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MATRIC NUMBER: 18/MHS04/005

DEPARTMENT: HUMAN NUTRITION AND DIETETICS

COURSE TITLE: HUMAN BIOCHEMISTRY AND NUTRITION II

LECTURER: DR AUSTIN

COURSE CODE: NTD 206

ASSIGNMENT:

1) DESCRIBE THE GLYCOLYTIC PATHWAY

2) COMPUTE THE STOICHIOCHEMISTRY OF COENZYME REDUCTION AND ATP FORMATION IN THE AEROBIC OXIDATION OF GLUCOSE VIA GLYCOLYSIS, THE PYRUVATE DEHYDROGENASE COMPLEX REACTION, THE CITRIC ACID CYCLE, AND OXIDATIVE PHOSPHORYLATION USING 1 NADH = 3ATP, 1 FADH = 2ATP

ANSWER:

1. **THE GLYCOLYSIS PATHWAY**

In glycolysis (Embden-Meyerhof pathway), a molecule of glucose is degraded in a series of enzyme-catalyzed reactions to yield two molecules of the three-carbon compound, pyruvate.

During the sequential reactions of glycolysis, some of the free energy released from glucose is conserved in the form of ATP and NADH.

Glycolysis has two phases: The preparatory phase (1) and The pay off phase.

* ***Preparatory phase* (1):**

The breakdown of the six-carbon glucose to two molecules of the three-carbon pyruvate, which occurs in first ten steps, the first five of which constitute the *preparatory phase* (1).

1. Glucose is first phosphorylated at the hydroxyl group on C-6.
2. The D-glucose 6-phosphate thus formed is converted to D-fructose 6-phosphate.
3. (2) is again phosphorylated, this time at C-1, to yield D-fructose 1, 6-bisphosphate. For both phosphorylations, ATP is the phosphoryl group donor.
4. Fructose 1,6-bisphosphate is split to yield two three-carbon

molecules, dihydroxyacetone phosphate and glyceraldehyde 3-phosphate.

1. The dihydroxyacetone phosphate is isomerized to a second molecule of glyceraldehyde 3-phosphate.

NB: Two molecules of ATP are put in before the cleavage of glucose into two three-carbon pieces; later there will be a good return on this investment.

The energy gain comes in the pay off phaseof glycolysis.

* **The pay off phase:**

1. Each molecule of glyceraldehyde 3-phosphate is oxidized and phosphorylated by inorganic phosphate (notby ATP) to form 1,3-bisphosphoglycerate.
2. Energy is then released as the two molecules of 1,3- pyruvate (steps 7 through 10).

* Much of this energy is conserved by the coupled phosphorylation of four molecules of ADP to ATP.
* The net yield is two molecules of ATP per molecule of glucose used, because two molecules of ATP were invested in the preparatory phase.
* Energy is also conserved in the payoff phase in the formation of two molecules of NADH per molecule of glucose.
* All the reaction steps takes place in the cytoplasm.

SIGNIFICANCE OF GLYCOLYTIC PATHWAYS

1. It is the only pathway that is taken place in all the cells of the body.
2. In red blood cell, Glycolysis is the only source of energy.
3. During strenuous exercise, when muscle tissue lacks enough oxygen, anaerobic glycolysis forms the major source of energy.
4. It can be considered a preliminary step before complete oxidation.
5. It provides carbon skeleton for synthesis of non-essential amino-acid as well as glycerol.
6. Most of the reactions are reversible which are also used for gluconeogenesis.

2) The stoichiometry of coenzyme reduction

|  |  |  |
| --- | --- | --- |
| REACTION | No of ATP  -1  -1  **38**  6  **38** | No of ATP |
| * **Glucose→** Glucose **6-phosphate -1** * **Fructose 6-phosphate →fructose 1,6-bisphosphate -1** * **2 Glyceraldehyde 3-phosphate→2 1,3-bisphosphoglycerate** * **2 1,3-Bisphosphoglycerate→2 3-phosphoglycerate** * **2 Phosphoenolpyruvate→2 pyruvate** * **2 Pyruvate→ 2 acetyl-CoA** * **2 Isocitrate2→a-ketoglutarate** * **2 α-Ketoglutarate→2 succinyl-CoA** * **2 Succinyl-CoA→2 succinate** * **2 Succinate→ 2 fumarate** * **2 Malate→ 2 oxaloacetate**   **TOTAL** | -1ATP  -1ATP  6  2NADH  2ATP  2  2  2ATP  6  2NADH  6  2NADH  6  2NADH  2ATP  2  (or2GTP)  2FADH2  4  2NADH  6 | |