CHAPTER I

Introduction
Lipids are characterized by molecular heterogeneity.\(^{(1)}\) Mainly miscibility properties classify lipids as one group. Lipids are involved in many biological process in animals, plants and microorganisms\(^{(2)}\) and defined as fatty acids and their derivatives and substances related biosynthetically or functionally to these compound.\(^{(3)}\) Lipids serve as major storage for energy in animal and plant tissues, maintaining the structural integrity of cells. Mobilization of reserve lipids and proteins play an important role in the removal of embryonal dormancy.\(^{(4)}\) In the membranes of nervous tissue, these function as transmitters of electrical signals.\(^{(5)}\) Lipids are required for insulation, water proofing, detergency, lubrication and other interfacial phenomenon. In marine mammals, these are used to adjust buoyancy. Simple lipids contain fatty acid esters of long chain alcohols. Complex lipids may contain lipids with phosphorous (phospholipids) or contain carbohydrate residues (glycolipids) or long chain amino alcohol (sphingolipids). Fatty acids constituting the lipids may be saturated or unsaturated, cyclic or acyclic and may contain substituents (hydroxy or keto group).\(^{(6)}\) A new system\(^{(7)}\) classifies lipids into different categories: fatty acyl, glycerolipids, glycerophospholipids, sphingolipids, saccharolipids and sterol lipids.

Fats are triesters made up of one glycerol and three fatty acids, so the more precise term is triacylglycerol or triglyceride - which is
the most common molecule found in fats and oils. Fats and oils provide most concentrated energy, supply essential fatty acids and serve as carriers of vitamins.\textsuperscript{(8)}

Fatty acids\textsuperscript{(9,10)} are long chain aliphatic carboxylic acids which are part of all lipid species. The fatty acids of plant, animal and microbial origin generally contain even number of carbon atoms in straight chains, with a carboxyl group at one extremity and with double bond in specific position in relation to this. In animal tissues, the common fatty acids vary in chain length from 14 to 22, but can span from 2 to 36 or even more. Individual groups of microorganisms can contain fatty acids with 80 or more carbon atoms, but higher plants usually exhibit a more limited chain length distribution. Fatty acids from animal tissues may have one to six double bonds, those from algae may have upto five, while those of higher plants may have more than three. Microbial fatty acids occasionally have more than one. Plants and microbial fatty acids can contain a wide variety of functional groups. It is the non-polarity of acyl chain, which makes lipid miscible in organic solvents and immiscible in aqueous systems. The non-polarity of the acyl chain is attributed to the many C-H bonds which are non-polar due to minimal electronegativity differences and also to the many C-C bonds. In general the acids contain even number of monocarboxylic acids of chain length C\textsubscript{4}-C\textsubscript{24}.  

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There are rare variations - longer or shorter chains, branched or cyclic chains or odd numbered chains. The substituent groups are incorporated into the aliphatic chains by enzyme systems. The delta (Δ) notation indicate position of double bond in chain counting from the carboxyl (-COOH) end whereas ω (omega) or η notations indicate position of the same from methyl end. Methyl esters of fatty acids which are volatile are used in gas-liquid chromatography for profile of the constituent fatty acids.

Triacylglycerols (TAG) are neutral type of lipids. The fat is stored in the form of TAG for energy and insulation. Different fatty acids esterify with glycerol giving a number of possible species.

Steroids are a group of lipids derived from cyclopentanoperhydrophenanthrene. Terpenoids act as intermediates in the synthesis of steroid class of compounds.

The phosphoglycerides\cite{10-14} include all derivatives of glycerophosphoric acid containing one or more acyl or related group. Phosphatidyl choline (lecithin), Phosphatidyl ethanolamine (cephalin), Phosphatidyl serine and Phosphatidyl inositol groups are important in plants and animals. The phospholipids constitute the cell membrane and are carriers of biologically active agents. Brain contains a protein phospholipids complex receptor.\cite{15-17}
The galactolipids-monogalactosyl and digalactosyl diglycerides are the plant fats – where diacylglycerols are joined by a glycoside linkage through position 3 to sugar moieties.

Plants are able to synthesize the needed unsaturated fatty acids which are all incorporated in the phospholipids, which in turn are used for membrane building. The specific physical properties of the membrane are due to the chain length and the degree of unsaturation of the fatty acids. In the animals, linoleic acid as precursor of arachidonic acid, can not be synthesized de novo by animals and must be taken up from vegetable sources. Such acids (ω3 or ω6) are termed as essential fatty acids (EFA) and serve as precursors\(^\text{18}\) of prostanoids. They have also an effect on hyperlipidemia. Aquatic animals also posses essential fatty acid.\(^\text{19}\) Several workers have reviewed the chemistry, biochemistry and biotechnology of lipids.\(^\text{20-26}\)

Majority of the reduced caloric fats and fat substitutes though similar in texture and flavour to natural fats, contain fatty acids that are not usually present in edible oils and fats and don’t match the chemistry and functions of natural fats e.g. these do not provide nutritionally important essential fatty acids (EFA).\(^\text{27,28}\)

Shortage of traditional oils has created considerable interests in developing new sources of oils and fats and evaluating their
suitability for edible purposes. Utilization of the full potential of minor oil seeds of tree origin is desirable. The minor oil seeds, although useful sources of oil belongs to less cultivated category of species and serve as non-traditional sources of vegetable oils. The Forests of Madhya Pradesh are rich source for some of these non-traditional raw materials, which have not so far been screened for edible or industrial purposes.

Chemical investigations of many non-traditional seed oils of Madhya Pradesh e.g. Feronia limonia,\textsuperscript{(29,30)} Brassica oleracea,\textsuperscript{(31)} Aegle marmelos,\textsuperscript{(32)} Conium maculatum,\textsuperscript{(33)} Balanites aegyptiaca,\textsuperscript{(34)} Pithecellobium dulce,\textsuperscript{(35)} Buchanania lanzan,\textsuperscript{(36,37)} Annona squamosa,\textsuperscript{(38)} Tectona grandis,\textsuperscript{(38)} Shorea robusta,\textsuperscript{(38)} Basella rubra,\textsuperscript{(39)} Garcinia indica,\textsuperscript{(40)} Syzygium cumini,\textsuperscript{(41)} Wrightia tinctoria\textsuperscript{(42)} and Boswellia serrata,\textsuperscript{(43)} have been carried in our Laboratory. Substantial work leading to Doctoral Theses on “Fats” have been carried in the Laboratory during the last decade.\textsuperscript{(44-49)} India has emerged as a major importer of edible oil. The Government hopes to increase the area under major oil seed crops to more than 30 million hectares in the near future.\textsuperscript{(50)}

Recently triglyceride types of seed oils have been chosen from some plants of Solanaceae\textsuperscript{(51)} and oil of Psoralea (Leguminosae) investigated.\textsuperscript{(52)} Alkyl resin have been studied from Pithecellobium\textsuperscript{(53)}
and lipid peroxidation products of soyabean oil determined.\textsuperscript{54} Preparation of oleochemicals for special application and making of structured lipids have been discussed in a recent seminar.\textsuperscript{55} Latest is report of triterpenoids from Orchid-Eria,\textsuperscript{56} from \textit{Ixora fintarysoniana}\textsuperscript{57} and from \textit{Echinops echinatus}.\textsuperscript{58} We have attempted aqueous extraction of corn oil which is economic and ecofriendly.\textsuperscript{59} Microorganism mediated formation of hydroxy fatty acid from corn oil\textsuperscript{60} and analysis of monoglycerides using different analytical techniques\textsuperscript{61} have recently been attempted in this Laboratory.

The latest trend of work includes lipid polyester content composition,\textsuperscript{62} role of bioactive molecules in liposome preparation,\textsuperscript{63} link between cognitive impairment and cardiovascular disorder,\textsuperscript{64} characterization of fatty acyl composition of complex lipids,\textsuperscript{65} role of biologically active oxidized lipid (phytoprostanes) in parental lipid nutrition,\textsuperscript{66} expression of acyl co-A binding protein\textsuperscript{67} and alkaline sphingomyelinase and sphingolipid metabolites in human meconium.\textsuperscript{68}
REFERENCES


19. “Phospholipids”, (Eds. J.N. Hawthorne and G.B. Ansell),


