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ORIGINAL CONTRIBUTION

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Trans fatty acid contents in spreads and cold cuts usually consumed by children

Trans-Fettsäuregehalte in von Kindern verzehrten Brotaufstrichen und -belägen

Summary A high intake of trans fatty acids in children may be disadvantageous because of untoward effects on lipoprotein metabolism and a possible impairment of arachidonic acid synthesis. We measured the trans fatty acid content of different brands of spreads and cold cuts typically consumed by German children because these foods may contribute a considerable portion of total trans fatty acid intake. The highest trans fatty acid contents were found in regular margarines (4.5, 0.0–10.6; median %-wt/wt of fatty acids, minimal–maximal), chocolate spreads (5.5, 0.7–11.1), butter (4.7, 3.7–5.2) and cheese (3.6, 1.8–4.0), while lower values were present in diet margarines (0.2, 0.0–0.4), vegetarian spreads (0.2, 0.1–0.4), peanut butter (0.0, 0.0–0.3) and sausages (1.7, 0.6–6.4). Calculations of typical dietary plans for young children show that food selection and variations in trans fatt acid contents may lead to marked differences in daily trans intake of > 100 % (3.1 g/d vs. 1.5 g/d). We propose that trans fatty acid content should be declared on labels of fatty food products to enable the consumer to choose, and further attempts should be made to lower trans fatty acid formation during technical hydrogenation.

Zusammenfassung Da nachteilige Folgen der Aufnahme von trans-Fettsäuren auf den Lipoproteinstoffwechsel und die Arachidonsäuresynthese bei Kindern befürchtet werden, untersuchten wir den trans-Gehalt in verschiedenen Brotaufstrichen und Brotbelägen, die bevorzugt von Kindern verzehrt werden. Dabei fanden sich die höchsten Gehalte in regulären Margarinen: (4,5; 0,0–10,6; Median der Gewichts-% der Fettsäuren, Minimum–Maximum), Nuß-Nougat-Cremes (5,5; 0,7–11,1 %), Butter 4,7; 3,7–5,2) und Käse (3,6; 1,8–4,0), während Diätmargarinen (0,2; 0,0–0,4), vegetarische Brotaufstriche (0,2; 0,1–0,4), Erdnußbutter (0,0; 0,0–0,3) und Wurst (1,7; 0, 6–6,4) niedrigere Gehalte aufwiesen. Die unterschiedlichen Gehalte führen zu Unterschieden in der aus Diätplänen berechneten täglichen trans-Aufnahme von > 100 % (3,1 g/d vs. 1,5 g/d) bei 4–7jährigen Kindern. Es erscheint uns sinnvoll, den trans-Fettsäuregehalt von fettreichen Lebensmitteln zu deklarieren, um dem Verbraucher eine gezielte Auswahl zu ermöglichen, und eine Minderung der Bildung von trans-Fettsäuren bei der technischen Fetthärtung anzustreben.

Key words Trans fatty acids – arachidonic acid – children – diet

Schlüsselwörter trans-Fettsäuren – Arachidonsäure – Kinder – Ernährung

Abreviations *LCP* = long chain polyunsaturated fatty acids *MONO* = monounsaturated fatty acids · *PUFA* = polyunsaturated fatty acids with 18 carbon atoms *TRANS* = trans fatty acids · *SAT* = saturated fatty acids · *SD* = standard deviation

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Introduction

While most unsaturated fatty acids found in foods are *cis* configurated, *trans* fatty acids are found in products originating from ruminating animals and in technically partially hydrogenated fats (2, 4, 17, 21, 25, 27). *Trans* fatty acids differ in their chemical configuration and their physicochemical properties from their respective *cis* isomers (27). Moreover, the metabolism of *trans* fatty acids differs from that of *cis* isomers, e.g. their β-oxidation is slower. *Trans* isomers are incorporated into plasma and tissue lipids, and they may cause altered membrane properties, reduced desaturation and elongation of essential fatty acids and reduced levels of arachidonic acid and prostaglandins in tissues (8, 13, 14, 16). High intakes of *trans* fatty acids have been reported to increase serum total and LDL-cholesterol levels and lipoprotein (a) and to reduce HDL-cholesterol in controlled studies (18, 19), but the debate about a relation of *trans* fatty acid intake with incidence rates of coronary heart disease is controversial (1, 23, 28, 29).

In premature infants, healthy children and human adults a negative correlation between percentage of *trans* fatty acids and arachidonic acid content in plasma phospholipids was reported, which is compatible with inhibition of essential fatty acid desaturation by *trans* fatty acids (7, 15). Arachidonic acid status is related to infantile growth and development (6, 12). Therefore it seems prudent to avoid high dietary intakes of *trans* fatty acids of infants and young children (5, 10, 11, 30).

The consumption of *trans* fatty acids is high in German pre-school children (26). Some of the major and readily changeable sources of intake are spreads and cold cuts eaten with bread. Therefore, we analyzed the *trans* contents of such spreads and cold cuts that are consumed and preferred by young children.

Material and methods

The 42 food samples analyzed were selected among commercially available products (Table 1) with the aim to obtain samples representative for foods typically consumed by children. The foods were bought at retail shops in the Munich area (Germany) in the summer of 1993 and were within their limits of shelf life. All reagents used for the analyses were of analytical grade.

From each food package, two separate samples of 1 g each were obtained. Total fat was extracted with chloroform/methanol (2:1), using 4 ml solvent per gram of food (3). The extract was taken to dryness and total fat content determined gravimetrically. Transesterification was performed with 1.5 ml methanolic hydrochloric acid at 80 °C for 40 min. After neutralization with carbonate buffer the fatty acid methyl esters were extracted into three times 1 ml hexane, taken to dryness and redissolved in 1.5 ml hexane containing 2 g/l butylhydroxytoluene as an antioxidant. For gas chromatographic analysis the samples were diluted ten times with hexane.

Table 1 List of individual brands of which samples were analyzed

Product group	Brand names	n
regular margarines	Sana, Bellasan, Flora soft, Lätta, Rama, SB, Sojola, Du darfst, Halbarine	9
diet margarines	becel, Deli Reform, Eden, Vitaquell	4
butter	Deller, Dt. Markenbutter, Rollenbutter, Weihenstephaner, Lätta, Homann	6
vegetarian spreads	Kutscher Paste, Frühstückspaste, Tofu Paste, Tofu Streichwurst, Delikatess Paste, Paprika Paste	6
peanut butter	OZ, Mandelmus, Ültje-Erdnuß-Creme	3
chocolate spreads	Milky Way, Nutella, Nutoka, Nuss-Fit, Schoko-Creme, Haselnuß-Nougat-Creme	6
cheese	Scheibletten Käse, Schmelzkäse, Schmelzkäse Kefir, Gouda mild	4
sausages	Kalbfleisch-Wurst, Leberwurst, Mortadella, Salami	4

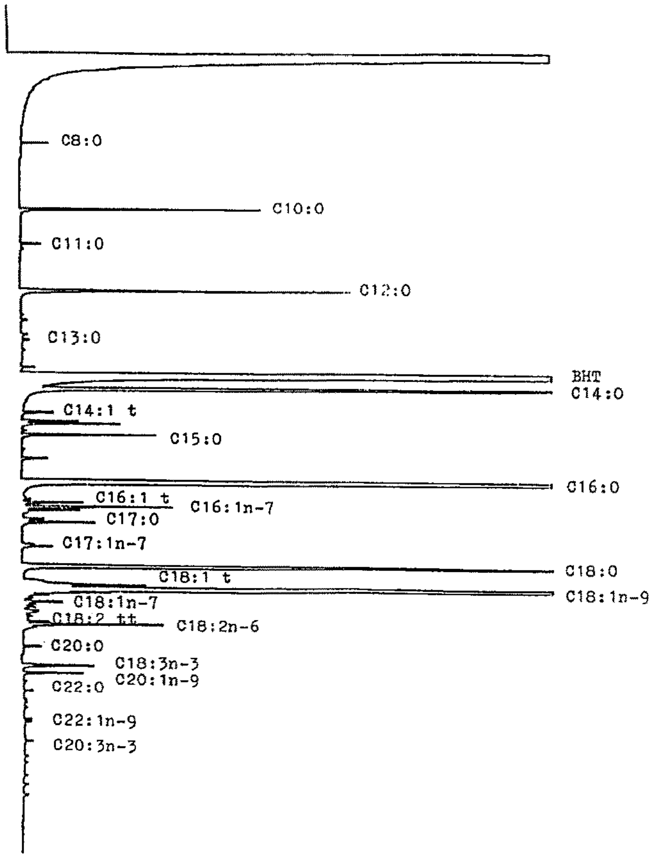

Fig. 1 Gas chromatogram of fatty acid methyl esters derived from a cheese sample.

Gas chromatography was performed on a Hewlett Packard 5890 series II GC (Waldbronn, Germany) equipped with a cool on column injector, a 50 m CPSil 88 column with 0.25 mm ID (Chrompack, Middleburg, The Netherlands) and a flame ionization detector (260 °C). Injections of 0.1 µl of sample were performed at an injector start temperature of 110 °C, which after a delay of 0.5 min was increased to 250 °C with a rate of 50 °C/min. Separation of compounds (fig. 1) was achieved with a carrier gas (He) pressure of 1.3 bar and a two-step temperature program starting at 85 °C (3 min), rising with 3.5 °C/min to 150 °C and from there on with 2.5 °C/min to 190 °C. A Hewlett Packard 3396 integrator was used for quantification. Results for fatty acids are given as weight percentages of the total fatty acids (chain length 12–24 carbon atoms) detected.

Calculation of the childhood diets and their energy and nutrient contents was performed with the diet program Diät 2000 version 3.0 (Soft & Hard, Rimbach, Germany).

Results

There were large differences in *trans* fatty acid contents between foods (Table 2).

Products of cow's milk (butter, cheese) show only small variations of *trans* fatty acid contents, as all products were purchased at the same time of the year. On the other hand the range of *trans* fatty acid contents is large in products containing technically hydrogenated fats. This is explained by the greater variety of ingredients used and differences in the processes used for manufacturing. Products of pure plant origin, without application of hydrogenation (e.g., peanut butter), contain no or only minimal amounts fo *trans* isomers.

The analytical method used enabled us to reliably detect fatty acids with percentages above 0.1, therefore we attempted to quantify *trans* monounsaturated fatty acids with 14, 16, 18 and 22 carbon atoms and linoleaidic acid, however, we were unable to separate different C 18:1 *trans* isomers. In the products studied, an average 83 ± 25 % (M ± SD) of total *trans* isomers were contributed by *trans* octadecenoic acids (C 18:1 t). The contribution of other *trans* fatty acids differs between product groups: catalytic hydrogenation (margarine) yields relatively more 18:1 t, while microbial hydrogenation in ruminants leads to a greater variety in chain length of the *trans* fatty acids, with a smaller proportion of total *trans* contributed by 18:1 t in butter.

Discussion

Our data show that foods typically consumed by children with bread contain considerable amounts of *trans* fatty acids. The results obtained are in good agreement with those of other recent investigations (20, 22), using much more demanding analytical techniques. Although inaccuracies may result from the neglecting of fatty acids with less than 12 carbon atoms, the results show clearly the large variations within or between product groups. In addition to the small sample number this invalidates comparisons of the means of the different product groups. Since there is concern about adverse effects of *trans* fatty acids, especially with respect to lipoprotein metabolism and vascular risks and to possible impairment of the synthesis of long-chain polyunsaturated fatty acids in children, it appears prudent to avoid high dietary intakes of *trans* fatty acids (10).

In order to estimate the influence of the products investigated here on *trans* intakes in typical childhood diets, we set up dietary plans for pre-school children with either randomly selected food or spreads and cold cuts chosen to minimise *trans* fatty acid intake. A diet which contains foods high in *trans* fatty acids shows that the daily intake of an infant aged 4–7 years may easily reach 3 g per day (Table 3). *Trans* fatty acid intake can be reduced by selecting foods from sources which are known to contain no *trans* fatty acids, e.g. unhydrogenated plant oil. A less demanding possibility is offered by the differences between various brands of products, which

Table 2 Percentage contribution (%-wt/wt) of total saturated (SAT), total *cis*-monounsaturated (MONO), total *cis*-polyunsaturated (PUFA), 18 carbon atoms), total *cis* long-chain polyunsaturated (LCP, 20–22 carbon atoms) and total *trans* fatty acids (TRANS). For each product group mean, standard deviation (SD), median, maximal and minimal values are presented

Products		SAT	MONO	PUFA	LCP	TRANS
regular margarines	mean	33.4	31.5	30.2	0.0	5.0
	SD	6.8	7.0	10.6	0.0	3.9
	median	36.0	31.6	25.9	0.0	4.5
	maximum	43.8	44.0	48.2	0.1	10.6
	minimum	23.9	21.2	18.7	0.0	0.0
diet margarines	mean	36.2	22.6	41.0	0.0	0.2
	SD	16.6	2.9	14.8	0.0	0.2
	median	31.9	22.6	44.4	0.0	0.2
	maximum	59.6	25.9	54.1	0.0	0.4
	minimum	21.4	19.3	21.2	0.0	0.0
butter	mean	60.5	27.8	7.1	0.0	4.6
	SD	12.0	2.1	10.5	0.1	0.5
	median	64.3	28.1	2.8	0.0	4.7
	maximum	67.6	30.9	28.4	0.1	5.2
	minimum	36.3	25.2	2.6	0.0	3.7
vegetarian spreads	mean	59.0	23.3	17.3	0.3	0.2
	SD	11.3	10.6	10.8	0.6	0.1
	median	60.4	22.0	12.8	0.0	0.2
	maximum	76.0	42.2	32.6	1.4	0.4
	minimum	45.8	10.8	6.1	0.0	0.1
peanut butter	mean	17.7	62.4	18.8	1.0	0.1
	SD	6.8	17.9	17.2	1.6	0.1
	median	19.5	67.0	22.8	0.0	0.0
	maximum	23.4	77.6	33.7	2.9	0.3
	minimum	10.2	42.7	0.0	0.0	0.0
chocolate spreads	mean	25.6	45.1	23.1	0.0	6.2
	SD	5.4	5.6	7.5	0.0	3.6
	median	26.6	44.1	23.2	0.0	5.5
	maximum	33.1	54.7	31.3	0.0	11.1
	minimum	19.0	40.1	11.5	0.0	0.7
cheese	mean	70.0	23.7	2.9	0.2	3.2
	SD	6.1	6.3	0.2	0.1	1.0
	median	69.0	25.2	3.0	0.2	3.6
	maximum	78.3	29.5	3.1	0.4	4.0
	minimum	63.6	14.7	2.6	0.1	1.8
sausage	mean	46.3	40.2	10.2	0.8	2.6
	SD	15.4	9.6	4.3	0.6	2.6
	median	47.0	41.9	10.2	0.9	1.7
	maximum	62.3	48.4	14.9	1.3	6.4
	minimum	28.9	28.5	5.5	0.0	0.6

allows to largely maintain personal preferences for food consumption, while selecting components low in *trans* isomers. Since more than 50 % of the *trans* fatty acids in our example diet are supplied by spreads and cold cuts, a preferential selection of low *trans* varieties of these foods may reduce the *trans* intake in the total diet to less than one half or an amount of 1.5 g per day (Table 4). This value can be regarded as low compared to the calculated average intake of 2.7 g (male) and 2.9 g (female) for German children of this age (26). Both diets follow the recommendation of the German Society for Nutrition (DGE) on intakes of the major nutrients (9). The marked reduction in *trans* intake is achieved with only minor reduction of total fat intake by 16 % and without increased intake of saturated fatty acids (24).

Table 3 Dietary plan for a child aged 4–7 years with randomly selected ingredients, supplying 1 719 kcal, which are contributed by fat (32 % of energy), carbohydrates: (54 %) and protein (14 %); own data and data taken from Steinhart & Pfalzgraf 1992

Meal	Food	Amount (g)	Trans-fatty acids (g)
breakfast	bread	60	–[a]
	chocolate spread A	30	0.5
	tea	300	–[a]
snack	bread	60	–[a]
	sausage A	20	0.1
	milk (full fat)	200	0.2
	banana	120	–[a]
lunch	schnitzel (pork)	80	0.1
	French fries	80	1.1
	lettuce	40	–[a]
	olive oil	10	–[a]
	lemonade	500	–[a]
snack	apple	150	–[a]
dinner	bread	120	–
	cheese A	15	0.2
	margarine A	10	0.8
	sausage B	15	0.1
	water/tea	400	–[a]
	Σtrans fatty acids		**3.1 g**

[a] supplying less than 0.05 g of *trans* fatty acids

Table 4 Dietary plan for a child aged 4–7 years selected to minimize *trans* fatty acid intake supplying 1 731 kcal which are contributed by fat (29 %), carbohydrates (57 %) and protein (14 %); own data and data taken from Steinhart & Pfalzgraf 1992

Meal	Food	Amount (g)	Trans-fatty acids (g)
breakfast	bread	60	–[a]
	chocolate spread B	30	0.1
	tea	300	–[a]
snack	bread	60	–[a]
	veg. spread A	30	–[a]
	milk (full fat)	200	0.2
	banana	50	–[a]
lunch	schnitzel (pork)	80	0.1
	French fries	80	1.1
	lettuce	40	–[a]
	olive oil	10	–[a]
	0.5 l lemonade	500	–[a]
snack	apple	150	–[a]
dinner	bread	120	–[a]
	veg. spread B	30	–[a]
	margarine B	10	–[a]
	veg. spread C	25	–[a]
	water/tea	400	–[a]
	Σtrans fatty acids		**1.5 g**

[a] supplying less than 0.05 g of *trans* fatty acids

We conclude that dietary *trans* fatty acid consumption of young children may be very high, but can be easily lowered by preferential selection of food products with low *trans* contents, without major changes of food habits. However, the consumer would require labeling of this fatty acid contents of food products in order to enable him to choose, as it has been introduced by Dutch margarine manufacturers (11). Furthermore, the food industry should be encouraged to improve production processes with respect to lowering *trans* contents, particularly since such technologies are available (21).

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