HEALTH drink commercials often claim to contain ingredients such as DHA and EPA. Apparently these magic compounds have a tremendous impact on our health and immunity, especially in children. These abbreviations make little sense to most of us though we happily include these health drinks in our diets hoping for the benefits promised by the commercials.

We were curious to know if these are just lofty claims about little known compounds or there actually exist such mighty compounds, represented by tiny names, with potential to improve health and longevity.

As we tried to get acquainted with DHA and EPA, we came to know that they are members of the ‘fat’ family. But is this not contradictory? On the one hand, dietary fat is blamed for heart disease, obesity, diabetes, and other health issues, and on the other hand, these compounds are being applauded for their magical effect on brain development, cardiac function and fetal development! Are there good guys and bad guys in the fat world? How are DHA and EPA related to fats?

To answer these questions it was important to take a close look at the composition of fats and the fat family tree.

Fats are an important part of diet along with carbohydrates and proteins. Dietary fat is an essential nutrient and source of energy required for many functions in the body. In fact, fat is the most concentrated energy source that provides 37 kJ/gram compared to 17 kJ/gram from carbohydrates or proteins. Fats are chiefly made of fatty acids. Biochemically, a fatty acid is a carboxylic acid (–COOH group) with a long hydro-carbon chain.

Dietary fat typically contains a mix of Saturated Fatty Acids and Unsaturated Fatty Acids. If there are double bonds between two carbon atoms in this hydrocarbon chain, then it is an unsaturated fatty acid, otherwise it is a saturated fatty acid. Those unsaturated fatty acids that contain a single double bond are called mono unsaturated fatty acids.

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acids (MUFA) and those with more than one double bond are called polyunsaturated fatty acids (PUFA).

Let’s visualise a fat family tree, where fats are made of saturated fatty acid and/or unsaturated fatty acid. The unsaturated fatty acid in turn can be a MUFA or a PUFA. PUFA are further classified based on the position of the first double bond from the methyl (-CH3) end of the carbon chain.

The Good and the Bad
Saturated fats, the so-called bad fats, are obtained from meat and dairy products. They are often blamed for causing clogged arteries and cardiovascular problems. Some studies have shown a direct link between saturated fat consumption and increased LDL and total cholesterol levels (Jakobsen et al., 2009). However, an analysis published in the American Journal of Clinical Nutrition found no link between saturated fat intake and increased risk of coronary heart disease or cardiovascular disease (Siri-Tarano et al., 2010).

Nevertheless, a separate analysis by the Harvard School of Public Health demonstrated that replacing saturated fats with an equal amount of polyunsaturated fats reduced the risk of coronary heart disease by 19% (Mozaffarian et al., 2010). Unsaturated fats help fight diseases that can be caused by excess consumption of saturated fats. Research over the last decade has shown that the trans-fats are actually worse than saturated fats as they increase LDL cholesterol and cause fatty plaques in arteries.

A direct connection of trans-fatty acids with breast cancer, shortening of pregnancy period, preeclampsia, disorders of nervous system and vision in infants, colon cancer, diabetes, obesity and allergy has been proven by many studies (Dhaka et al., 2011). Unsaturated fatty acids help lower LDL (bad) cholesterol while also boosting HDL (good) cholesterol. They are considered to be good for health.

Now, what are some of the common sources of fatty acids in diet? Saturated fatty acids such as myristic (C14), palmitic (C16) and stearic (C18) acids are found in milk and dairy products, poultry, vegetable oils and animal fats. Most confectionary products, snacks and fried food usually contain high levels of saturated fats. MUFAs mainly comprise oleic acid, an 18 carbon fatty acid with a double bond between C9 and C10.

Plant-based oils, including avocado, canola, olive, peanut, safflower and sunflower oils have high levels of these fatty acids and are good choices for healthier eating. Two of the most important PUFAs, Linoleic acid (LA) and Alpha linoleic acid (ALA) cannot be synthesized by the human body and must be included in diet. These are therefore called essential amino acids.

Omega Fatty Acids
As mentioned earlier, fatty acids are straight chain hydrocarbons, possessing a carboxyl group at one end. The carbon next to the carboxyl group is known as alpha. The next is beta and so on. Fatty acids can be of variable lengths and the last position is labeled as omega, the last letter in Greek alphabet.

The physiological properties of unsaturated fatty acids largely depend on the position of the double bond with respect to the last or omega carbon and not the carboxylic group. Therefore, the fatty acids are named in a way that describes the position of unsaturation with respect to the omega carbon. For example, omega 3 signifies that the first double bond exists as the third C-C bond from the methyl (CH3) terminal of the fatty acids. Mammals including humans lack the ability to introduce double bonds in FAs beyond C9 and C10. Fatty acids such as Linoleic acid, an omega 6 acid with double bonds at C9 and C12, and Alpha Linolenic acid (ALA), an omega 3 PUFA, with double bonds at C9, C12 and C15 are essential fatty acids that act as precursors of important bio-molecules.
Although humans cannot synthesize Linoleic acid and ALA, they can synthesize other important PUFAs such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) from Linoleic acid and ALA. Aha! So now we know what DHA and EPA represent. But why are these so important and where can we get these fatty acids apart from health drinks?

**Food Rich in DHA and EPA**

Human body can convert ALA into DHA or EPA but the percentage conversion is very low, only 2–10%. Linoleic acid, which is an 18-carbon fatty acid with two double bonds (18:2), is found in vegetable oils (corn, safflower, sunflower, and soybean) and animal meats. Omega 3 acids such as ALA are found in flaxseed, canola oil, walnuts and specialty eggs enriched with omega acids.

EPA can be found in fish, fish oils, marine sources; DHA can be found in fish, fish oils, and specialty egg/dairy products. Some of the common plant oils have significant levels of ALA — 7% by weight in soybean oil, 10% in canola oil, and 20% in hemp oil. Much higher amounts are found in the oils from flax, perilla (an herb of the mint family found in Japan), and chia (a member of the mint family found in South America) with approximately 50-60% of the fatty acids being in the form of ALA.

Recently, strains of flaxseed oils have become available that contain approximately 70% by weight of the oil as ALA, significantly higher than the 50-55% found in conventional flax oil varieties. Many fish and crustaceans are important sources of DHA and EPA. Hundred grams of anchovies, Atlantic herring, Mackerel and Salmon contain 1.5, 2, 1.8 and 2.1 grams of DHA plus EPA respectively. Good quantities of omega fatty acids are also found in shark and swordfish, but the increased concentration of pollutants in these fish makes their consumption slightly unsafe. Recently, algal sources are also being used for the production of DHA used as an important ingredient in baby food.

It is important to maintain an appropriate balance between omega 6 and omega 3 fatty acids, as these two substances work together to promote good health (Kidd et al., 2007). This is important because some omega 6 fatty acids tend to promote inflammation while omega 3 fatty acids reduce inflammation.

Also, both omega fats compete for the same enzymes in the body. Excess of any one of these prevents the other from carrying out its functions. Thus, the ratio of pro- and anti-inflammatory compounds present in the body is influenced by the ratio of omega 6 to omega 3 in the body. Excess of pro-inflammatory chemicals leads to chronic diseases such as diabetes, arthritis, stroke, dementia and cancer.

Most medical experts consider an optimal omega-6/omega-3 ratio to be 2:1 or even 1:1. People around the globe commonly consume between 10:1 to 50:1 ratio of omega 6 to omega 3. Since cooking oils are an indispensable part of our daily diet it is important to evaluate the common cooking oils in terms of their omega 3 and omega 6 content.

The cooking oil of choice should ideally have a good ratio of omega 3 versus omega 6. They should be rich in monounsaturated fats and not be overly processed to remove vital nutrients. Oils with high PUFA content easily turn rancid due to their inherent instability. The oxidation of PUFA begins the moment the oil is extracted and exposed to heat, air and light, causing degradation of the oil and forming free radicals. The degradation gets worse when oil is heated.

So, PUFA rich oils should be consumed fresh and finished soon. Oils burn when they are heated for long periods.
of time. Upon burning the oil denatures and produces potentially carcinogenic compounds such as polycyclic aromatic hydrocarbons. Thus, it is important to be mindful of the smoke points of various oils beyond which they start burning.

**Mega Benefits of Omega 3 and Omega 6**

Scientists were first alerted to the many benefits of EPA and DHA in the early 1970s when Danish physicians observed that Greenland Eskimos had an exceptionally low incidence of heart disease and arthritis despite the fact that they consumed a high-fat diet. Intensive research soon discovered that two of the fats they consumed in large quantities, EPA and DHA, were actually highly beneficial.

More recent research has established that fish oils (rich in EPA and DHA) play a crucial role in the prevention of atherosclerosis, heart attack, depression, and cancer. Extensive research in the last two decades has proven that omega 3 fatty acids, especially DHA and EPA, are critical to good health.

Both omega 6 and omega 3 fatty acids are stored in the cell membranes of tissues and have two primary functions. First, they are structural components of cell membranes where they ensure fluidity, stability, and act as gate-keepers in the cell. Second, both omega 6 and omega 3 fatty acids are converted into a number of important, biologically active molecules called prostaglandins.

There are three types of prostaglandins: PG1, PG2, and PG3.

- **PG1** have many beneficial effects, including reducing inflammation, inhibiting blood clotting and maintaining various regulatory states in the body. The strong anti-inflammatory properties help the body recover from injury by reducing pain, swelling and redness.
- **PG2** have the opposite effects of PG1. They usually increase inflammation, constrict blood vessels and encourage blood clotting. These properties are important in case of a wound or injury, as without these prostaglandins, a person could bleed to death from the slightest of cuts. However, in excess, these prostaglandins may be harmful.
- **PG3** have multiple functions in the body. They are important in protecting the body from various modes of injury. One of their most important functions is their role in decreasing the rate at which PG2 are formed. Because of their role in reducing inflammation caused by PG2, PG3 are often described as having anti-inflammatory properties.

Optimal concentrations of omega 3 and omega 6 supports brain cell function and development, provides cardiovascular support, supports eye and retina health and the immune system. It has recently been shown that omega fatty acids present in fish help protect the vision in multiple ways, especially in reduction of ‘dry eye syndrome’, a common life style problem today. Consuming fish or fish oil improves the quality of tears, and thereby ensures good eye health. Omega fatty acids also slow down the progress of both early and late stage eye diseases.

DHA is proven essential for pre- and post-natal brain development, whereas EPA is more influential on behavior and mood. Both generate neuro-protective metabolites and reduce attention deficit disorder, autism, dyslexia and aggression. During the last trimester of fetal life and the first two years of childhood, the brain undergoes a period of rapid growth termed the ‘brain growth spurt’. DHA is a nutrient absolutely required during this spurt for sensory, perceptual, cognitive and motor neural systems. EPA is present in the colostrum and breast milk though the exact importance is not clear.

It is clear however that nature itself has provided us with an invaluable solution for tackling many of the diseases and developmental problems prevalent today. Recognizing the unique benefits of EPA and DHA and the serious consequences of a deficiency, the US National Institutes of Health recently published Recommended Daily Intakes of fatty acids. They recommend a total daily intake of 650 miligram of EPA and DHA, 2.22 miligram/day of alpha-linolenic acid and 4.44 miligram/day of linoleic acid. Saturated fat intake should not exceed 8% of the total calorie intake or about 18 miligram/day.

In this day of chronic heart disease and lifestyle problems, while some fat family members such as the trans-fats are to be shunned, others such as the omega 3s are to be embraced. Consumption of the right amount of omega fatty acids, especially omega 3 fatty acids, can be helpful in the control of common health-related issues such as heart disease, cancer, allergies, mental disorders, skin disorders and arthritis.

**Greenland Eskimos were found to have exceptionally low incidence of heart disease and arthritis despite the fact that they consumed a high-fat diet**

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