

Lecture 21

Pentose Phosphate Pathways, Glycogenesis & Glycogenolysis

1. Discuss the role of glycogen synthase in glycogen synthesis?

Answer: Glycogen synthase (UDP-glucose-glycogen glucosyltransferase) is an enzyme involved in converting glucose to glycogen. It takes short polymers of glucose and converts them into long polymers.

It is a glycosyltransferase enzyme that catalyses the reaction of UDP-glucose and (1,4- α -D-glucosyl)_n to yield UDP and (1,4- α -D-glucosyl)_{n+1}.

In other words, this enzyme converts excess glucose residues one by one into a polymeric chain for storage as glycogen. Its presence in the bloodstream is highest in the 30 to 60 minutes following intense exercise. It is a key enzyme in glycogenesis.

2. What is the fate of lactate generated in muscle after vigorous exercise?

Answer: After vigorous exercise oxygen content in the blood is reduced and partially anaerobic condition is generated. Under this anaerobic condition in the erythrocytes pyruvate is converted to lactate by the enzyme lactate dehydrogenase (LDH), and the lactate is transported out of the cell into the circulation. The conversion of pyruvate to lactate, under anaerobic conditions, provides the cell with a mechanism for the oxidation of NADH (produced during the glyceraldehyde 3 phosphate dehydrogenase reaction) to NAD⁺ which occurs during the Lactate dehydrogenase catalyzed reaction. This reduction

is required since NAD^+ is a necessary substrate for glyceraldehyde 3 phosphate dehydrogenase, without which glycolysis will cease.

3. Which enzyme is responsible for the branching to form glycogen?

Answer: α -1-6-amyloglucosidase

4. Which of the following generates free glucose during the enzymatic breakdown of glycogen in skeletal muscle?

- (a) phosphorylase
- (b) debranching enzyme
- (c) α -1-6-amyloglucosidase
- (d) amylase
- (e) glucose-6-phosphatase

Answer: α -1-6-amyloglucosidase

5. The metabolic function of the pentose phosphate pathway is:

- A) Act as a source of ADP biosynthesis.
- B) Generate NADPH and pentoses for the biosynthesis of fatty acids and nucleic acids.
- C) Participate in oxidation-reduction reactions during the formation of H_2O .
- D) Provide intermediates for the citric acid cycle.
- E) Synthesize phosphorus pentoxide.

Answer: generate NADPH and pentoses for the biosynthesis of fatty acids and nucleic acids.