Omega-3 fatty acids EPA and DHA.
Marine oil supplements to build a better health.

Why do we need supplement today, our ancestors had none?

The long chain omega-3 fatty acids were consumed in access by our ancestors. Only during the last 100 years the average intake of omega-3 fatty acids has been reduced by 80 %.

Our ancestors consumed lots of long chained omega-3 fatty acids from seafood, brain and marrow. As a consequence of the abundance of long chain omega-3 fatty acids in the food, no evolutionary pressure was put on endogenous production of long chained omega-3 fatty acids. Therefore the enzyme systems are not sufficient in humans to provide for the need. Although, smaller (18-carbon) omega-3 and omega-6 fatty acids are consumed, the production of longer, more unsaturated long chain fatty acids are sluggish or insufficient in many conditions. Moreover, our ancestors of hunter-gatherers had a diet of large amounts of omega-3 fatty acids compared to omega-6 fatty acids (ratio <1/2). Today our diet of essential fatty acids consists of large amounts of fatty acids from vegetable oils and meat, dramatically changing the ratio of omega-3 to omega-6 fatty acids (ratio >1/25).

In summary; for the modern man, the production of EPA and DHA from short chained fatty acids is not sufficient to obtain adequate levels. Therefore, a direct supply of EPA and DHA through consumption of fat fishes or EPA/DHA supplements is necessary to benefit from the health preserving potential of the omega-3 fatty acids.

The Eskimo story.

Findings in the Eskimo population of Greenland gave the omega-3 research a boost. The Eskimos consume a very high fat diet, they live in a hostile environment and are subjected to an enormous stress compared to most people. Still, even the oldest Eskimos have open arteries similar to those of our children. In spite of their high fat diet, deaths from acute myocardial infarction are less than 10 percent of what is observed in western societies. The answer to this paradox is the high content of EPA and DHA in their diet. The Eskimo traditional diet supplies the individual with about 10 g/day of long chained omega-3 fatty acids. The maximum allowed amount of omega-3 fatty acids in food supplements is in most countries 3 g/day. Thus, the Eskimo food consumption gives us an opportunity to study the effects of life long consumption of therapeutical amounts of EPA and DHA. We have learned from studies among the Eskimos, that omega-3 fatty acids have preventive effects against cardiovascular diseases. Moreover, the Eskimos have generally good health, with extremely low rates of cardiovascular disease, hypertension, arthritis and diabetes. Still, the Eskimos become vulnerable for diseases once they abandon their traditional way of life by e.g. moving to a western city. In summary, the studies in Eskimos therefore motivate higher intakes of EPA and DHA to preserve a good health.

EPA and DHA are products from the small floating phytoplankton; omega-3 factories in a vast ocean.

The oceans are the habitat of the tiny phytoplankton, the sole producer of the marine EPA and DHA fatty acids. The chloroplast of the plankton contains the only biochemical machinery for the production of marine omega-3 fatty acids. This biochemical machinery is absent in all higher animals. The omega-3 fatty acids are transported through the food chains to become enriched in fat fishes, marine mammals and other higher animals. Omega-3 fatty acids become incorporated into cellular membranes of all sea living creatures and are crucial for the adaptation to cold waters, securing good membrane fluidity and flexibility even at low temperatures. Crude fish oil preparations are made and purified EPA and DHA enriched marine oils are subsequently produced for human use. Therefore, the phytoplankton production of omega-3 fatty acids is not only essential to all marine entities, but may also be utilized to achieve health benefits for humans.

What is an omega-3 fatty acid?

Most fatty acids are excellent energy stores for the active human and easily oxidized to yield lots of energy. All fatty acids consist of a single chain of hydrocarbons bound together by single or double bounds. The individual fatty acids are characterized by the length of the hydrocarbon chain, the number of double bounds, and the position of the first double bound. Saturated fatty acids have no double bounds, whereas mono-unsaturated fatty acids have one double bound and the polyunsaturated fatty acids (PUFA) have two or more double bounds. The human enzyme systems are able to synthesize most fatty acids, but some fatty acids are essential. There are two families of essential fatty acids: the linolenic acid family (omega-6) found in most vegetable oils and the alfa-linolenic acid family (omega-3) which is most abundant in marine oils. Moreover, the human enzyme systems are not able to produce omega-3 fatty acids from omega-6 fatty acids or vice versa. Using shorter length fatty acids as ‘backbones’, longer chained and more saturated fatty acids may be metabolised by the action of specific enzymes in humans. Thus, theoretically consumption of alfa-linolenic (omega-3) fatty acid will produce appreciable amounts of EPA and DHA. However, this is not the case. In many diseases and conditions (e.g. after viral infections, rheumatism, diabetes) the activity of these enzymes (particularly the desaturases) are greatly reduced. In addition, the enzymes are often competitively inhibited by consumption of large amounts of linolenic acid, trans-fatty acids and saturated fatty acids. In such conditions a deficiency of long chain essential fatty acids (e.g. EPA and DHA) may develop, unless the long chained fatty acids (EPA and DHA) are supplemented as such.

Omega-3 deficiency.

Omega-3 fatty acids are highly concentrated in the brain and retina, where they constitute up to 50 percent of the cellular membranes. Deficiency of omega-3 fatty acids changes the biochemistry and function of the brain and retina. Experiments in animals and observations in preterm human infants have revealed that deficiency of omega-3 fatty acids leads to reduced visual acuity, impaired vision, abnormal electroretinogram and stereotypic behaviour. In many of

these respects the important omega-3 fatty acid is the DHA. In premature infants the conversion of the precursor omega-3 fatty acid, linolenic acid, to DHA is very poor. Thus, DHA should be supplemented as such to avoid deficiency. Impaired cognition and reduced IQ may also be the result of omega-3 deficiency in early life. In one described case of omega-3 deficiency impairments such as numbness, reduced ability to walk, pain in the legs, blur vision and general weakness were observed. In other cases delayed wound healing, inhibition of growth, skin dryness and increased infection tendencies have been reported in addition to neurological symptoms. A connection between long chain omega-3 fatty acids and aggression, dyslexia and concentration has recently been focussed in clinical trials. From the results described above, it is clear that omega-3 fatty acids are indeed essential. Particularly in early life, both clinical and subclinical manifestations of omega-3 fatty acid deficiency may be avoid by supplementation of long chained omega-3 fatty acids EPA and DHA.

Omega-3 fatty acids for the health of your heart.

The most prominent and well-known effect of omega-3 fatty acids is their ability to reduce the risk of cardiovascular disease, morbidity and mortality. High levels of blood triglycerides and free fatty acids are associated with increased risk of cardiovascular diseases. Omega-3 fatty acids reduce the levels of blood triglycerides and free fatty acids in a dose dependent manner, however, even low doses of long chain omega-3 fatty acids may significantly lower plasma triglycerides. Arrhythmia may lead to cardiac arrest and subsequently to death. When the intake of omega- 3 fatty acids is high, the risk of primary cardiac arrest as a result of myocardial infarction and arrhythmia is reduced by >50%. Omega-3 fatty acids may reduce the rate of restenosis following angioplasty. By reducing the interaction between the arterial wall and white blood cells, omega-3 fatty acids prevent an initial step in the plaque formation, and consequently inhibit the development of atherosclerosis. Both platelet aggregation, blood viscosity, blood clotting and fibrinolysis are positively influenced by omega-3 fatty acids. Intake of omega-3 fatty acids may also lower both diastolic and systolic blood pressure. A significant reduction in lipoprotein (a) (Lp(a)), a predictor of cardiovascular disease, is also observed after intake of fish oil. Thus, consumption of omega-3 fatty acids may reduce the risk of cardiovascular diseases.

A low or normal plasma cholesterol is no guarantee for longevity.

Cardiovascular diseases are often combinations of an array of unfortunate circumstances. Loss of insulin sensitivity is one of the fastest growing western lifestyle diseases. Insulin resistance syndrome (IRS) is characterized by the occurrence of a number of disadvantageous condition such as high triglycerides, low HDL-cholesterol, high blood pressure, non-insulin dependent diabetes mellitus (NIDDM), abdominal obesity, glucose intolerance, increased uric acid and abnormalities of the fibrinolytic system. The presence of one of these factors may not represent a significant risk of disease. However, when two or more of these risk factors occur simultaneously they represent a major threatening situation that may lead to cardiovascular disease, infarction and an early dead has developed. This situation is classified as IRS. Moreover, the dyslipemia in IRS is in addition to high triglyceride and low HDL cholesterol associated with extended postprandial lipemia, elevated plasma free fatty acids and small, dense LDL particles. Thus, despite the ‘silent‘ or subclinical levels of most risk factors, IRS patients

are at high risk of developing cardiovascular diseases. Marine oils, in particular EPA, reduce plasma triglycerides and free fatty acids, which may reduce the accumulation of fat in certain tissues. Marine oils may also increase the insulin sensitivity and this may improve several of the characteristics of IRS. Thus, consumption of marine oils greatly reduces the risk of disease in the IRS patient group.

In many chronic diseases consumption of omega-3 fatty acids may help to ameliorate the symptoms.

Inflammatory diseases are all characterized with production of potent inflammatory mediators such as the prostaglandines. Prostaglandines are potent messenger molecules between cells. They are produced from either gamma-linolenic acid, arachidonic acid or EPA (all fatty acids with 20-carbon length). Studies have shown that intake of omega-3 fatty acids may inhibit the production of pro- inflammatory mediators by more than 50 percent. Moreover, prostaglandines produced from EPA have generally milder effects than those derived from arachidonic acid. Through modulating the immune response and the production of inflammatory mediators omega-3 fatty acids may ease the symptoms of several inflammatory diseases including redness, pain and swelling. Omega-3 fatty acids may also ameliorate symptoms in autoimmune diseases such as lupus and nephropathy. In clinical trials in patients with lung diseases such as asthma and cystic fibrosis, reduction in the production of pro-inflammatory mediators have been observed after fish oil supplementation. Consumption of oily fish may be associated with reduced asthma risk in airway hyper-responsive children. Crohn's disease is characterised with a lifelong inflammation in the intestine. Reduced rate of relapses has been observed after EPA supplementation. Thus, omega-3 fatty acids may help to relieve.

Membrane functions and omega-3 fatty acids.

DHA incorporation in the membranes is necessary for life at low temperatures to ensure high membrane fluidity and functionality. In humans DHA is enriched in membranes were the fluidity is crucial for cellular function such as in the brain synaptic membranes and retinal rods. Pre- and perinatal growth and development of the central nervous system and visual acuity is dependent on DHA. Since the fetus and newborn have very limited capacity to synthesize DHA, DHA is considered a conditionally essential nutrient during the last trimester of the pregnancy and the first six months of infancy. DHA is normally provided for by the mother, however, maternal stores of DHA may become depleted if not followed up by increased intake. In addition, maternal marine oil supplementation prolong gestation, reduce incidence of premature births and increase birth weight. Results are accumulating suggesting a prominent role of DHA in brain function. Good results are achieved in dyslexics including improvement in reading ability and behavior. Promising results are reported from omega-3 fatty acids supplementation in schizophrenia. Children with attention-deficit/hyperactive disorder have low levels of omega-3 fatty acids and a relationship between omega-3 status and the severity of behavioral problems is indicated. Recent results indicate that long chain omega-3 fatty acids may positively modulate both depression and aggression. Peroxisomal disorders are extremely serious diseases with poor short-term prognosis. Treatment of these patients aimed at balancing their diet of DHA and AA have been very successful. Low DHA levels is associated with many neurological disease

entities such as multiple sclerosis, kinky hair disease and juvenile neuronal ceroidlipofuscinosis, however, intervention studies may in the future decide the causality of these events.

Nutritional trends.

In the thirties the essential fatty acids were acknowledged as necessary for proper nutrition and good health. During the fifties much attention was focussed on the polyunsaturated fatty acids (PUFA) ability to improve blood lipid status, in particular their ability to lower plasma cholesterol when compared to saturated fatty acids. Based on these findings it was recommended that we should eat less fatty saturated fatty acids and more PUFAs subsequently vegetable oils were used in many dishes instead of butter. More detailed information became available during the sixties and seventies and people were advised to eat more fiber rich products, resulting in a elevated consumption of oat products. During the eighties low fat (light) products were marketed in excess to reduce the fat intake to 30 % of calories after nutritional advices. Currently much attention is focussed on the health aspects of omega-3 fatty acids, and fortification and supplementation technologies with EPA and DHA are progressively gaining attention in the market and may be the next major nutritional trend. As product quality and the pureness of oils increase, and unpleasant 'fishy' taste and smell are reduced to a minimum, the marine oils may become the new nutritional trend by the end of the century. Current advice from most nutritionists include high fish intake (30-60 g/day), omit saturated fat and trans-fatty acids and reduce the total intake of fat to less than 30 percent of the food energy. Many researchers and scientists will additionally recommend you to take omega-3 supplements in many conditions and in deficiencies.

Conclusion.

Intake of long chained omega-3 fatty acids may prevent onset of cardiovascular disease and be beneficial in the treatment of heart disease. Omega-3 fatty acids reduce deaths from myocardial infarction by stabilizing the electric conductance in the heart, inhibiting arrhythmia and ventricular fibrillations. Omega-3 fatty acids is probably the safest and best treatment for hypertriglyceridemia which is associated with high risk of atherosclerosis and heart disease. Omega-3 significantly lowers blood levels of triglycerids. The risk of mortality and morbidity from cardiovascular diseases may be reduced by a daily intake of 1-2 g of omega-3 fatty acids.

Omega-3 fatty acids are very important in early life development of brain and retina. Omega-3 fatty acid supplementation is therefore important during the last trimester of pregnancy and during the first months of life, when the brain is developed.

The herein discussed multiple effects of omega-3 fatty acids is based upon the most recent research data. Compared to our ancestors, most modern humans have very low levels of omega-3 fatty acids. The effects of omega-3 fatty acids are not effects similar to those from a drug therapy, but rather an expression of a general deficiency in large populations. Highly purified marine oils with high EPA and DHA contents are considered a safe alternative when properly fortified with vitamin E as antioxidant. On the other hand, concerns are raised against high intakes of cod liver oil that contains high levels of vitamin A and D.