

They have the common

- Relatively **insoluble in water**
- **Soluble in nonpolar solvents** such as ether and chloroform.

I. Simple Lipids

Esters of fatty acids with various alcohols:

(a) Neutral fats (Triglycerol, TG): These are triesters of fatty acids with glycerol.

(b) Waxes are esters of fatty acids with higher monohydroxy aliphatic alcohols.

- **True waxes are esters of higher fatty acids** *with* cetyl alcohol ($C_{16}H_{33}OH$) or other higher straight chain alcohols.
- **Cholesterol esters** are esters of fatty acid with cholesterol.
- **Vit A and Vit D esters** are palmitic or stearic acids esters of Vit A (Retinol) or Vit D respectively.

TYPES OF FATTY ACIDS

Straight chain FA: These may be:

- **Saturated FA:** Those which contain **no double bonds**.
- **Unsaturated FA:** Those which contain **one or more double bonds**.

(a) Saturated FA: Their general formula is $C_nH_{2n+1}COOH$

• **Examples:**

- Acetic acid CH_3COOH
- Propionic acid C_2H_5COOH
- Butyric acid C_3H_7COOH
- Caproic acid $C_5H_{11}COOH$
- Palmitic acid $C_{15}H_{31}COOH$
- Stearic acid $C_{17}H_{35}COOH$ and so on.

- Saturated fatty acids having 10 carbon or less number of carbon atoms are called as **lower fatty acids**, e.g. acetic acid, butyric acid, etc. Saturated fatty acids having more than 10 carbon atoms are called **higher fatty acids**, e.g. palmitic acid, stearic acid, etc.
- Milk contains significant amount of lower fatty acids.

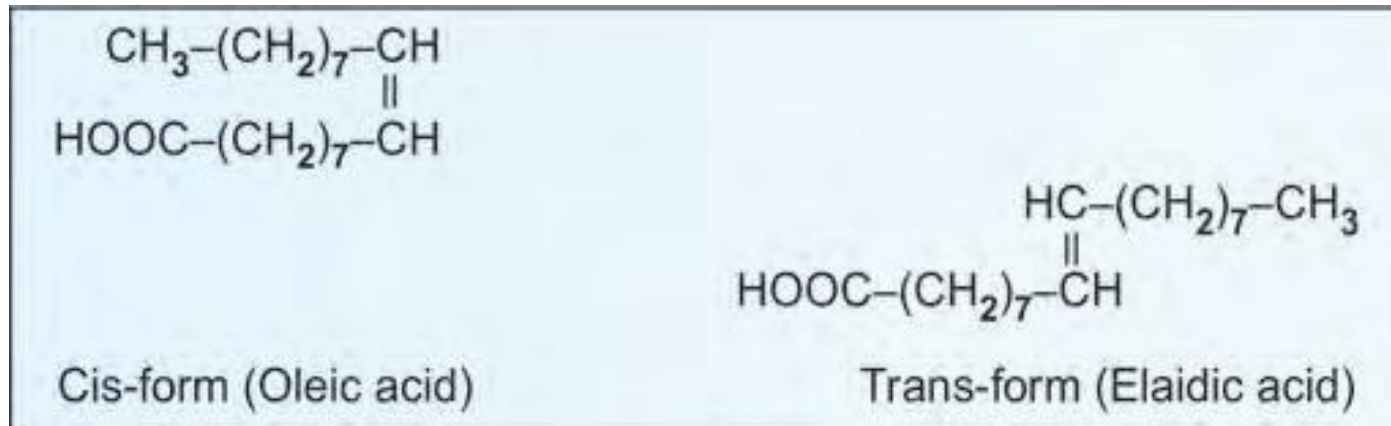
(d) A widely used convention is to *express the fatty acids by formula to indicate:*

- The number of carbon atoms
 - The number of double bonds and
 - The positions of the double bonds.
- **For example oleic Acid (mol. formula C₁₇H₃₃ COOH)** has **one double bond** between C₉ and C₁₀, thus: $10\ 9\ \text{CH}_3\ (\text{CH}_2)_7 - \text{CH} = \text{CH}\ (\text{CH}_2)_7 - \text{COOH}$
- **According to above criteria**, it is **expressed as 18 : 1; 9**,
[18 indicates the number of carbon atoms, 1 indicates the number of double bond and 9 indicates the position of the double bond].

ESSENTIAL FATTY ACIDS

- *Three polyunsaturated fatty acids, linoleic acid, linolenic acid and arachidonic acid are called “essential fatty acids” (EFA).*
- They ***cannot be synthesised in the body and must be*** provided in the diet.
- Lack of EFA in the diet can produce growth retardation and other deficiency manifestation symptoms.

- The **polyunsaturated fatty acids (PUFA)** exist in cis configuration in naturally occurring lipids.



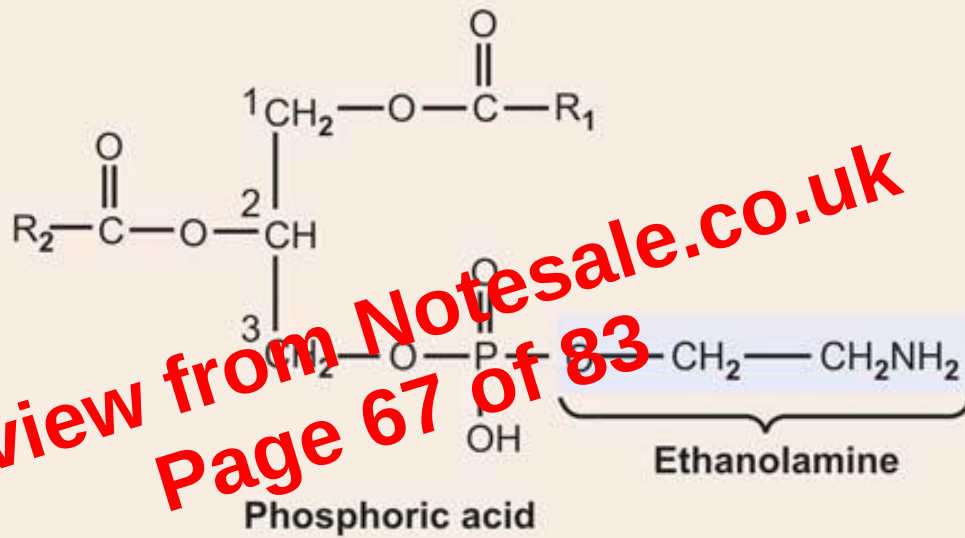
- Oxidative rancidity is the result of partial oxidation of unsaturated fatty acids with resultant formation of epoxides and peroxides of small molecular weight fatty acids by peroxides and free radicals.
- Many natural fats and oils may contain antioxidants (e.g. vitamin E), which prevent the occurrence of oxidative rancidity.
- PUFA are more easily oxidized; so vegetable oils with a high content of PUFA are usually preserved with addition of antioxidants.

- **Role in blood coagulation:** Phospholipids play an essential part in the blood coagulation process. Required at the stage:
Conversion of **prothrombin to thrombin** by active factor X, and Possibly also in the activation of factor VIII by activated factor IX.
- **Insulation:** Phospholipids of myelin sheaths provide the insulation around the nerve fibres.
- **Cofactor:** Phospholipids are required as a cofactor for the activity of the enzyme lipoprotein lipase and triacylglycerol lipase.

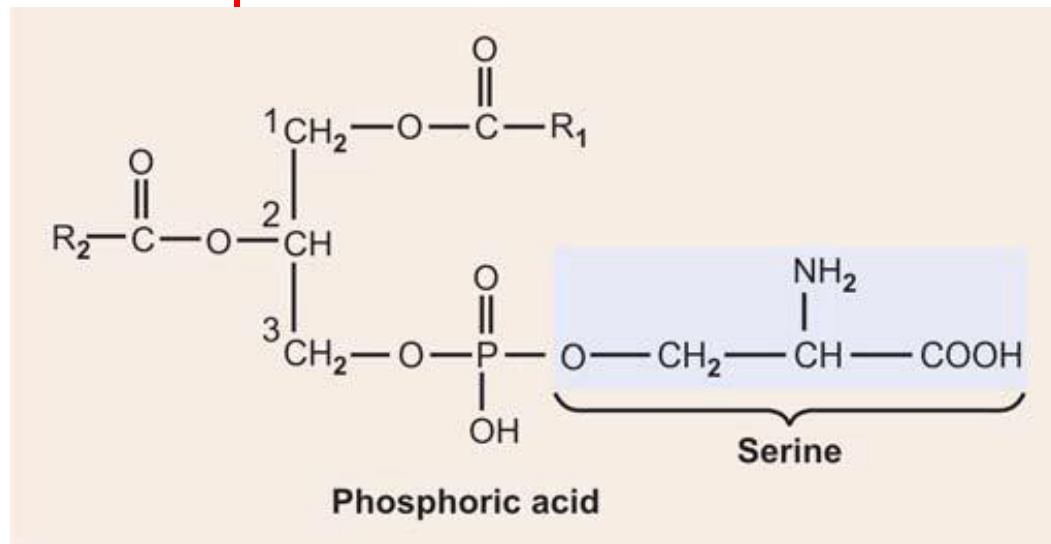
- **Role in transport of lipids from liver:**
- Endogenous TG is carried from Liver to various tissues as lipoprotein complex
- **Role in electron transport**

Probably Phospholipid help to couple oxidation with phosphorylation and maintain electron transport enzymes in active conformation and proper relative positions.

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- Cephaline



- Phosphatidylserine

CHOLESTEROL

Cholesterol is the most important sterol in human body. Its molecular formula is $\text{C}_{27}\text{H}_{45}\text{OH}$. Its structural formula is given in **Figure**

It possesses

“cyclopentanoperhydrophenanthrene nucleus”.

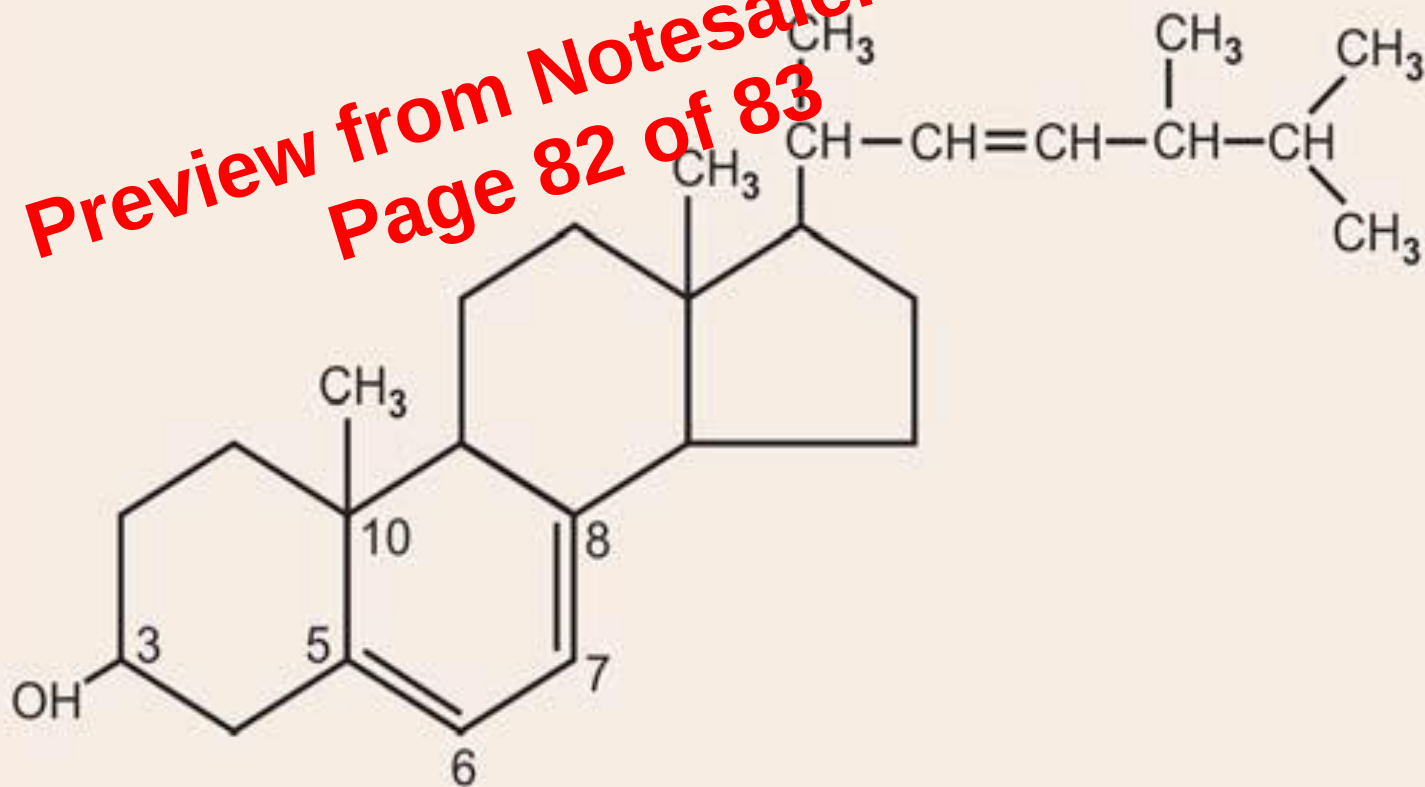
It has an $-\text{OH}$ group at C_3 .

It has an unsaturated double bond between C_5 and C_6 .

It has two $-\text{CH}_3$ groups at C_{10} and C_{13} .

It has an eight carbon side chain attached to C_{17} .

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Ergosterol