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B.Sc. Part III (Hons) Zoology

Paper V, Gr-I,

Metabolism of Carbohydrate: glycogenesis (Part-I)

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Introduction :- Glycogen is a storage fuel that plays its role specially in situations of exceptional glucose demand. Liver and muscles are the major tissues storing glycogen, although liver stores a larger concentration of glycogen (8% - 10% of its weight) than muscles (1 - 2%) of muscle weight. The total amount of glycogen in liver is about half to that in muscle because of higher muscular mass. Glycogen is stored in the cytosol of hepatocytes and myocytes in the form of granules, whose mol. wt. ranges from 6×10^6 to 1.6×10^6 KD. These granules also contain enzymes for glycogenesis, glycogenolysis and glycolysis. After every meal, glycogen deposits in the Liver increase manyfold

and after long deprivation of food i.e. during fasting, hunger and Starvation, glycogen deposits deplete to zero. Hepatic portal veins that transport digested food and substances from small intestine to liver also transports all the glucose molecules to liver. The required amount of glucose is released to the blood circulation via hepatic vein; ~~Colon~~, the rest is converted to glycogen by a process called glyco-genesis. During fasting or under starvation, blood glucose level declines and glycogen deposits of liver undergoes breakdown by a process called glycogenolysis and glucose molecules are released into hepatic vein for restoration of blood glucose level, virtually entire glycogen gets depleted after 24 hrs of fasting. However, muscle glycogen is not used for maintaining blood glucose level. Muscles lack the enzyme glucose-6-Phosphatase; ~~Cat~~ hence free glucose is not generated from muscle glycogen. Muscle glycogen is used very fast during strenuous muscular activity. Red muscles having abundance of mitochondria

myoglobin and blood supply are found in flight muscles of birds. They use glycogen for the production of Adenosine TriPo4, gensiting C_2 and H_2O. Oxidation through mitochondrial Electron T. chain System. However, white muscles (found in breast muscles of chicken) having little mitochondria, blood System and myoglobin, use glycogen very fast, through glycolytic oxidation during brisk muscular activities and generate ATP and lactate but no C_2 and H_2O. Skeletal muscles of our body possesses both white and red muscles and are suitable for intense muscular activities for shorter duration and sustained muscular activities for longer duration. Glycogen deposits are restored when muscles come to rest.

Process of glycogenesis

Glycogenesis comprises Five steps of Reactions, beginning with phosphorylation of glucose.

1 **Phosphorylation of glucose:** - Similar to the first step in glycolysis, in glycogenesis too, glucose is phosphorylated to glucose-6-Poy by

the Enzyme Glukokinase in liver. (Hexokinase in other tissues). The phosphorylation uses energy and Poy of ATP in the presence of Mg^{++}. The reaction is irreversible.

2. Conversion of Glucose-6-Poy to Glucose-1-Poy — The conversion of glucose-6-Poy to Glucose-1-Poy involves shifting of Poy C-6 to C-1 of phosphoglucose by the enzyme phosphoglucomutase.

3. Formation of UDP glucose :- In this step, glucose-1-Poy reacts with UTP by the action of enzyme UDP-glucose Pyrophospho-rylase (also called glucose-1-Poy Uridyl transferase). Glucose-1-Poy replaces β and γ Poy of UTP as PyroPoy and itself get linked to α-Poy by a Phosphoester bond forming UDPglucose also called Active glucose although this reaction is reversible, it is pulled forward by the enzyme Pyrophosphorylase, which removes PyroPoy by degrading it to two free Poyes. UDP glucose possesses large negative free energy and is donor of glucose unit of glycogen. (contd)