ENTNER-DOUDOROFF (ED) PATHWAY

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INTRODUCTION

- The Entner–Doudoroff pathway is an alternate series of reactions that catabolize glucose to pyruvate.
- The Entner-Doudoroff pathway was first reported in 1952 by Michael Doudoroff and Nathan Entner.
- There are a few bacteria that substitute classic glycolysis with the Entner-Doudoroff pathway. They may lack enzymes essential for glycolysis, such as phosphofructokinase-1.

TYPE OF BACTERIA USING ED PATHWAY

- This pathway is generally found in *Pseudomonas*, *Rhizobium*, *Azotobacter*, *Agrobacterium* and a few other Gram-negative genera.
- Very few Gram-positive bacteria have this pathway, with *Enterococcus faecalis* being a rare exception.
- Most organisms that use the pathway are aerobes due to the low ATP yield per glucose such as *Pseudomonas*, a genus of Gram-negative bacteria, and *Azotobacter*, a genus of Gram-negative bacteria.

EXAMPLES OF BACTERIA USING ED PATHWAY ARE:

- *Pseudomonas*, a genus of Gram-negative bacteria
- *Azotobacter*,a genus of Gram-negative bacteria
- *Rhizobium*,a plant root-associated and plant differentiation-active genus of Gram-negative bacteria
- *Agrobacterium*,a plant pathogen (oncogenic) genus of Gram-negative bacteria.
- *Escherichia coli*, a Gram-negative bacterium
- *Enterococcus faecalis*, a Gram-positive bacterium
- *Zymomonas mobilis*, a Gram-negative facultative anaerobe
- *Xanthomonas campestris*, a Gram negative bacterium which uses this pathway as main pathway for providing energy.

DISTINCT FEATURES OF THE ENTNER–DOUDOROFF PATHWAY

- This pathway occurs in both aerobic and anaerobic condition.
- Occur in prokaryotes only.
- It occurs in cytoplasm.
- Pyruvate and glyceraldehyde-3-phosphate produced from glucose by ED pathway.

ED PATHWAY

- It occurs only in prokaryotes and it uses 6-phosphogluconate dehydratase and 2-keto-3-deoxyphosphogluconate aldolase to create pyruvate from glucose.
- The Entner–Doudoroff pathway also has a net yield of 1ATP for every glucose molecule processed, as well as 1 NADH and 1 NADPH.
- By comparison, glycolysis has a net yield of 2 ATP and 2 NADH for every one glucose molecule processed.

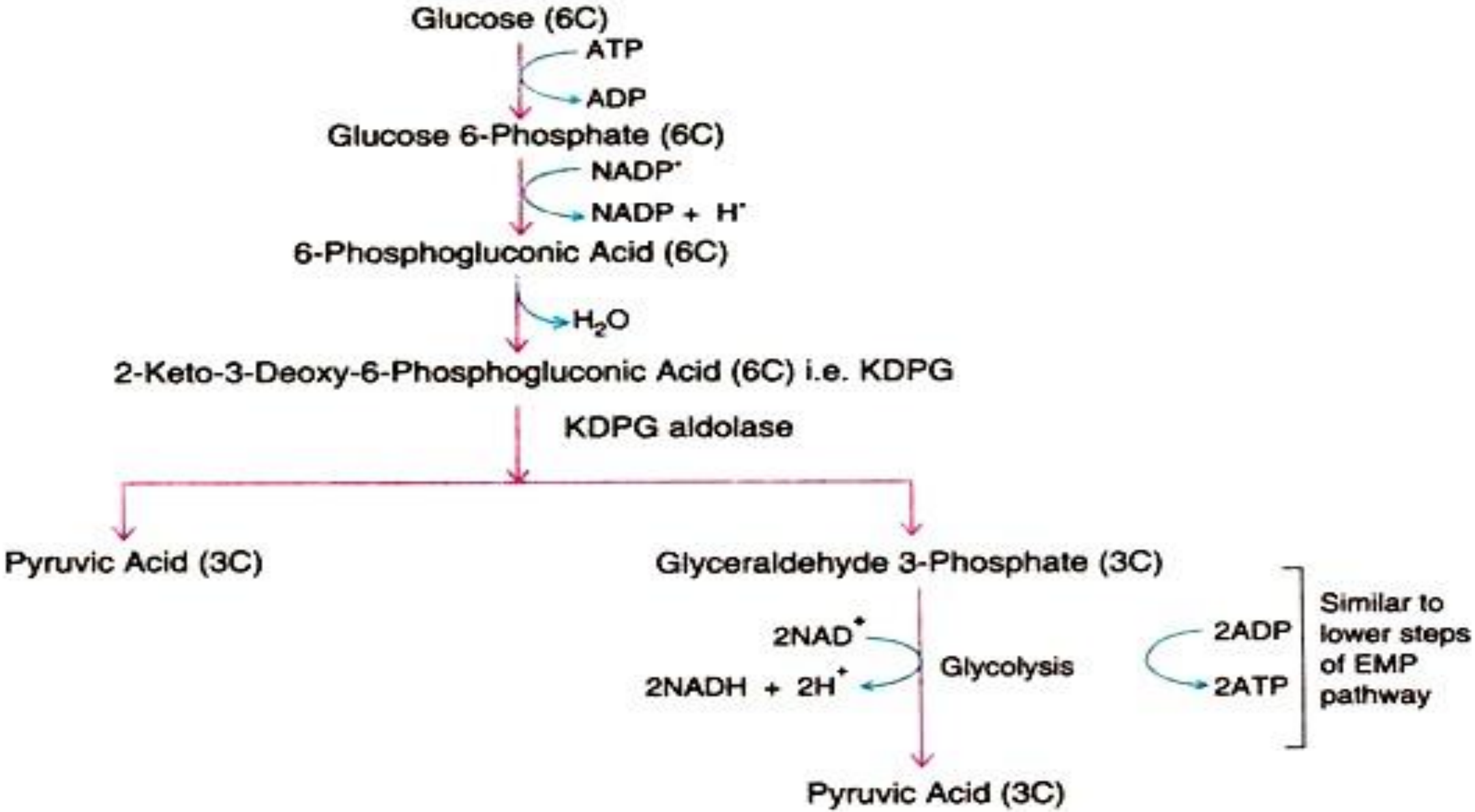

Fig. 12.7 : Entner-Doudoroff pathway.

Entner–Doudoroff (ED) pathway

4.4.2 Key enzymes of the ED pathway

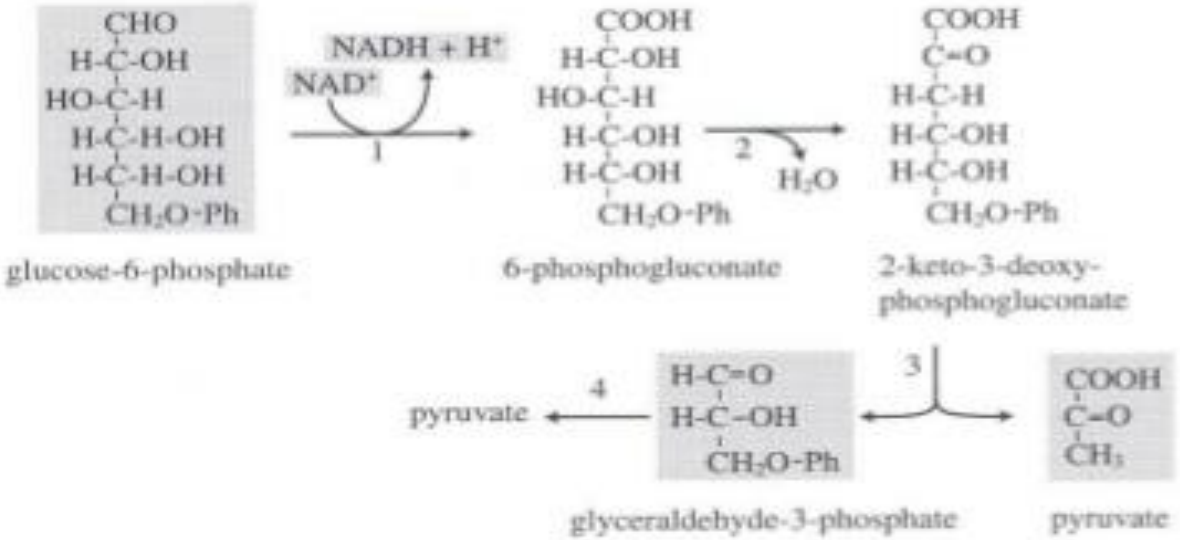

Figure 4.6 The Entner–Doudoroff (ED) pathway.

This metabolism is known only in prokaryotes, mainly Gram-negative bacteria, that do not possess the EMP pathway.

1, glucose-6-phosphate dehydrogenase; 2, 6-phosphogluconate dehydratase; 3, 2-keto-3-deoxy-6-phosphogluconate aldolase; 4, as in the EMP pathway.

- NAD(P)$^+$-dependent glucose–6–phosphate dehydrogenase converts glucose–6–phosphate to 6–phosphogluconolactone that is converted to 6–phosphogluconate.
- 6–Phosphogluconate dehydratase removes water molecule from 6–phosphogluconate and produces 2–keto–3–deoxy–phosphogluconate (KDPG).
- KDPG aldolases splits KDPG into pyruvate and glyceraldehyde–3–phosphate.
- The key enzymes in the ED pathway are 6–phosphogluconate dehydrogenase and KDPG aldolase.

STEPS OF ED PATHWAY

1. At first glucose is phosphorylated to glucose -6-phosphate by the enzyme hexokinase.

2. Glucose-6-phosphate is then oxidized to 6-phosphogluconolactone releasing a molecule of NADPH. This reaction is catalysed by the enzyme glucose-6-phosphate dehydrogenase.

3. Hydrolase enzyme converts 6-phopshogluconolactone to 6-phosphogluconate.

4. 6-phosphogluconate undergoes dehydration reaction catalysed by 6-phosphogluconate dehydratase to form 2-keto 3-deoxy 6-Phosphogluconate (KDPG).

5. KDPG splits to form pyruvate and glceraldehyde-3-phosphate. It is catalysed by KDPG aldolase enzyme

6. Glyceraldehyde-3-phosphate is then metabolized by glycolysis to form pyruvate.

SIGNIFICANCE OF ED PATHWAY

- This pathway used two specific enzymes ie. 6-phosphogluconate dehydratase and KDPG aldolase.
- This pathway generates 1 ATP, 1 NADH and 1 NADPH from one glucose molecule.

REFRENCES:

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