

# LIPIDS

Lipids are fatty acid esters of alcohol and related substances which are oily greasy organic compound insoluble in water but soluble in monopolar organic solvent like benzene, ether, chloroform, kerosene etc. It is also made up of C, H, O like carbohydrate but poor in oxygen. Some lipids also contain P, S and N. All lipids are not fat eg. steroid.

Term lipid was coined by Bloor. General formula of lipid is  $C_nH_{2n}O_2$ . These are mainly found in cell membrane, seeds, plant pigments, butter, ghee, natural rubber, blood, muscle, brain, wax, lycopene, menthol etc. Lipids are important dietary constituents having high energy value.

## CLASSIFICATION:

Lipids can be divided into two major classes. Class I lipids - are saponifiable lipids and can be saponified with alkalis to yield soap eg. triglycerides, waxes, phospholipids, glycolipids.

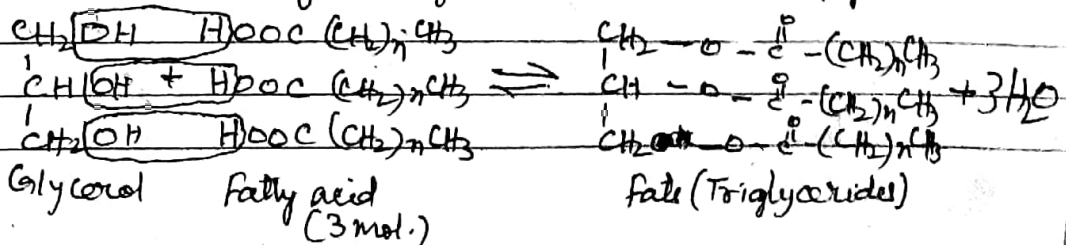
Class II lipids - are non-saponifiable lipids as they are not hydrolysed by alkali eg. Steroids, cholesterol etc.

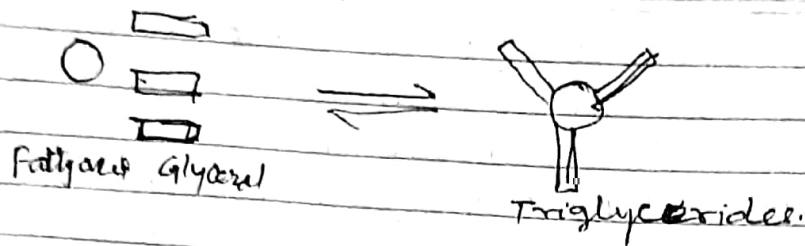
According to name of fatty acids, Bloor recognised three types of lipids

- ① Simple lipids (Homolipids).
- ② Conjugated lipids
- ③ Derived lipids.

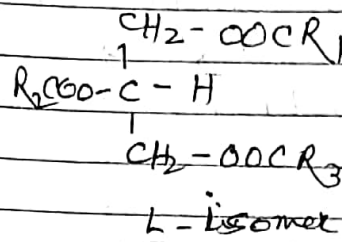
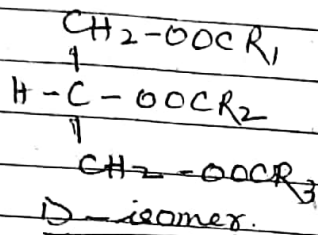
### ① Simple Lipids:

These are ester of fatty acids with trihydric or monohydric alcohol. Simple alcohol is glycerol which is trihydric (3 OH group) sugar alcohol. True fats, oils, waxes, cutin, suberin are simple fat. They are formed by esterification of 3 molecules of fatty acids with one molecule of trihydric alcohol like glycerol.





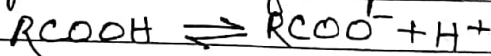
L & D isomers: The naturally occurring fats are of L-type. Other are D-type. The two types are only differ due to asymmetry is created at C2.



### Fatty acids:

Fatty acids are organic molecule with general formula  $\text{CH}_3(\text{CH}_2)_n\text{COOH}$  or  $\text{RCOOH}$ , where R is a hydrocarbon chain. Fatty acids vary in chain length from acetic acid ( $\text{C}_2$ ) to lignoceric acid ( $\text{C}_{24}$ ). Butyric acid is the 4 carbon shortest fatty acid.

The carboxylic acid ( $-\text{COOH}$ ) group of a fatty acid is strongly polar. It ionise in water at intra cellular pH by the loss of a proton.



Fatty acids are divided into two classes

- ① Saturated fatty acid
- ② Unsaturated fatty acid

#### ① Saturated fatty acids:

In Saturated fatty acid, each carbon atom has two hydrogen atoms attached to it. one of the terminal carbon atom has three hydrogen atoms while other has a carboxylic group.

Melting point of these acid is high (eg.  $60^\circ\text{C}$  tristearic and  $69.6^\circ\text{C}$  for Stearic acid).

This carbon chain is straight. They are



(# break paragraph)

## WAXES:

Waxes are esters of fatty acids with monohydric alcohol of high molecular weight. The fatty acids of waxes have 14C to 36C atoms. Alcohol have 16C atoms to 36C atoms.

Waxes are secreted by bees, cutaneous glands and plants. In insects as protective covering in aquatic plants. Waxes are the chief storage form of fuel in plankton.

The bee wax contains palmitic acid and myricyl alcohol. The sperm whale (spermaceti) wax contains palmitic acid and acetyl alcohol.

## COMPOUND LIPIDS:

Compound lipids are the lipids linked to non-lipids. The non-lipids may be phosphoric acid, a carbohydrate, or protein etc.

### ① Phospholipids:

Phospholipids formed by addition of an additional compound lipid having phosphate as their additional chemical substance in the form of phosphoric acid known as phospholipids.

These include:-

- i) Lecithin: The lipids formed by one molecule of glycerol, two molecules of fatty acids, one molecule of phosphoric acid and one molecule of nitrogenous base choline.

Lecithin help in synthesis of lipoprotein, transportation and utilization of lipids.

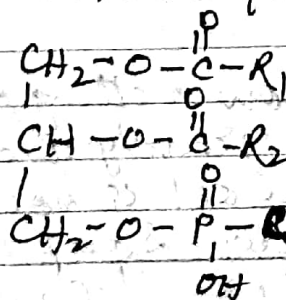


Fig. Lecithine

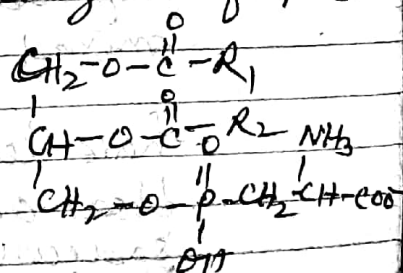


Fig. Cephaline

ii) Cephaline: Cephalin is similar to that of lecithin except ethanolamine, Colamine or amino acid Serine instead of choline.

Cephalin occurs in animal tissues, soya bean oil etc.

iii) plasmalogen: They are composed of fatty acids, aliphatic aldehyde, glycerol, phosphoric acid along with a molecule of nitrogenous base either ethanolamine or choline.

These are found in the brain, muscles and seeds of higher plants.

iv) phosphingosides (sphingomyelin): Esters formed by the combination of one molecule of fatty acid, one molecule of phosphoric acid, one molecule of choline and sphingosine without glycerol. These are present in brain and myelin sheath.

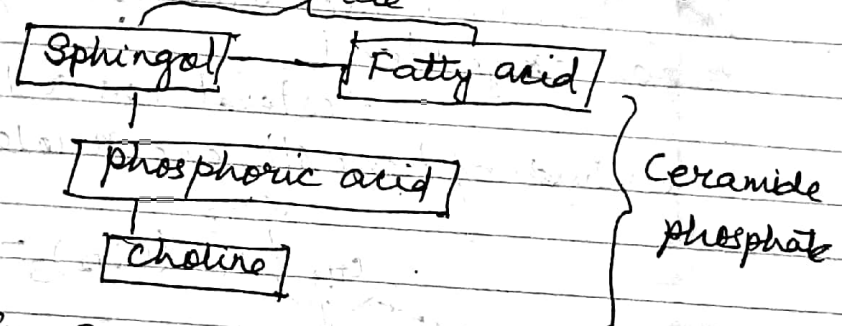


Fig. Sphingomyelin.

② GLYCOLIPIDS: Glycolipids are formed as to  $[Fatty\ acid] + [Sphingosine] + [Glucose\ or\ galactose]$ .

It includes cerebrosides and ganglioside.

i) Cerebrosides: These formed white matter of brain and myelin sheath of nerve.

ii) Gangliosides: Gangliosides serve as antigen and form grey matter of brain, membrane of RBC.

③ Lipoprotein: Compound lipid having protein as their additional chemical substance. It is found in blood and plasma membrane etc.

③ DERIVED LIPIDS: Lipids like substance obtained on the hydrolysis of simple lipids or compound lipids are known as derived lipids. These differ from simple <sup>or compound</sup> lipids having cyclic structural rather than straight chain. These includes Sterol, Steroid and Coloure pigments.

① Sterol: Wax like solid alcohol of steroids are known as sterols. The common sterol present in animals is cholesterol.

Cholesterol is present in human blood, plasma. It helps in synthesis of membrane lipid, steroid hormones, bile salt and vitamin D. The precursor of vit D is known as ~~ergosterol~~ ergosterol.

Cholesterol has a 1,2, cyclopentano perhydrophenanthrene nucleus.

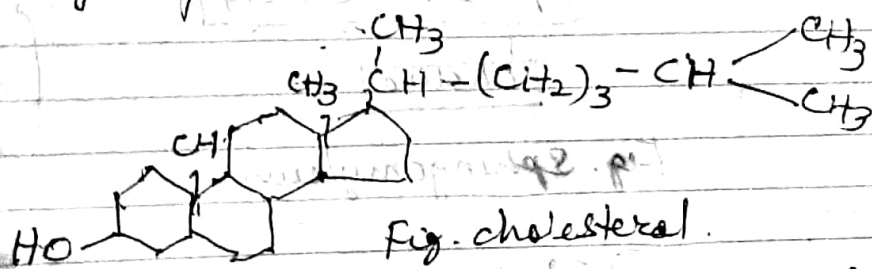


Fig. cholesterol.

(ii) Steroids: Biologically active soluble lipids having cyclical structure is known as steroids. These includes hormones secreted by adrenal cortex. These includes mineralocorticoids and glucocorticoids. Sex hormones secreted by gonads such as estrogen, progesterone, testosterone, vitamin A, D, E and K, bile acid etc.

MCQs

QUESTIONS

## BIOCHEMISTRY

1. An organic molecule is broken into its structural units, which are amino acids. The organic molecule is—
  - a) Fat
  - b) Carbohydrate
  - c) Protein
  - d) Steroid.
2. The derivatives of pyruvic and  $\alpha$ -ketoglutaric acids are
  - a) Glucose
  - b) Amino acids
  - c) Fatty acids
  - d) Glycerol.
3. Amino acids may be
  - a) Negatively charged
  - b) Positively charged
  - c) Zwitterions
  - d) All of the above.
4. The variation in the properties of amino acids is due to
  - a) Alkyl group
  - b) Amino group
  - c) Carboxyl group
  - d) All of the above.
5. Which of the following statement is true.
  - a) All amino acids are levo rotatory.
  - b) All amino acids are dextro-rotatory.
  - c) Most of the plant amino acids are levo rotatory.
  - d) Most of the plant amino acids are dextro rotatory.
6. The heterocyclic amino acid is represented by
  - a) Lysine
  - b) Proline
  - c) Tyrosine
  - d) Glycine
7. There are eight essential amino acids, which include
  - a) Cysteine, methionine, tyrosine.
  - b) Valine, alanine, proline.
  - c) Tryptophan, Leucine, Methionine.
  - d) Isoleucine, Aspartic acid, Glutamic acid.
8. Amino acids do not contribute in the synthesis of
  - a) Enzymes
  - b) Hormones
  - c) Pigments
  - d) Mucilage
9. A rich source of protein is
  - a) Soyabean
  - b) Millet
  - c) Leafy vegetables
  - d) All of the above.
10. Protein is a polypeptide chain. The peptide bond occurs between carboxyl and amine groups. It can be represented as
 

$\begin{array}{c} \text{C} \\   \\ \text{a) C—N} \\   \\ \text{H} \\   \\ \text{O} \\    \\ \text{c) C—N} \\    \\ \text{H} \end{array}$	$\begin{array}{c} \text{H} \\   \\ \text{b) C—N} \\    \\ \text{O} \\ \text{d) H}_3\text{N—COOH} \end{array}$
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11. The combination of 12 molecules of amino acids will lead to release of
  - a) 12 molecules of  $\text{H}_2\text{O}$
  - b) 24 molecules of  $\text{H}_2\text{O}$
  - c) 11 molecules of water
  - d) 6 molecules of water.
12. Find out the correct statement.
  - a) All proteins have three dimensional structure
  - b) All proteins are made up of similar number of amino acids.
  - c) All proteins have the same electrophoretic mobility
  - d) None of the above.
13. The property of protein depends upon.
  - a) Number and sequence of amino acids
  - b) Number of amino acids but not on their sequence
  - c) Sequence of amino acids but not their number
  - d) Neither on number nor on sequence of amino acids.

14. *The insoluble protein represented by hair, and fibroin of silk is*
- a) Histone                      b) Glutelin  
c) Scleroprotein              d) Prolamine.
15. *Which of the following protein structure is represented by helical coil and pleated sheet ?*
- a) Primary structure  
b) Secondary structure  
c) Tertiary structure  
d) Quaternary structure.
16. *A protein moves towards anode when subjected to electrophoresis*
- a) The protein has greater proportion of arginine and lysine  
b) The protein has greater proportion of aspartic acid and glutamic acid  
c) The protein is electrically neutral  
d) The protein has high molecular weight
17. *One of the following is not a protein group.*
- a) Myosin, Insuline, Pepsin  
b) Actin, Collagen, Trypsin  
c) Myoglobin, Ptylin, Renin  
d) Thyroxine, Estrogen, Androgen.
18. *Which of the following represents both globular and fibrous proteins ?*
- a) Actin filament              b) Myosin filament  
c) Collagen fibre              d) All of the above.
19. *The tertiary structure of protein is maintained by—*
- a) Hydrogen bond              b) Disulphide bond  
c) Electrostatic bond        d) All of the above.
20. *A Conjugated protein with metal as prosthetic group is*
- a) Heparin                      b) Haemoglobin  
c) Casien                        d) None of the above.
21. *When two leucines face each other in a tertiary structure, the expected interaction will be*
- a) Electrostatic interaction  
b) Disulphide bridge  
c) Hydrophobic interaction  
d) Hydrogen bonding
22. *How many peptide bonds will be formed in a protein of 150 amino acides ?*
- a) 75                              b) 150  
c) 149                            d) 151.
23. *Which of the following statement is true about a polypeptide chain formation ?*
- a) Number of water molecules released is equal to number of amino acids.  
b) Number of water molecules released is equal to peptide bonds.  
c) Number of water molecules released differ from number of peptide bonds.  
d) None of the above is correct.
24. *Which of the following group is a better storage product ?*
- a) Starch and glycogen  
b) Glucose and fructose  
c) Sucrose and maltose  
d) Glucose and lactose.
25. *The instant source of energy is*
- a) Protein                        b) Carbohydrate  
c) Fatty acid                    d) Glycerol.
26. *The Polyhydroxy aldehyde or ketone having hydrogen and oxygen in the ratio of water, is*
- a) Fat                              b) Wax  
c) Amino acid                  d) Glucose.
27. *The Carbohydrate found in genetic material is*
- a) Triose                         b) Hexose  
c) Pentose                        d) Cellulose.
28. *The Number of water molecules released in the formation of oligosaccharides, is equal to*
- a) Number of monosaccharides  
b) Number of monosaccharides minus one  
c) Number of monosaccharides plus one  
d) Number of monosaccharides minus number of hydrogen molecules
29. *Monosaccharides are*
- a) Straight chain compounds  
b) Ring chain compounds  
c) Isomeric compounds  
d) All of the above.

30. Ringed monosaccharides occur
- Only in pyranose form
  - Only in furanose form
  - In both pyranose and furanose form
  - None of the above.
31. The carbohydrate obtained from sea weeds and a good culture medium for bacteria is
- Pectin
  - Agar
  - Cellulose
  - Starch.
32. Chitin which forms a part of hard exoskeleton in Arthropods is
- Protein
  - Fat and protein
  - Carbohydrate and protein
  - A combination of all of the above.
33. Wax is
- Polysaccharide
  - Polypeptide
  - Monosaccharide
  - Triglyceride
34. Blubber which is found under the skin of whale is—
- Fat
  - Carbohydrate
  - Protein
  - A combination of all of the above.
35. Saponification is associated with
- Fat
  - Protein
  - Carbohydrate
  - Fatty acid.
36. Which of the following statement is correct
- All proteins are enzymes
  - All enzymes are proteins
  - All enzymes except some are proteins
  - None of the above are correct statements.
37. Which of the following is a correct statement ?
- Enzymes are specific to their substrate
  - Apoenzyme is the proteinous part of enzyme
  - Enzymes are denatured by change in three dimensional structure.
  - All of the above are correct.
38. Which of the following is not an attribute of enzyme. [NCERT 1976]
- They are proteinous in nature
  - They speed up the biochemical reactions
  - They are specific in nature.
  - They are used up in reaction.
39. The protein part of enzyme is called [BHU 1980]
- Apoenzyme
  - Holoenzyme
  - Prosthetic group
  - None of the above.
40. Michaelis constant is substrate concentration
- When enzyme velocity becomes half
  - When enzyme velocity is doubled
  - When enzyme action is stopped
  - When enzyme is denatured.
41. Enzymes lyases catalyse
- Linking of groups from substrate
  - Transfer of groups from substrate
  - Removal of groups from substrate
  - Conversion of groups from substrate.
42. A substrate analogue inhibits enzyme action. It explains
- Substrate specificity
  - Lock and key hypothesis of enzyme action
  - Enzyme specificity
  - More than one is correct.
43. The ratio of the enzyme to substrate molecule can be as high as [CPMT 1984]
- 1 : 1000,000
  - 1 : 100,000
  - 1 : 50,000
  - 1 : 1000
44. Glucose 1, 6 diphosphate is converted into fructose 1, 6 diphosphate. The enzyme which activates the reaction is
- Transferase
  - Isomerase
  - Ligase
  - Oxido-reductase
45. It is a trace element. It is found in vitamin B<sub>12</sub> which prevents anaemia. It is
- Zinc
  - Magnesium
  - Cobalt
  - Iron.

46. A person suffers from water and acid-base imbalance. It means he is lacking
- Water
  - Chlorine
  - Iodine
  - Manganese.
47. The high latent heat of water helps
- Storage of water in body
  - Maintenance of body temperature
  - Increase in body temperature
  - Decrease in body temperature.
48. A solution is identified to contain protein. The test is
- Molisch's test
  - Millon's test
  - Biuret test
  - More than one is correct.
49. Benedict's reagent is added to a given solution in test tube. When it is heated a red precipitate appears
- The solution contains carbohydrate
  - The solution contains protein
  - The solution contains fat
  - The solution contains both carbohydrate and protein.
50. Formation of fat begins in the body when  
[CPMT 1982]
- Blood sugar level is constant
  - Glucose is converted into glycogen
  - Muscle and liver cannot store more glycogen
  - Glucose combines with glycerol.
51. NAD is a
- Holoenzyme
  - Coenzyme
  - Apoenzyme
  - Allozyme.
52. Casein is
- Fat
  - Glycoprotein
  - Phosphoprotein
  - Lipoprotein.
53. Glucosamine is
- Acetylated amino acid
  - Acetylated glucose
  - Glucose and acetylated amino acid
  - Fatty acid and acetylated amino acid.
54. Mineral which is an important component of bone is
- Sulphur
  - Phosphorus
  - Iodine
  - Cobalt.
55. Substrate and enzyme combine with each other like lock and key. The statement refers to
- Fischer
  - Koshland
  - Morgan
  - De Vries
56. Mineral which play significant role in transmission of nerve impulse are
- Sodium and Potassium
  - Potassium and Calcium
  - Calcium and Sodium
  - Calcium and Magnesium.
57. Minerals required for proper muscle physiology are
- Phosphorus and Sulphur
  - Calcium and Magnesium
  - Sodium and Calcium
  - Chlorin and Flourine.
58.  $K_m = \frac{1}{2} V_{max}$  shows relationship between
- Enzyme concentration and substrate concentration
  - Substrate concentration and enzyme action
  - Enzyme action and product concentration
  - Substrate and product concentration.
59. Which is not true about protein
- Protein is soluble
  - Protein is insoluble
  - Protein is contractile
  - Protein is double helix.
60. Enzyme action can be stopped by
- High temperature
  - Competitive inhibitor
  - Allosteric modulation
  - More than one of the above
  - All of the above.
61. The substrate that enters first in the energy chain is
- Protein
  - Carbohydrate
  - Fat
  - Mineral

62. *The structural carbohydrate is*  
a) Chitin  
b) Cellulose  
c) Starch  
d) More than one of the above.
63. *The protein found in cereals is*  
a) Globulins                      b) Glutelins  
c) Histones                        d) Albumins.
64. *Diabetes mellitus is due to absence of a*  
a) Protein                         b) Carbohydrate  
c) Fat                                d) Minerals.
65. *The percentage of carbon in protein is about*  
a) 25%                                b) 30%  
c) 55%                                d) 70%
66. *The element which is responsible for transport of gases is*  
a) Phosphorus                      b) Iodine  
c) Magnesium                        d) Copper.
67. *The element which is constituent of energy coin is*  
a) Calcium                         b) Zinc  
c) Phosphorus                      d) Cobalt.
68. *The metabolic activity of nervous tissue can be maintained by*  
a) Nickel                             b) Lithium  
c) Zinc                                d) Phosphorus.
69. *Which of the following is not a macromolecule*  
a) Polypeptide                      b) Polysaccharide  
c) Triglyceride                      d) None of the above.
70. *The carbohydrate insoluble in water, is*  
a) Glucose                          b) Maltose  
c) Sucrose                          d) Cellulose.
71. *Energy can be readily obtained from.*  
a) Glucose                          b) Starch  
c) Maltose                          d) Egg.