Fatty Acid Composition of Meat from Ruminants, with Special Emphasis on *trans* Fatty Acids

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ABSTRACT: The fatty acid composition was determined in 39 samples of beef, 20 samples of veal, and 34 samples of lamb, representative of the supply of ruminant meat in Denmark. Five cuts of beef and veal and three cuts of lamb with increasing fat content were selected, and analysis of the fatty acid methyl esters was performed by gas–liquid chromatography (GLC) on a polar 50-m capillary column CP Sil 88 with flame-ionization detection. Lamb had the highest content of saturated fatty acids (52.8 ± 1.8 g/100 g fatty acids), higher than beef and veal (45.3 ± 3.1 and 45.4 ± 0.8 g/100 g fatty acids, respectively). *Cis* monounsaturated fatty acids were 49.2 ± 3.1, 44.9 ± 1.8, and 37.7 ± 1.7, and polyunsaturated fatty acids were 3.3 ± 0.7, 5.8 ± 2.0, and 5.0 ± 0.1 g/100 g fatty acids in beef, veal, and lamb, respectively. Beef contained 2.1 ± 0.8 g *trans* $C_{18:1}$ per 100 g fatty acids, about half that found in veal (4.0 ± 1.2 g/100 g fatty acids) and lamb (4.5 ± 0.6 g/100 g fatty acids). *Trans* $C_{16:1}$ was 0.24 ± 0.01, 0.14 ± 0.02, and 0.79 ± 0.02 g/100 g fatty acids in beef, veal, and lamb, respectively. Only small variations in *trans* and other fatty acids could be demonstrated between cuts. The overlap between *cis* and *trans* $C_{18:1}$ by capillary GLC was verified by argentation–thin-layer chromatography followed by GLC, on three samples of veal and three samples of lamb. In veal 1.0 g, and in lamb 1.4 g *trans* $C_{18:1}$ per 100 g fatty acids were hidden under the *cis* $C_{18:1}$ peak. The mean intake of *trans* fatty acids from ruminant meat is estimated at 0.2 g/d.

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KEY WORDS: Argentation–TLC, beef, fatty acids, GLC, intake, lamb, ruminant meat, *trans* fatty acids, veal.

Trans fatty acids (TFA) are formed in small amounts in ruminants by biohydrogenation of dietary unsaturated fatty acids, and they appear in the fatty tissues. Dietary intake of TFA comes partly from the meat and milk of these animals (1), the other major contribution being industrially hydrogenated vegetable and marine oils in margarine and shortenings (2). *Trans* octadecenoic acid is usually the quantitatively most important TFA in food, the main isomer being vaccenic acid (*trans*-11 $C_{18:1}$) in ruminant fat and elaidic acid (*trans*-9 $C_{18:1}$) in vegetable fat (3).

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Recently, the health implications of dietary TFA, especially on the risk of cardiovascular disease, have been discussed extensively (4–7). As a result, the margarine industry in Denmark has decreased TFA and increased *cis* monounsaturates in many of their products (2).

While relatively good data exist on TFA in margarines and shortenings, and there are also some data on TFA in ruminant milk and meat (8), little is known of the content of TFA in ruminant meat cuts. It is the aim of the present investigation to supply such data.

EXPERIMENTAL PROCEDURES

Sample description. Thirty-nine samples of beef, 20 samples of veal, and 34 samples of lamb were examined. Five cuts of veal and five cuts of beef with low to high fat contents (thick flank "cap off"; outside, round; chuck; rump; and brisket, middle part) were taken from three different slaughterhouses four times during the year. For beef, samples included imported meat from Germany, The Netherlands, and Ireland. Three cuts of lamb (shoulder, leg, and loin) were taken from two different slaughterhouses four times during the year, including samples from New Zealand. Each meat sample consisted of about 1 kg. The samples are representative for the supply of ruminant meat in Denmark.

Sample preparation. All meat samples were homogenized twice in a meat grinder, mixed by stirring, placed in bags, and frozen until analysis, which was undertaken not more than 2 mon later.

Methods of analysis. The fat was determined by boiling 5 g of homogenized sample with hydrochloric acid, followed by automatic filtration and extraction of the fat with diethyl ether/petroleum ether (Tecator, Höganäs, Sweden), which was partly evaporated and diluted to 25 mL with petroleum ether. The solvent was evaporated from an aliquot of 20 mL, and the fat was weighed (9). The fatty acids were determined in another aliquot of 2–5 mL after evaporation and addition of heptadecanoic acid as an internal standard, by boiling the fat with methanolic potassium hydroxide. After methylation by boiling with boron trifluoride, and extraction of the fatty acid methyl esters with *n*-heptane, separation was completed with gas–liquid chromatography (GLC; PE 8500, Perkin-Elmer Corp., Norwalk, CT) on a 50-m capillary column, CP

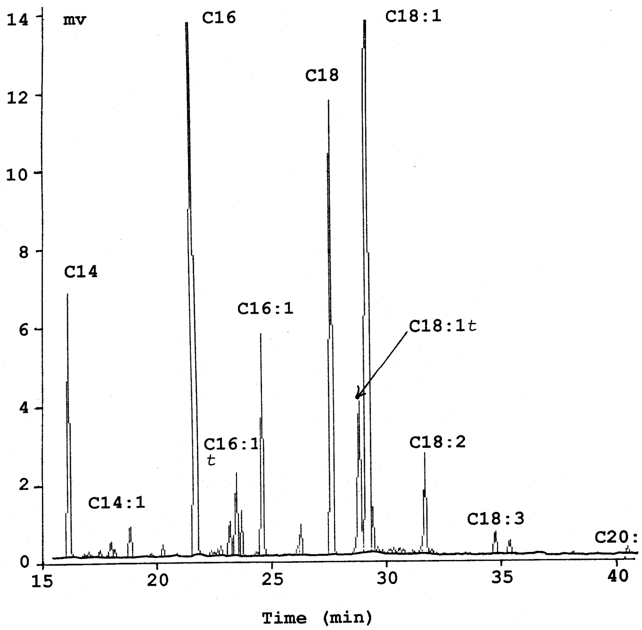

FIG. 1. Typical gas chromatogram of fatty acid methyl esters of lamb meat on a 50-m CP Sil 88 capillary column and other conditions as described in the Experimental Procedures section..

Sil 88, 0.25 mm i.d., 0.2 μm df (Chrompack International, Middleburg, The Netherlands) with flame-ionization detection (2), flow rate 0.7 mL/min. The temperature program was: start temperature 120°C, ramp rate 2°C per min, oven temperature 220°C, detector temperature 350°C, programmed temperature vaporizer injection system from 40 to 300°C. A typical chromatogram of a lamb sample is shown in Figure 1. With this temperature program and column, there was good separation between *cis* and *trans* $C_{18:1}$, but there was still minor overlap between some of the isomers, tending to underestimate the *trans* content. To determine the magnitude of the overlap, argentation thin-layer chromatography (TLC) was performed on three samples of veal and three samples of lamb from retail outlets in Copenhagen, Denmark. As described earlier (2), the fatty acid methyl esters were separated by TLC by application as a spot on Kieselgel plates (Merck, Darmstadt, Germany) impregnated with a solution of 5% silver nitrate. The spots visualized with dichlorofluorescein were scraped off, and the saturated fatty acids and TFA were combined. The fatty acids were then determined by GLC, again using C_{17} from the spot with saturated fatty acids as an internal standard for the determination of TFA.

Analytical quality assurance. All analyses were carried out as double determinations in different series, each series consisting of 17 samples and one in-house reference material (liver paste). A Nu-Chek-Prep standard, GLC 17A' or 68 (Nu-Chek-Prep Inc., Elysian, MN), was analyzed every day; and five times during the project, BCR (Community Bureau of Reference, Brussels, Belgium) reference materials CRM 162 Soya-maize oil and CRM 163 beef-pig fat blend were analyzed. From the double determinations, the standard deviation was ascertained by making the so-called R-charts over the deviation on the double determination of the fatty acids palmitic (C_{16}), stearic (C_{18}), oleic ($C_{18:1}$), and linoleic ($C_{18:2}$). For the meat samples, a relative standard deviation of about 4% was found for all four fatty acids with about 90 double determinations. The results were well controlled, both regarding precision and variation, during the entire investigation.

Statistical analysis and data presentation. The Student's unpaired *t*-test or one-way analysis of variance (ANOVA) was used, followed by the Tukey-Kramer multiple comparison test. Two-sided *P*-values of less than 0.05 were considered statistically significant. Results are given as means and standard deviations in the text and as means and ranges in Tables 1 and 2. Fatty acids grouped under "others" in the tables are divided equally between the fatty acid classes in results expressed as g/100 g fatty acids.

RESULTS AND DISCUSSION

Total fat and fatty acid composition in ruminant meat cuts are shown in Table 1. In the five cuts of meat from beef and veal, the fat content increased from 5.9 g/100 g in thick flank to 18.4 g/100 g in brisket. In the three cuts of meat from lamb, the fat content increased from 12.0 g/100 g in shoulder to 20.4 g/100 g in loin. Despite efforts to standardize the cuts, there was great variation in their fat and fatty acid contents, probably depending on the variation in fat content between animals. The contents of saturated, monounsaturated, and polyunsaturated fatty acids, expressed per 100 g of fatty acids, were similar in the different cuts from beef, veal, and lamb. Saturated fatty acids were significantly higher in lamb, compared to beef or veal, 45.3 ± 2.9, 45.4 ± 0.8, and 52.8 ± 1.8 g/100 g fatty acids in cuts from beef, veal, and lamb, respectively (ANOVA: $P < 0.0001$; beef vs. veal: not significant (NS); beef vs. lamb: $P < 0.001$; veal vs. lamb: $P < 0.001$). In beef, veal, and lamb, *cis* monounsaturated fatty acids were 49.2 ± 3.1, 44.9 ± 1.8, and 37.7 ± 1.7 g/100 g fatty acids, respectively (ANOVA: $P < 0.0001$; beef vs. veal: $P < 0.05$; beef vs. lamb: $P < 0.0001$; veal vs. lamb: $P < 0.0001$), and polyunsaturated fatty acids were 3.3 ± 0.7, 5.8 ± 2.0, and 5.0 ± 0.1 g/100 g fatty acids, respectively (ANOVA: $P < 0.0001$; beef vs. veal: $P < 0.001$; beef vs. lamb: $P < 0.001$; veal vs. lamb: NS).

Trans $C_{18:1}$ was 2.1 ± 0.8, 4.0 ± 1.2, and 4.5 ± 0.6 g/100 g fatty acids in beef, veal, and lamb, respectively—significantly lower in beef fat than in veal and lamb fat (ANOVA: $P < 0.0001$; beef vs. veal: $P < 0.01$; beef vs. lamb: $P < 0.001$; veal vs. lamb: NS), which is in good agreement with other investigations (8). The influence of milk as the main fat source for calves could explain the higher content of TFA in veal fat. The content of *trans* $C_{18:1}$ in g/100 g fatty acids varied between cuts, in beef from 1.4 in outside round to 3.2 in brisket, and in veal from 2.7 in outside round to 5.7 in brisket. In lamb cuts, the *trans* $C_{18:1}$ content varied from 4.0 to 5.3 g/100 g fatty acids between cuts.

By argentation–TLC we found some overlap of *cis* and *trans* $C_{18:1}$ isomers during direct capillary GLC, as shown in Figure 2 for veal and in Figure 3 for lamb. On the average, in

TABLE 1
Fatty Acid Composition [g fatty acid/100 g meat; mean (range)] in Meat from Beef, Veal, and Lamb

Meat cut	n^a	C12	C14	C14:1	C16	C16:1*c*	C16:1*t*	C18	C18:1*c*	C18:1*t*	C18:2*c*	C18:2*c,t*	C18:3	C20:4	Others	Fat
Beef	8	—	0.15	0.04	1.40	0.21	0.02	0.67	2.10	0.08	0.11	—	0.01	0.01	0.07	5.90
Thick flank			(0.06–0.23)	(0–0.08)	(0.71–2.19)	(0.11–0.37)	(0–0.04)	(0.46–0.97)	(1.36–3.10)	(0.04–0.22)	(0.07–0.14)		(0–0.07)	(0–0.04)	(0.05–0.21)	(3.6–9.1)
Beef	8	—	0.17	0.1	1.5	0.45	0.01	0.56	2.7	0.08	0.12	—	0.01	0.03	0.14	7.1
Outside round			(0.05–0.36)	(0.01–0.20)	(0.46–2.89)	(0.08–0.84)	(0–0.04)	(0.28–1.08)	(0.73–4.80)	(0.02–0.20)	(0.06–0.20)		(0–0.05)	(0–0.06)	(0.02–0.28)	(2.1–12.6)
Beef	8	—	0.35	0.08	3	0.44	0.05	1.9	4.4	0.32	0.18	—	0.04	—	0.18	13.3
Chuck			(0.14–0.61)	(0–0.13)	(1.30–4.9)	(0.15–0.72)	(0–0.09)	(1.46–2.70)	(1.82–6.5)	(0.14–0.72)	(0.09–0.26)		(0–0.09)		(0.07–0.45)	(6.7–19.2)
Beef	8	—	0.45	0.2	3.5	0.79	0.02	1.31	5.1	0.17	0.19	—	0.03	—	0.22	14.5
Rump			(0.17–0.96)	(0.06–0.55)	(1.50–5.9)	(0.30–1.34)	(0–0.13)	(0.80–1.70)	(2.3–7.7)	(0.05–0.39)	(0.11–0.28)		(0–0.16)	(0–0.3)	(0.05–0.96)	(6.6–24.1)
Beef	7	—	0.48	0.15	4.2	0.81	0.03	2.4	6.5	0.43	0.24	0.02	0.08	—	0.27	18.4
Brisket			(0.25–0.80)	(0.05–0.28)	(1.92–6.7)	(0.26–1.52)	(0–0.08)	(1.81–3.21)	(3.2–9.4)	(0.22–0.60)	(0.14–0.34)	(0–0.07)	(0–0.17)		(0–0.49)	(10.0–25.8)
Veal	4	—	0.09	0.02	0.82	0.13	—	0.5	1.16	0.07	0.13	—	0.01	0.03	0.04	3.7
Thick flank			(0.02–0.15)	(0–0.04)	(0.26–1.49)	(0.04–0.30)	—	(0.19–0.83)	(0.41–2.33)	(0.04–0.11)	(0.11–0.13)		(0–0.03)	(0–0.04)	(0–0.07)	(1.6–6.6)
Veal	4	—	0.15	0.07	1.2	0.33	—	0.51	1.8	0.09	0.13	—	—	0.03	0.1	5.3
Outside round			(0.05–0.37)	(0–0.22)	(0.49–3.02)	(0.07–1.00)	(0–0.02)	(0.26–1.15)	(0.62–4.6)	(0.03–0.17)	(0.09–0.19)			(0–0.05)	(0.04–0.20)	(2.3–13.5)
Veal	4	—	0.25	0.08	2	0.4	0.01	1.2	3	0.43	0.23	—	0.01	0.04	0.12	9.3
Chuck			(0.12–0.44)	(0–0.20)	(1.03–3.6)	(0.12–0.74)	(0–0.05)	(0.66–2.31)	(1.13–5.2)	(0.06–1.09)	(0.15–0.39)		(0–0.02)	(0.04–0.04)	(0.05–0.23)	(4.3–16.8)
Veal	4	—	0.31	0.1	2.4	0.54	—	1.2	3.7	0.2	0.2	—	—	0.01	0.13	10.79
Rump			(0.08–0.54)	(0–0.25)	(0.47–4.4)	(0.07–1.17)	(0–0.01)	(0.27–1.99)	(0.57–6.6)	(0.06–0.26)	(0.14–0.26)			(0–0.05)	(0.07–0.26)	(2.2–19.3)
Veal	4	—	0.57	0.29	4.2	0.96	0.02	1.6	5.6	0.64	0.3	—	—	0.01	0.24	16.6
Brisket			(0.20–1.34)	(0.05–0.88)	(1.5–9.6)	(0.18–2.53)	(0–0.08)	(0.90–2.61)	(1.7–12.1)	(0.23–1.58)	(0.21–0.40)			(0–0.03)	(0.05–0.56)	(6.0–34.0)
Lamb	11	0.05	0.53	—	2.3	0.2	0.08	1.9	3.4	0.45	0.2	—	0.12	—	0.28	12
Shoulder		(0–0.10)	(0.20–0.99)		(1.16–6.0)	(0.08–0.62)	(0–0.13)	(0.79–4.0)	(1.58–8.6)	(0.18–0.74)	(0.12–0.37)	(0–0.05)	(0–0.17)		(0.22–0.54)	(6.4–30)
Lamb	9	0.07	0.83	—	3.6	0.35	0.11	2.5	5.1	0.52	0.29	0.02	0.16	—	0.44	17.4
Leg		(0–0.21)	(0.42–2.06)		(1.98–7.1)	(0.15–0.90)	(0–0.25)	(1.31–3.4)	(2.69–9.3)	(0.18–1.24)	(0.16–0.46)	(0–0.08)	(0–0.27)		(0.32–0.87)	(9.8–29.2)
Lamb	11	0.07	0.9	—	4	0.31	0.14	3.7	5.5	0.63	0.29	0.04	0.2	—	0.43	20.4
Loin		(0–0.24)	(0.05–1.76)		(0.48–7.5)	(0.03–0.71)	(0–0.27)	(0.88–8.4)	(0.60–10.8)	(0.17–1.70)	(0.13–0.40)	(0–0.02)	(0–0.28)		(0.12–1.26)	(3.2–43.0)

[a]*n* = number of independent samples.

TABLE 2
Fatty Acid Composition [g fatty acid/100 g fatty acids; mean (range)] in Beef, Veal, and Lamb

Meat cut	n^a	C12	C14	C14:1	C16	C16:1*c*	C16:1*t*	C18	C18:1*c*	C18:1*t*	C18:2*c*	C18:2*c,t*	C18:3	C20:4	Others
Beef	8	—	3.1	0.8	28.8	4.3	0.4	13.8	43.1	1.6	2.3	—	0.2	0.2	1.4
Thick flank			(1.2–4.7)	(0–1.6)	(14.6–45.1)	(2.3–7.6)	(0–0.8)	(9.5–20.0)	(28.0–63.8)	(0.8–4.5)	(1.4–2.8)		(0–1.4)	(0–0.8)	(1.0–4.3)
Beef	8	—	2.9	1.7	25.6	7.7	0.1	9.5	46.0	1.4	2.0	—	0.2	0.5	2.4
Outside round			(0.9–6.1)	(0.2–3.4)	(7.3–49.3)	(1.4–14.3)	(0–0.7)	(4.8–18.4)	(12.4–81.8)	(0.3–3.4)	(1.0–3.4)		(0–0.9)	(0–1.0)	(0.3–4.8)
Beef	8	—	3.2	0.7	27.4	4.0	0.5	17.4	40.2	2.9	1.6	—	0.4	—	1.6
Chuck			(1.3–5.6)	(0–1.2)	(11.9–44.8)	(1.4–6.6)	(0–0.8)	(13.3–24.7)	(16.6–59.4)	(1.3–6.6)	(0.8–2.4)		(0–0.8)		(0.6–4.1)
Beef	8	—	3.8	1.7	29.2	6.6	0.2	10.9	42.6	1.4	1.6	—	0.3	—	1.8
Rump			(1.4–8.0)	(.5–4.6)	(12.5–49.2)	(2.5–11.2)	(0–1.1)	(6.7–14.2)	(19.2–64.3)	(0.4–3.3)	(0.9–2.3)		(0–1.3)	(0–2.5)	(0.4–8.0)
Beef	7	—	3.1	1.0	26.9	5.2	0.2	15.4	41.6	2.8	1.5	0.1	0.5	—	1.7
Brisket			(1.6–5.1)	(0.3–1.8)	(12.3–42.9)	(1.7–9.7)	(0–0.5)	(11.5–20.6)	(20.5–60.2)	(1.4–3.8)	(0.9–2.2)	(0–0.4)	(0–1.1)		(0–3.1)
Veal	4	—	3.0	0.7	27.3	4.3	—	16.7	38.7	2.3	4.3	—	0.3	1.0	1.3
Thick flank			(0.7–5.0)	(0–1.3)	(8.7–50.0)	(1.3–10.0)		(6.3–27.7)	(13.7–77.7)	(13.7–3.7)	(3.7–4.3)		(0–1.0)	(0–1.3)	(0–2.3)
Veal	4	—	3.4	1.6	27.2	7.5	—	11.6	40.8	2.0	2.9	—	—	0.7	2.3
Outside round			(1.1–8.4)	(0–5.0)	(11.1–68.4)	(1.6–22.7)	(0–0.5)	(5.9–26.1)	(14.1–104.3)	(0.7–3.9)	(2.0–4.3)			(0–1.1)	(0.9–4.5)
Veal	4	—	3.2	1.0	25.7	5.1	0.1	15.4	38.6	5.5	3.0	—	0.1	0.5	1.5
Chuck			(1.5–5.7)	(0–2.6)	(13.2–46.3)	(1.5–9.5)	(0–0.6)	(8.5–29.7)	(14.5–66.9)	(0.8–14.0)	(1.9–5.0)		(0–0.3)	(0.5–0.5)	(0.6–3.0)
Veal	4	—	3.5	1.1	27.3	6.1	—	13.7	42.1	2.3	2.3	—	—	0.1	1.5
Rump			(0.9–6.1)	(0–2.8)	(5.3–50.1)	(0.8–13.3)	(0–0.1)	(3.1–22.6)	(6.5–75.1)	(0.7–3.0)	(1.6–3.0)			(0–0.6)	(0.8–3.0)
Veal	4	—	4.0	2.0	29.1	6.7	0.1	11.1	38.8	4.4	2.1	—	—	0.1	1.7
Brisket			(1.4–9.3)	(0.3–6.1)	(3.3–30.5)	(1.2–17.5)	(0–0.6)	(6.2–18.1)	(11.8–83.9)	(1.6–10.9)	(1.5–2.8)			(0–0.2)	(0.3–3.9)
Lamb	11	0.5	5.6	—	24.2	2.1	0.8	20.0	35.8	4.7	2.1	—	1.3	—	2.9
Shoulder		(0–1.1)	(2.1–10.4)		(12.2–63.1)	(0.8–6.5)	(0–1.4)	(8.3–42.0	(16.6–90.4)	(1.9–7.8)	(1.3–3.9)	(0–0.5)	(0–1.8)		(2.3–5.7)
Lamb	9	0.5	5.9	—	25.7	2.5	0.8	17.9	36.5	3.7	2.1	0.1	1.1	—	3.1
Leg		(0–1.5)	(3.0–14.7)		(14.2–50.8)	(1.1–6.4)	(0–1.8)	(9.4–24.3)	(19.2–66.4)	(1.3–8.9)	(1.1–3.3)	(0–0.6)	(0–1.9)		(2.3–6.2)
Lamb	11	0.4	5.6	—	24.7	1.9	0.9	22.8	33.9	3.9	1.8	0.2	1.2	—	2.7
Loin		(0–1.5)	(0.3–10.9)		(3.0–46.2)	(0.2–4.4)	(0–1.7)	(5.4–51.8)	(3.7–66.6)	(1.0–10.5)	(0.8–2.5)	(0–1.2)	(0–1.7)		(0.7–7.8)

[a]*n* = number of independent samples.

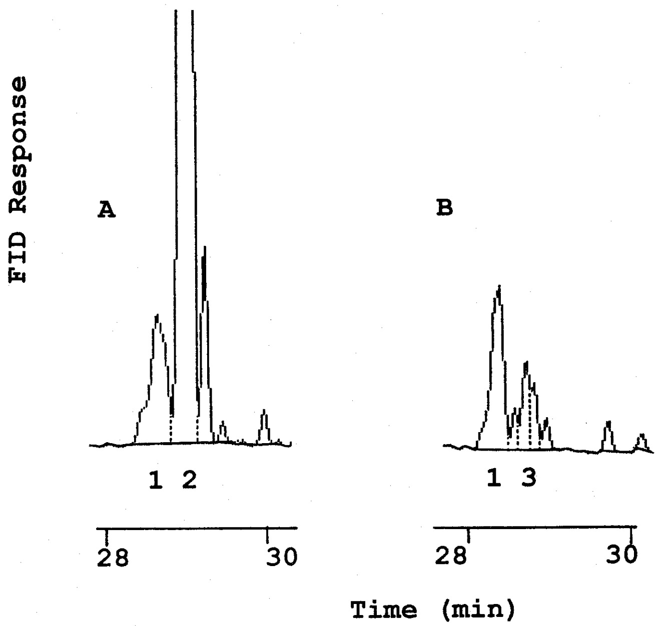

FIG. 2. Veal. Gas–liquid chromatography (GLC) of *cis* and *trans* $C_{18:1}$ fatty acid methyl esters before (A) and after (B) argentation–thin-layer chromatography (TLC). Conditions are described in the Experimental Procedures section. 1: *trans*-11 $C_{18:1}$ (major isomer). 2: *cis* $C_{18:1}$ + "overlap." 3: Other *trans* $C_{18:1}$ isomers.

veal we found an increase from 3.6 to 4.6 g, and in lamb from 6.6 to 8.0 g *trans* $C_{18:1}$ per 100 g fatty acids before and after argentation–TLC, with a similar decrease in *cis* $C_{18:1}$. This means that the figures given above for the TFA content are underestimated by about 20%.

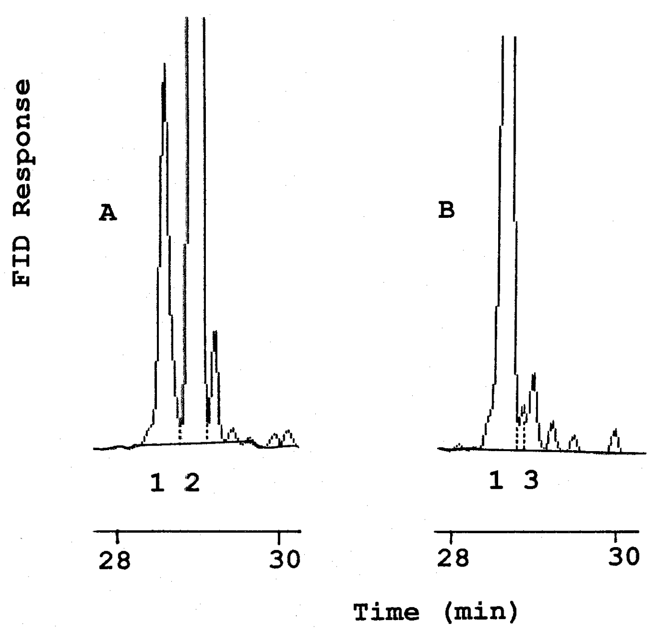

FIG. 3. Lamb. GLC of *cis* and *trans* $C_{18:1}$ fatty acid methyl esters before (A) and after (B) argentation–TLC. Conditions are described in the Experimental Procedures section. 1: *trans*-11 $C_{18:1}$ (major isomer). 2: *cis* $C_{18:1}$ + "overlap." 3: Other *trans* $C_{18:1}$ isomers. See Figure 2 for abbreviations.

TABLE 3
Calculation of the Intake of *trans* Fatty Acids from Ruminant Meat

	Meat intake[a]		TFA intake[b]	
	Average (g/d)	Q95[c] (g/d)	Average (g/d)	Q95 (g/d)
Beef and veal, 15% fat	29.1	112.9	0.17	0.71
Lamb, 20% fat	2.7	22.9	0.03	0.29

[a]Reference 10.
[b]Corrected for overlap between *cis* and *trans* $C_{18:1}$ by gas–liquid chromatography and with *trans* $C_{16:1}$ included, which indicates 4.2 g and 6.7 g *trans* fatty acid per 100 g fatty acids in beef + veal and lamb, respectively.
[c]Q95 = 95th percentile.

Trans $C_{16:1}$ was 0.24 ± 0.01, 0.14 ± 0.02, and 0.79 ± 0.02 g/100 g fatty acids in beef, veal, and lamb fat, respectively (ANOVA: $P < 0.0001$; beef vs. veal: $P < 0.0001$; beef and veal vs. lamb: $P < 0.0001$). In all meat samples in which *trans* $C_{16:1}$ was found, the content was between 0.4 and 1.4 g/100 g fatty acids (highest in lamb), but in the veal cuts, *trans* $C_{16:1}$ was only found in one sample out of four, and in beef cuts mainly in thick flank and chuck, while in the lamb cuts only a few samples were without *trans* $C_{16:1}$.

A few beef and lamb samples also contained *trans* $C_{18:2}$ at 0.4 to 1 g/100 g fatty acids, but none was found in veal meat.

Fatty acids expressed as a percentage of fat were 82.8 ± 0.4, 82.9 ± 0.5, and 80.1 ± 0.4% in beef, veal, and lamb, respectively, significantly lower in lamb than in beef and veal (ANOVA: $P < 0.0005$; lamb vs. beef and veal: $P < 0.01$, beef vs. veal: NS). However, no significant difference (ANOVA) was found between cuts, which means that the part of the fat recovered as fatty acids was independent of the fat content of the meat.

Intake of TFA with meat from ruminants is calculated in Table 3, based on data from the recent national food survey (10). Beef and veal are the most important sources of ruminant meat in Denmark. The average intake of 0.2 g TFA per day is without nutritional importance. However, 5% of the adult population consumes 1 g or more of TFA per day from ruminant meat, which is a substantial amount compared to the recently calculated average Danish intake of 2.5 g TFA per day from all sources (Leth, T., 1997, unpublished data).

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