Dept. of Biochemistry

Introductory Biochemistry

Biomolecules_Carbohydrate _Lecture_6

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Physiologically important glycosides

1. **Glucovanillin** (vanillin-D-glucoside) is a natural substance that imparts vanilla flavour.

2. **Cardiac glycosides** (steroidal glycosides) : Digoxin and digitoxin contain the aglycone steroid and they stimulate muscle contraction.

3. **Streptomycin**, an antibiotic used in the treatment of tuberculosis is a glycoside.

4. **Ouabain** inhibits $Na^+ - K^+$ ATPase and blocks the active transport of Na^+.

5. **Phlorhizin** produces renal damage in experimental animals.

Physiological Important of Glycosides

Cardiac glycoside

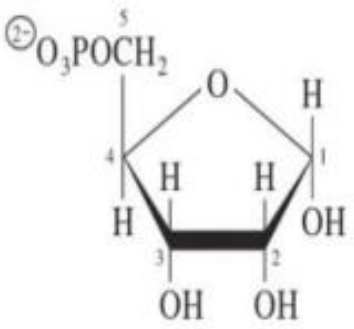
Introduction

- Cardiac glycosides are important class of naturally occurring glycoside which exert both beneficial and toxic effects on the heart.
- They are potentially used to treat congestive heart failures.
- They posses specific action on cardiac muscle, increasing tone, excitability and contractility of this muscle and thus allowing the weakened heart to function more efficiently.
- Hence, it act as cardio tonic agents.

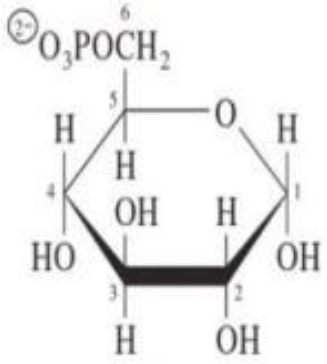
Derivatives of Monosaccharides

A. Sugar Phosphates

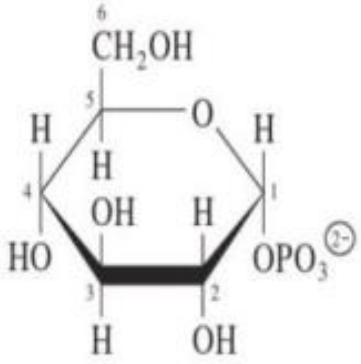
Monosaccharides in metabolic pathways are often converted to phosphate esters. The triose phosphates, ribose 5-phosphate, and glucose 6-phosphate are simple alcohol-phosphate esters.



α-D-Ribose 5-phosphate



α-D-Glucose 6-phosphate

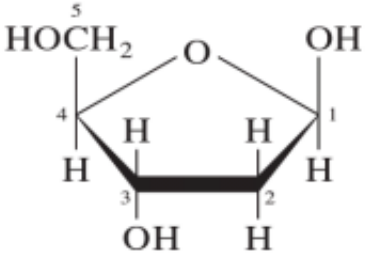


α-D-Glucose 1-phosphate

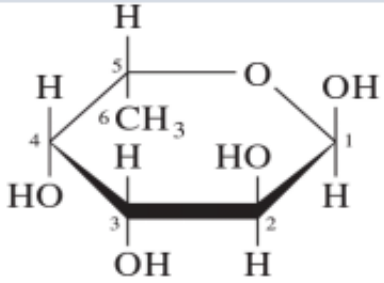
B. Deoxy Sugars

A hydrogen atom replaces one of the hydroxyl groups in the parent monosaccharide. 2-Deoxy-D-ribose is an important building block for DNA.

L-Fucose (6-deoxy-L-galactose) is widely distributed in plants, animals, and microorganisms.



β-2-Deoxy-D-ribose

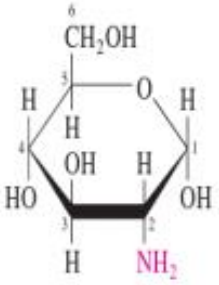


α-L-Fucose
(6-Deoxy-L-galactose)

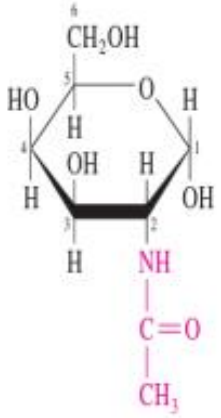
Derivatives of Monosaccharides

C.Amino Sugars

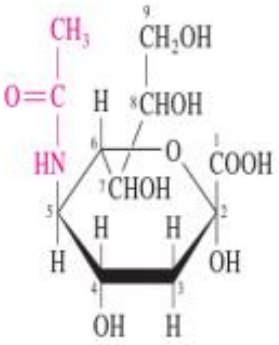
In a number of sugars, an amino group replaces one of the hydroxyl groups in the parent monosaccharide. Sometimes the amino group is acetylated. Three examples of amino sugars are shown below:



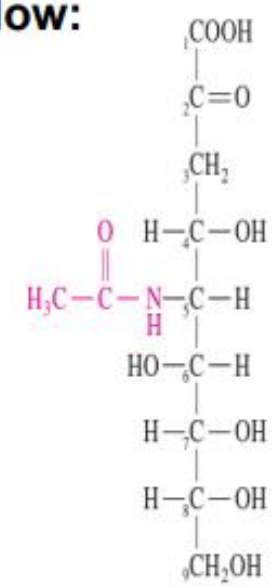
α-D-Glucosamine



N-Acetyl-α-D-galactosamine



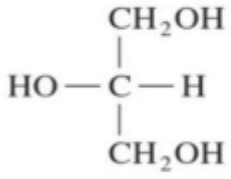
N-Acetyl-α-D-neuraminic acid



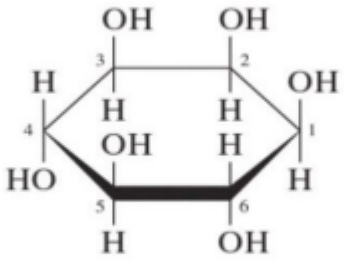
N-Acetyl-D-neuraminic acid

D. Sugar Alcohols

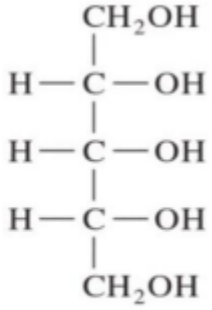
In a sugar alcohol, the carbonyl oxygen of the parent monosaccharide has beenreduced, producing a polyhydroxy alcohol. Three examples of sugar alcohols. Glycerol and myo-inositol are important components of lipids Ribitol is a component of flavin mononucleotide (FMN) and flavinadenine dinucleotide (FAD) In general, sugar alcohols are named by replacing the suffix –ose of the parent monosaccharides with -itol.



Glycerol



myo-Inositol

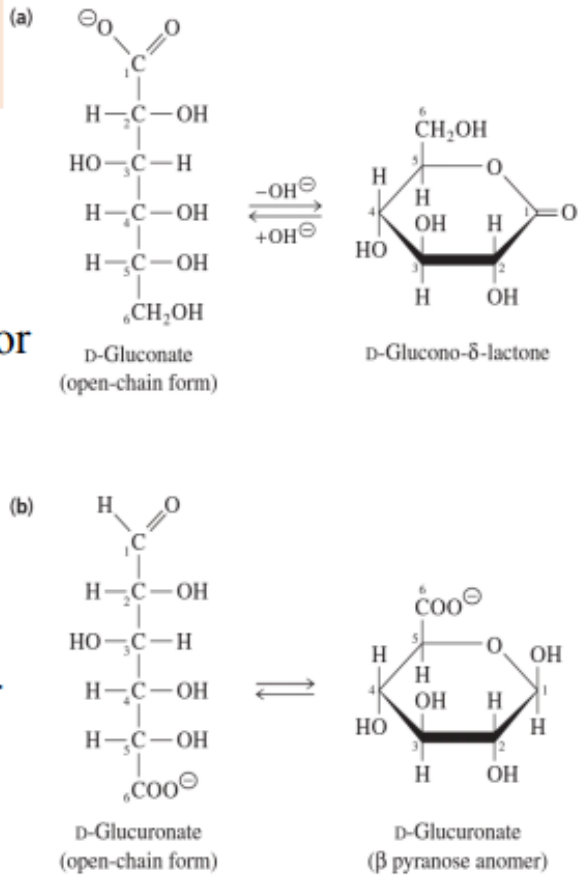


D-Ribitol

Derivatives of Monosaccharides

E. Sugar Acids

Sugar acids are carboxylic acids derived from aldoses, either by oxidation of C-1(the aldehydic carbon) to yield an aldonic acid or by oxidation of the highest-numbered carbon (the carbon bearing the primary alcohol) to yield an alduronic acid. The structures of the aldonic and alduronic derivatives of glucose-gluconate and glucuronate.



F.Ascorbic Acid

L-Ascorbic acid, or vitamin C, is an enediol of a lactone derived from D-glucuronate. Primates cannot convert glucuronate to ascorbic acid and must therefore obtain ascorbic acid from the diet. Ascorbic acid is an essential cofactor for the enzymes that catalyze the hydroxylation of proline and lysine residues during collagen synthesis

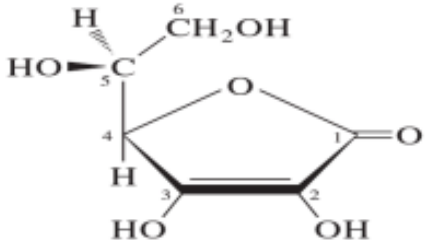


Figure 8.18 ▲
L-Ascorbic acid (vitamin C).

Disaccharides

Maltose (Malt Sugar)

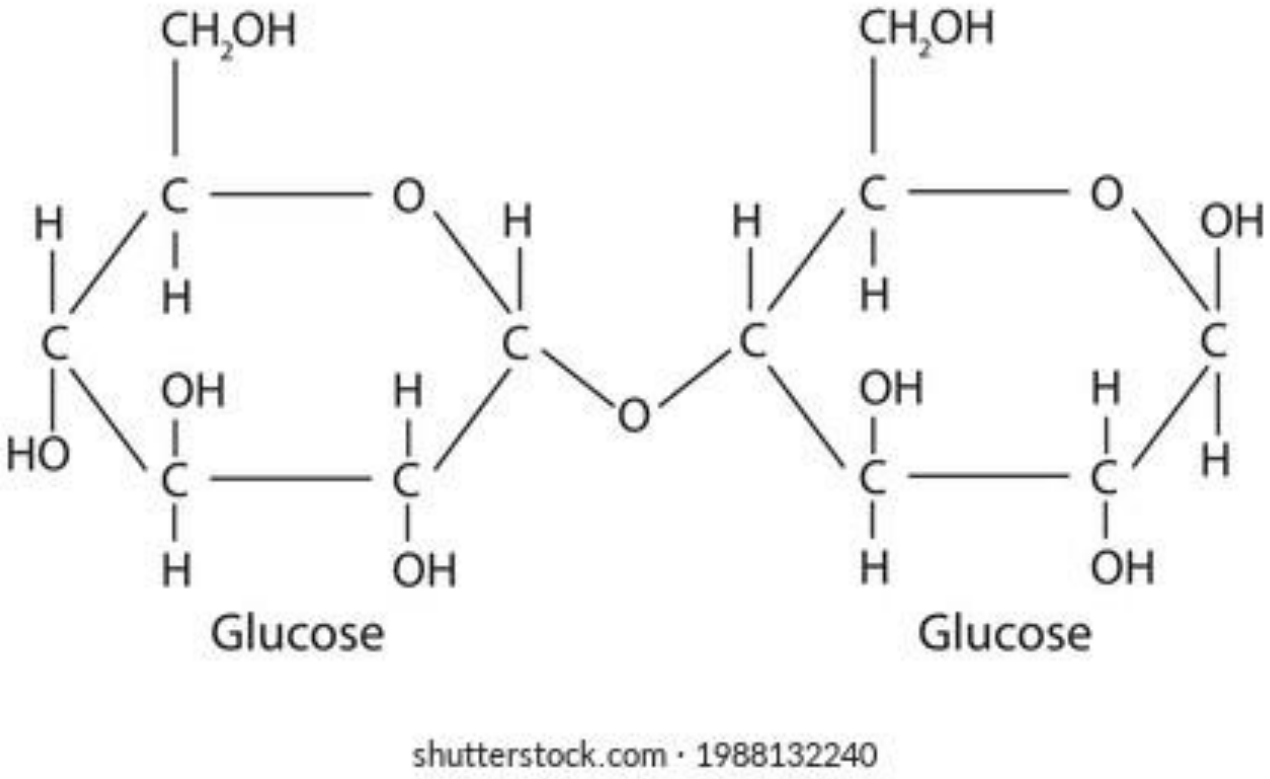
Maltose is known as malt sugar.

- The glycosidic bond is α(1→4).
- It is formed by the breakdown of starch by the action of the enzyme α-amylase.
- Intestinal enz Maltase gives 2 units of glucose

Ex: Barley seeds (Grains), Germinating cereals, Malt etc

- One of the anomeric carbons is free, so maltose is a reducing sugar.

Maltose


CH2OH
O
H
OH
HO
Glucose
Glucose
shutterstock.com · 1988132240

LACTOSE

Lactose (Milk Sugar)

The glycosidic bond is b(1→4).

- One of the anomeric carbons is free, so lactose is a reducing sugar.
- Sources : Milk and Milk products
- Lactose producing in lactating mammary glands
- Enzyme lactase hydrolyses lactose to glucose and galactose

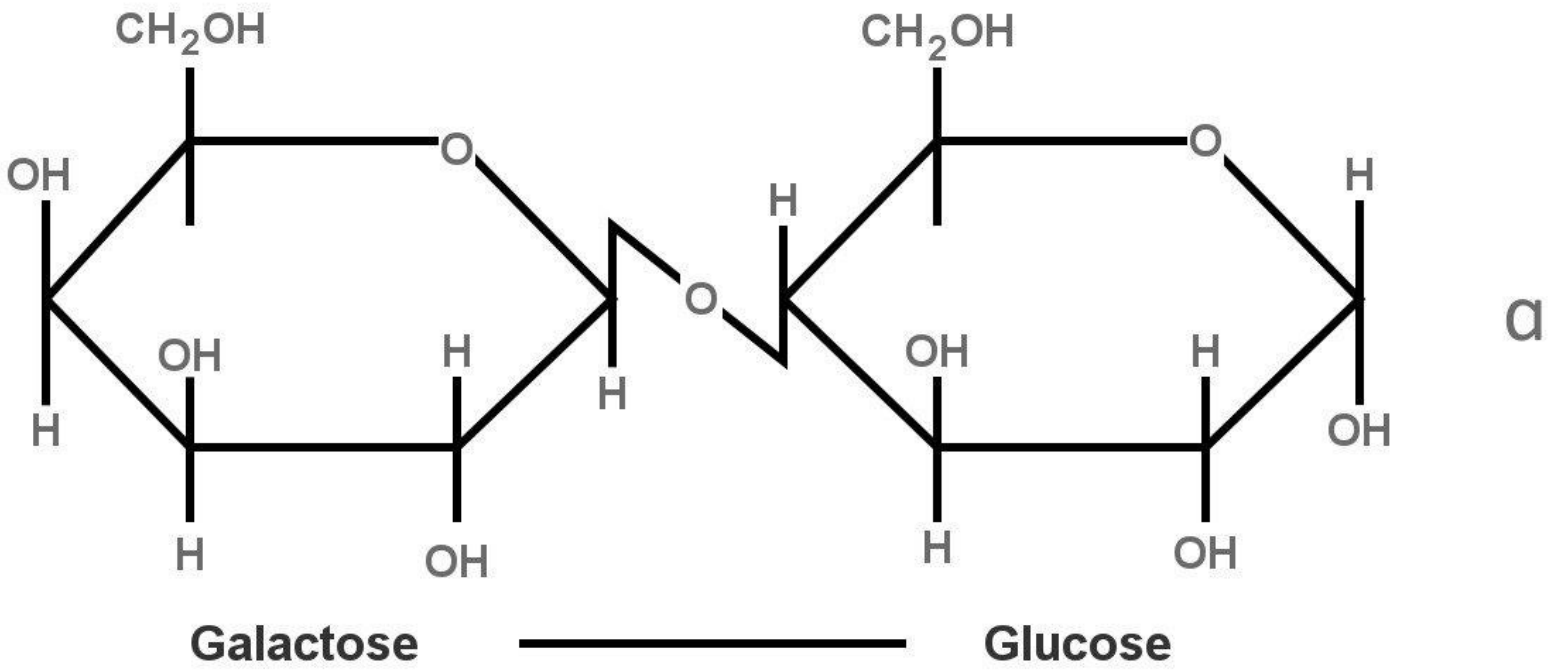
Lactose intolerance

Lactose intolerance :

An intolerance to lactose can occur in people who inherit or lose the ability to produce the enzyme lactase that hydrolyzes lactose into its monosaccharide units.

Symptoms: Persistent diarrhea, giddiness, anorexia etc

LACTOSE

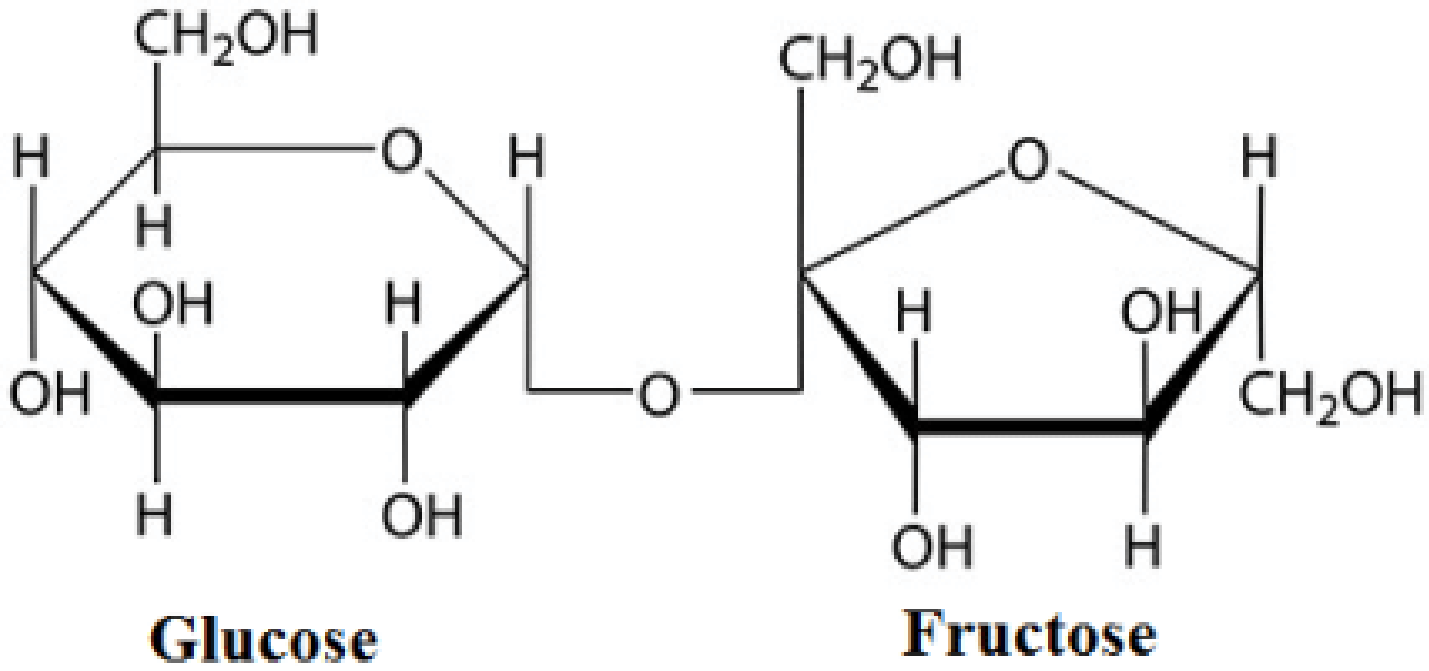


Sucrose

- Disaccharide: Sucrose
- Inversion:

  Sucrose, as such is dextrorotatory (+66.5°) But, when hydrolysed, sucrose becomes levorotatory (–28.2°). The process of change in optical rotation from dextrorotatory (+) to levorotatory (–) is referred to as inversion.
- The hydrolysed mixture of sucrose, containing glucose and fructose, is known as invert sugar.
- Sucrose is hydrolyzed to fructose and glucose by an enzyme sucrase which is also called invertase.

SUCROSE


CH2OH
H
O
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CH2OH
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OH
CH2OH
OH
H
Glucose
Fructose