

The Impact of the Nutrition Labeling and Education Act (NLEA) on Fat Analysis

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In response to the nutrition labeling regulations proposed in November 1991, AOAC International formed a task force to assess the adequacy of Official Methods of Analyses for nutrient labeling. A subcommittee was formed to address concerns regarding fat methodology including the absence of a clear definition of fat for labeling purposes, the appropriateness of methods for various food matrices, and the lack of official methods for some matrices. The Task Force proposed a chemical definition of fat as the sum of fatty acids expressed as triglycerides. FDA published the final regulations on January 6, 1993 and defined fat as the total lipid fatty acids express as triglycerides. In view of the published regulations, validated methods were assessed for adequacy. In addition, AOAC is looking to validate methodologies where adequate methods do not exist such as for the sum of fatty acids.

**The Impact of
NLEA
on
Fat Analysis**

Subcommittee Charter

- Recommend chemical definition for fat
- Identify suitability of official validated fat methods for food matrices
- Recommend matrices/ methods needing further study

However,

**Nonfat material such as
flavor compounds, fat
soluble vitamins, etc.
may also be extracted**

**AOAC Fat Methodology
Subcommittee**

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**Issue
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What is Fat?**

- Fat has been interchangeably described as lipids
- Crude fat is defined as an ether extract
- Fat now accepted as a subclass of lipids

Lipid Classes

- Mono-, Di, & Triglycerides
- Phospholipids
- Glycolipids
- Sphingolipids
- Steroids and Sterols (and their esters)
- Waxes
- Free Fatty Acids

Source of Fatty Acids

- Mono-, Di, & Triglycerides
- Phospholipids
- Glycolipids
- Sterol Esters
- Vitamin A Esters
- Free Fatty Acids

Bread Crumbs Fat Analysis by Various Methods

<i>METHOD</i>	<i>AQAC#</i>	<i>%FAT</i>	<i>S.D.</i>
Soxhlet, Pet	945.16	1.39	0.10
Soxhlet, Diethyl	920.39	1.88	0.16
General Mojonnier	989.05	2.24	0.005
Acid Hydrolysis - Re-extraction	945.44	3.46	0.01
Chloroform - Methanol	983.23	4.03	0.04
Acid Hydrolysis - Flour	922.06	4.41	0.08
Acid Hydrolysis	926.32	5.13	0.10

Other Lipid Methodologies

- Fatty Acid Distribution
- Cholesterol
- Cis/trans

Variations in Fat Methodologies

- Sample pre-treatment
- Sample digestion
- Extraction solvent
- Re-extraction procedures

Nutritional significance of fat value on label

- Calories from fat

Subcommittee recommended a single concise definition for fat

- Sum of the fatty acids expressed
as triglycerides

Issues

- Study of methods
- Solvents - chlorinated
hydrocarbons
- Ether soluble
nondigestible fat
substitutes

**List Of Total Fat
Methodologies
Which Are Adequate
To Meet NLEA Regulations**

<u>AOAC #</u>	<u>TITLE</u>	<u>BRIEF DESCRIPTION</u>	<u>APPLICABLE MATRICES</u>	<u>COMMENTS</u>
960.39	Crude Fat in Meat	(Pet or diethyl ether) extraction	Baby food-meats, meats	Mono-, di- and triglycerides and traces of other lipid components
976.21	Crude Fat in Meat	Rapid specific gravity method. Tetrachloro-ethylene extraction	Baby food-meats, meats	Mono-, di- and triglycerides, and most of the sterols, glycolipids, phospholipids and waxes
985.15	Crude Fat in Meat & Poultry Products	Rapid microwave-methylene chloride solvent extraction	Baby food-meats, meats	Mono-, di- and triglycerides, glycolipids phospholipids, and waxes, yield of sterols may be depressed
920.39B	Crude Fat in Animal Feed	Diethyl ether extraction	Cereal & products; not adequate if product was heat processed, extruded	Mono-, di-, and triglycerides and traces of other lipid

				or has sugar added	components
920.39C	Crude Fat in Animal Feed	Diethyl ether extraction; water prewash if high in sugar		Cereals & products, sweet mixes (cakes & pies) Not adequate if heat processed	Mono-, di-, and triglycerides; may not quantitatively extract total lipids; recommend further review or study of method
945.18A	Fat in Cereal Adjuncts	Pet ether extraction		Cereals & products, sweet mixes (cakes & pies) Not adequate if heat processed	Mono-, di-, and triglycerides; may not quantitatively extract total lipids; recommend further review or study of method
945.38F	Fat in Grains	Refers to 920.39C		Cereals & products Adequate if not heat processed	Mono-, di- and triglycerides and traces of other lipid components
933.05	Fat in Cheese	Acid hydrolysis, pet and diethyl ether extraction; re-extraction		Cheese	Mono-, di- and triglycerides and traces of other lipid components; yield of sterols greatly reduced

905.02	Fat in Milk	Alkaline treatment pet and diethyl ether extraction; re-extraction	Dairy	Mono-, di- and triglycerides and traces of other lipid components
989.05	Fat in Milk	Alkaline treatment, pet and diethyl ether extraction	Dairy	Mono-, di- and triglycerides and traces of other lipid components
938.06	Fat in Butter	Diethyl or pet ether extraction	Butter	Mono-, di- and triglycerides and traces of other lipid components
920.111A	Fat in Cream	Alkaline treatment, pet and diethyl ether extraction; re-extraction	Dairy	Mono-, di-, and triglycerides and traces of other lipid components
920.111B	Fat in Cream	Babcock, acid hydrolyses, volumetric analysis	Dairy	Mono-, di- and triglycerides, phospholipids and reduced sterol yield
952.06	Fat in Ice Cream & Frozen Desserts	Alkaline treatment, pet and diethyl ether extraction re-extraction	Dairy	Mono-, di- and triglycerides and traces of other lipid

945.48G	Fat in Evaporated Milk	Alkaline treatment, pet and diethyl ether extraction; re-extraction (refers to 905.02)	Dairy	components Mono-, di- and triglycerides and traces of other lipid components
932.06	Fat in Dried Milk	Alkaline treatment, pet and diethyl ether extraction	Dairy	Mono-, di-, and triglycerides and traces of other lipid components
948.15	Crude Fat in Seafood	Acid hydrolysis, pet and diethyl ether extraction	Fish, shellfish	Mono-, di-, and triglycerides, fatty acid portion of phospholipids and glycolipids; in some products with high sugar content, may overestimate fat; may reduce yield of sterols
964.12	Crude Fat in Seafood	Babcock, acid hydrolysis, volumetric analysis	Fish, shellfish	Mono-, di- and triglycerides, phospholipids; yield of sterols

986.25	Fat in Milk-Based Infant Formula	Alkaline treatment, pet and diethyl ether extraction; re-extraction (refers to 945.48G)	Infant formula/ medical	Mono-, di- and triglycerides and traces of other lipid components
925.32	Fat in Eggs	Acid hydrolysis, pet and diethyl ether extraction	Eggs/egg products May not be adequate for containing sugar	Mono-, di- and triglycerides, fatty acid portion of and glycolipids; may reduce yield of sterols
948.22	Crude Fat in Nuts and Nut Products	Diethyl ether extraction	Nuts; not adequate for nuts containing sugar	Mono-, di-, and triglycerides and traces of other lipid components
950.54	Total Fat in Food Dressings	Acid hydrolysis pet and diethyl ether extraction	Oils/fats (dressings)	Mono-, di- and triglycerides, fatty acid portion of phospholipids and glycolipids
945.44	Fat in Fig Bars & Raisin filled cookies	Acid hydrolysis, pet and diethyl ether; re-extraction	Sweet mixes (cakes & pies) and baked cereal products	Mono-, di- and triglycerides and fatty acid portion of phospholipids and glycolipids; may

					reduce yield of sterols re-extraction may not remove all sugars recommend further study
963.15	Fat in Cacao Products	Pet ether extraction	Chocolate products		Mono-, di, and triglycerides and traces of other lipid components
925.07	Fat in Cacao Products	Pet and diethyl ether extraction	Candy		Mono-, di, and triglycerides and traces of other lipid components
920.177	Ether Extract of Confectionary	Pet & diethyl ether extraction; re-extraction	Candy		Mono-, di, and triglycerides and traces of other lipid components
920.172	Ether Extract of Prepared Mustard	Diethyl ether extraction	Mustard		Mono-, di, and triglycerides and traces of other lipid components

**Fatty Acid Methodology and Cis-Cis
Methylene Interrupted Procedures**

963.22	Methyl Esters of Fatty Acids in Oils and Fats	Gas Chromatographic method following preparation of methyl esters (according to 969.33)	All	Fatty Acid profile; recommend further review or study of method to make method adequate for quantitative analysis of fatty acids
979.19	Cis, Cis-Methylene Interrupted Polyunsaturated Fatty Acids in Oils	Spectrophotometric Method	All	

Total Lipids

<u>AOAC #</u>	<u>TITLE</u>	<u>BRIEF DESCRIPTION</u>	<u>APPLICABLE MATRICES</u>	<u>COMMENTS</u>
983.23	Fat in Foods	Amylase/Protease treatment, chloroform-methanol extraction.	All	Method extracts total lipids including, mono-, di, triglycerides, sterols, glycolipids, phospholipids and waxes; method is <i>not</i> for determining total fat. May be used as an extraction method for various lipid fractions.