MINOR FATTY ACIDS IN FATS FROM BEEF AND BOER-GOATS

Kühne D.
Federal centre for meat research, Kulmbach, Germany

Key-words: Beef, Boer-goats, fatty acids, CLA, PUFA, odd-numbered fatty acids, methyl-branched fatty acids, Food, Sex

Background

In several trials we estimated the pattern of fatty acids (FA) from beef and kids from Boer-goats. Beef came from pasture and was finally intensive fed, goat-kids have been investigated for its suitability as a niche-product. Most minor FA from fat can be attached to three groups: 1. methyl-branched and odd-numbered FA, 2. polyunsaturated FA (PUFA) and 3. conjugated linoleic acid (CLA). The content of PUFA and CLA in intramuscular fats from ruminants is of special interest because of its importance for the consumer: PUFA are very important for the endogenous synthesis of prostaglandins, CLA is the first FA with known anticancerogenic effects.

Objectives

The production of meat from ruminants leads to fats as by-products. Fat from ruminants is different from those of non-ruminants and some ethical groups wish to have proved this fact. This differentiation can realized obviously by the content of minor FA of the type of methyl-branched and odd-numbered FA in the fats.

The consumer can reject the intake of animal fat, but intramuscular fat is consumed together with meat unavoidably. In this fat the content of essential FA of the total lipids is relatively high, the content of conjugated linoleic acid is relatively low. The influence of food, sex and fat localization has been investigated.

Methods

Fats were melted at 80°C and 10 µl solved in 750 µl toluene. For the analysis of intramuscular fats 2,5 g minced meat was mixed with 12.5 ml methanol-dichlormethane (1:2 Vol), the mixture dried and filtered and 750 µl liquid phase separated. To the fat-containing solutions there was added 250 µl of trimethyl-sulfoniumhydroxide (0.2 m) in methanol as described by Schulte et.al. (1989). 1 µl of this mixture was injected directly into a gaschromatograph (Hewlett Packard 6980) and separated on a 30 m capillary DB23, 0.25 mm ID, Split 1:20, with hydrogen as carrier gas, injection temperature 275°C and temperature program. The methylester of the FA were identified mainly by comparison with mixtures of known composition.

Results and discussion

There are remarkable differences in the pattern of FA of ruminants and non-ruminants. Despite of the usual teaching doctrine that only unbranched and even-numbered FA result from synthesis with acetyl-Coenzyme-A there are many methyl-branched and odd-numbered FA in fats from ruminants (Table 1). The content of this class of FA is higher in goats than in beef and is most high in subcutaneous fat, lowest in intramuscular fat (Table 2). The pattern of FA of this class allows to distinguish fats from ruminants from those of non-ruminants.

With the used capillary for analysis we found very near to linoleic acid a second peak which has been added earlier to the first. We suppose that it is octadeca-trans-16-enoic acid (w3-181-trans), as described by Precht and Molkentin (2001). Because of the low and constant content of this component there is an influence on the ratio of w3/w6 only to other than intramuscular fat (IF). The ratio of linolenic-/linoleic-acid in IF was 0.35 in beef and 0.39 in goat, whereas the ratio of w3/w6 was 0.55 resp.0.54. The calculation with additional w3- and w6-FA (Table 3) had no marked influence on the ratio in IF but to other fats (Table 4).

CLA shows the highest content in subcutaneous and the lowest in intramuscular fat of beef (Table 5). The greatest influence comes from food: hey or grass leads to the highest contents of CLA.

Conclusion

Minor FA from methyl-branched and odd-numbered type give the ability to distinguish between the fat of ruminants and the fat of other species. There are remarkable amounts of essential w3- and w6-FA in intramuscular fat. Recognizing additionally w-3- and w-6-FA shows that the ratio becomes higher and more advantageous from dietary view than only the calculation with linolenic and linoleic acid. But there is only a remarkable shifting in fats other than intramusc.fat.

The content of conjugated linoleic acid is forced by feeding grass and hey. In relation to other fats CLA-content in IF is low, so the most important natural source of this compound for man remains milk and milk-products.

Literature

Precht D., Molkentin J., Milchkonferenz, Berlin 20.-21.9.2001, Abstracts C 17

Schulte, E., Weber, K., Rapid preparation of fatty acid methyl esters from fats with trimethylsulfonium hydroxide or sodium methylate, Fat Science Technology 91 (5), 181-183 (1989)

Table 1: Analysed methyl-branched and odd-numbered fatty acids

Fatty acid	Abbreviation	Fatty acid	abbreviation
12-methyl-myristic	(anteiso-150)	12-methyl-tridecanoic*	(iso-140)*
14-methyl-palmitic	(anteiso-170)	13-methyl-myristic	(iso-150)
Pentadecanoic	(s-15)	14-methyl-pentadecanoic	(iso-160)
Margaric	(s-17)	15-methyl-palmitic	(iso-170)
Margaroleic	(w9-171)	16-methyl-margaric	(iso-180)

*classed by retention index

Table 2: Sum of methyl-branched and odd-numbered fatty acids in fats from beef and goat

Type of fat (n)	%	Goat – kidney (89)	5,37
Beef – subcutan. (254)	4,50	Goat – subcutan. (54)	6,15
Beef – intermusc (253)	4,82	Goat – belly (55)	5,89
Beef – intramusc (199)	3,23	Goat – intramusc (54)	4,40

Table 3: Analysed polyunsaturated fatty acids (all-cis)

omega-6-type (name)	abbreviation	omega-3-type (name)	abbreviation
Octadecadi-9,12-enoic (Linoleic)	w6-182	Octadecatri-9,12,15-enoic (Linolenic)	w3-183
Eicosadi-11,14-enoic	w6-202	Eicosatri-11,14,17-enoic	w3-203
Eicosatri-8,11,14-enoic	w6-203	Eicosatetra-8,11,14,17-enoic*	w3-204*
Eicosatetra-5,8,11,14-enoic (Arachidonic)	w6-204	Eicosapenta-5,8,11,14,17-enoic (EPA)	w3-205
Docosadi-13,16-enoic*	w6-222*	Docosapenta-7,10,13,16,19-enoic (DPA)	w3-225
Docosatri-10,13,16-enoic*	w6-223*	Docosahexa-4,7,10,13,16,19-enoic (DHA)	w3-226
Docosatetra-7,10,13,16-enoic*	w6-224*		

* classed by retention index

Table 4: Sum of PUFA in fats from beef and goat in %

Type of fat (n)	omega-3-type	of that linoleic	omega-6-type	of that linolenic	w3/w6	linoleic/linolenic
Beef – subcutan.	0,94	0,56	0,83	0,77	1,13	0,73
Beef – intermusc	0,96	0,58	0,86	0,80	1,12	0,73
Beef – intramusc	2,95	1,15	5,19	4,06	0,55	0,35
Goat – subcutan.	1,28	0,90	1,35	1,15	0,95	0,78
Goat – intramusc	4,02	2,00	7,05	5,39	0,54	0,39
Goat – kidney	1,11	0,75	1,35	1,07	0,82	0,70
Goat – belly	1,70	1,16	1,72	1,43	0,99	0,81

Table 5: Influences on CLA (cis-9, trans-11) in fats from beef and goat, values in %

Boer-goats		**Beef**	
Means and number			
0.64 ± 0.19, n = 46		0.47 ± 0.25, n = 71	
Feeding		**Main food source**	
extensive	0.65	Hey	0.55
intensive	0.62	Maize	0.31
Localization of fat			
Kidney	0.49		
Belly	0.56	Intermuscular	0.46
Subcutaneous	0.79	Subcutaneous	0.60
Intramuscular	0.70	Intramuscular	0.35
Sex			
Female	0.65	Heifers	0.56
Male	0.62	Bulls	0.43
		Steers	0.54