

Is Our Balanced Food Really Balanced? Correcting ω6/ω3 Ratio through Combating Oxidation is the Key to the Success for Better Health

Vijai K S Shukla*

International Food Science Centre A/S,
Denmark

*Corresponding author: Shukla VKS

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Opinion

"My tastes are simple and I am satisfied with the best" – Winston S. Churchill and Oscar Wilde.

Food is all about balance; it's all about taste.

Medicines and food have a common origin. This ancient proverb is, in one form or another, core to the medicinal folklore of almost all cultures around the globe. Modern science, however, is only now beginning to provide solid evidence for this concept. There is ample evidence that certain vitamins – and particularly their antioxidants activities can help to prevent or delay the onset of diseases such as heart disease and cancer. However, a host of non-nutritive components of plant foods, especially polyphenols and phytoestrogens, have come to be recognized as "chemopreventers" (i.e., naturally occurring chemical component with the strong capacity to prevent certain diseases).

Tracing back to 1929 to the historic volume 82 of the *Journal of Biological Chemistry* clearly reveals two opposing views, developed by McAmis and co-workers and the husband-and-wife team of George and Mildred Burr, regarding the essentiality of ω6 and ω3 fatty acids. The high impact of linoleic acid, the so-called ω6 essential fatty acid (EFA), became a focus in the minds of scientists and technologists, leading to overconsumption of linoleic acid-containing products. Not much attention was paid to the findings of McAmis and co-workers. For the last three decades, human nutrition research has concentrated on establishing the benefits of oils rich in essential polyunsaturated fatty acids (PUFA) and long-chain polyunsaturated fatty acids (LCPUFA) to human physiological functions. Research has shown that EFA are important to living systems and to the regulation of life processes. PUFA and LCPUFA in the ω3 and ω6 families are the precursors of prostanoids and eicosanoids that have a variety of biological activities. ω3 fatty acids are known to have a direct effect on the heart muscle itself: increasing blood flow, decreasing arrhythmias, improving arterial flexibility and altering other cellular processes that are associated with heart functions. Paleolithic man was a hunter-gatherer, eating lean meat, fish, green vegetables, fruits, nuts and berries and exercising

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heavily and often. In modern Western society, the human diet is composed mainly of wheat, maize (corn), rice and a variety of precooked or industrially fried food, leading to a relative deficiency of ω3 PUFA. The huge intake of undesired oxidized oils from various food sources, coupled with a lack of exercise, also contributes significantly to the deterioration of human health. This EFA imbalance is exacerbated by consumptions of meat from animals fed a diet of grain relatively rich in ω6 PUFA rather than wild plants with high ω3 content. Even farmed fish contain lower amount of ω3 PUFA than those living in the wild. Overall, the ratio of ω6/ω3 PUFA in the modern diet is as high as 20-25:1, instead of the ideal ratio of 1:1. The ω6/ω3 ratio in the brain is 1:1, in fat tissues 5:1 and in other tissues 4:1.

Total imbalance of ω6/ω3 fatty acids ratio in human health

This total imbalance in western diet today contributes heavily to the pathogenesis of many chronic diseases, including cardiovascular diseases, obesity, depression and eczema, etc.

The return of ω3 acids into the food supply

ω3 fatty acids must be incorporated in foods rather than be used solely as a dietary supplement. Furthermore, the development of a variety of ω3-rich foodstuffs would allow increased dietary intakes with little change in dietary habits. In the diet ω3 fatty acids can be increased by using oils rich in α-linolenic acid (18:3ω3) and the ω6/ω3 ratio reduced by avoiding vegetable oils rich in linoleic acid (18:2ω6). The use of vegetable oils rich in monounsaturated

fatty acids (oleic acid, 18:1), e.g., rapeseed/canola oil, also improves the ω_6/ω_3 ratio in the diet. The International Food Science Centre has recently developed a nutritional oil blend, Nutridan, from cold-pressed vegetable oils. The oil has a very high α -linolenic acid (18:3 ω_3) content and a ω_6/ω_3 ratio less than 1. This oil can be used in baked goods, such as breads, croissants, buns and cakes, yet it is also suitable or making table spreads, mayonnaise and salad dressing. It can be encapsulated for various pharmaceutical applications as well. The unique property of Nutridan is that by continuous use of this product one can reduce the ω_6/ω_3 ratio to half within a period of 12 weeks. Excessive intake of *omega6* generates inflammation whereas *omega3* produces anti-inflammatory compounds. All major diseases start in the body and progresses slowly to more serious conditions. We have successfully demonstrated that by modulating diet with 30 grams of Nutridan per day, for a period of 12 weeks only, we could seriously reduce the ω_6/ω_3 ratio in average more than 35% which in turn resulted in better health in terms of wellbeing, new energy, reduced blood pressure, reduced blood sugar and cholesterol. While Nutridan manipulation did result in improved ω_6/ω_3 ratio, we must emphasize that our manipulation success could be attributed to our Internally Stabilized process, which provides totally intact non-oxidized lipid. The most important feature of Nutridan is its high oxidative stability. Oils rich in PUFA are highly sensitive to oxidation. Exposure of a polyunsaturated oil to air, heat and light leads to a free radical chain reaction at the allylic carbon atom yielding a variety of oxidized products, the first of which is unstable hydroperoxides that readily furnish the short-chain volatile aldehydes responsible for the odors and flavors associated with rancid fat. Determination of the anisidine value, which measures the amount of aldehydes produced, is indicative of the extent of these oxidative effects. We faced enormous problems in stabilizing ω_3 fatty acids because of their sensitivity toward oxidation. Numerous papers describe these problems in detail and also provide solutions to eradicate these in future production processes. Our work (e.g., *inform* 9:955-961, 1998) and that of others have shown that the anisidine value of many encapsulated EFA oils can be as high as 6.0, with a peroxide value of 6.9, whereas for fish oil capsules it varies from 14.3 to 34.0. These polyunsaturated oils due to their high degree of unsaturation are easily oxidized and form complex mixtures of high molecular weight oxidation products which are injurious to our health. We were the first to demonstrate the presence of these materials in encapsulated health oils.

Stabilization of a nutritional PUFA oil with natural antioxidants

Nutridan has been internally stabilized with natural antioxidants from rosemary leaves, giving a Totox value ($2 \times$ peroxide value + anisidine value) of less than 3, ex-works. Rosemary extracts are obtained from the herb *Rosmarinus officinalis*, which is native to the Mediterranean and North Africa. Rosemary is known for its seasoning, healing, antiseptic and antibiotic properties. Research found that the antioxidant properties of rosemary extracts are

due to the high content of diterpenes, namely, carnosic acid and carnosol (together the account of over 90% of the antioxidant activity), epirosmanol, isorosmanol and others. The flavonoid luteolin, found in rosemary leaves, also has antioxidant properties. Antioxidants from rosemary leaves, act as: (a) inhibitors of lipid peroxidation, (b) metal chelators and (c) active scavengers for superoxide radicals. It is proven fact that dietary lipids and antioxidant nutrients such as rosemary extract influence bone formation and cartilage biology. Free radical damage contributes to the etiology many diseases conditions such as cardiovascular, inflammatory, cataract and cancer. Natural antioxidants such as Rosemary hold a great promise in preventing free radical induced tissue damage, by preventing the formation of radicals, scavenging them or by promoting their decomposition.

To control the development of rancidity in the manufacture of top-quality PUFA oils, the following precautions must always be taken:

- Use high-quality, freshly produce raw materials
- Always store in a cool, dark and dry place under an inert atmosphere of nitrogen
- Use stainless steel drums, containers or tanks to avoid trace metal contamination
- Use stringent quality control to avoid mixing any old oils in any part of the process
- Prolong shelf life using the optimal level of antioxidants
- Heat the oils to the minimum practical temperature required for processing. All forms of excess heating should be avoided.
- Avoid air leakage. Any micro leakage allowing the influx of even trace amounts of air can induce the development of thermal polymers, oxidative polymers and thermal oxidative polymers.

Future Perspectives

We are totally lagging behind in the food industry to provide consumers balanced and totally intact (non-oxidized) foods. In the past, the food industry focused on improving processing and increasing product shelf life. Now the product development focus is on nutritional quality. The definition of food safety needs to expand in order to include nutrient structural changes and food composition. The scientific base for product development and collaboration among agricultural, nutritional and medical scientists is far away from fusion. This should result in greater involvement to respond to an ever-increasing consumer interest in the health attributes of food. Foods should be designed to be balanced with built-in properties of our taste buds and thus in essence provide consumers the products for better and safer health. Formulators have so much to offer in this field, but they are lacking imperfection to deliver the final products.