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B.Sc - Part III (Hons) Paper V

Structure and Classification of Fats (Part I)

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Fats are diverse form of compounds soluble in nonpolar solvents, such as Benzene, chloroform, acetone and ethenol, but insoluble in polar solvents such as water. Basically, they are esters of fatty acids with alcohols but may also possesses other compounds such as phosphate, inositol and N-containing base, monosaccharides and Sialic acids. The fatty acids of lipids may be saturated or unsaturated with different lengths of Carbon chain. The alcohol is mainly glycerol but long chain alcohols, cetyl alcohol, myristyl alcohol, or long chain unsaturated amino alcohol named Sphingosine are also found

Lipid fats form important constituents of membrane systems of cells. They are also carriers of fat soluble vitamins (A, D, E and K) with food. They are storage form of energy but are dynamic in status as 20% of them is used and replaced everyday. It provides higher amount of energy (9 Cal gm^{-1})

Compared to Carbohydrate (6 cal g^{-1}). Subdermal deposits of fats act as heat insulator and help in maintaining body temperature in poikilotherms. The myelin sheath of nerve fibres is formed of lipid, which helps in the propagation of nerve impulse. Defect in lipid metabolism leads to obesity, coronary heart disease, blood pressure, Ketonuria, atherosclerosis and so on.

Classification of Fats

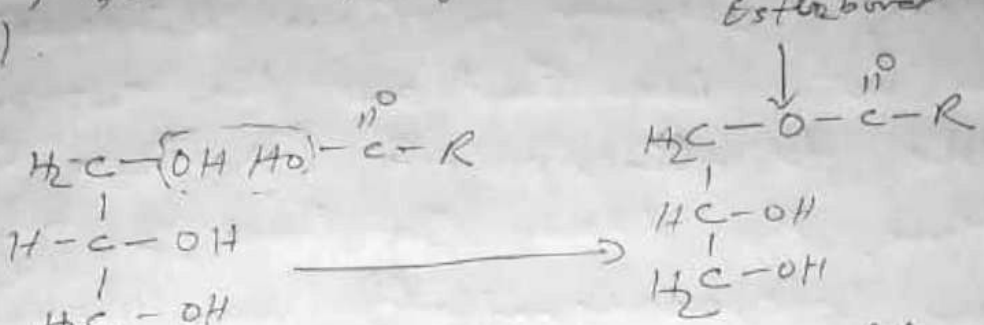
Fats have been classified into two categories — 1 Simple Fats and
2 Compound Fats

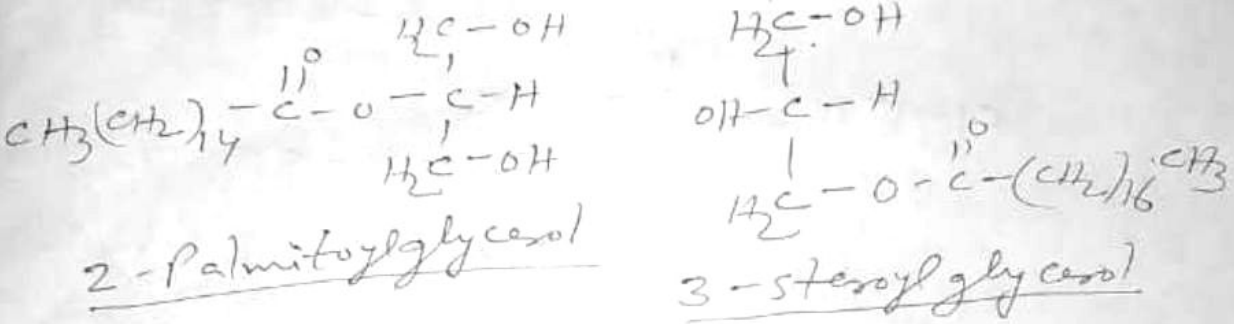
1 **Simple Fats** → Simple fats are esters of fatty acids with alcohols and are free of any other compounds. There are again are of two types —

A Acylglycerols and B Waxes

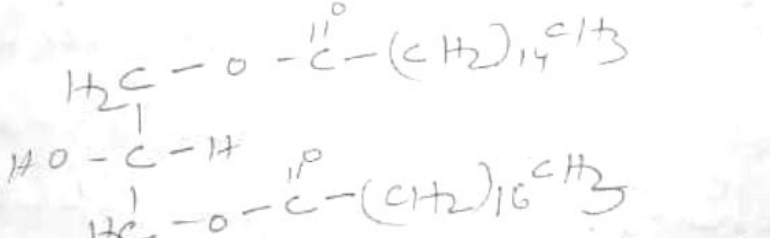
A **Acylglycerols** — They are esters of fatty acids with trihydric alcohol, glycerol. An acylglycerol is called a fat, if it is solid at room temperature, and named oil, if it is liquid at room temperature. When alcoholic group of glycerol forms an ester bond with carboxyl group of fatty acid, an acylglycerol is formed. Depending on the number of fatty acids forming ester bonds with one, two or three OH groups of glycerol, the acylglycerols are named mono acyl, diacyl, or

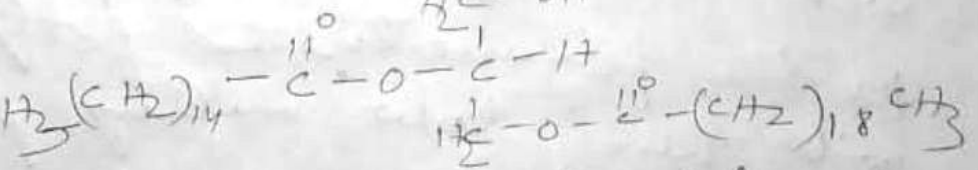
triacylglycerols respectively. The monoacylglycerol may be 1-monoacyl, 2-monoacyl, or 3-monoacylglycerol depending on the specific carbon to which the fatty acid is linked. Likewise, diacylglycerols are named 1,2-diacylglycerol, 1,3-diacylglycerol or 2,3-diacylglycerol.





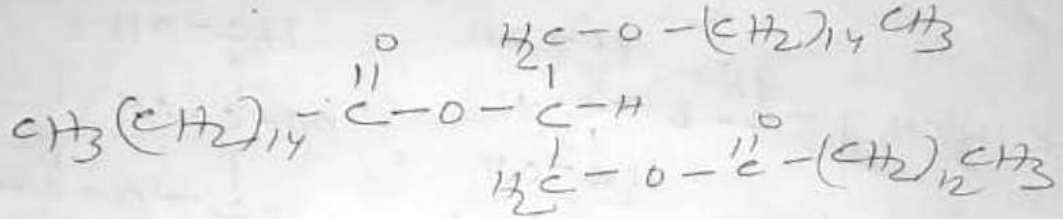
Some examples of Monoacylglycerols





Some examples of Diacylglycerols

Likewise, triacylglycerols are also of different types depending on the types of fatty acids and the specific -Carbons to which they are linked. One may assume loosely that C-1 and C-3 are identical but stereochemically (viewing in three dimensions). They are not identical and the enzymes are able to discriminate the two carbons. Hence, the three carbons of glycerol are stereochemically numbered as Sn-1, Sn-2 and Sn-3.



1,2-Dipalmitoyl 3-myristoyl glycerol

[Example of a triacylglycerol]

The melting point of triglycerol depend on the degree of unsaturation and lengths of the chains. Thus Simple lipids with long chain saturated fatty acids will have high melting point and the polyunsaturated fatty acids will have low melting points. This is because the double bonds in cis in nature. And thus the fatty acids bend at different points

depending on the position of double bond. Different molecules of lipids with such bend chains are unable to assemble coherently thus disperse at low temp. Contrary to it, long chain fatty acids without double bonds are linear molecules and are able to assemble coherently and thus require higher temp. to disperse. Triacylglycerols are primarily storage form of lipids and are used as energy source. They also perform other functions such as subdermal insulation and maintaining body temperature and subdermal cushions as protection against external injury. They also provide buoyancy in aquatic environment.

B Waxes

Waxes are esters of fatty acids with long chain monohydric alcohols such as Cetyl Alcohol and Myristyl alcohol.

$CH_3(CH_2)_{14}CH_2-O-\overset{\overset{O}{\|}}{C}-R$. A Wax

Cetyl Alcohol Fatty Acid

$CH_3(CH_2)_{30}CH_2-O-\overset{\overset{O}{\|}}{C}-R$. A Bee Wax

Myristyl Alcohol Fatty Acid

structure of Waxes

2) Compound fats -- continued in Part II