The omega-3 fatty acids are long-chain polyunsaturated fatty acids ranging from 18 to 22 carbon atoms in chain length with the first of many double bonds beginning at the third carbon (upon counting from the methyl end of the fatty acid structure). The fish/fish oil-based omega-3 polyunsaturated fatty acids (also referred to as n-3 fatty acids or n-3 polyunsaturates) consist of DHA, docosahexaenoic acid (22 carbon atoms, 6 double bonds) and EPA, eicosapentaenoic acid (20 carbon atoms, 5 double bonds). The general structures for DHA and EPA are depicted in Figure 1.

It is noted that DHA and EPA can be designated in abbreviated form as 22:6w3 or 22:6n-3 (i.e., 22 carbon atoms with 6 double bonds of the omega-3 configuration) and 20:5n-3, respectively. The number before the colon indicates the number of carbon atoms in the fatty acid chain and the number after the colon indicates the number of double bonds between adjacent carbon atoms (unsaturated sites) in the structure. Hence, the X:Y designation for DHA is 22:6 and the n-3 indicates that the first of six double bonds begins at the third carbon atom when beginning the carbon counting at the methyl end of the fatty acid structure.
Structures of Omega-3 Fatty Acids

Whereas plant foods and vegetable oils completely lack DHA plus EPA, some do contain varying amounts of the omega-3 (n-3) polyunsaturated fatty acid known as ALA, a-linolenic acid (18:3n-3), abbreviated as ALA or ALA, which has 18 carbon atoms and 3 double bonds as seen in Figure 1. Many vegetable oils (including corn, safflower, sunflower, and soybean oils) are greatly enriched with omega-6 fatty acid known as LA, linoleic acid (18:2n-6) having 18 carbon atoms and 2 double bonds of the omega-6 configuration. A few plant sources (including non-hydrogenated canola oil, ground flaxseed, and walnuts) are rich sources of ALA. The second omega-6 fatty acid known as AA, arachidonic acid (20:4n-6), is consumed in low amounts in a typical diet; as for dietary cholesterol, it is found in animal and not plant food sources. The metabolism of LA in the body gives rise to significant amounts of AA. A fourth omega-3 fatty acid known as DPA, docosapentaenoic acid (22:5n-3), is a very minor constituent of the North American diet but a significant component of marine mammals, particularly seal oil where it represents approximately 5% of the total fatty acids present.

It is noteworthy that polyunsaturated fatty acids have highly curved structures as depicted for the various polyunsaturated fatty acids in Figure 1. These curved structures are due to the presence of the many natural double bonds (of the 'cis' configuration) which bring about a folding over of the fatty acid structures. Furthermore, the presence of multiple double bonds results in a lowering of the melting point of these fatty acid structures such that all of them are highly fluid and in liquid form at a room temperature of 23ºC and even more so at internal human body temperatures of 37ºC.

Fig. 1: Chemical structures of linoleic acid (LA), alpha-linolenic acid (ALA), arachidonic acid (AA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).