Pentose cycle

The **pentose cycle** (pentose phosphate pathway, hexose monophosphate shunt) is an oxidative catabolic pathway in the cytoplasm that provides the reduced cofactors **NADPH** and **five-carbon carbohydrates (pentoses)**. It is a metabolic "transformation of glucose" whose "goal is not the creation of ATP".

NADPH is consumed in anabolic reactions, primarily in the biosynthesis of steroid substances and fatty acids. The formation of pentoses (ribose-5-phosphate) is necessary for the synthesis of nucleotides and nucleic acids. The pentose cycle takes place mainly in the cytosol of tissues producing steroid substances or fatty acids – liver, testes, ovaries, adrenal cortex, mammary gland, adipocytes and erythrocytes (reduction of glutathione). Furthermore, it is also important for providing NADPH for **NADPH oxidase** in the respiratory burst phase.

The pentose cycle is divided into two parts:

- **Oxidative** - conversion of hexose to pentose and reduction of $NADP^+$ to $NADPH+H^+$.
- **Nonoxidative** (regenerative) - individual monosaccharides (C3, C4, C5, C6, C7) are converted.

By repeating these reactions, the glucose-6-phosphate molecule is gradually oxidized to **6 CO_2' *and* *12 NADPH*** is produced.

File:Pentose cycle.png

Pentose cycle diagram
Enzymes catalyzing individual reactions: 1 – hexokinase, 2 – glucose-6-phosphate dehydrogenase, 3 – 6-phosphogluconolactonase, 4 – phosphogluconate dehydrogenase, 5 – ribulose-5-phosphate epimerase, 6 – ribulose-5-phosphate isomerase, 7 – transketolase, 8 – transaldolase , 9 – transketolase

Oxidative phase

1. oxidation of **G-6-P'** by *glucose-6-phosphate dehydrogenase* to 6-phosphogluconolactone and the first **NADPH** is formed
2. Lactone is cleaved by hydrolase to form **6-phosphogluconate** with free carboxyl ends.
3. the enzyme ``phosphogluconate dehydrogenase *decarboxylates 6-phosphogluconate* to ``ribulose-5-phosphate *(pentose), a second* ``*NADPH* is formed and the carboxyl groups are split off as **CO_2**
4. ribulose-5-phosphate is changed to **ribose-5-phosphate'** by isomerization

During the oxidative phase, **2 molecules of $NADPH+H^+$'** are formed by the conversion of **G-6-P to lactone'** and **6-phosphogluconate to ribulose- 5-phosphate**.

Nonoxidative phase

Adapts the frequent production of NADPH and pentose phosphates to the current consumption. Ribulose-5-phosphate is converted to **fructose-6-phosphate'' *and*** *glyceral-3-phosphate*, both of which can then enter glycolysis. Or glucose-6-phosphate is regenerated from fructose-6-phosphate and can return to the cycle.

The graft donor is ketose in both, the acceptor is aldose. Graft transfer produces various intermediates:

- sedoheptulose-7-phosphate;
- erythrose-4-phosphate;
- fructose-6-phosphate;
- glyceraldehyde-3-phosphate.

Regulation

The speed is mainly determined by the activity of the enzyme ``glucose-6-phosphate dehydrogenase*, which is increased when $NADP^+$ is supplied. An excess of NADPH slows down the reaction.*

Links

Related Articles

- Glycolysis
- Glucose
- NADPH
- Fatty acid synthesis
- Glutathione

Source

- MATOUŠ, Bohuslav, et al. *Fundamentals of medical chemistry and biochemistry.* 2010. edition. Prague : Galen, 2010. ISBN 978-80-7262-702-8.

- KIDNEY, Miroslav, et al. *Biochemistry for medical students. Part I.* 2. edition. Prague : Karolinum, 2009. 269 pp. ISBN 978-80-246-1416-8.