the FELIX Letter
A COMMENTARY ON NUTRITION
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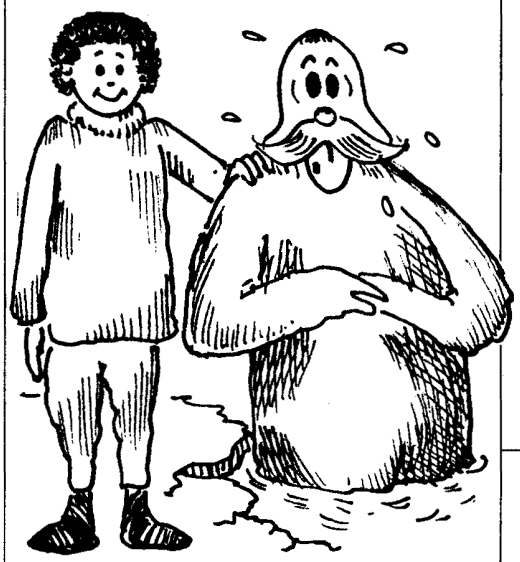
OIL AND HEALTH

A few months ago, when I began exploring the research literature on essential dietary oils, I anticipated informational riches but hardly the gusher I seem to have hit. Again, reading the journals, I marvel at the detachment scientific workers can manifest even when they have developed research data so momentous that the implications practically flash on and off like Las Vegas neon lights! However, having witnessed, over and over again, the time gap that can occur between the unveiling of what I would consider blockbuster research, and its acceptance into nutrition or medical practice, I can now recognize the scientist's cool impassivity for the protective mechanism that it is.

In all likelihood, he or she will have spent a lot of time defending painstakingly acquired data against criticism by confreres, both here and abroad, who may be pursuing opposite lines of investigation. As can happen, the opposing studies may be weak but disproportionately funded by rather grand vested interests. Despite the worthiness of our scientist's findings, they may not see the light of day in many journals nor be widely acknowledged. Researchers can try to insulate themselves from this unnerving occupational hazard by assuring themselves that true fulfillment arises from the research process alone (hah! hah!) . . . but what of the research efforts themselves? If, as often happens, funding dwindles because economic interests prefer an early death with an unmarked grave for them, we may all be the losers.

The essential fatty acids (EFA) are a case in point: they have become, first, an economic issue, with their essentiality (to human growth and health) coming in a poor second. Until the 20th century, the food-oil business was small and regional. Goose and chicken fat, lard, and butter were commonly rendered or churned at home, while small producers made oil from nuts like walnuts or the seeds of flax, also known as linseed. (Even in ancient times they made linen thread from the flax plant and wove it into clothing and coverings.) In modern times, food-oil production has evolved from a cottage industry to a mammoth, worldwide one. I've looked through a variety of journals in both the Chemistry and the Natural Resources libraries at U.C. Berkeley devoted to the complex science of food-oil production, which attest to the resources of multinational firms who mount operations on a colossal scale.

In the process, we have gained a lot of oil, but may be losing our health. Let me explain . . .



Fish Tales

Recent literature marks a growing awareness that marine oils are potential preventers of heart and artery problems [*Felix Letters* 14 & 15]. In comparisons of the cardiovascular health of Greenland's native Eskimos with that of Europeans and Americans, the Eskimos won hands down. Was it racial and genetic, or did it have to do with diet? Eskimo hunters and their families who were studied ate their age-old, fat-ridden diet of fish, seal, and walrus and had almost no heart attacks or strokes. The Western people on their modern diet had plenty.

Sea mammals and fish in Greenland's cold waters are loaded with fat, but much of it was found to be the highly unsaturated Omega-3 variety.* The Omega-3 content of Eskimo blood lipids reflected the high content in their diet. Table 1 is translated and modified from the French journal, *Cahiers de Nutrition et de Dietetique, XVII,* Dec. 1982, pp 223-234.

Can a reversal be achieved in blood lipids of non-Eskimos by a diet high in Omega-3's? The answer: *even a few weeks cause marked changes for the better.* Danish, German, Japanese, Welsh, etc. people on experimental diets high in Omega-3 fats respond quickly with blood lipid improvements associated with better cardiovascular health. The Eskimo-fatty-acid story is shaking up a lot of researchers. *Everyone* in the modern medical world — except for a few stubborn fools — had assumed that the only essential fatty acids worth bothering about were the Omega-6's, namely linoleic and arachidonic acids. Despite international acceptance in the 1930's of

* **Fatty acids are chains of carbon-hydrogen atoms with an acidic carbon-oxygen group at one end. The two families of essential fatty acids, Omega-3 and Omega-6, are "unsaturated": at least four hydrogen atoms have been removed, making the chains less stiff. The more desaturations, the less rigid the links so that even at cold temperatures they are oils rather than solid fats. In the Omega-3 family, the first hydrogen removed is always at the *third* carbon. In the same way, the Omega-6 fatty acids always have their first desaturated bond at the *sixth* carbon.**

Linoleic ("linn-o-lay-ick"), the Omega-6 parent fatty acid, has 18 carbons and two unsaturated bonds. It can be desaturated and/or lengthened by the body to make other Omega-6's, such as Gamma-linolenic acid (GLA), with 3 unsaturated links, or arachidonic acids, which is 20 carbons long with 4 unsaturated bonds. Despite the confusion of the name, "Gamma-linolenic," all of the above are Omega-6's because they have their first desaturation at the sixth carbon.

The Omega-3 parent fatty acid, alpha-linolenic ("linn-o-lenn-ick"), can also be desaturated and lengthened by the body's enzymes, so that its 18 carbons and three desaturated bonds can grow to form EPA (20 carbons, 5 unsaturated bonds) and DHA (22 carbons, 6 unsaturated bonds)—the Omega 3's newly recognized to be important to cardiovascular health.

From each of the fatty acid families, the body makes distinctive prostaglandins whose separate functions are slowly being identified by medical science.

Table 1. Distribution of Essential Fatty Acids (EFA) in blood lipids, correlated with deaths from cardiovascular diseases

POPULATIONS	Omega-6 EFA (%)	Omega-3 EFA (%)	Deaths from Cardiovascular Diseases
ESKIMOS (Greenland)	21%	17%	0
SWEDES (Stockholm)	65	3	+ +
DANES (Copenhagen)	54	7	+ +
AMERICANS (Berkeley CA)	61	3	+ + +
SCOTS (Edinburgh)	56	3	+ + + +
FINNS (Tempere)	48	2	+ + + +

EFA:
Omega-6's = Linoleic and Arachidonic
Omega-3's = Alpha-linolenic, EPA, & DHA

milestone studies deeming both linoleic *and alpha-linolenic,* an Omega-3, to be essential, something funny happened later, in that funding and support for studies on the health benefits of linoleic began pouring in — but tended to dry up for similar work on the Omega-3's. Experiments challenging the essentiality of Omega-3's cropped up and a number of researchers, while conceding that rats *might* need them, expressed doubt that humans did. Illogically, with little in the way of supportive data, this grew to be the prevailing attitude.

An example is the worldwide promotion of commercial infant milks, ostensibly patterned after breast milk, which list linoleic acid but omit Omega-3 fatty acids from their formulations. Nature, on the other hand, supplies real breast milk with *both* — as it turns out, with good reason!

Hearts and Money

The term "essential fatty acids" was becoming synonymous with the Omega-6's alone. The roots of this lie in good measure with the food-oil industry. The scary heart attack epidemic, beginning in the 1920's and mounting rapidly by the 1950's, touched all our lives. When hard or "saturated" fats and cholesterol in our diet began to be pinpointed as culprits, manufacturers of "unsaturated" oil and margarine expanded hugely to meet the new medical imperatives. They, and the advertising firms, have been humming softly all the way to the bank ever since. Thanks to their selfless educational campaigns, doctor and kindergartner alike know how wonderful polyunsaturated oils and margarines are for their arteries!

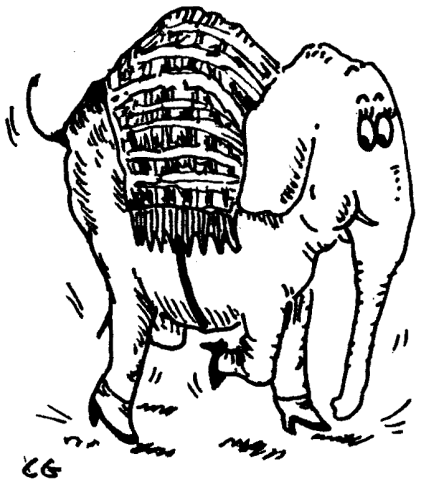
There is at least one small flaw in this. Human beings require *two* families of EFA to protect their arteries (and other tissues). The food-oil people have drenched us with megatons of oil with only *one* — mainly linoleic of the Omega-6 family. The reason is economic: *they keep better.* **

Openly and without apology, their journals offer handy hints on how to reduce the Omega-3 content of seeds by selective breeding, and how to get rid of the rest of the Omega-3 fatty acids during the refining process. The industry doesn't like them because they oxidize easily and produce 'off-flavors.' Soy bean oil was a fairly good source of alpha-linolenic, but the industry promotes agricultural efforts to produce beans whose alpha-linolenic content will be reduced to an "acceptable" low. Rape seed, used widely in Canada, is another one whose naturally high content is getting the genetic alteration treatment. An alternative ploy has been to flood us with oils having just about no alpha-linolenic at all: safflower, sunflower, cottonseed, corn, peanut, palm, and coconut. Their increasing use in the home is mirrored and magnified a thousandfold by their use in that other modern behemoth: the food processing industry.

** The other flaw is that the ubiquitous hydrogenating of fats (re-adding the hydrogen atoms to produce a more solid fat or to remove the Omega-3's) causes a strange species of fatty acids to appear—*trans*-fatty acids. Researchers know now that they can be incorporated into our cell membranes, where they perform a lot of mischief, including interfering with normal functioning of the natural fatty acids they have replaced. Margarines, like solid shortenings, are loaded with *trans*-fatty acids, which harm the very arteries that margarine is supposed to protect.

Oil and Business

There are no individual villains. We are dealing with multinational corporations whose one health concern is the robustness of their economic indexes. The Omega-3's are good (and essential) for health, but not so good for the oil business. Ergo, they are gradually found to be not so essential for health!



The removal of alpha-linolenic from oil only adds to what we lose daily through steel-roller milling of grains to remove another ancient source, the germ. We now eat more meat and less fish and seafood which are the only reliable suppliers of the long-chain polyunsaturated Omega-3's known as EPA and DHA. If Western scientists hadn't been so lulled by the tune, "All you need is . . . linoleic!", played by the food-oil pipers, they might have been more alert to the possibility that an industrially created imbalance in fatty acid consumption was taking place. Three research developments are helping to set things straight. First has been the verification in the 1970's that the major EFA of the human brain, from fetus onward, are arachidonic (an Omega-6) and *docosahexaenoic or DHA, an Omega-3 — with DHA predominating.* Secondly, we learned that the prostaglandins were made from both Omega-6 AND Omega-3 fatty acids in our cells. Thirdly, there is evidence we now have that the polyunsaturated Omega-3's from the sea may provide the ultimate protection from heart attacks and strokes.

The message about the predominance of DHA in the brain was unequivocal and normally should have alerted clinicians at least ten years ago to the dietary implications, had the research climate not been so clouded. A little review of biochemistry would have reminded them that the human body cannot transform the Omega-6's into Omega-3's nor vice versa, so that both should be in the mother's diet during pregnancy and lactation, for optimum development of the baby's brain. I marvel at the circuity of the (highly unsaturated) mind that can wiggle around this theoretical obstacle and continue to maintain that linoleic can do it all! When a pregnant laboratory rat is given Omega-6's as the only essential fatty acids, a "substitute" for DHA is found in the infants' brains, derived from linoleic acid. The baby rats, however, show behavioral abnormalities and don't do so hot in the maze!

Is it possible, that not just television, video games, and loud rock, but a similar "substitution" could be addling the pates of *our* young???

A Better Balance

The Omega-6/Omega-3 ratio in the tissues of Greenland's native Eskimos frees them from heart attacks and strokes. Achieving a better balance in terms reasonable for our own culture may prove to be good for our hearts AND our brains. Donald O. Rudin, M.D., as noted in *Letters* 14 & 15, goes further and says that the Western imbalance lies at the root of the dominant diseases including the major psychoses. He characterizes this array of seemingly unrelated disorders all as facets of a modern-day pellagra, which, like the pellagra of earlier days, will have to be healed with nutritional measures. In *Felix Letter* 17, I'll be presenting his scholarly rationale, also an update on his patients who have been on linseed oil and a guided diet program for a while now (The three pellagras, *J. Orthomol. Psychiatry,* 12(2), 1983). His work may yet prove to be the definitive one that nudges 21st century medicine into acceptance of nutritional therapy as a "primary pharmacology." (Meanwhile, the medical patrimony is favoring it with the kind of baleful stares reserved for someone in the next pew who's singing the wrong hymn!)

Our Fatty-Acid Needs

Right now, as I see it, many of us are contemplating, or attempting, a corrective program based on the knowledge that the fatty acid balance of our tissues is indeed responsive to dietary manipulations, so I hope the following tables will be useful.

It would be nice to find help from the medical community, but I don't think many are ready to take up the cudgels. If you think I'm wrong, you, too, are welcome to hunt around in current medical journals, flipping through gaily-colored ads of inflamed viscera being soothed by the latest nostrum, to find the sparing attention being given the matter. Or, you might try asking how you can achieve a better fatty-acid ratio in your diet and watch your doctor's eyes glaze over! (If you're lucky enough to have access to the progressive variety, the hope is, even if they're not familiar with the matter, they'll listen with interest and make an effort to find out.)

The roles of alpha-linolenic have yet to be defined. In our cells, it can form EPA (which may be converted to certain prostaglandins) or to DHA, which is especially important to the brain, retina of the eyes, and the testes. Some workers believe our ability to convert alpha-linolenic to EPA or DHA is limited, and we're better off getting EPA and DHA directly from foods. A number believe alpha-linolenic is needed to increase the formation of a very beneficial group of prostaglandins from the Omega-6's, by competing for enzymes that might otherwise be used to form arachidonic acid. (Some of the metabolic products of arachidonic are known to increase blood clotting, spasms in arteries, inflammatory reactions, etc.)

In *normal* health, our need for *linoleic acid* can be generously met by a tablespoon a day of average oil or a handful of walnuts, sunflower, or pumpkin seeds; and of *alpha-linolenic* by a teaspoon of oil such as linseed, wheat germ, or walnut. Our old friend codliver oil provides about 0.45 grams EPA and 0.55 grams DHA per (5 ml) teaspoon.

As yet, science is only beginning to explore the "mega" use of the Omega-3 oils therapeutically. They are known to strongly affect prostaglandin and steroid production, and I personally would be apprehensive about trying large amounts except under medical guidance. This is doubly true if one has cardiovascular problems.

On the other hand, I feel very comfortable urging increased consumption of the *whole* foods that are high in Omega-3, principally fish, sea foods, and sea vegetables, unless specific medical prohibitions exist. In combing the literature to find how much of the higher-chain Omega-3's were used safely and effectively in experimental programs, I found these as good examples:

Japanese fishermen in a coastal village have healthier blood lipids than farmers in a nearby community, researchers found. *Average daily fish intake of fishing village: 250 grams, or 8.8 oz. This provides about 2.5 grams of EPA.* The farming village ate 90 grams of fish a day (3 oz.), which gave them 0.9 grams of EPA. Everything, of course is relative; Japanese farmers have much better cardiovascular health, on the average, then Americans, and eat much more fish, seafood, and kelp.

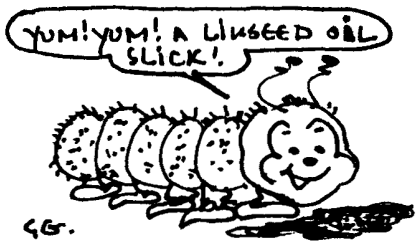
In a British study, healthy males showed improved blood lipids after six weeks of taking 1 tsp of codliver oil four times a day with meals (20 ml). *This provided 1.8 grams of EPA and 2.2 grams of DHA daily.*

IMPORTANT: Dr. Rudin and others point to a greater need for *vitamin E and selenium* when intake of Omega-3's increases, to protect tissues against oxidation.

Cooking and Omega-3's

Readers have asked if the Omega-3's are destroyed at cooking temperatures. ("Would carob brownies made with linseed oil still have the Omega-3's intact?") Data clearly show that the higher the heat and the more reheating of the same oil, the more transformation there is of the Omega-3's into "new chemical species" that are not good for us. Commercial processing of oils involves prolonged heating up to 482°F (250°C). (I've requested information on "cold-pressed" linseed, etc. and I'm trying to learn more about unrefined oils as reliable sources.)

If Omega-3 fatty acids are plentiful in the foods or the oils we buy, studies indicate that reasonable cooking preparations will not harm them. Internal temperatures in cooking, baking, broiling, sauteing, grilling, and roasting seldom go higher than 212°F (100°C). (In charring and deep browning there may be some surface losses.) However, in deepfat frying, oils can be heated as high as 375°F (190°C), and repeated fryings with the same oil will sharply reduce Omega-3's and encourage their transformation into artefactual species.



Yes, by all means make carob brownies with linseed oil! It was a "traditional cooking oil used in Northern Europe until WW II," Dr. Rudin notes.

Table 2. SOURCES OF ALPHA-LINOLENIC ACID (based on portion sizes commonly used)

	ALPHA-LINOLENIC (18:3 W3)	LINOLEIC (18:2 W6)
FATS & OILS		
One Tbs (13.6 grams):		
LINSEED OIL	7.5 grams	1.8 grams
WALNUT OIL	1.8	7.8
WHEAT GERM OIL	1.3	5.7
SOY BEAN OIL	1	7.2
RAPE SEED OIL	0.7	2
POULTRY FAT	0.2	0.4

Olive, corn, peanut, sunflower, pumpkin, safflower, sesame and cottonseed oils, in descending order, have 0.1 grams or less of alpha-linolenic per tbsp. Except for olive oil, they have large amounts of linoleic, from 3.7 grams per tbsp. for peanut oil, to 10 grams for safflower.

WALNUTS		
1 oz. or approx. 14 walnut halves (28 grams)	1.6 grams	8.4 grams

Other nuts, including pumpkin and sunflower seeds, have very little alpha-linolenic.

GREEN LEAFY VEGETABLES are believed to be fair sources and I have written for a table of values from a newer study, since they are not included in my current references, except for cooked spinach: 1 cup (180 grams) has 0.45 grams alpha-linolenic.

Other than leafy greens, most vegetables and fruits, including avocados, have very small amounts of alpha-linolenic.

DAIRY PRODUCTS		
1 oz. (28 grams):		
Butter	0.3 grams	0.3 grams
Cream or Cream Cheese	0.19	0.18

MEATS & POULTRY

Wild game birds such as grouse, partridge & pheasant have from 0.6 to 1 gram alpha-linolenic per 100 grams (3.5 oz.).
Domestic poultry has little.
Hare and rabbit: 0.7 grams per 100 grams
Lamb: 0.7 grams per 100 grams
Beef is poor source.

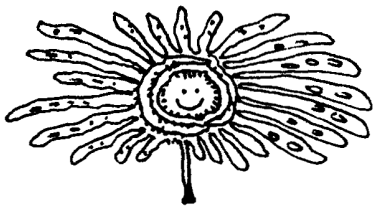
GRAINS		
1 oz. (28 grams):		
Wheat germ	0.1 grams	1.2 grams
Other than the germ, grains have very little alpha-linolenic:		
Rolled oats	0.03	0.7
Whole buckwheat	0.03	0.2

Table 3. SOURCES OF THE LONG-CHAIN POLYUNSATURATES EPA & DHA

	EPA Eicosapentaenoic Acid 20:5 W 3	DHA Docosahexaenoic Acid 22:6 W 3
Typical Fatty Fish - Best Sources		
100 grams (3.5 oz.):		
HERRING	1.17 grams	1.08 grams
MACKEREL	1.07	1.85
PILCHARDS (Canned in tomato sauce)	1.04	0.20
SALMON	0.89	1.19
KIPPER	0.72	0.67
CANNED SARDINES (minus oil)	0.71	0.56
Seafood - 100 grams		
CRAB	0.78	0.37
LOBSTER	0.51	0.24
SHRIMP	0.36	0.26
Prawn	0.27	0.13
Cod Roe	0.20	0.28
Mussels	0.15	0.06
Scallops	0.11	0.08
Oysters	0.10	0.11
Lean Fish - 100 grams		
Lemon Sole	0.24	0.11
Plaice	0.20	0.16
Halibut	0.11	0.25
Cod	0.08	0.16
Haddock	0.05	0.10

Fruits, vegetables, nuts, grain contain none.
Dairy products - only trace amounts.
Poultry and meat: essentially no EPA.
EGG YOLK has 0.3 grams DHA.
Brains: 0.5 grams DHA per 100 grams.

Fresh sea vegetables—the many algae varieties-become the best sources of EPA and DHA for vegetarians. An excellent book, *Vegetables From the Sea* (Japan Publications, Inc., Tokyo, 1983) by Drs. S. and T. Arasaki, husband-and-wife scientists of Japan, has careful sketches to help in identifying seaweeds and recipes for using them enjoyably, as millions have done for centuries in Japan, China, Burma, Korea, Polynesia, etc. Although other nutrients remain, the lipids disappear when seaweeds are dried, so EPA and DHA can be gotten from fresh seaweed only.



Illustrations are by Clay Geerdes.

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