

UNIT – 3

Lipid Metabolism: An Introduction

- Lipid metabolism encompasses the processes of synthesis, storage, and utilization of lipids in the body, including fats and oils.

β -Oxidation of Saturated Fatty Acid (Palmitic Acid):

- **Pathway:** β -Oxidation is a catabolic pathway that occurs in the mitochondria.
- **Mechanism:** During β -oxidation, palmitic acid (a 16-carbon saturated fatty acid) is broken down into acetyl-CoA units through a series of reactions.
- **Significance:** This process generates energy and is essential for the metabolism of fatty acids.

Formation and Utilization of Ketone Bodies; Ketoacidosis:

- Ketone bodies, including acetoacetate and β -hydroxybutyrate, are produced from excess acetyl-CoA.
- Ketone bodies serve as an alternative energy source, especially during periods of fasting or low carbohydrate intake.
- Ketoacidosis is a condition where excess ketone bodies accumulate in the blood, leading to a decrease in blood pH.

De Novo Synthesis of Fatty Acids (Palmitic Acid):

- De novo synthesis of fatty acids occurs mainly in the liver.
- It involves the conversion of acetyl-CoA to palmitic acid (a 16-carbon saturated fatty acid) through a series of enzymatic reactions.
- This process is essential for the synthesis of fats for energy storage and structural components.

Biological Significance of Cholesterol:

- Cholesterol is a lipid molecule that is crucial for the formation of cell membranes and the synthesis of steroid hormones, vitamin D, and bile acids.
- It plays a vital role in maintaining membrane fluidity and is involved in various physiological processes.

Conversion of Cholesterol into Bile Acids, Steroid Hormones, and Vitamin D:

- Cholesterol is converted into primary bile acids in the liver, which are essential for the emulsification and absorption of dietary fats.
- In the skin, cholesterol is converted to vitamin D in response to sunlight exposure.
- Cholesterol is a precursor for the synthesis of steroid hormones, including cortisol, aldosterone, and sex hormones.

Disorders of Lipid Metabolism:

- **Hypercholesterolemia:** This condition is characterized by elevated levels of cholesterol in the blood and is a risk factor for atherosclerosis and heart disease.
- **Atherosclerosis:** Atherosclerosis is the buildup of plaque in the arteries due to the accumulation of cholesterol and other lipids.
- **Fatty Liver:** Fatty liver, or hepatic steatosis, is the accumulation of fat in liver cells, often due to excessive alcohol consumption or obesity.
- **Obesity:** Obesity is characterized by an excess accumulation of body fat, often resulting from an imbalance between energy intake and expenditure.

Amino Acid Metabolism: An Overview

- Amino acid metabolism encompasses the processes of biosynthesis and catabolism of amino acids.

General Reactions of Amino Acid Metabolism:

- **Transamination:** Amino acids are converted into their corresponding α -keto acids through the transfer of amino groups. This is a reversible reaction.
- **Deamination:** Removal of the amino group from an amino acid, yielding an α -keto acid and ammonia.
- **Decarboxylation:** Removal of the carboxyl group from an amino acid, yielding an amine.
- **Urea Cycle:** A series of reactions in the liver that converts ammonia into urea, a less toxic compound, which is then excreted in urine.

Catabolism of Phenylalanine and Tyrosine:

- **Phenylalanine:** Converted into tyrosine through hydroxylation.
- **Tyrosine:** Can be further catabolized to produce energy and precursors for various molecules, including catecholamines (dopamine, noradrenaline, adrenaline).
- **Metabolic Disorders:** Phenylketonuria (PKU) results from phenylalanine hydroxylase deficiency, leading to phenylalanine accumulation. Tyrosinemia can result from defects in enzymes of tyrosine catabolism.

Synthesis and Significance of Biological Substances:

- **5-HT (Serotonin):** A neurotransmitter involved in mood regulation and other functions.
- **Melatonin:** A hormone that regulates sleep-wake cycles.
- **Dopamine, Noradrenaline, Adrenaline:** Catecholamines with various roles in the nervous system, stress response, and more.

Catabolism of Heme:

- Heme is a component of hemoglobin and myoglobin.

- Heme catabolism in the liver leads to the formation of biliverdin, which is then converted to bilirubin and excreted in bile.

Hyperbilirubinemia and Jaundice:

- Hyperbilirubinemia is the accumulation of excess bilirubin in the blood.
- Jaundice is a yellowing of the skin and eyes due to elevated bilirubin levels.
- This can result from various conditions, including liver disease and hemolytic anemias.

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