

Describe the regulation of pfk-1 and pfk-2 and the production of fructose-2,6-bis...

[Science](#), [Biology](#)



Regulation of PFK and PFK-2 and the Production of Fructose-2, 6-bisphosphate The conversion of fructose-6-phosphate (F-6-P) to fructose-1, 6-bisphosphate (F-2, 6-bisP), is catalyzed by 6-phosphofructo-1-kinase (PFK-1) using ATP. This is an essential irreversible step in the regulatory process of glycolysis. This step has different regulation mechanisms in the liver/hepatocytes and the muscle cells.

In the liver, when glucose levels are high (postprandial), F-6-P is converted to F-2, 6-bisP by 6-phosphofructo-2-kinase (PFK-2) by an irreversible step. High levels of F-2, 6-bisP in turn activate PFK-1 by a process called feed forward stimulation due to which glycolysis is activated and gluconeogenesis is inhibited. When the glucose levels are low, F-2, 6-bisP is converted to F-6-P. This reaction is catalyzed by the phosphorylated form of PFK-2 called fructose bisphosphatase-2 (FBPase-2). PFK-2 and fructose bisphosphatase-2 (FBPase-2) are similar bi-functional enzymes. Phosphorylation of PFK-2 is done by protein kinase A (PKA). PKA is activated by increased levels of cAMP driven by the hormone glucagon during fasting state. The reverse reaction is catalyzed by a phosphatase, which is activated by the hormone insulin.

Postprandial, there is an increased level of insulin, which is produced in response to increased glucose levels. During low glucose levels, glucagon increases the levels of cAMP in the liver cells. cAMP then activates PKA, which phosphorylates PFK-2 to form FBPase-2. FBPase-2 in turn converts F-2, 6-bisP to F-6-P, this in general is inhibiting the glycolysis (Rider 562).

In muscle cells too, fructose-6-phosphate is converted to fructose-1, 6-bisphosphate, by PFK-1 using ATP. In muscle cells, PFK-1 is activated by AMP. The muscles use up ATP and convert it to AMP. Increased levels of AMP

stimulate glycolysis and increases ATP production. However, increased levels of ATP inhibit PFK-1 allosterically. High levels of citrate also inhibit PFK-1 in muscle cells. In liver cells the major regulators of PFK-1 are F-2, 6-bisP and F-6-P, while in muscle cells, the major regulators of PFK-1 are AMP and ATP. Thus, it can be seen that PFK-1 and PFK-2 are regulated differently in liver cells and muscle cells.

Fig. 1. Schematic representation of regulation of PFK-1 and PFK-2 in liver cells.

Works Cited

Rider, M. H., L. Bertrand, D. Vertommen, P. A. Michels, G. G. Rousseau, and L. Hue

“ 6-phosphofructo-2-kinase/fructose-2, 6-bisphosphatase: head-to-head with a bifunctional enzyme that controls glycolysis”. *Biochem J* 381. 3(2004): 561-79. Print.