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Fatty acid and lipid composition of children's food. I. Analytical methods; composition of commercially available supplementary foods for juniors

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Summary

Analytical methods and the results of the analysis of the lipids of commercially available canned supplementary foods for juniors are described.

Lipids were extracted, separated into polar and non-polar fractions and the components (triglycerides, monoglycerides, free fatty acids, cholesterol ester, and phospholipids) were then identified and estimated, by comparison with reference substances and by gas chromatography.

To determine the degree of unsaturation and positional distribution of the fatty acids, the triglycerides were hydrolyzed by pancreatic lipase to monoglycerides with the fatty acid in 2-position of glycerol, and the fatty acids and the monoglycerides were also separated by gas chromatography. Linoleic acid, 18.2ω6, was found as the predominant fatty acid in the 2-position of the triglycerides. The other fatty acids being distributed equally to all positions of glycerol with the exception of few minor fatty acids.

Fat contributed to 31 to 48 percent of the total energy supply of the analyzed items; linoleic acid providing 0.4 to 2.4 percent of this energy assuming that one can of these products is consumed daily.

Zusammenfassung

Die analytischen Methoden und die Ergebnisse der Analysen der Lipidbestandteile von käuflich erhältlicher Beikost für ältere Säuglinge und Kleinkinder werden beschrieben.

Die Lipide wurden mit Äthanol/Zyklohexan extrahiert, chromatographisch in polare und nichtpolare Fraktionen getrennt; die Fettklassen (Triglyzeride, Monoglyzeride, freie Fettsäuren, Cholesterinester und Phospholipide) wurden getrennt und durch Vergleich mit Referenzsubstanzen und durch Gaschromatographie identifiziert bzw. bestimmt.

Zur Bestimmung der Fettsäuren in der 2-Position der Triglyzeride wurden die Triglyzeride mit Pankreaslipase zu entsprechenden Monoglyzeriden hydrolysiert und die entstandenen Monoglyzeride gaschromatographisch getrennt. Die Linolsäure, 18.2ω6, wurde als vorherrschende Fettsäure in der 2-Position der Triglyzeride gefunden. Die anderen Fettsäuren wurden mit Ausnahme weniger gleichmäßig über die einzelnen Positionen verteilt.

Das Fett machte 31 bzw. 48 % der Gesamtkalorien der untersuchten Präparate aus. Vorausgesetzt, daß ein Gläschen pro Tag gefüttert wird, werden dadurch 0,6 bis 2,4 % der Energie in Form von Linolsäure zugeführt.

Key words: nutrition, children, food, fat, lipid composition

Introduction

The fat in food is a heterogenous mixture of different lipids and triglycerides. During the intestinal degradation and resorption, these compounds behave differently, for instance, the fatty acid substitute in position 2 of the glycerol of triglycerides might have an influence on resorption (1, 2, 3). Up to now there has been a lack of data on fat composition of whole food and diets of healthy and sick children beyond infancy. This makes it difficult to judge adequately the relations of fat composition and fat tolerance of different pathological states.

The aim of this and the following papers is to fill up this gap in order to obtain a basis for evaluating the physiology and pathology of fat in children's food. The first paper contains a description of the analytical methods and the results of the analysis of commercially available canned supplementary solid foods for juniors. These were analyzed because they are frequent meals in this country. Therefore the following five products were chosen:

Chicken breast with vegetables and noodles; Veal in vegetables and rice; Ham with vegetables and noodles (with egg); Spinach with fresh egg and potatoes; Carrots with butter; (all products from Hipp KG, Pfaffenhofen, F.R.G.).

Five samples of each kind produced at the same time were examined. To determine whether there are essential differences between different batches, five additional samples of another batch of one product were analyzed some months later. The examination of the infants' meals according to the following scheme will be reported here (fig. 1).

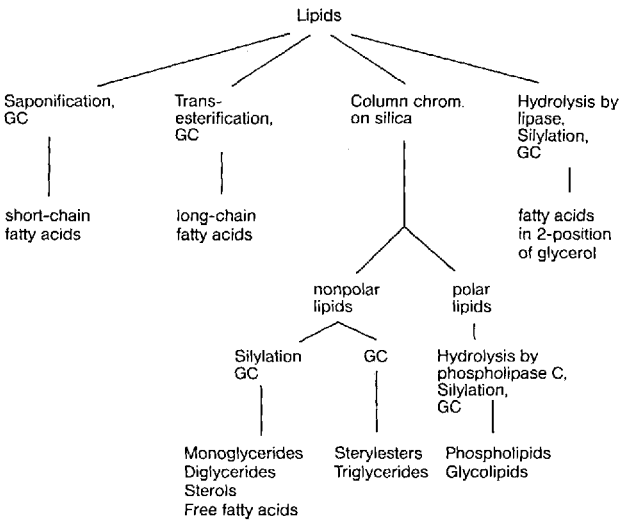

Fig. 1. Scheme of the examination of lipids from supplementary foods for juniors.

Methods

1. Preparation of samples

100-g portions of the material were thoroughly homogenized, filled into plastic dishes and frozen at −70 °C for 5 hours. Immediately thereafter they were freeze-dried overnight, homogenized once again and stored at −20 °C under N_2.

2. Protein determination

The method of Kjeldahl was used with a catalysator mixture (E. Merck, Darmstadt, F.R.G.) according to Wieninger containing copper, salt, and selenium. The sample size was 1 g of freeze-dried material. Protein content was calculated from: % protein = % nitrogen × 6.25.

3. Lipids

5 g of freeze-dried material was weighed together with fine sand into an extracting thimble from filter paper. It was then extracted with ethanol/cyclohexane (1/1) for 5 hours in an apparatus consisting of a round-bottom flask, an extraction tube for the thimble and a reflux condenser placed on a hot plate. The resulting solution was evaporated to dryness under reduced pressure. The residue was dissolved in 15 ml of dry ether and allowed to stand overnight in a dark place. Then the solution was filtered quantitatively and evaporated to dryness. The residual fat was weighed and stored at −20 °C under N_2.

a. *Short-chain fatty acids* (butyric, caproic acid) (modification of a technique described by Diemair and Schams (5)): 25 mg of lipids were saponified for 30 min with isopropanolic KOH (0.5 mol/l) under reflux. Approximately 0.5 mg of n-valeric acid was added as internal standard. The solvent was removed and the dry residue of fat soaps was treated with a solution of formic acid in CH_2Cl_2. The sample was then analyzed by gas chromatography.

Chromatographic conditions:

Gas chromatograph: Packard Model 417 with FID, modified for capillary columns; column: glass capillary, length 25 m, int. diam. 0.25 mm coated with WG-11 (WGA, Griesheim, F.R.G.); carrier gas: nitrogen, 3 ml/min, split ratio 1:10; purge gas: nitrogen, 30 ml/min; detector gas: hydrogen 30 ml/min, air 250 ml/min; injector temp. 200 °C, detector temp. 275 °C; oven temp. 140–230 °C, programmed with 5°C/min; recorder: BD 8 (Kipp & Zonen, Delft, Netherlands).

b. *Mid- and long-chain fatty acids.* 5 mg of lipids were refluxed with 2 ml of hydrochloric acid in methanol (0.7 mol/l) for 1 hour. The excess HCl was neutralized by 100 mg of solid $Na_2SO_4/NaHCO_3/Na_2CO_3$ (2/2/1). As internal standard *n*-eicosane had been used, which was added before transesterification.

Chromatographic conditions:

Gas chromatograph: Packard Model 417 with FID, modified for capillary columns; column: glass capillary, length 50 m, int. diam. 0.27 mm coated with 5 % Carbowax 20 M; carrier gas: nitrogen 2 ml/min, split ratio 1:10; purge gas: nitrogen 30 ml/min; detector gas: hydrogen 30 ml/min, air 250 ml/min; injector temp. 200 °C, detector temp. 300 °C; oven temp. 120–220 °C, programmed with 5°C/min; recorder: BD 8 (Kipp & Zonen, Delft, Netherlands); integrator: Autolab 6300 Digital Integrator (Autolab Spectra Physics, Darmstadt, F.R.G.).

c. *Separation of lipid classes* (modification of a technique described by Kates (6)): 10 mg of lipids were dissolved in chloroform and quantitatively transferred to a small column (length 80 mm, int. diam. 5 mm) filled with silica (prepared by heating the adsorbent for 4 hours at 120 °C followed by deactivation with 10 % water) in chloroform. The nonpolar lipids were eluted with 60 ml of chloroform and immediately thereafter the column was washed with 60 ml of methanol to isolate the polar lipids. Column fractions were analyzed by thin layer chromatography (TLC). Developing solvents were hexane/diethylether and acetic acid (80:20:2 by vol) for neutral lipids, and chloroform-methanol-acetic acid-water (25:15:4:2 by vol) for polar lipids.

Iodine vapour was used to visualize the separated lipid classes. Identification were made on the basis of migration relative to reference standards.

Both eluates were evaporated to dryness and mixed with hexadecane as internal standard.

One part of the $CHCl_3$-fraction was directly analyzed for sterylesters and triglycerides by gas chromatography; the other was treated prior to GC with 200 µl of pyridine, 50 µl of HMDS and 25 µl of TMCS for 2 hours at 50 °C to give the TMS ethers of the free OH-functions.

The residue of the methanol fraction was suspended in 1 ml of Tris-HCl-buffer solution, pH 7.3, 0.3 ml of $CaCl_2$-solution (1 %), 0.25 ml of ether and 25 µl of phospholipase C (from Bacillus subtilis, Boehringer, Mannheim, F.R.G. (7)). The sample was stirred for 2 hours at 30 °C, then cooled. The lipids were extracted with 2.5 ml of $CHCl_3$/methanol (2/1). The $CHCl_3$ solution was dried over Na_2SO_4, evaporated to dryness and the residue was silylated as described above.

Chromatographic conditions:

Gas chromatograph: Packard Model 417 with dual FID in differential mode; columns: glass columns, length 1.4 m, int. diam. 4 mm packed with SE-30 (1.5 % on Chromosorb W HP); carrier gas: nitrogen 30 ml/min; detector gas: hydrogen 40 ml/min, air 300 ml/min; injector temp. 300 °C, detector temp. 375 °C; oven temp. 100–350 °C, programmed with 10°C/min; recorder: BD 8 (Kipp & Zonen, Delft, Netherlands); integrator: Autolab 6300 Digital integrator (Autolab Spectra Physics, Darmstadt, F.R.G.).

d. *Fatty acids in 2-position of glycerol.* The estimation of the fatty acids in the 2-position of glycerol has been performed by a modification of the method of Luddy et al. (8):

10 mg of lipids and 1 mg of hexadecane (int. standard) were mixed with 1 ml of Tris-HCl-buffer solution, pH 8.5, 0.25 ml tauroglycocholic acid solution (0.05 %) and 0.25 ml of $CaCl_2$-solution (1 %) and heated to 40 °C. After addition of approximately 10 mg of lipase (from pig pancreas, Fluka, Neu-Ulm, F.R.G.) the sample was hydrolyzed at 40 °C while constantly shaking for exactly 5 min, then cooled in an ice bath and acidified with 1 ml of HCl (1 Mol/l). The lipids were extracted twice with 2 ml of CH_2Cl_2. The combined CH_2Cl_2-layers were shaken once with Na_2CO_3-solution (10 %) to remove the main part of the free fatty acids produced. The aqueous layer was discharged and the CH_2Cl_2-solution dried over Na_2SO_4 and evaporated to dryness. The residual monoglycerides were converted to their TMS ethers by reaction with 100 µl of HMDS, 50 µl of TMCS and 500 µl of pyridine.

Chromatographic conditions:

Gas chromatograph: Packard Model 417 with FID, modified for capillary columns; column: glas capillary, length 20 m, int. diam. 0.27 mm coated with SE-30 and subsequently deactivated with Carbowax 20 M at 280 °C; carrier gas: nitrogen 3 ml/min, split ratio 1:10; purge gas: nitrogen 30 ml/min; detector gas: hydrogen 30 ml/min, air 280 ml/min; injector temp. 250 °C, detector temp. 350 °C; oven temp. 120–250 °C, programmed with 10 °C/min; recorder: BD 8 (Kipp & Zonen, Delft, Netherlands); integrator: Autolab 6300 Digital Integrator (Autolab Spectra Physics, Darmstadt, F.R.G.).

4. Evaluation of the methods

For the methods described above the standard deviations of the analytical figures were determined from 10 to 20 analyses of one sample.

It was found to be approximately 3 mg/100 g of food for the determination of the short-chain and long-chain fatty acids. The quantification of the lipid classes was possible with a standard deviation of 5 mg/100 g of food. Mean and standard deviation have been calculated according to the Student's t-test because single values were distributed normally.

Table 1. Analyses data of supplementary food for juniors: I = chicken breast with vegetables and noodles; II = veal in vegetables and rice; III = ham with vegetables and noodles (made with egg); IV = carrots in butter; V = spinach with fresh eggs and potatoes (batch 1); VI = spinach with fresh eggs and potatoes (batch 2).

	I	II	III	IV	V	VI
	g/100 g					
Protein	3.90 –4.02	3.69 –3.85	4.10 –4.39	0.85 –0.88	2.70 –2.73	2.60 –2.69
lipid	3.52 –3.68	3.63 –3.67	3.18 –3.95	2.10 –2.14	3.81 –3.93	4.52 –4.53
Fatty acids						
4:0	0.032–0.036	0.056–0.064	0.015–0.021	0.048–0.072	0.067–0.075	–
6:0	0.017–0.025	0.021–0.037	0.005–0.010	0.035–0.038	0.051–0.060	0.055–0.073
8:0	0.008–0.012	0.012–0.015	0.003	0.013–0.018	0.021–0.030	–
10:0	0.017–0.024	0.028–0.033	0.006–0.010	0.033–0.044	0.045–0.072	0.047–0.082
12:0	0.022–0.033	0.041–0.047	0.023–0.032	0.043–0.077	0.084–0.129	0.064–0.099
iso-14	–	0.001–0.002	–	0.002–0.003	–	–
14:0	0.10 –0.13	0.18 –0.22	0.067–0.073	0.018–0.020	0.23 –0.29	0.23 –0.36
14:1 w 5	0.010–0.013	0.019–0.022	0.003	0.016–0.017	0.018–0.036	0.018–0.067
15:0	0.012–0.015	0.017–0.019	0.005	0.021–0.022	0.025–0.045	0.032–0.066
iso-16	0.002–0.004	0.005	0.001–0.002	0.005–0.006	0.007–0.014	–
16:0	0.66 –0.75	0.71 –0.75	0.72 –0.83	0.048–0.052	0.85 –0.92	0.83 –0.90
16:1 w 7	0.086–0.106	0.065–0.075	0.064–0.074	0.031–0.032	0.041–0.048	0.035–0.072
16:2 w 4	–	–	–	–	0.005–0.008	–
17:0	0.008–0.012	0.013–0.014	0.009–0.011	0.011–0.013	0.016–0.018	0.008–0.021
17:1 w 7	0.005–0.008	0.011–0.012	0.009–0.012	0.009–0.012	0.009–0.013	–
iso-18	–	0.001–0.002	–	0.001–0.002	0.002	–
18:0	0.19 –0.22	0.25 –0.27	0.30 –0.37	0.016–0.017	0.21 –0.24	0.21 –0.28
18:1	0.93 –1.02	0.89 –0.93	1.07 –1.29	0.43 –0.45	0.62 –0.68	0.75 –0.87
18:2 w 6	0.41 –0.48	0.13 –0.14	0.20 –0.29	0.074–0.079	0.086–0.098	0.13 –0.16
18:3 w 6	–	0.006–0.008	–	–	–	–
18:3 w 3	0.036–0.044	0.022–0.024	0.015–0.021	0.018–0.021	0.062–0.075	0.10 –0.14
20:0	–	–	0.003–0.007	–	–	–
20:1 w 9	0.008–0.011	0.005–0.007	0.017–0.022	–	–	–

	I	II	III	IV	V	VI
	g/100 g					
20:2 w 6	–	0.001	0.006–0.008	–	–	–
20:4 w 6	0.003–0.005	0.006–0.008	0.010–0.014	–	0.005–0.008	–
22:6 w 3	–	0.002–0.003	–	–	–	–
Lipid classes						
TG						
C-28	0.018–0.022	0.032–0.040	–	0.023–0.027	0.033–0.048	0.028–0.034
C-30	0.013–0.024	0.035–0.044	0.016–0.024	0.029–0.034	0.046–0.068	0.040–0.043
C-32	0.020–0.033	0.050–0.061	0.019–0.028	0.044–0.048	0.076–0.091	0.060–0.073
C-34	0.040–0.055	0.085–0.092	0.030–0.044	0.088–0.095	0.15 –0.17	0.11 –0.14
C-36	0.078–0.093	0.14 –0.15	0.074–0.10	0.15 –0.16	0.24 –0.27	0.18 –0.25
C-38	0.094–0.112	0.17 –0.18	0.078–0.11	0.18 –0.20	0.26 –0.29	0.26 –0.31
C-40	0.072–0.083	0.13 –0.14	0.061–0.11	0.15 –0.16	0.19 –0.21	0.21 –0.25
C-42	0.065–0.077	0.11 –0.14	0.048–0.12	0.088–0.099	0.15 –0.16	0.17 –0.19
C-44	0.074–0.094	0.12 –0.15	0.053–0.12	0.077–0.088	0.16 –0.17	0.15 –0.19
C-46	0.073–0.102	0.18 –0.20	0.077–0.11	0.10 –0.11	0.21 –0.23	0.19 –0.22
C-48	0.017–0.022	0.35 –0.37	0.14 –0.23	0.13 –0.16	0.31 –0.35	0.25 –0.32
C-50	0.057–0.067	0.70 –0.74	0.57 –0.69	0.20 –0.27	0.43 –0.52	0.39 –0.48
C-52	1.21 –1.35	1.28 –1.37	2.14 –2.67	0.23 –0.32	0.63 –0.81	0.71 –0.84
C-54	0.97 –1.23	0.47 –0.51	0.48 –0.68	0.08 –0.13	0.15 –0.25	–
FFA						
C-16	0.014–0.020	0.015–0.022	0.017–0.021	0.005–0.008	0.014–0.030	0.002–0.008
C-18	0.012–0.018	0.014–0.026	0.013–0.019	0.008–0.013	0.010–0.018	0.003–0.005
MG						
C-16	–	0.006–0.011	0.003–0.006	–	0.006–0.010	0.002–0.015
C-18	0.002–0.008	0.008–0.011	0.007–0.011	–	–	–
Sterols						
Cholest.	0.026–0.043	0.064–0.068	0.056–0.097	–	0.073–0.11	0.032–0.047
Lyso-PL						
C-16	–	0.009–0.016	0.007–0.011	–	0.005–0.021	0.002–0.006
C-18	–	0.011–0.024	0.011–0.018	–	0.016–0.039	0.001–0.004

	I	II	III	IV	V	VI
	g/100 g					
PL						
C-32	–	0.006–0.008	–	–	0.013–0.029	0.005–0.007
C-34	–	0.038–0.053	0.030–0.063	–	0.092–0.22	0.075–0.078
C-36	–	0.059–0.095	0.012–0.057	–	0.070–0.19	0.050–0.063
C-38	–	0.043–0.065	0.020–0.035	–	0.030–0.095	0.014–0.031
C-40	–	–	–	–	0.004–0.009	–
Fatty acids in 2-position (Mol-%)						
6:0	–	–	–	0.3– 0.6	0.1– 0.3	0.2– 0.4
8:0	0.4– 0.6	0.2– 0.8	–	0.8– 0.8	0.6– 0.9	0.7– 1.4
10:0	0.9– 1.1	1.0– 1.7	0.1– 0.2	2.3– 2.8	1.1– 3.2	1.9– 4.1
12:0	1.2– 1.5	3.2– 4.9	0.4– 0.6	3.2– 4.1	3.6– 6.0	3.6– 6.0
14:0	6.5– 8.5	9.3–12.4	4.3– 5.0	17.3–18.2	10.9–17.6	17.8–20.1
16:0	23.3–24.9	23.1–25.4	57.8–63.4	41.0–43.0	42.6–53.3	34.5–37.6
16:1	–	3.6– 4.7	2.5– 4.5	2.9– 3.4	2.3– 4.1	2.0– 2.1
18:0	2.7– 2.9	4.1– 7.0	2.3– 3.1	0.4– 0.9	3.7– 4.8	2.3– 4.0
18:1	25.4–29.2	35.5–37.7	12.2–16.3	13.5–21.9	11.5–14.6	16.2–17.1
18:2	28.1–33.3	11.6–15.5	12.8–16.3	8.3–15.0	12.0–14.4	17.4–20.9

Results and discussion

The results of the examination of the canned supplementary solid foods for juniors are listed in table 1.

1. Lipid isolation

There is a number of published methods for the isolation of lipids from food. Here the treatment with boiling ethanol/cyclohexane, followed by a separation of the ether insoluble material (e.g. carbohydrates) was chosen because of its ability to isolate the lipids present almost quantitatively without any alterations of the composition (9). In our hands yields of polar and nonpolar lipid classes were usually greater than 98 %.

2. Short-chain fatty acids

Figure 2 shows a gas chromatographic separation of short-chain fatty acids of a sample analyzed. The gas chromatographic determination of butyric and caproic acid without derivatization presents some problems

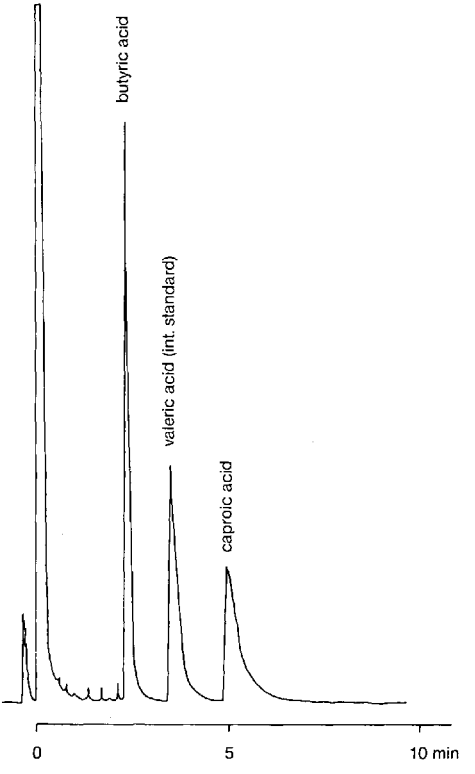

Fig. 2. Gas chromatographic separation of short-chain fatty acids from a lipid sample.

because of their high volatility and the bad chromatographic characteristics of free carboxylic acids. The best results were obtained when a polar acidic stationary phase was used as GC column and the short-chain fatty acids were injected together with an excess of other free acids. This may be due to a suppression of dissociation of the carboxylic function.

Butyric and caproic acids are typical components of milk fat, allowing a calculation of the milk fat content of the total lipids based on the amounts of 4:0 and 6:0 found. Every sample of the analyzed food consisted of a certain amount of butter fat, varying between 8 and 80 % of the total lipids.

3. Long-chain fatty acids

Figure 3 shows a gas chromatographic separation of medium-chain and long-chain fatty acids as methyl esters of the fat of the analyzed food.

The chromatograms of the food lipids show fatty acids from C_8 to C_{24}. Originating from cow milk lipids medium-chain fatty acids (8:0, 10:0, 12:0), odd numbered ones (15:0, 17:0, 17:1) and branched-chain ones (iso-16, iso-18) could be found. The fatty acids present in the lipid samples were identified by comparison with a standard solution of fatty acid methyl esters and their identity was confirmed by chromatography on two other

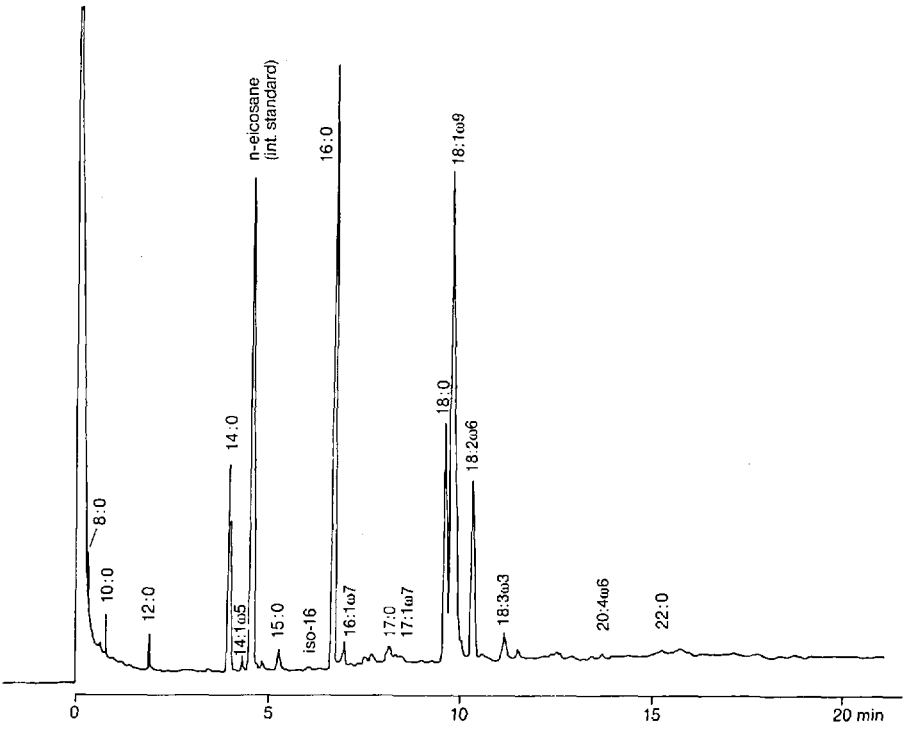

Fig. 3. Gas chromatographic separation of medium-chain and long-chain fatty acids as methyl esters from a lipid sample.

capillary columns with different polarity of the stationary phase (SE-30 and WG-11). Under the chromatographic conditions employed there was no separation of the isomeric 18:1 acids. They were calculated as one substance.

4. Separation of lipid classes

The separation of lipid classes by gas chromatography is shown in Figure 4.

The separation was performed by several successive steps. At first the whole lipid extract was divided into two fractions by column chromatography on silica: the nonpolar lipids (triglycerides, free fatty acids, steryl esters, sterols) by using $CHCl_3$ as eluent and the polar lipids (phospholipids and glycolipids) by elution with methanol[1]). Among the nonpolar lipids only triglycerides and steryl esters can be detected directly by GC while the others must be converted, e.g. to the trimethylsilyl (TMS) esters, prior to GC.

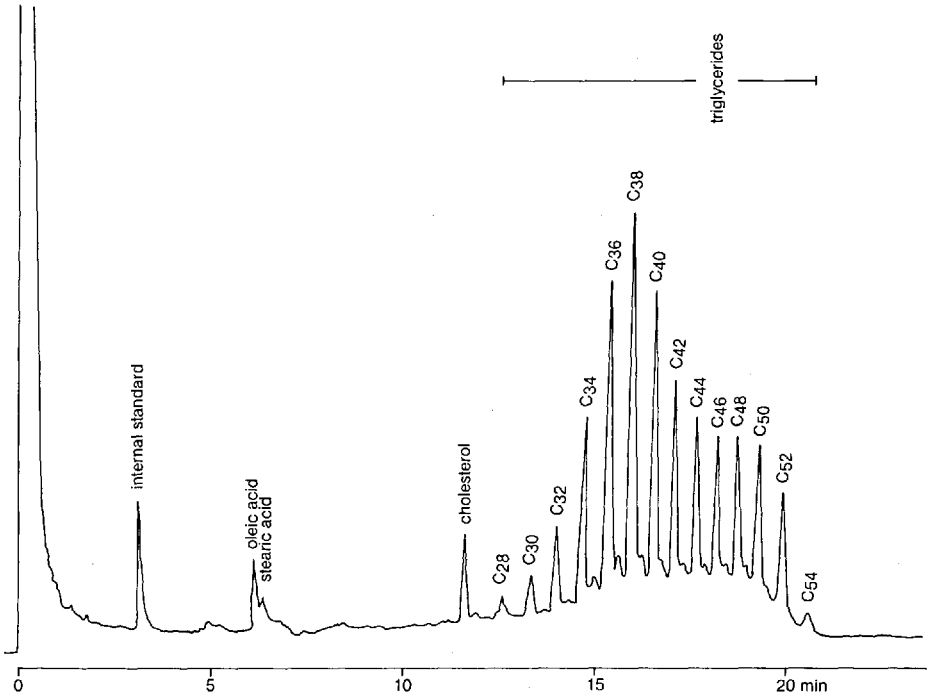

Fig. 4. Gas chromatographic separation of the nonpolar lipid components from a food sample.

[1]) Using standard mixtures of the common lipid components, the optimal conditions for the separation (amount and activity of silica, amounts of solvents) were established.

Because of the ionic function, the gas chromatographic separation of the phospholipids is only possible after hydrolysis of the phosphatidylcholine.

The components present in the sample of the junior supplementary food were identified by comparison with reference substances and by gas chromatography on a capillary column.

In all supplementary foods the presence of medium-chain triglycerides could be shown. Besides the triglycerides, which represent the main portion of the whole lipids, the other lipid classes were found in only small amounts. Among these minor components cholesterol and phospholipids were predominant.

5. Fatty acids in 2-position of glycerol

Figure 5 outlines the GC separation of 2-monoglycerides originating from triglycerides of a food sample.

The main drawback of the GC separation of the lipid classes shown above is that the components of one class are only separated according to the chain length of the fatty acids bound. For triglycerides, however, the degree of unsaturation of the fatty acids is of interest. Therefore the triglycerides were hydrolyzed by pancreatic lipase to give the correspond-

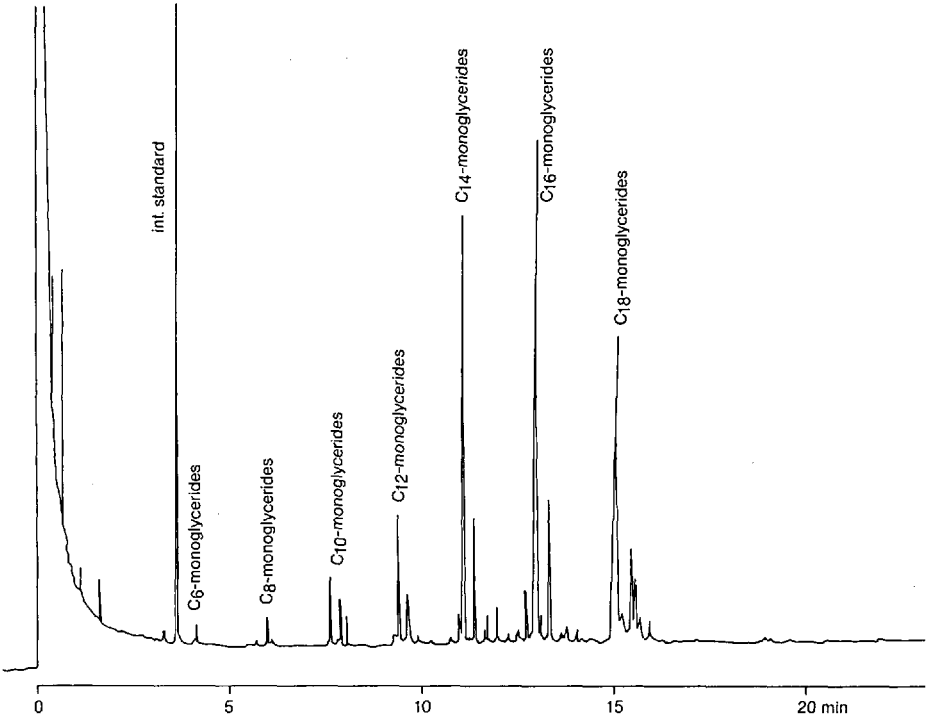

Fig. 5. Gas chromatographic separation of the monoglycerides resulting from pancreatic lipase hydrolysis of a lipid sample.

ing 2-monoglycerides which were then analyzed by GC. To achieve a separation of saturated and unsaturated compounds it was necessary to use capillary columns.

Besides some variations, the distribution of the fatty acids in junior supplementary food was found to be quite uniform for the different meals examined. Excepting 8:0, 10:0, 18:0 and 18:2 the fatty acids were equally distributed to all positions of glycerol. Accordingly the amount of one fatty acid in the 2-position was approximately 30 % of the total amount present in the lipids. 8:0, 10:0 and 18:0 were only rarely present in the 2-position (15 % of the total amount) while linoleic acid was bound preferentially (50–100 % of the total amount) to this position.

6. Evaluation of the fat content of the supplementary food for juniors

The mean energy derived from fat (as percentage of the total energy) of the different items was 39, 39, 43, 48 and 31, respectively. This is not far from the average value of the daily food intake of young German toddlers. Stolley et al.'s (4) calculation for these was between 33 and 37 percent. The linoleic acid related to the total fat was 12.2, 3.9, 6.4, 3.1 and 3.6 percent, respectively. If one assumes that one can of the products is consumed daily then this will correspond to 2.4, 0.8, 1.4, 0.8 and 0.6 percent of the daily energy uptake.

For pancreatic lipase fats are preferentially hydrolyzed in the 1- and 3-position of a triglyceride. This leads to a mixture of free fatty acids and esters at the 2-position of glycerol. In the case of the long-chain fatty acids it has been found that the relative absorbability of the free fatty acids is lower than that of the 2-monoglycerides and that among the different monoglycerides 2-monopalmitin is absorbed best (1, 2, 3, 11). This could be essential for fat absorption, at least in young human babies. Filer et al. (2) found that fats rich in palmitic acid esterified to the 2-position are absorbed better by premature infants than fats which have a lower content of palmitic acid in this position, e.g. butter fat. The analyses performed point to a high content of butter fat in the products analyzed. However, it is certainly premature and not justified to extend the better intestinal absorption of 2-monopalmitate as found in very young infants to young toddlers, for whom the canned supplementary food for juniors is determined.

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