of this study was to determine and compare the content of rumenic acid and *trans* isomers of C18:1 in samples of raw round beef and beef product made from the same material: it was first cured, then cooked and smoked.

Material and methods.

The samples of beef meat and beef product were obtained from Meat Processing Plant in Łuków „Łmeat' S.A. Meat samples originated from animals fed traditionally: on the pasture in the summer and indoors in the winter.

Lipid extraction was performed according to Wolff (9). Analyses of fatty acid methyl esters profile were carried out using HP6890 gas chromatograph fitted with an autosampler for split-type injection (split ratio 50:1) and a flame ionization detector (FID). Analyses were performed on capillary column coated with polar cyanopropyl polyphenylsilicone phase film (50 m x 0.22 mm i.d. x 0.25 μm film thickness); carried gas – helium. Temperature of injector was 210°C, and flame ionization detector - 230°C, temperature of column was programmed - 160°C (35min) - 3°C/min to 210°C (10 min). Standards of *trans* isomers C18:1 and CLA were purchased from Sigma and Larodan.

The results in the table are given as arithmetic mean ± SD. CLA and *trans* C18:1 were expressed in grams per 100 grams of fat. Results were evaluated by two factorial analysis of variance (type of food x season of the year). Significant differences between means were estimated by Least Significant Difference Fisher's test (Statgraphic). Correlation coefficients were calculated using the least square test.

Results

Table 1. The profile of fatty acid pool in raw round beef and beef product"

Fatty acid or group of fatty acids (g/100 g fat)	Raw round beef		Beef product	
	Summer (n=7)	Winter (n=8)	Summer (n=7)	Winter (n=8)
ΣSFA	a 36,64 ± 2,29	b 40,06 ± 2,02	ab 38,39 ± 4,52	ab 39,81 ± 2,65
ΣMUFA	a 29,36 ± 6,76	b 39,4 ± 3,02	a 30,69 ± 6,84	b 40,2 ± 2,76
ΣPUFA	b 28,69 ± 7,86	a 17,66 ± 4,35	b 25,31 ± 9,24	a 15,04 ± 3,49
Σ*trans* C18:1	b 1,58 ± 0,42	a 0,82 ± 0,27	b 1,60 ± 0,57	a 1,14 ± 0,30
CLA (C18:2, c9, t11)	b 0,31 ± 0,07	a 0,13 ± 0,01	b 0,28 ± 0,09	a 0,16 ± 0,02
C18:0	b 15,67 ± 1,25	a 13,9 ± 0,72	b 16,29 ± 2,74	a 13,73 ± 1,16
ΣC18:1 c9, c11	a 25,39 ± 5,85	b 34,81 ± 2,92	a 26,8 ± 6,05	b 35,44 ± 2,78
C18:2	b 12,73 ± 3,45	a 7,56 ± 2,68	b 12,27 ± 4,24	a 7,45 ± 2,05
C18:3	b 4,84 ± 1,65	a 1,58 ± 0,58	b 3,83 ± 1,73	a 2,04 ± 0,50

*) Means in the same rows with different superscripts differ significantly ($p \leq 0,05$)

The results presented in table 1 indicate that profile of fatty acid pool in raw round beef depends on season of the year, precisely on farm managment system and confirm well-documented seasonal variations in milk composition. Technological process did not have significant effect on the profile of fatty acid pool in beef product compared to raw meat. Meat of animals fed on pasture contained more both *trans* C18:1 and CLA than meat from animals fed indoor. Jiang et al. (6), Jahreis et al.-(4, 5) found a substantial variation of the content of *trans* C18:1 and rumenic acid in milk fat to be in relation to ratio of forage to concentrate in dairy cow feed. In more detailed nutritional studies French et al. (2) and Pastushenko et al. (7) demonstrated that the simplest and the best way to increase the CLA content in milk fat is to include grass to the animal feed. Our results indicating that the content of *trans* C18:1 and CLA in beef of animals fed grass rich in linoleic and α-linolenic acid on pasture is significantly higher than in beef of animals fed indoor are in agreement with earlier nutritional studies on the effects of composition of animal feed on the composition of milk fat.

In previous studies on the content of CLA in raw steaks (ribeye, round, T-bone and sirloin) and ground patties (fried, baked, broiled or microwaved) Shantha et al. (8) demonstrated that thermal treatment of meat may increase the CLA content in final product compared to raw meat when calculations are made per gram of material. However, when CLA concentrations were compared after converting per gram of fat basis, there were no significant differences between thermal treated beef products and raw meat as well as among cooking methods and processing conditions. Our results confirm that the content of CLA in beef product cured, then cooked and smoked is unchanged in comparison with raw round beef when the calculations are made in grams per 100 grams of fat basis. Similarly, the content of *trans* C18:1 in raw beef and beef product did not differ significantly (table 1).

CLA and *trans* C18:1 share the same metabolic pathway. Therefore, the contents of CLA and *trans* C18:1 are positively correlated in rumen contents, fat depots and milk, although their ratio (CLA/*trans* C18:1) varies (1). Our results demonstrated strong correlation between CLA and *trans* C18:1 in raw beef (r=+0.91), and somewhat weaker in beef product (r=+0.87). The concent of *trans* C18:1 and CLA in raw beef and beef product correlated positively (r=+0.58 and r=+0.77, respectively).

Recent studies indicate that CLA may be synthesized *in vivo* from vaccenic acid (C18:1, t11). Griinari et al. (3) in studies with sterculic oil (inhibitor Δ9 desaturase) estimated that 64% of CLA in milk fat was of endogenous origin. The ratio of CLA origin (endogenous/exogenous) in beef remains to be evaluated.

Conclusions

1. The content of CLA and *trans* C18:1 in beef depends on farm managment system.
2. Technological processing (curring, cooking and smoking) did not affect CLA content in beef.
3. The concentration of CLA and *trans* C18:1 in raw beef and beef product correlated positively.

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