CHEMISTRY AND BIOLOGICAL ROLE OF CARBOHYDRATES IN THE BODY-1
- **Chiral centers**: Asymmetric carbons, i.e., carbon atom with four different substituents.
- **Enantiomers**: Mirror images, Stereoisomers.

![Chiral center diagram](image)

**D-glyceraldehyde**

**L-glyceraldehyde**
MONOSACCHARIDE DERIVATIVES OF BIOLOGICAL IMPORTANCE

- Oxidation Products (Sugar Acids)
- Reduction Products (Sugar Alcohols)
- Amino Sugars
- Sugar Phosphates
LECTURE OUTLINE

By the end of the lecture, the student should know:

- The functions and biological importance of monosaccharides.
- The functions and biological importance of disaccharides.
- The functions of oligosaccharides.
IMPORTANCE OF MONOSACCHARIDES:

GLUCOSE

- The storage form of glucose in humans is glycogen.
- In plants it is stored mainly in the form of starch.
- Dietary sources: fruits, vegetables (in the form of starch), honey.
BIOLOGICAL SIGNIFICANCE

- BRAIN CELLS, RBCS AND THE GROWING EMBRYO ONLY UTILIZE GLUCOSE AS A SOURCE OF ENERGY.

- ENERGY SOURCE FOR CELLS IN THE BODY.

- BUILDING BLOCK OF DISACCHARIDES AND POLYSACCHARIDES

- IT IS THE SUGAR PRESENT IN BLOOD.

- NORMAL VALUES
  - FASTING: 70 TO 99MG/DL
  - RANDOM: BELOW 140 MG/DL
DISORDERS ASSOCIATED WITH GLUCOSE

- DIABETES MELLITUS
- GLYCOSURIA

→ RENAL SUGAR THRESHOLD
IT IS THE MAXIMUM CAPACITY OF KIDNEYS TO REABSORB GLUCOSE.
FRUCTOSE: IMPORTANCE AND BIOLOGICAL SIGNIFICANCE

- DIETARY SOURCES: FRUIT JUICES, HONEY AND SUGAR CANE.

- SWEETEST SUGAR

- SEMINAL FLUID IS RICH IN FRUCTOSE.

- SPERM UTILIZES FRUCTOSE FOR ENERGY

- IN THE SEMINIFEROUS TUBULAR EPITHELIAL CELLS, FRUCTOSE IS FORMED FROM GLUCOSE.
GALACTOSE: IMPORTANCE AND BIOLOGICAL SIGNIFICANCE

- DIETARY SOURCE: DIARY PRODUCTS
- LESS SWEET THAN GLUCOSE
- USED IN THE SYNTHESIS OF MILK SUGAR IN MAMMARY GLANDS
- IT IS A CONSTITUENT OF GLYCOLIPIDS AND GLYCOPROTEINS
- IT IS REQUIRED FOR THE DEVELOPMENT OF BRAIN AND NERVOUS TISSUE IN INFANTS.
MANNOSE

- IT DOES NOT OCCUR FREE IN NATURE

- IN THE HUMAN BODY, IT IS FOUND AS A CONSTITUENT OF GLYCOPROTEINS

- ITS REDUCTION PRODUCT THAT IS MANNITOL IS IMPORTANT CLINICALLY IN CEREBRAL EDEMA.
IMPORTANCE OF PENTOSES

- RIBOSE: IT IS A CONSTITUENT OF NUCLEIC ACID THAT IS RNA
- 2-DEOXYRIBOSE: IT IS A CONSTITUENT OF DNA
Glycosides

Carbonyl Carbon of a Monosaccharide is attached, by an Acetal linkage, to an Alcoholic group of a second compound. (Acetal is an organic molecule where two separate oxygen atoms are single bonded to a central carbon atom)

Methyl Glucoside
GLYCOSIDES

- Glycosides are compounds in which:
  - A Monosaccharide is attached to an Alcoholic group of a second compound By Glycosidic Linkage.

- Glycosidic Linkage is Defined as an:
  - Acetal Linkage Between Carbonyl Carbon of a Monosaccharide and Hydroxyl Group of an Another Compound.
IN GLYCOSIDES OTHER COMPOUND MAY OR MAY NOT BE A MONOSACCHARIDE

- When the alcoholic compound in a Glycoside is a Non-Carbohydrate it is called Aglycon.

- In methyl Glucoside Methyl group is an Aglycon.
Methyl Glucoside

In methyl glucoside, the methyl group is an aglycon.
Disaccharides are glycosides in which both the components are monosaccharides, such as lactose (glucose + galactose)
Glycosides are named according to the monosaccharide which contributes the carbonyl carbon e.g.,

- Glucoside
- Galactoside
LACTOSE

- Also called milk sugar because it naturally occurs only in milk.

- On hydrolysis it yields one molecule of glucose and one molecule of galactose which are linked together through 1-4 glycosidic linkage.

- Two Monomer Units of Lactose are:-
  - Glucose.
  - Galactose.
**BIOLOGICAL SIGNIFICANCE OF LACTOSE**

- Sole source of Carbohydrates in Neonates.
- Absorption of Calcium.
- Source of Galactose (for developing Brain)
- Clinical Aspects.
  - Lactosuria (During pregnancy and lactation).
  - Lactose intolerance.
LACTOSE INTOLERANCE:

- DUE TO THE ABSENCE OF THE ENZYME LACTASE

- UNDIGESTED LACTOSE LEADS TO BACTERIAL FERMENTATION IN COLON AND GENERATION OF GASES.

- THESE PRODUCTS CAUSE DIARRHEA, BLOATING AND PAIN IN THE GIT.

- TREATMENT: FORMULA FEED
**Sucrose**

- It is common table sugar.
- Mainly found in Sugar Cane.
- It has 1,2 glycosidic linkage.
- Two Monomer Units of Sucrose are:
  - Glucose.
  - Fructose.
- **Clinical Significance:** Small amounts of oral sucrose placed in the infant's mouth reduces procedural pain.
MALTOSE

- YIELDS UPON THE HYDROLYSIS OF STARCH (AMYLASE)

- MADE UP OF TWO MOLECULES OF GLUCOSE

- GLYCOSIDIC LINKAGE (1,4)

CLINICAL SIGNIFICANCE:

- MALTASE IS DIGESTED BY THE ENZYME MALTASE. BABY FOODS CONTAIN MALTOSE BECAUSE IT IS EASILY DIGESTED.
OLIGOSACCHARIDES

- COMPRISED OF THREE TO TEN MONOSACCHARIDES

- EXAMPLE: FRUCTOOLIGOSACCHARIDES

- CELL MEMBRANE PROTEINS CONTAIN OLIGOSACCHARIDES.

- THE OLIGOSACCHARIDE UNITS OF GLYCOPROTEINS ARE RICH IN INFORMATION AND ARE FUNCTIONALLY IMPORTANT.