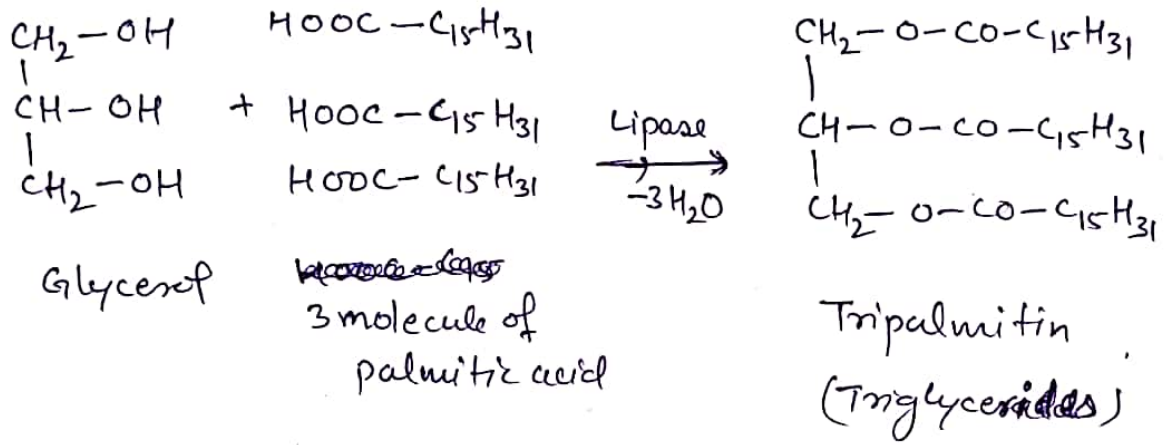
Lipids (Greek lipos - fat)

- Lipids are heterogeneous group of compounds related to fatty acids & include fats, oils, waxes and other related substances
- Lipids are oily / greasy substances, relatively insoluble in water and soluble in organic solvents (like ether, chloroform etc.) and thus are hydrophobic in nature
- Chemically, the fats are defined as the esters of glycerol and fatty acids or as the triglycerides of fatty acids.



Glycerol — 3 molecule of palmitic acid — Tripalmitin (Triglyceride)

→ Alcohols :- Alcohols found in lipid may be saturated and commonly are glycerol, cholesterol, cetyl alcohol and myricyl alcohol.
$CH_3(CH_2)_{14}CH_2OH$ $CH_3(CH_2)_{28}CH_2OH$.

→ fatty acids :- • Fatty acids are long chain organic acids having 4 to 30 carbon atoms

• They have single carboxyl group and long, nonpolar hydrocarbon tail, which gives lipid their hydrophobic nature.

Types of fatty acids:-

① Saturated fatty acids:-

- The hydrocarbon chain of fatty acid contains only single bonds.
- Mostly contain even number of carbon atoms in it. General formula for these acids is $C_nH_{2n+1}COOH$

eg:- Butyric acid (C-4), Myristic acid (C-14), Palmitic acid (C-16), Stearic acid (C-18)

② Unsaturated fatty acids:-

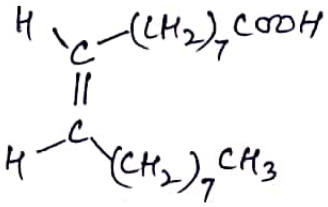
- The hydrocarbon chain contains one or more double bonds.
- These may be classified, depending on double bond present in hydrocarbon chain.
  - → Monoethenoid acids → contain one double bond commonly called as Monounsaturated fatty acids (MUFAs)
    eg:- oleic acid.
  - → Diethenoid acids :- contain two double bonds
    eg:- Linoleic acid
  - → Triethenoid acid :- contain three double bonds
    eg: Linolenic acid
  - → Tetraethenoid acid :- contain 4 double bonds
    eg:- Arachidonic acid

↓ Polyunsaturated fatty acids (PUFAs)

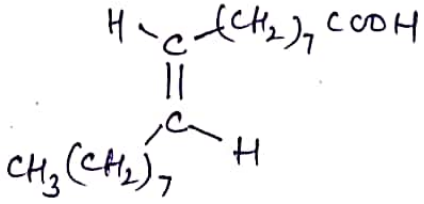
* Linoleic, Linolenic & Arachidonic acids are essential fatty acids must be obtain from diet

Geometric isomerism →

- The unsaturated fatty acids exhibit geometric (cis-trans) isomerism.
- Mostly found as unstable cis isomer than stable trans isomer.



oleic acid



Elaidic acid.

fatty acids.
non conjugated: -CH=CH-CH₂-CH=CH-CH₂
conjugated CH=CH-CH=CH-CH=CH

③ Hydroxy or oxygenated fatty acids
- contains hydroxyl group in the chain
eg: ricinoleic acid in castor oil, cerebronic acid.

④ Cyclic fatty acids:-
→ contains ring structure in hydrocarbon chain
eg:- chaulmoogric acid contain cyclopentyl ring (at(C_{18}))
(in chaulmoogra oil)

Biological role:-

1. The fat / lipid serve as efficient source of energy which is stored in adipose tissues hence are concentrated fuel reserve of the body.
2. They serve as an insulating material in subcutaneous tissues and around certain organs.
3. Fats combined with proteins (lipoprotein) are an important consituents of cell membrane and mitochondria of cell; which regulate the membrane permeability.

4. They serve as a source & carriers of fat soluble vitamins (A, D, E, K)

5. Lipids are important as cellular metabolic regulators (steroid hormones, & prostaglandins)

6. phospholipids play an important role in absorption and transportation of fatty acids.

7. Hormone synthesis:- Adrenocorticoids, progesterone, Estrogen, testosterone, oxtocin, cholic acid & vitamin D are synthesised from cholesterol.

8. Blood cholesterol lowering HDL → tissue → clearance
LDL – blood → tissue.

Classification of Lipids:

- **Lipids**
  - **simple lipids or Homolipids**
    - **Fats & oils (Triglycerides)**
      - simple triglycerides
      - Mixed triglycerides
    - **waxes**
      - Bees wax
      - sperm whale wax
  - **compound lipids or Heterolipids**
    - **Phospholipids**
      - phosphoglycerides
      - phosphoinositides
      - phosphosphingosides
    - **Glycolipids (Cerebrosides)**
      - Kerasin
      - Nervon
      - oxynervon
    - **Lipoproteins**
    - **others**
      - sulpholipids
      - aminolipids
      - Lipopolysaccharides
  - **Derived**
    - steroids
    - Terpenes
    - Carotenoids
    - Alcohols
    - fatty acids
    - Vitamins
    - Hydrocarbons
    - Ketone bodies.