Biochemistry lectures

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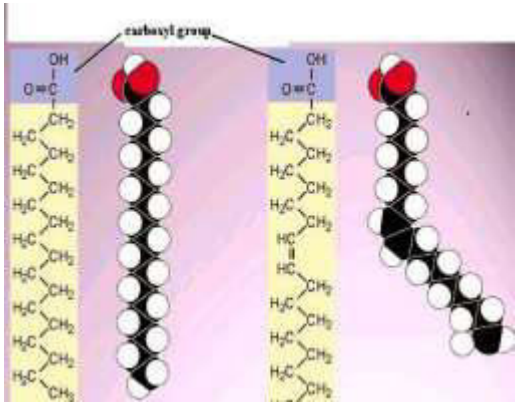

Classification of Lipids and Fatty Acids

Biochemistry for medics

➢ Objectives

- Know the types of lipids
- Know the structure, function, classification and clinical importance of lipids

REFERENCES

1. Lehninger Principle of Biochemistry, 4th ed. 2005.
2. Lippincott's Reviews of Biochemistry, 3rd ed. , 2018.
3. General , Organic , and Biological Chemistry, 5th edition , H. Stephen Stoker, 2010.

lipids

❖lipids are a heterogeneous group of compounds, including fats, oils, steroids, waxes, and related compounds, that are related more by their physical than by their chemical properties.

❖They have common properties :

(1) relatively insoluble in water and

(2) soluble in nonpolar solvents such as ether and chloroform.

Functions of lipids

- Storage form of energy
- Important dietary components because of their high energy value and also because of the fat-soluble vitamins and the essential fatty acids contained in the fat of natural foods.
- Structural components of biomembranes
- Serve as thermal insulators in the subcutaneous tissues and around certain organs
- Nonpolar lipids act as electrical insulators, allowing rapid propagation of depolarization waves along myelinated nerves

Functions of lipids (Contd)

- Provide shape and contour to the body
- Act as metabolic regulators
- Combinations of lipid and protein (lipoproteins) are important cellular constituents, occurring both in the cell membrane and in the mitochondria, and serving also as the means of transporting lipids in the blood.

Classification of lipids

1-Simple lipids: Esters of fatty acids with various alcohols.

a. Fats: Esters of fatty acids with glycerol. Oils are fats in the liquid state.

b. Waxes: Esters of fatty acids with higher molecular weight monohydric alcohols.

Classification of lipids(Contd)

2. Complex lipids: Esters of fatty acids containing groups in addition to an alcohol and a fatty acid.

a. Phospholipids: Lipids containing, in addition to fatty acids and an alcohol, a phosphoric acid residue. They frequently have nitrogen-containing bases and other substituents, eg, in glycerophospholipids the alcohol is glycerol and in sphingophospholipids the alcohol is

sphingosine.

b. Glycolipids (glycosphingolipids): Lipids containing a fatty acid, sphingosine, and carbohydrate.

c. Other complex lipids: Lipids such as sulfolipids and aminolipids. Lipoproteins may also be placed in this category.

Classification of lipids(Contd)

3) Precursor and derived lipids: These include-
fatty acids
glycerol
steroids
other alcohols
fatty aldehyde
ketone bodies
hydrocarbons, lipid-soluble vitamins, and hormones.

FATTY ACIDS

- Fatty acids are aliphatic carboxylic acids
- Have the general formula R-(CH2)n-COOH
- They occur mainly as esters in natural fats and oils but do occur in the unesterified form as free fatty acids, a transport form found in the plasma.
- Fatty acids that occur in natural fats are usually straight-chain derivatives containing an even number of carbon atoms.
- The chain may be saturated (containing no double bonds) or unsaturated (containing one or more double bonds).

Classification of Fatty Acids

Fatty acids can be classified in many ways-

1) According to nature of the hydrophobic Chain

a) Saturated

b) Unsaturated

c) Branched chain fatty acids

d) Substituted Fatty acids

Saturated fatty acids do not contain double bonds, while unsaturated fatty acids contain double bonds

Biological Importance (functions) of Fatty Acids

1-Fatty acids are the building blocks of dietary fats. The human body stores such fats in the form of triglycerides.

2)- Fatty acids are also required for the formation of membrane lipids such as phospholipids and glycolipids.

3) -They are required for the esterification of cholesterol to form cholesteryl esters.

4) They act as fuel molecules and are oxidized to produce energy.

Biological roles of Fatty Acids

- **Acts as fuel in the body.** (caloric value: 9 Kcals/gm)
- Deposits of fats underneath the skin = exert **insulating effects.**
- The mesenteric fat around organs (kidney) = **padding and protecting internal organs.**
- **Building materials.** (cholesterol – hormone synthesis)

Biological roles of Fatty Acids

- **Lipids supply the essential fatty acids** which cannot be synthesized in the body..
- The **Nervous system** is particularly rich in lipids.
- **Vitamins A, D, E and K are fat soluble.**

(lipid/fat is needed for absorbing these vitamins)

- **Lipoproteins and phospholipids** are important constituents of cell wall & mitochondria.

Biological roles of Fatty Acids

- **Adult:** ingests 60-150g of lipids per day of which 90% is triacylglycerol (TAG).
- **Balance:** cholesterol, cholesteryl, esters, phospholipids and free fatty acids (FFA)

TYPES OF FATTY ACIDS
(according to the number of double bonds)

Saturated (No bond)

Monounsaturated (1 bond)

Polyunsaturated (>1 bond)

Clinical significance of lipids

- Following diseases are associated with
- abnormal chemistry or metabolism of lipids-
- Obesity
- Atherosclerosis
- Diabetes Mellitus
- Hyperlipoproteinemia
- Fatty liver
- Lipid storage diseases

We hope to reach with you for useful and appropriate information

Best regards