BIOCHEMISTRY- BP203T

UNIT: 1 METABOLISM OF CARBOHYDRATES

CLASS:1

TOPIC: CARBOHYDRATE METABOLISM

METABOLISM OF CARBOHYDRATES

¬ Hundreds of reactions simultaneously take place in a living cell, in a well-organized and integrated manner. The entire spectrum of chemical reactions occurring in the living system, is collectively referred to as metabolism.

A metabolic pathway (or metabolic map) constitutes a series of enzymatic reactions to produce specific products. The term metabolite is applied to a substrate or an intermediate or a product in the metabolic reactions. Metabolism is broadly divided into two categories:

1. CATABOLISM:

¬ The degradative processes are concerned with the breakdown of complex molecules to simpler ones, with a concomitant release of energy. ¬ The very purpose of catabolism is to trap the energy of the biomolecules in the form of ATP and to generate the substances (precursors) required for the synthesis of complex molecules.

2. ANABOLISM:

¬ The biosynthetic reactions involving in the formation of complex molecules from simple precursors. For the synthesis of a large variety of complex molecules, the starting materials are relatively few. These include pyruvate, acetyl-CoA CoA and the intermediates of the citric acid cycle. Besides the availability of precursors, the anabolic reactions are dependent on the supply of energy (as ATP or CTP) and reducing equivalents. The anabolic and catabolic pathways are not reversible and operate independently. As such, the metabolic pathways occur in specific

cellular locations (mitochondria, microsomes, etc.) and are controlled by different regulatory signals.

Energy metabolism deals with the metabolic pathways concerned with the storage and liberation of energy.

CARBOHYDRATES:

¬ Carbohydrates are the major source of energy for living cells. As such, carbohydrates are the first cellular constituents, synthesized by green plants during photosynthesis from carbon dioxide and water, on absorption of light.

¬ Thus, light is the ultimate source of energy for all biological processes.

¬ The monosaccharide glucose is the central molecule in carbohydrate metabolism since all the major pathways of carbohydrate metabolism are connected with it.

¬ Glucose is utilized as a source of energy; it is synthesized from non-carbohydrate precursors and stored as glycogen to release glucose as and when the need arises.

¬ The fasting blood glucose level in normal individuals is 70-100mg/dl (4.5-5.5mmol/)) and it is very efficiently maintained at this level.

¬ Liver plays a key role in monitoring and stabilizing blood glucose levels. Thus, the liver may be appropriately considered as a glucostat monitor.

Carbohydrate metabolism refers to the various biochemical processes responsible for the formation, breakdown, and interconversion of carbohydrates in living organisms. Carbohydrates are one of the primary sources of energy for the body, and their metabolism plays a crucial role in maintaining energy balance.

1. **Carbohydrates as Energy Sources**
   Carbohydrates are broken down into simple sugars, primarily glucose, which is then used to produce ATP (adenosine triphosphate)—the energy currency of cells.

2. **Main Processes of Carbohydrate Metabolism**

   - **Glycolysis**: The breakdown of glucose to pyruvate, producing a small amount of ATP and NADH.

- **Gluconeogenesis**: The synthesis of glucose from non-carbohydrate sources (e.g., amino acids, lactate).
- **Glycogenesis**: The formation of glycogen (storage form of glucose) from glucose.
- **Glycogenolysis**: The breakdown of glycogen back into glucose.
- **Pentose Phosphate Pathway (PPP)**: Produces NADPH and ribose-5-phosphate for anabolic reactions and nucleotide synthesis.
- **Citric Acid Cycle (TCA/Krebs Cycle)** and **Oxidative Phosphorylation**: Further oxidation of glucose derivatives to generate large amounts of ATP.

3. **Hormonal Regulation**
   Carbohydrate metabolism is tightly regulated by hormones:
   - **Insulin**: Promotes glucose uptake, glycolysis, and glycogenesis.
   - **Glucagon** and **Epinephrine**: Stimulate glycogenolysis and gluconeogenesis during fasting or stress.
4. **Physiological Importance**
   - Maintains blood glucose levels.
   - Provides energy to tissues, especially the brain and red blood cells.
   - Supports biosynthetic processes through intermediate metabolites.

Carbohydrate metabolism is a dynamic and adaptable system that responds to dietary intake, energy demands, and hormonal signals to sustain life and health.