Republic of Iraq
Ministry of Higher Education & Scientific research
Al-Mustaqbal University
Science College
Medical physics Department

Analytical Chemistry

For

Third Year Student

Lecture 3

By

Dr. Karrar M. Obaid

2024-2025

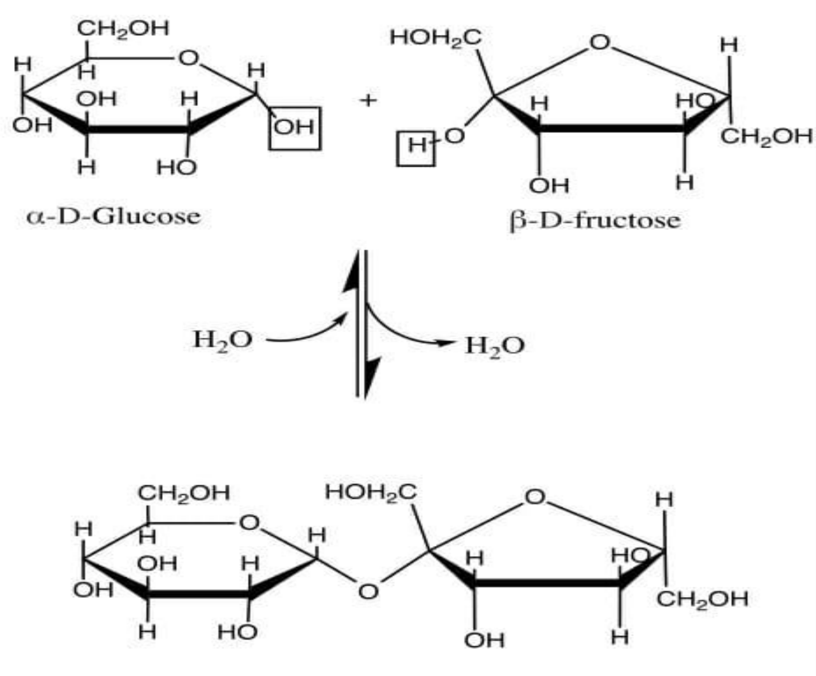
Carbohydrates (Di & Polysaccharides)

Disaccharide = condensation between two monosaccharides (O-glycosidic bond)

Oligosaccharides = three to ten monosaccharides

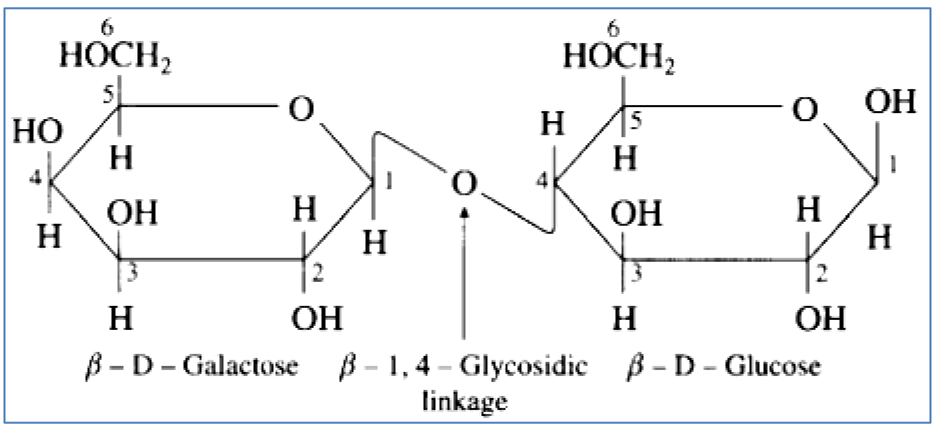
The most common disaccharides are: Sucrose (cane or beet sugar - made from one glucose and one fructose) Maltose (made from two glucoses) Lactose (milk sugar - made from one glucose and one galactose) The formula of these disaccharides is $C_{12}H_{22}O_{11}$

Sucrose: Sucrose (common table sugar) is obtained commercially from cane or beet. The anomeric carbon atoms of a glucose unit and a fructose unit are joined in this disaccharide; the configuration of this glycosidic linkage is α for glucose and β for fructose. Sucrose can be cleaved into its component monosaccharides by the enzyme sucrase.



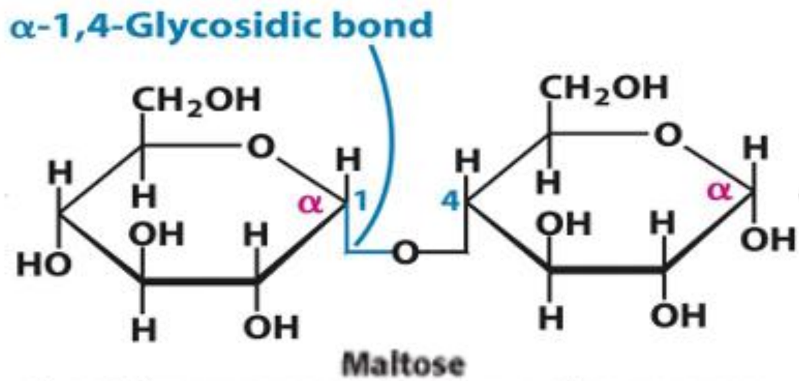
α-D-glucopyranosyl-(1→2)-β-D fructofuranose
(Sucrose)

Lactose: (sugar of milk) Lactose is the most important carbohydrate in the milk of mammals, Cow's milk contains 4.5% lactose, while human milk contains up to 7.5%, consists of galactose joined to glucose by a β-1,4-glycosidic linkage. Lactose is hydrolyzed to these monosaccharides by lactase in human beings and by βgalactosidase in bacteria.



(β-D-Galactopyranosyl-(1→4)-α-D-glucopyranose

Maltose: originally isolated from malt Two D-glucose residues are joined by a glycosidic linkage between the α-anomeric form of C-1 on one sugar and the hydroxyl oxygen atom on C-4 of the adjacent sugar. Maltose comes from the hydrolysis of starch and is in turn hydrolyzed to glucose by maltase.



(α-D-Glucopyranosyl-(1→4)-α-D-glucopyranose

Polysaccharides

- Most carbohydrates found in nature occur as polysaccharides, polymers of medium to high molecular weight.
- Homopolysaccharides are polymers of a single monosaccharide, whereas heteropolysaccharides contain more than one type of monosaccharide ,Three important Polysaccharides are **starch, glycogen and cellulose**

Starch – large molecule with variable number of glucose units; storage carbohydrate of plants

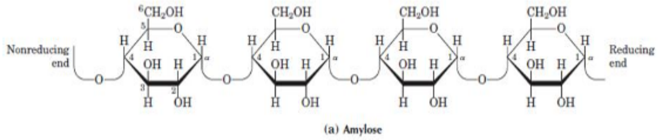
Amylose – is a linear polymer of glucose linked with mainly α(1→4) bonds

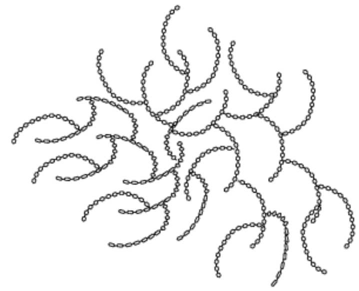
Amylopectin – chain of glucose molecules (a-1,4), every 30th glucose branch to other glucose residues (a-1,6)

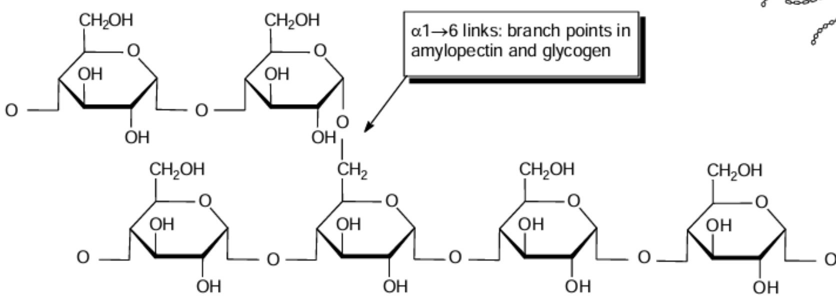
Glycogen - storage carbohydrate of mammalian muscle and liver
- similar to amylopectine, but branch every 10th glucose

Non-starch polysaccharides– not digested by human enzymes
- e.g. Cellulose (glucose linked β-1,4), chitin, pectin

The end of the polysaccharide with an anomeric **C1** not involved in a glycosidic bond is called the reducing end.







Hydrolysis of starch by amylase in saliva and pancreatic juice results in formation of Dextrin

Glycogen

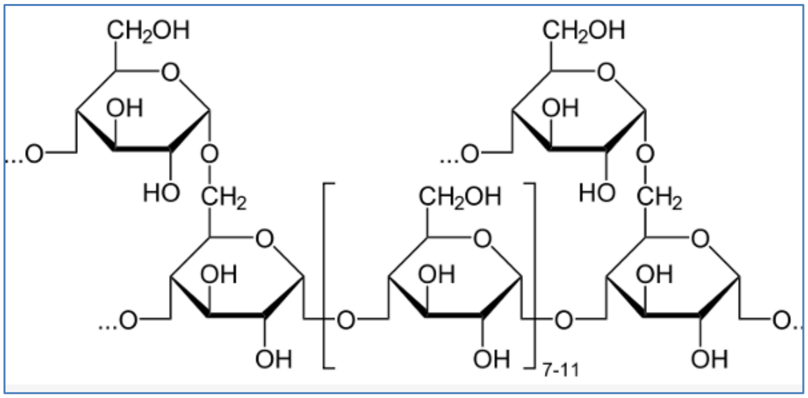
1- Having a similar structure to amylopectin of starch, but more branches.and is commonly referred to as animal starch.

2- Glycogen does not possess a reducing end.

3- The „reducing end“ glucose residue is not free but is covalently bound to a protein termed glycogenin

4- Main storage of glucose in liver and skeletal muscle.

5-The glycogen granules contain both glycogen and the enzymes of glycogen synthesis (Glycogenesis) and degradation (Glycogenolysis).



ellulose

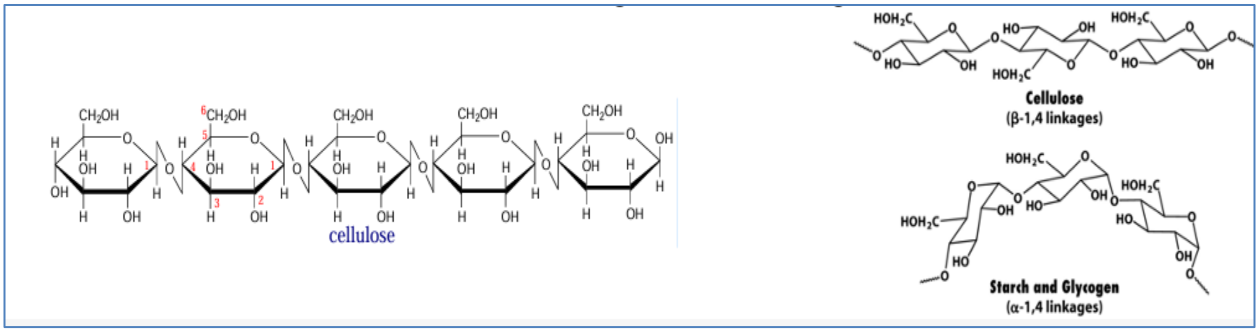
1.Cellulose is a polysaccharide of glucose found in plants, consists of linear chains of glucose units. It is an unbranched polymer of glucose residues joined by β-1,4 linkages.

2. The β configuration allows cellulose to form very long, straight chains. Fibrils are formed by parallel chains that interact with one another through hydrogen bonds.

3. The α-1,4 linkages in glycogen and starch produce a very different molecular architecture from that of cellulose. A hollow helix is formed instead of a straight chain.

4. These differing consequences of the α and β linkages are biologically important. The straight chain formed by β linkages is optimal for the construction of fibers having a high tensile strength.

5. Mammalslack cellulases and therefore cannot digest wood and vegetable fibers.


cellulose
Cellulose
(β-1,4 linkages)
Starch and Glycogen
(α-1,4 linkages)