LIPID : STRUCTURE AND BIOLOGICAL SIGNIFICANCE

Biological lipids are a chemically diverse group of compounds, the common and defining feature of which is their insolubility in water. Fats and oils are the principal stored forms of energy in many organisms. Phospholipids and sterols are major structural elements of biological membranes. Other lipids, although present in relatively small quantities, play crucial roles as enzyme cofactors, electron carriers, light absorbing pigments, hydrophobic anchors for proteins, "chaperones" to help membrane proteins fold, emulsifying agents in the digestive tract, hormones, and intracellular messengers.

Q.What are the storage lipids?

The fats and oils used almost universally as stored forms of energy in living organisms are derivatives of fatty acids. The fatty acids are hydrocarbon derivatives, at about the same low oxidation state (that is, as highly reduced) as the hydrocarbons in fossil fuels. The cellular oxidation of fatty acids (to CO_2 and H_2O), like the controlled, rapid burning of fossil fuels in internal combustion engines, is highly exergonic.

Q.What is the basic principle behind nomenclature of fat?

Simplified nomenclature for these compounds specifies the chain length and number of double bonds, separated by a colon; for example, the 16-carbon saturated palmitic acid is abbreviated 16:0, and the 18-carbon oleic acid, with one double bond, is 18:1. The positions of any double bonds are specified by superscript numbers following Δ (delta); a 20-carbon fatty acid with one double bond between C-9 and C-10 (C-1 being the carboxyl carbon) and another between C-12 and C-13 is designated 20:2 (9,12).

Q.How do the naturally occurring saturated and unsaturated fatty acids form?

In nearly all naturally occurring unsaturated fatty acids, the double bonds are in the **cis** configuration. **Trans** fatty acids are produced by fermentation in the rumen of dairy animals and are obtained from dairy products and meat**.** They are also produced during hydrogenation of fish or vegetable oils.

Q.Which form of fatty acid is more harmful to our body?

Because diets high in *trans fatty acids* correlate with increased blood levels of LDL (bad cholesterol) and decreased HDL (good cholesterol), it is generally recommended that one avoid large amounts of these fatty acids.

Q.How the physical property of fatty acid is determined?

The physical properties of the fatty acids, and of compounds that contain them, are largely determined by the *length and degree of unsaturation* of the hydrocarbon chain.

The nonpolar hydrocarbon chain accounts for the poor solubility of fatty acids in water. Lauric acid (12:0, Mr 200), for example, has a solubility in water of 0.063 mg/g—much less than that of glucose (Mr 180), which is 1,100 mg/g. The longer the fatty acyl chain and the fewer the double bonds, *the lower is the solubility in water*. The carboxylic acid group is polar (and ionized at neutral pH) and accounts for the slight solubility of short-chain fatty acids in water. Melting points are also strongly influenced by the length and degree of unsaturation of the hydrocarbon chain. At room temperature (25 ^{o}C), the saturated fatty acids from 12:0 to 24:0 have a waxy consistency, whereas unsaturated fatty acids of these lengths are oily liquids. This difference in melting points is due to different degrees of packing of the fatty acid molecules (**Figure 1**).

In the fully saturated compounds, free rotation around each carbon–carbon bond gives the hydrocarbon chain great flexibility; the most stable conformation is the fully extended form, in which the steric hindrance of neighboring atoms is minimized.

In unsaturated fatty acids, a *cis* double bond forces a kink in the hydrocarbon chain. Fatty acids with one or several such kinks cannot pack together as tightly as fully saturated fatty acids, and their interactions with each other are therefore weaker. Because it takes less thermal energy to disorder these poorly ordered arrays of unsaturated fatty acids, they have markedly lower melting points than saturated fatty acids of the same chain length.

Q.Triacylglycerols are the Fatty Acid Esters of Glycerol—Justify.