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UNIT
02

Chemical and Cellular Basis of Life
Lipids

SAMPATH
LANKADHEERA

B.Sc. (Hons), M.Sc.

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SAMPATH LANKADHEERA

Unit 02 Chemical and Cellular Basis of Life
Lipids

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Biology

Unit - 02

Chemical and Cellular Basis of Life

o Lipids

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**Unit
02**

Chemical and Cellular Basis of Life
○ Lipids

Smart Note

SAMPATH LANKADHEERA

B.Sc. Hons. M.Sc. (Biotechnology)

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Lipids

- Diverse group of hydrophobic molecules
- Large biological molecules but not considered as polymers or macromolecules.
- Consist of C, H, O and H:O ratio is not 2:1. Comparatively more H are present.
- Biologically important types of lipids: Fats, Phospholipids and Steroids.





Fats

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- Hydrocarbon chains of fatty acids contribute to the hydrophobic nature of the fats.
- Based on the nature of hydrocarbon chains of fatty acids, they are categorized as

a) Saturated fats-

- fats are made up of saturated fatty acids: fatty acids with hydrocarbons having no any double bonds.
- Usually animal fats come under this category.
- They are mostly solid at room temperature. Eg: Butter

(a) Saturated fat

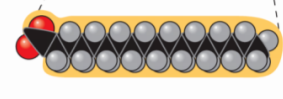
At room temperature, the molecules of a saturated fat, such as the fat in butter, are packed closely together, forming a solid.



Structural formula of a saturated fat molecule (Each hydrocarbon chain is represented as a zigzag line, where each bend represents a carbon atom and hydrogens are not shown.)

CCCCCCCCCCCCCCCC(=O)OCCCCCCCCCCCCCCCC(=O)OCCCCCCCCCCCCCCCC(=O)O

Space-filling model of stearic acid, a saturated fatty acid (red = oxygen, black = carbon, gray = hydrogen)




b) Unsaturated fats-

- fats are made up of unsaturated fatty acids- fatty acids with hydrocarbons having one or more double bonds.
- Usually plant fats come under this category. They are mostly liquid in room temperature. Eg: vegetable oils.

(b) Unsaturated fat

At room temperature, the molecules of an unsaturated fat such as olive oil cannot pack together closely enough to solidify because of the kinks in some of their fatty acid hydrocarbon chains.

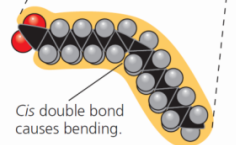


Structural formula of an unsaturated fat molecule

CCCCCCCC=CCCCCCCC(=O)OCCCCCCCC=CCCCCCCC(=O)OCCCCCCCC=CCCCCCCC(=O)O

Space-filling model of oleic acid, an unsaturated fatty acid

Cis double bond causes bending.



- Unsaturated fats may classify based on the nature of their double bonds.
 - Cis* Unsaturated fat
 - Trans* Unsaturated fat
- Consumption of excess saturated fats and trans unsaturated fats contribute atherosclerosis.

Phospholipids

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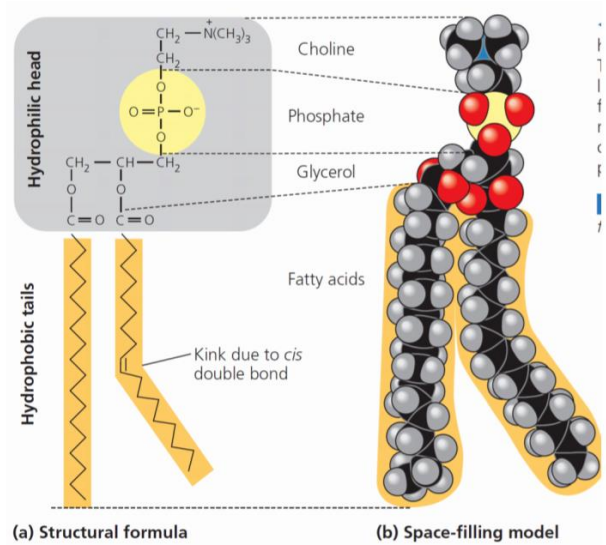
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Functions of Lipids

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Tests for Lipids

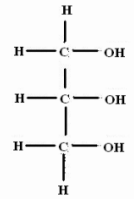
1. Sudan Test



- Sudan III and Sudan IV are red dyes in alcoholic solutions.
- Soudan III and Soudan IV are red dyes.
- Add 2ml of oil to 2ml of water present in a test tube and add few drops of the Sudan reagent and shake.
- Red coloured oil layer separate from the solution.
- If lipids absent shining globules will not appear and the solution will turn to pink colour.
- Take a thin section of a tissue add Sudan reagent and observe under the microscope.

MCQ

- Which of the following is incorrect regarding lipids?
 (1) Soluble in organic solvents. (2) Act as energy reserves. (3) Proportion of H: O: is 2: 1.
 (4) Testosterone and estrogen are lipids. (5) Composed, C, H and O.
- The following molecule is released after hydrolysis of,
 (1) Carbohydrates (2) Proteins (3) Lipids (4) DNA (5) ATP
- Which of the following statement is correct regarding fats and oils?
 (1) H:O ratio is 2:1. (2) Abundant component in cell wall. (3) Rapidly digested by invertase.
 (4) They present in the endospermic of seeds.
 (5) When used as respiratory substrates they release more CO₂ than the absorbed O₂. (95/Bot)
- Which of the following statement in incorrect regarding lipids?
 (1) They are insoluble in water. (2) They are composed of C, H and O. (3) They are polymer substances.
 (4) They form an essential component of cell membrane. (5) They are some time used as respiration substrate. (95/Bot)
- Which one of the following statements about lipids is incorrect?
 (1) They are soluble in organic solvents. (2) They are composed mainly of C, H, and O
 (3) They function as energy reservoirs. (4) The ratio of H; O; in a lipid molecule is 2:1.
 (5) Testosterone and estrogen are lipids. (93/zoo)
- Which of the following statement about lipid is correct
 (1) Lipids are macromolecules consisting C, H and O
 (2) Each hydrocarbon chain of saturated fat contain one double bond.
 (3) When fats are formed glycerol and fatty acids are joined by glycosidic bonds.
 (4) H to O ratio of lipids are higher than 2: 1 ratio.
 (5) Two phosphate groups are present in a phospholipid molecule.



Structured

- Why lipids are not considered as polymers.

- What are lipids involve in following functions.
 Stored food -
 Hormones -
 Vitamins -
- What is the benefit of storing lipids as a stored food than carbohydrates

- What are structures formed by lipids and state the type of lipid

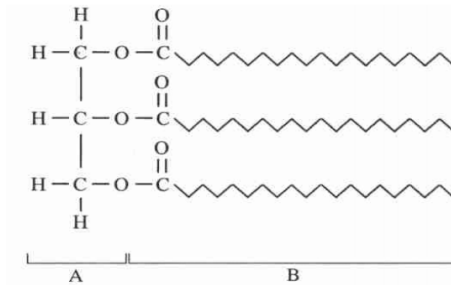
Structure	Lipid type



11. Fill following table

Lipid	Only in animals	Only in plants	Plants and animals
Fat			
Phospholipid			
Steroids			
Cutin			
Suberin			
Wax			

12. Answer questions based on the molecule given below.



(i) Name parts labeled as A and B

A -
 B -

(ii) Name this type of lipids.

.....

(iii) Name the chemical reaction used to form bond between A and B.

.....

(iv) State one function of this type of lipid in living organisms

.....

(v) State one feature of the molecule of this type of lipid which make them suitable for the function you have mentioned.

.....



Lined writing area with 30 horizontal dotted lines for student responses.




Giving suitable examples, write an account of the basic chemical features and biological functions lipids.

Answer : Model

1. Lipids are diverse group of hydrophobic molecules
2. Large biological molecules but not considered as polymers or macromolecules.
3. Consist of C, H, O and H:O ratio is not 2:1. Comparatively more H are present.
4. Biologically important types of lipids: Fats
5. Phospholipids
6. Steroids.
7. Fats are made up of glycerol and fatty acids;
8. Glycerol belongs to alcohol group having 3 carbons where each of them bear single hydroxyl group.
9. Fatty acids are hydrocarbon chains with long (16-18) carbon skeleton with a carboxyl group at its one terminal.
10. Acid part of the molecule is polar and the long hydrocarbon chain is non polar.
11. Fatty acid molecules bind to each hydroxyl group of glycerol by ester bond.
12. Resulting fat molecules are called as triacylglycerol.
13. Hydrocarbon chains of fatty acids contribute to the hydrophobic nature of the fats.
14. Based on the nature of hydrocarbon chains of fatty acids, they are categorized as
15. Saturated fats and Unsaturated fats.
16. Saturated fats are fats made up of saturated fatty acids: fatty acids with hydrocarbons having no double bonds.
17. Usually animal fats come under this category.
18. They are mostly solid at room temperature.
19. e.g: butter.
20. Unsaturated fats are fats made up of unsaturated fatty acids - fatty acids with hydrocarbons having one or more double bonds.
21. Usually plant fats come under this category.
22. They are mostly liquid in room temperature.
23. eg: Vegetable Oils.
24. Unsaturated fats may classify based on the nature of their double bonds.
25. a) *Cis* Unsaturated fat
26. b) *Trans* Unsaturated fat
27. Phospholipids
28. Phospholipids are major components of the cell membranes.
29. They are composed of two fatty acids and one phosphate group attached to one glycerol molecule.
30. The phosphate group gives the negative electrical charge to the phospholipid molecule.
31. Typically an additional polar molecule or small charged molecule is also linked to the phosphate group
32. eg. choline.
33. The two ends of the phospholipids show different behavior.
34. The hydrocarbon tails are hydrophobic while phosphate group and its attachment (head) are hydrophilic.
35. Steroids
36. Steroids are an important structural lipid present in cells and cell membranes.
37. Biological Functions of Lipids, Food reserve as energy source (triglycerides such as fats and oils)
38. Maintain the fluidity of plasma membrane (phospholipids, cholesterol)
39. They act as signaling molecules (eg: Hormones) that travel through the body
40. Found as components of animal cell membrane (cholesterol)



 sampath lankadheera

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