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COURSE TITLE: CLINICAL BIOCHEMISTRY AND XENOBIOTICS

Answer

1. No, Vitamin C is not a coenzyme but functions as a cofactor in many enzymatic reactions in the body that mediate a variety of essential biological functions. They include;

1) Steroid synthesis: In adrenal cortex, vitamin C is involved in the hydroxylation reactions of steroids.

2) Adrenaline synthesis: In adrenal medulla it serves as a reducing agent in hydroxylation reactions in the synthesis of adrenaline and noradrenaline from tyrosine.

3) Vitamin C aids in the hydroxylation of γ-butyrobetaine to carnitine.

4) Bile acid formation: Vitamin C is required for the hydroxylation of cholesterol in bile acid synthesis to 7 alpha hydroxylase.

5) Degradation of tyrosine: The oxidation of p hydroxyphenylpyruvate to homogentisate requires vitamin C which is catalyzed by homogentisate oxidase, which is a ferrous ion containing enzyme that also requires vitamin C.

6) Folate metabolism: Folic acid is converted to its active form tetrahydrofolate (THF) with the help of vitamin C.

2. Chemistry of phospholipids

Phospholipids is a type of complex lipid, they are made up of fatty acid, glycerol or other alcohol, phosphoric acid and nitrogenous base. Phospholipids are the major lipid constituents of cell membranes and like fatty acids, phospholipids are amphipathic in nature, i.e. each has a hydrophilic or polar head (phosphate group) and a long hydrophobic tail (containing two fatty acid chains).

There are two classes of phospholipids:

1) Glycerophospholipids or phosphoglycerides: they contain glycerol as the alcohol. They are phospholipids derived from glycerol where the hydroxyl groups at C1 and C2 of glycerol are esterified with two fatty acids. The C3 hydroxyl group of the glycerol is esterified to phosphoric acid and resulting compound called, phosphatidic acid. Phosphatidic acid is a key intermediate in the biosynthesis of other glycerophospholipids. In glycerophospholipid, phosphate group of phosphatidic acid becomes esterified with the hydroxyl group of one of the several nitrogen base or other groups.

Glycerophospholipids are divided into seven types:

1) Phosphatidylcholine (lecithin)

2) Cardiolipin (Diphosphatidylglycerol)

3) Lysophospholipids

4) Phosphatidylserine

5) Phosphatidylethanolanine (Cephalin)

6) Phosphatidylinositol

7) Plasmalogens

2) Sphingophospholipids: they contain sphingosine as the alcohol. They are Phospholipids derived from alcohol sphingosine instead of glycerol e.g. sphingomyelin.

Sphingomyelin is the only phospholipid in membranes that is not derived from glycerol. Instead, the alcohol in sphingomyelin is sphingosine, an amino alcohol. In sphingomyelin, the amino group of the sphingosine is linked to a fatty acid to yield ceramide (sphingosine fatty acid complex) whereby, the primary hydroxy group of sphingosine is esterified with phosphorylcholine. Sphingomyelin is one of the principal structural lipids of membranes of nerve tissue.

Functions of Phospholipids

1) Phospholipids are the major lipid constituents of cell membranes.

2) They regulate permeability of membranes as well as activation of some membrane bound enzymes.

3) Phospholipids aid in insulating the nerve impulse (like the plastic or rubber covering around an electric wire) from the surrounding structures, e.g. sphingomyelins act as electrical insulators in the myelin sheath around nerve fibers.

4) Phospholipids are important constituents of lipoproteins.

5) Phospholipids act as a lipotropic factor. Lipotropic factor is the component that prevents fatty liver, i.e. accumulation of fat in the liver.

6) These are good emulsifying agentsthat help in intestinal absorption of lipids.

3. Differences between phospholipids and glycolipids

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| Phospholipids | Glycolipids |
| 1. Phospholipids are Lipids containing, in addition to fatty acids and an  Alcohol (glycerol or sphingosine), a phosphoric acid residue. | While glycolypids are Lipids containing fatty acid, alcohol sphingosine and  Additional residues are carbohydrates with nitrogen base. |
| 2. They contain phosphate group | They do not contain phosphate group |
| 3. They are the major lipid constituents of cell membranes. | They are important constituents of the nervous tissue, such as brain and outer leaflet of all cell membrane. |
| 4. In phospholipids, the hydroxyl groups at C1 and C2 of glycerol are esterified with two fatty acids and the C3 hydroxyl group of the glycerol is esterified to phosphoric acid and resulting compound called, phosphatidic acid. | While the amino group of sphingosine is esterified by a  Fatty acid and one or more sugar units are attached to the hydroxyl group of sphingosine. |