The most common monosaccharide is fructose.

Fructose does not promote the secretion of insulin and enter the cells through GLUT5 which is insulin independent.

FRUCTOSE METABOLISM:

1 minor pathway

phosphorylation of glucose and fructose by hexokinase to produce glucose 6 phosphate and fructose 6 phosphate

phosphorylation of fructose 6 phosphate by phosphofructokinase-1 to produce fructose 1,6 bisphosphate

cleavage of fructose 1,6 bisphosphate by aldolase A or aldolase B to produce glyceraldehyde 3 phosphate and dihydroxyacetone phosphate

2 major pathway

phosphorylation of fructose by fructokinase to produce fructose 1 phosphate

cleavage of fructose 1 phosphate by aldolase B to produce glyceraldehyde and dihydroxyacetone phosphate

fructokinase has a higher affinity for fructose than hexokinase

the rate of fructose metabolism is higher than the rate of glucose metabolism due to the bypass of phosphorylation by phosphofructokinase-1

Aldolase A is present in all organs.

Aldolase B is present in the liver, kidneys and small intestine.

PATHWAYS OF GLYCERALDEHYDE:

1

phosphorylation of glyceraldehyde by triokinase to produce glyceraldehyde 3 phosphate

2

reduction of glyceraldehyde by alcohol dehydrogenase to produce glycerol

phosphorylation of glycerol by glycerol kinase to produce glycerol phosphate

addition of three fatty acids to glycerol phosphate to produce triacylglycerols or oxidation of glycerol phosphate to produce dihydroxyacetone phosphate

fructokinase deficiency cause essential fructosuria.

fructose accumulates in the blood and is excreted in the urine.

aldolase B deficiency cause hereditary fructose intolerance.

fructose 1 phosphate accumulates and leads to ATP depletion.

glycolysis increase and leads to hypoglycemia and lacticacidemia.

AMP production increase and leads to hyperuricemia.

severe disturbance in liver and kidney metabolism that may lead to liver and kidney failure.

COMPLETE CONVERSION OF GLUCOSE TO FRUCTOSE:

reduction of glucose to sorbitol by aldose reductase

oxidation of sorbitol to fructose by sorbitol dehydrogenase

liver, ovaries and seminal vesicles to supply sperm cells with fructose

INCOMPLETE CONVERSION OF GLUCOSE TO FRUCTOSE:

reduction of glucose to sorbitol by aldose reductase

kidneys, eyes and myelinated neurons

CHRONIC HYPERGLYCEMIA:

glucose enters the cells that contain aldose reductase independent of insulin

the rate of glycolysis increase to the maximum rate and the conversion of glucose to fructose starts

sorbitol accumulates and decreases the water potential of the cells that do not contain sorbitol dehydrogenase and leads to cell death

neuropathy retinopathy nephropathy cataracts

galactose is an epimer of glucose at carbon 4

galactose enters the cells independent of insulin

GALACTOSE METABOLISM:

phosphorylation of galactose by galactokinase to produce galactose 1 phosphate

galactose 1 phosphate + UDP glucose (transferase) UDP galactose + glucose 1 phosphate (reversible)

UDP galactose uses:

glycosaminoglycans synthesis

glycoproteins synthesis

glycolipids synthesis

lactose synthesis

UDP galactose (epimerase) UDP glucose

glucose 1 phosphate (phosphoglucomutase) glucose 6 phosphate

glucose 6 phosphate (glucose 6 phosphatase) glucose

GALACTOKINASE DEFICIENCY:

reduction of galactose by aldose reductase to galactitol

galactitol accumulates and decreases the water potential of the cells and leads to cell death

causes galactosemia and galactosuria

TRANSFERASE DEFICIENCY:

galactose 1 phosphate accumulates and leads to ATP depletion

glycolysis increase and leads to hypoglycemia and lacticacidemia

causes liver damage, brain damage and cataracts

oxidation of UDP glucose by UDP glucose dehydrogenase to produce UDP glucuronic acid which is used in glycosaminoglycans synthesis.

lactose is a disaccharide of galactose and glucose with beta 1,4 linkage

UDP galactose + glucose (lactose synthase) lactose + UDP

prolactin stimulate the synthesis of lactose in mammary glands only

lactose consists of two proteins:

1 galactosyltransferase

UDP galactose + glucose lactose + UDP

UDP galactose + N-acetylglucosamine N-acetyllactosamine + UDP

2 alpha lactalbumin

a protein that bind to galactosyltransferase to determine the specificity for glucose

N-acetyllactosamine uses:

glycosaminoglycans synthesis

N-linked glycoprotein synthesis

glycolipids synthesis