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Dietary Carbohydrates

Monday, January 07, 2008 11:00 AM

- 5. What are the dietary source of glucose, fructose, and galactose?
 - a. Starch --> glucose
 - b. Sucrose --> glucose and fructose
 - c. Glycogen --> glucose
 - d. Lactose --> galactose and glucose
- 6. What are the structural features of glucose, fructose, and galactose?
 - a. Glucose:



D-Galactose L-Galactose

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- How is glucose transported into hepatocytes? Does insulin stimulate transport? Sugars go directly to liver via portal blood flow and enter glycolytic pathways. Enter hepatocytes via GLUT2 transporter (Km = 15 mM, not influenced by insulin); high Km means only active when blood glucose is high
- 8. What are the kinetic properties of glucokinase?
 - a. Only in liver and pancreatic B-cells
 - b. Converts glucose --> glucose-6-P
 - c. High Km (8 mM), at 10-15mM near max

ĊH₂OH

- d. Low rate at blood glucose levels (5 mM)
- e. Not inhibited by glucose-6-P
- 9. How is the activity of glucokinase regulated? What is the effect of insulin? How does glucokinase regulatory protein control levels of glucokinase?
 - a. Insulin
 - i. Causes rapid increase in glucokinase mRNA
 - ii. Leads to increased glucokinase production
 - iii. cAMP turns off transcription
 - iv. Type I diabetics do not produce glucokinase
 - b. Glucokinase Regulatory Protein
 - i. @low glucose levels --> GRP is bound to glucokinase (inactive)
 - ii. High glucose (post-meal) --> GRP dissociates and glucokinase is activated

- iii. Fructose-6-P promotes GRP binding, Fructose-1-P reverses binding
- 10. How is fructose metabolized in liver? What enzyme is specified to the liver? What are the products of aldolase B reaction? How does fructose metabolism affect glucokinase activity?
 - a. Metabolism
 - i. Phosphorylated to F-1-P by fructokinase
 - ii. Aldolase B converts F-1-P to Glyceraldehyde and DHAP
 - iii. Glyceraldehyde converted to Glyceraldehyde-3-P via glyceraldehyde kinase
 - iv. DHAP --> G3P via triose phosphate isomerase
 - v. G3P+DHAP can go to gluconeogenesis
 - vi. G3P can continue on to glycolysis
 - b. Aldolase B is specific to the liver and produces glyceraldehyde and DHAP
 - c. F-1-P can decrease binding of GRP to glucokinase thus preserving glucokinase activity
- 11. How is galactose converted to glucose-1-P? What are the key enzymes? What is the role of UDPglucose? What enzyme is defective in most cases of Galactosemia? What reactions are involved in cataract formation?
 - a. Metabolism
 - i. Galactokinase makes galactose-1-P
 - ii. Galactose-1-P Uridylyl Transferase: Galactose-1-P + UDP-glucose --> Glucose-1-P + UDP Galactose
 - iii. UDP-Galactose-4-epimerase : UDP-Galactose NAD+ --> UDP-Glucose
 - iv. Phosphoglucomutase: Glucose-1-P --> G6P
 - v. G6P to glycolysis
 - b. Key enzymes are transferase and epimerase
 - c. Galactosemia
 - i. Genetic
 - ii. Mutated transferase
 - iii. Failure to thrive, MR
 - iv. Cataracts
 - 1) Aldose reductase uses NADPH: Galactose --> Galactitol; Glucose --> Glucitol (sorbitol)
 - 2) Sugar alcohols cause cloudy whiteness to form
 - 3) Glucitol can be converted to fructose
 - 4) Seen in patients with galactosemia, diabetes
 - 5) Km of aldose reductase is 200 mM; cataracts only form in uncontrolled diabetes/galactosemia