

Omega 3 Fatty Acids

By Jon Devries Ph. D.

BACKGROUND

Fats and oils consist primarily of the triesters of a variety of fatty acids and a polyhydric alcohol (glycerol) and are thus commonly called triglycerides, although fatty acids may also be present as free fatty acids, monoglycerides, diglycerides, phospholipids, glycolipids, or sterylipids. Individual fatty acids are classified according to their degree of unsaturation, i.e. classified as saturated, monounsaturated or polyunsaturated fatty acids. Solid triglycerides are referred to as fat while liquid triglycerides are called oils. It is generally accepted that the makeup of the fatty acids in the fat or oil can have an influence on the health (particularly cardiovascular health) of the individual consuming them. For example, fats and/or oils high in monounsaturated fatty acids and polyunsaturated fatty acids (in particular the Omega 3 fatty acids) are considered to have a positive health effect, particularly on cardiovascular health.

HEALTH CLAIM ON DHA AND EPA

On September 8, 2004, the US Food and Drug Administration made available a qualified health claim for reduced risk of coronary heart disease (CHD) on conventional foods that contain the omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). These fatty acids are not essential to the diet; however, scientific evidence indicates that these fatty acids may be beneficial in reducing CHD. "Coronary heart disease is a significant health problem that causes 500,000 deaths annually in the United States," said Dr.

Lester M. Crawford, Acting FDA Commissioner. "This new qualified health claim for omega-3 fatty acids should help consumers as they work to improve their health by identifying foods that contain these important compounds."

The FDA intends to exercise its enforcement discretion with respect to the following qualified health claim: *"Supportive but not conclusive research shows that consumption of EPA and DHA omega-3 fatty acids may reduce the risk of coronary heart disease. One serving of [name of food] provides [x] grams of EPA and DHA omega-3 fatty acids. [See nutrition information for total fat, saturated fat and cholesterol content.]"*

In 2000, FDA announced a similar qualified health claim for dietary supplements containing EPA and DHA omega-3 fatty acids and the reduced risk of CHD. FDA recommends that consumers not exceed more than a total of 3 grams per day of EPA and DHA omega-3 fatty acids, with no more than 2 grams per day from a dietary supplement.

DAILY VALUE APPROVED FOR ALA

Alpha-linolenic acid (ALA) is an omega-3 fatty acid essential for human health and serves as a precursor in the human body to the formation of DHA and EPA. On May 16, 2004 the USFDA approved a petition establishing daily values and nutrient content claims for ALA on food labels. Based upon the Dietary

ASSAY PRINCIPAL

Triglycerides and other fatty acid containing molecules are unbound from food matrices using an acid or base hydrolysis, and extracted into a mixture of petroleum and ethyl ether. Pyrogallol acid is added to minimize oxidative degradation of fatty acids. The fatty acids of the fatty acid-containing compounds are then transesterified with BF₃/MeOH to form fatty acid methyl esters (FAMES). FAMES and each individual Omega 3 fatty acid is quantitatively measured by capillary gas chromatography comparing to a known quantity of internal standard and the respective Omega 3 fatty acid standard. For purposes of considering the

allowed FDA health claim for Omega 3 fatty acids, the total of EPA (Eicosapentaenoic acid [20:5n-3]) and DHA (Docosahexaenoic acid [20:6n-3]) are provided at the bottom of the analytical report (an example is shown on page 3).

Lower Detection Limit	0.01%
Reporting Units	% of sample (w/w)
Information required	Estimate of fat content

NUTRITION INFORMATION

Recommended Daily Intakes (per the FDA qualified health claim

- ▶ Not more than 3 g/day of EPA plus DHA from foods
- ▶ Not more than 2 g/day of EPA plus DHA from supplements

REFERENCES

AOAC Official Methods of Analysis, 996.06
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Reference Intake report of the Institute of Medicine of the National Academies of Science, the minimum recommended Daily Value of ALA is set at 1300 mg. Therefore products containing more than 260 mg per serving of ALA can claim to be a rich, high, or excellent source. Products containing 130 to 260 can make a good source claim for ALA Omega 3.

Ω-3 CONTENT OF SOME FOODS

Typically, EPA and DHA omega-3 fatty acids are contained in oily fish, such as salmon, lake trout, tuna and herring. ALA omega-3 fatty acid is found in plant sources such as flax and oats.

FOOD	EPA mg/ 100g	DHA mg/ 100g	ALA mg/ 100g
Halibut	141	372	25
Salmon- (freshwater)	709	2150	551
Tuna	1080	2290	275
Cod	64	120	3
Flaxseed	0	0	16,800
Oats	0	0	81-120
Walnuts	0	0	2100-8500

WHAT ARE OMEGA 3 FATTY ACIDS?

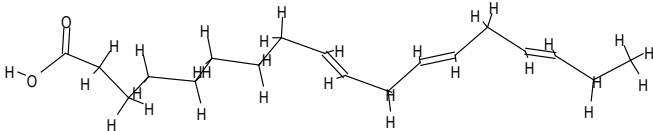
Fatty acids are structured with a carboxylic acid group on one end, and a methyl group on the other end. Omega 3 fatty acids tend to be highly unsaturated with the terminal double bonds located at 3 carbon atoms from the methyl end.

Omega 3 Fatty Acid (n-3) (carbon number:double bonds)	Common Name
C18:3*	Alpha Linolenic
C18:4	Octadecatetraenoic
C20:3	Eicosatrienoic
C20:4	Arachidonic
C20:5**	Eicosapentaenoic (EPA)
C22:3	Docosatrienoic
C22:5	Docosapentaenoic
C22:6**	Docosahexaenoic (DHA/DCA)

so source claims can be made for foods such as good, high, rich in, or excellent source.
 **Fatty acids applicable for qualified health claim on cardiovascular health.

OMEGA 3 NOMENCLATURE: Omega (from the Greek meaning last or end) indicates how many carbon atoms from the end of the fatty acid chain the last double bond is located in an unsaturated fatty acid. The more general nomenclature for fatty acids is Cxx:y n-a, where “xx” is the number of carbon atoms in the fatty acid chain, “y” is the number of double bonds in the fatty acid chain, and “a” is the number of carbon atoms between the terminal end of the chain and the last double bond. Fatty acid carbons are always numbered starting at the carboxylic acid end of the molecule. Thus the structure:

would have the designation C18:3n-3. It will also go by the common name of alpha-linolenic acid. The



common name of “lino” refers to linen or flax, since most common fatty acid names are derived from the source in which the acid was first discovered by our forefather chemists. Examples are capric acid was first found in goat fat, palmitic in palm oil, stearic in bovine (steer) fat etc.

* Essential fatty acid, has a daily value established

Fatty Acid	Normalized by Weight %	Triglyceride in Product %	Saturated Fatty Acid in Product %	Mono Unsaturated Fatty Acid in Product %	Cis-Cis Poly Unsaturated Fatty acid in Product %	Trans Fatty Acid in Product %
4:0 Butyric	0.049	0.010	0.009			
6:0 Caproic	0.020	0.004	0.004			
8:0 Caprylic	0.034	0.007	0.006			
10:0 Capric	0.044	0.009	0.008			
11:0 Undecanoic						
12:0 Lauric	0.226	0.046	0.043			
13:0 Tridecanoic						
14:0 Myristic	0.236	0.048	0.045			
14:1 Myristoleic						
14:1 <i>trans</i> -Myristelaidic						
15:0 Pentadecanoic	0.034	0.007	0.007			
15:1 Pentadecenoic						
16:0 Palmitic	5.486	1.117	1.064			
16:1 <i>trans</i> -Palmitelaidic	0.113	0.023				0.022
16:1 Palmitoleic	0.221	0.045		0.043		
17:0 Margaric	0.069	0.014	0.013			
17:1 Margaroleic	0.064	0.013		0.012		
18:0 Stearic ^a	4.533	0.923	0.884			
18:1 <i>trans</i> 6-Petroselenic						
18:1 <i>trans</i> -Elaidic	16.518	3.363				3.218
18:1 <i>trans</i> 11-Vaccenic						
18:1 Petroselenic						
18:1 Oleic ^a	56.724	11.549		11.053		
18:1 Vaccenic						
18:1 Octadecenoic						
18:2 <i>trans</i> -Linolelaidic	4.892	0.996				0.953
18:2 <i>trans</i> 9-Linolelaidic						
18:2 <i>trans</i> 12-Linolelaidic						
18:2 Linoleic	5.314	1.082			1.035	
20:0 Arachidic	0.737	0.150	0.144			
18:3 <i>g</i> -Linolenic	0.500	0.102			0.098	
20:1 Eicosenic <i>cis</i> 5						
20:1 Eicosenic <i>trans</i> 11						
20:1 Eicosenic <i>cis</i> 8						
20:1 Eicosenic <i>cis</i> 11						
20:1 Eicosenic <i>cis</i> 13	1.572	0.320		0.307		
18:3 α -Linolenic	0.447	0.091			0.087	
18:2 Linoleic conjugated **						
18:2 Linoleic conjugated **						
21:0 Heneicosanoic	0.359	0.073	0.070			
18:2 Linoleic conjugated **	0.039	0.008				0.008
18:4 Octadectetraenoic	0.015	0.003			0.003	
20:2 Eisocadienoic	0.034	0.007			0.007	
22:0 Behenic	0.383	0.078	0.075			
20:3 <i>g</i> -Eicosatrienoic						
22:1 Cetoleic						
22:1 Erucic	0.118	0.024		0.023		
20:3 Eicosatrienoic						
20:4 Arachidonic	0.025	0.005			0.004	
23:0 Tricosanoic	0.029	0.006	0.006			
22:2 Docosadienoic						
24:0 Lignoceric	0.177	0.036	0.035			
20:5 Eicosapentaenoic	0.333	0.068			0.065	
24:1 Nervonic	0.187	0.038		0.037		
22:3 Docosatrienoic						
22:4 Docosatetraenoic						
22:5 Docosapentaenoic						
22:6 Docosahexaenoic	0.476	0.097			0.093	
Total	100.00	20.36	2.41	11.48	1.39	4.19
			Saturated Fatty Acid	Mono Unsaturated Fatty Acid	Cis-Cis Poly Unsaturated Fatty Acid	Trans Fatty Acid
Percentage of Fatty Acid Components Based on Total Fat			12.40	58.93	7.14	21.52
Omega 3 EPA and DHA for Qualified Health claim					0.158	
Total Omega 3 Fatty Acids including EPA and DHA					0.248	