

## Omega-3 Fatty Acids: Dr. J. S. Pai

Fats and oils are composed of triglycerides of fatty acids and those fatty acids with 2 or more cis double bonds that are separated from each other by methylene group are called polyunsaturated fatty acids (PUFA). Commonly there are two types of PUFA, omega-3 and omega-6 fatty acids.

Omega-3 (also called n-3) fatty acids are unsaturated fatty acids having a double bond in n-3 position which is the third bond from the methyl end of the fatty acid. Important dietary omega-3 fatty acids (FA) are  $\alpha$ -linolenic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Humans cannot synthesise these de novo but can form 20- and 22-carbon omega-3 FA from 18-carbon ALA.

There are also omega-6 (n-6) FA occurring in fat and oil sources, the commonest being linoleic acid (LA) and arachidonic acid (AA). These are called essential fatty acids as they were found to be essential for normal growth in young children and animals. These facilitated normal growth and also were beneficial in skin integrity, renal function etc. Small amounts of omega-3 FA are also found to contribute to healthy growth and play important protective role in many other conditions.

Both omega-3 and omega-6 FA are necessary to maintain good health. Fats containing good amount of PUFA are called polyunsaturated fats and those containing large proportion of saturated fatty acids (SFA) like stearic, palmitic and lauric are called saturated fats. Vegetable oils like sunflower, safflower, corn and soybean oils contain high amounts of PUFA and are called polyunsaturated fats, while animal fats like butter and lard are called saturated fats. PUFA consumption has been shown to lower total amount of LDL cholesterol in blood thus lower risk of cardiovascular disease. Some oils like coconut and palm kernel, have a large proportion of SFA and are shown to increase the LDL cholesterol. There are also some oils like olive and groundnut oils having large amounts of oleic acid (monounsaturated fatty acid). These are also beneficial in lowering cholesterol. Recent research studies have shown that there are some definite health benefits of omega-3 FA especially because of the present predisposition toward cardio-vascular ailments and many other problems because of our dietary habits and modern lifestyle.

### Health Benefits of Omega-3

Omega-3 FA reduce the LDL cholesterol, the bad cholesterol, and research indicates that their consumption may reduce risk of coronary heart disease. There is evidence that people with other problems of blood circulation including varicose veins benefit from omega-3 as they stimulate circulation and breakdown of fibrin, a compound involved in clot formation. They also help reduce blood pressure and there is evidence that shows omega-3 FA reduce blood triglycerides and their regular intake lowers both primary and secondary heart attack risk.

Other reported benefits include conditions like rheumatoid arthritis and cardiac arrhythmias. Research supports anti-inflammatory benefits of omega-3 FA in patients with neck pain and with rheumatoid arthritis. Relief was comparable to those getting non-steroidal anti-inflammatory drugs (NSAID). Omega-3 can reduce joint tenderness and need for corticosteroids in rheumatic arthritis.

Trial with omega-3 in fish oil and mustard oil was conducted for one year in Indian patients with suspected acute myocardial infarction. After one year total cardiac events were significantly less when compared with control. Nonfatal infarctions were also significantly less. They also showed significant reduction in total cardiac arrhythmias as well as in oxidative stress. Study suggests that omega-3 FA may provide rapid protective effects in patients with acute myocardial infarction. In another study, consuming omega-3 FA was associated with decreased cardiovascular death. Therapeutic effect appears to be due to suppression of fatal arrhythmias rather than stabilisation of atherosclerotic plaques.

There are reports suggesting that large intakes of omega-3 oils intake reduces the risk of ischemic and thrombotic stroke and have not shown major adverse effects, but very large intake are not advisable. In a major study with over 11,000 patients with recent myocardial infarction were given 1g/day omega-3 FA and they showed substantial reduction in occurrence of death.

Infants have been given omega-3 FA in cow's milk and showed improvement in immune function. Pregnant women consuming omega-3 FA showed less risk of low birth weight and premature birth. During pregnancy, omega-3 FA are incorporated into fetal brain and retinal lipids. Maternal intake of omega-3 FA must be sufficient to maintain maternal tissue stores and meet fetal accretion. Acceptable Macronutrient Distribution Range (AMDR) of 0.6-1.2% of energy for omega-3 FA is recommended for pregnant women.

A study was carried out with children with learning and behavioural problems. When they were given 3g/day omega-3 and omega-6 FA with vitamins and minerals showed improved developmental health especially regarding learning and focus. Omega-3 appear to reduce Attention-Deficit Hyperactivity Disorder (ADHD)-related symptoms in some children. Omega-3 fatty acids reduced hyperactivity in children with autism spectrum disorders.

Omega-3 FA also show neuro-protective action in Parkinson's disease. A protective effect has also been reported in Alzheimer's disease. Low brain omega-3 are thought to contribute to negative and neurocognitive symptoms in schizophrenia.

### Health Risks

There are some risks of overuse of omega-3 FA. In patients taking aspirin or warfarin, more than 3g/day omega-3 FA may have possibility of increased bleeding. Also very large doses may have chances of hemorrhagic stroke. They may reduce glycaemic control in diabetes at high doses and may also suppress immune and inflammatory responses leading to decreased resistance to infections. Persons with congestive heart failure, chronic recurrent angina or getting inadequate blood flow to heart are advised to talk to physicians before taking omega-3 FA or eating foods high in them. For normal individuals taking foods high in omega-3 FA, do not have any major concerns of adverse effects. Adverse effects are generally minor and typically gastrointestinal like diarrhea, which are eliminated when dose is reduced or discontinued.

## Daily values

Fats are not assigned recommended daily allowances. Micronutrients have acceptable intake and for omega-3 men have been recommended 1.6g/day and women 1.1 g/day. Their AMDR is 0.6% to 1.2% of total calories. Growing body of literature suggests that higher intakes of ALA, EPA and DHA may afford some protection against coronary heart disease. AMDR for EPA and DHA has been recommended at 10%. Some researchers also believe that omega-6 intake should not be more than 4 to 5 times that of the omega-3 intake. WHO recommends LA (omega-6) to ALA (omega-3) ratio of 5-10 in the diet. Japan's Ministry of Health & Welfare suggests 4:1 ratio of omega-6 to omega-3 considering very high intake of fish. Ideal ratio of omega-6 to omega-3 would about 5:1.

## Omega-3 of Foods

Good sources of ALA are leafy green vegetables, nuts, vegetable oils canola, soy, flax seeds. Good sources of EPA & DHA are fish and organ meat. LA is found in many vegetable oils.

Most abundant sources of EPA and DHA are oily fish like salmon, herring, mackerel and sardine and contain seven times omega-3 compared to omega-6. Other oily fish like tuna contain less. Consumers of oily fish should be aware of potential presence of heavy metals and fat-soluble pollutants like PCB, dioxin etc. Supplement manufacturers remove them improving the safety. Although fish is a good source of omega-3, fish do not synthesise them but obtain them from algae.

Flax seeds have linseed oil, very high in omega-3 content, six times richer than most fish oils. It contains about 55% ALA, which is converted in body to EPA and DHA at 2-15% and 2-5% efficiency respectively. Oil from brown algae (kelp) is a good source of EPA and walnut and acai palm fruit also contain omega-3 fatty acids.

## Omega-3 & Omega-6 FA in Diet Together

Some seed oils have both omega-3 and omega-6 FA together as in rape or mustard oil, soy oil etc. The omega-6 are predominant and mainly consisting of LA. There are minor proportions of omega-3 FA, mostly ALA. Some of the ratios of omega-6 to omega-3 FA in some common oils: canola (rape) 2:1, soybean 7:1, olive 3-13:1, sunflower (no omega-3), flax 1:3, cottonseed (almost no omega-3), peanut (no omega-3), and corn oil 46 to 1 ratio of omega-6 to omega-3 FA.

Omega-3 and omega-6 FA form eicosanoids that have important biological functions in the body and have short active time before being metabolised. However, if synthesis exceeds metabolism rate, there is accumulation of eicosanoids from omega-6 FA that have deleterious effects. Eicosanoids from omega-3 FA are formed less rapidly than those from omega-6 FA and their formation competes with each other. Eicosanoids from omega-3 FA are anti-inflammatory as opposed to those from omega-6 FA being inflammatory and are associated with clumping of platelets, arthritis, lupus and asthma. Thus ratio of omega-3 to omega-6 FA is important to keep a balance between eicosanoids.

Since the synthesis of longer chain omega-3 and omega-6 FA also competes with each other and since longer chain omega-3 FA, EPA and DHA are more beneficial, it is important that ALA should be sufficiently high concentration compared with LA in the diet so formation of EPA and DHA from ALA will not be hindered much.

## Omega-3 and Vegetarian Diet

Vegetarian diets are normally low in total fat, saturated fat and cholesterol compared with non-vegetarian diet. Vegetarian usually consume relatively low ALA compared with LA and consume very little of EPA and DHA as these are usually obtained from non-vegetarian sources. Consequently tissue levels of omega-3 FA are very low in vegetarians and are denied the benefits such as cardio-protective effects. Conversion of ALA to EPA and DHA is also low (5-10% for EPA & 2-10% for DHA). Hence total requirement for omega-3 is much higher for vegetarians who mostly get their omega-3 through ALA. Vegetarians must make dietary changes to improve omega-3 status.

Vegetarians may not accept fish diet or fish oil supplements. Even non-vegetarians who habitually do not consume fish, may have difficulty with fish diet. EPA and DHA are extracted from marine sources including fish oil and algae. Seed oils are now developed that are rich in omega-3 FA. Transgenic varieties of canola (Rapeseed), soybean and safflower rich in EPA and DHA are being developed. However, most vegetarians may depend on ALA for their requirements of omega-3 FA. Although more of it is required in order to get the similar benefits as EPA and DHA but there are reports to show that ALA is effective in reducing CHD risk.

In one study with middle aged Indians, canola oil was added to groundnut and sunflower oils to elevate ALA level and decrease LA level in order to balance the omega-3 to omega-6 ratio. Even modest increase has shown significant improvement in omega-3 nutritional status. ALA intake is inversely associated with risk of CHD.

## Fortification of Beverages with Omega-3

Recent trend of adding omega-3 to beverages has been accepted by consumers. Their preference to have these healthy nutrients through beverages has shown rapid growth of omega-3 fortified foods especially beverages from \$100 million in 2002 to \$2 billion in 2006 and is expected to reach \$7 billion in 2011. Omega-3 supplementation in food has been a recent trend with global food companies launching products like bread, pizza, yogurt, orange juice, milk, confections and infant formula fortified with omega-3.

Milk has been considered to be very healthy beverage by consumers and addition with nutrients and nutraceuticals to it are more easily accepted. In fact one effort of producing omega-3 rich milk was done by a Canadian company by feeding cows with omega-3 rich feed. There are some difficulties but they produced omega-3 milk. It would be easier to just add omega-3 FA to milk as is done by many companies in the Europe and

the US. Several companies have launched milk and milk based beverages as well as other beverages. Now such products are available in India. With cardio-vascular diseases rising at alarming rates, such products that lower the risk will be highly desirable.

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