CHAPTER 4
LIPIDS

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4.1 INTRODUCTION

Lipids are organic compounds found in living organisms that are soluble in nonpolar solvents. The ability of lipid to dissolve in nonpolar organic solvents results from their significant hydrocarbon component – the part of the molecule responsible for its "oils" or "fatness". The word lipid come from the Greek lypos, means "fat".

Lipids are a broad group of naturally occurring molecules which include fats, waxes, sterols, fat-soluble vitamins (such as vitamins A, D, E and K), monoglycerides, diglycerides, phospholipids, and others. The main biological functions of lipids include energy storage, as structural components of cell membranes, and as important signalling molecules.

- Structural components in cell membranes (e.g. phospholipids)
- Means to store energy (e.g. triglycerols)
- Chemical signals, vitamins or pigments
- Protective molecules (outer coating of cells)

4.2 LIPID CLASSES

Lipid can be classified as below:

- Fatty acid (FA) and its derivatives
- Triacylglycerol (TAG)
- Wax ester
- Phospholipids
- Sphingolipid
- Isoprenoids

4.2.1 Fatty acid (FA) and Its Derivatives

Fatty acids, one of a major group of lipid, are carboxylic acids with long hydrocarbon chains. Fatty acid hydrocarbon chain lengths are between 12 to 20 carbons. The common fatty acids of plant tissues are C_{16} and C_{18} straight-chain compounds with zero to three double bonds of a *cis* (or *Z*) configuration. Such fatty acids are also abundant in animal tissues, together with other even numbered components with a somewhat wider range of chain-lengths and up to six *cis* double bonds separated by methylene groups (methylene-interrupted). The systematic and common names of those fatty acids encountered most often, together with their carbon number, are listed in the **Table 4.1**.

Table 4.1: Common naturally occurring fatty acids

Systematic Name	Common name	Carbon number
Saturated Fatty Acids		
Dodecanoic	Lauric	12:0
Tetradecanoic	Myristic	14:0
Hexadecanoic	Palmitic	16:0
Octadecanoic	Stearic	18:0
Eicosanoic	Arachidic	20:0
Docosanoic	Behenic	22:0
Unsaturated Fatty Acids		
cis-9-hexadecenoic	Palmitoleic	16:1 (n-7)
cis-9-octadecenoic	Oleic	18:1 (n-9)
Polyunsaturated Fatty Acids		
9,12-octadecadienoic	Linoleic	18:2 (n-6)
6,9,12-octadecatrienoic	γ-linolenic	18:3 (n-6)
9,12,15-octadecatrienoic	α-linolenic	18:3 (n-3)
5,8,11,14-eicosatetraenoic	Arachidonic	20:4 (n-6)
5,8,11,14,17-eicosapentaenoic	EPA	20:5 (n-3)
4,7,10,13,16,19-docosahexaenoic	DHA	22:6 (n-3)

Fatty acid can be **saturated** with hydrocarbon which is no carbon-carbon double bonds or **unsaturated** which have carbon-carbon double bonds **(Figure 4.1)**. The unsaturated fatty acids can occur in two isomeric forms: ***cis-*** or ***trans-*** . *The Cis - isomeric form* is similar or identical groups are on the same side of a double bond. If the form is opposite sides of a double bond, the molecule is referred as *trans-* isomer **(Figure 4.2 & 4.3).**

The melting point of saturated fatty acids increases with increasing molecular weight because of increased of van der Waals interactions between the molecules. The unsaturated fatty acids have a lower melting point than saturated fatty acid because its structure is not pack as saturated fatty acids. So the energy that required to break up the bond of unsaturated fatty acids is less than saturated fatty acids. Therefore they are liquid at room temperature.