

ALAYEN IRAQI UNIVERSITY
Health and Medical
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General Chemistry

Carbohydrates

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Definition:-

Carbohydrates may be defined chemically as aldehyde or ketone derivatives of polyhydroxy alcohols or as compounds that yield these derivatives on hydrolysis

Carbohydrates are:-

- A major source of energy from our diet.
- Composed of the elements C, H, and O.
- Also called saccharides, which means “sugars.”
- Carbohydrates are produced by photosynthesis in plants.

glucose is synthesized in plants from CO₂, H₂O, and energy from the sun then oxidized in living

*Chemically, carbohydrates contain mainly two functional groups, carbonyl group (

aldehyde or or ketone) and a number of hydroxyl groups. Accordingly carbohydrates are now

defined optically active polyhydroxy aldehydes or polyhydroxy ketones or the compound that

can be hydrolysed to either of them

Classification of carbohydrates

carbohydrates, the division into four major groups

- **Monosaccharides** contain a single polyhydroxy aldehyde or ketone unit (e.g., glucose, fructose) .



- **Disaccharides** consist of two monosaccharide units linked together by a covalent bond (e.g., sucrose).



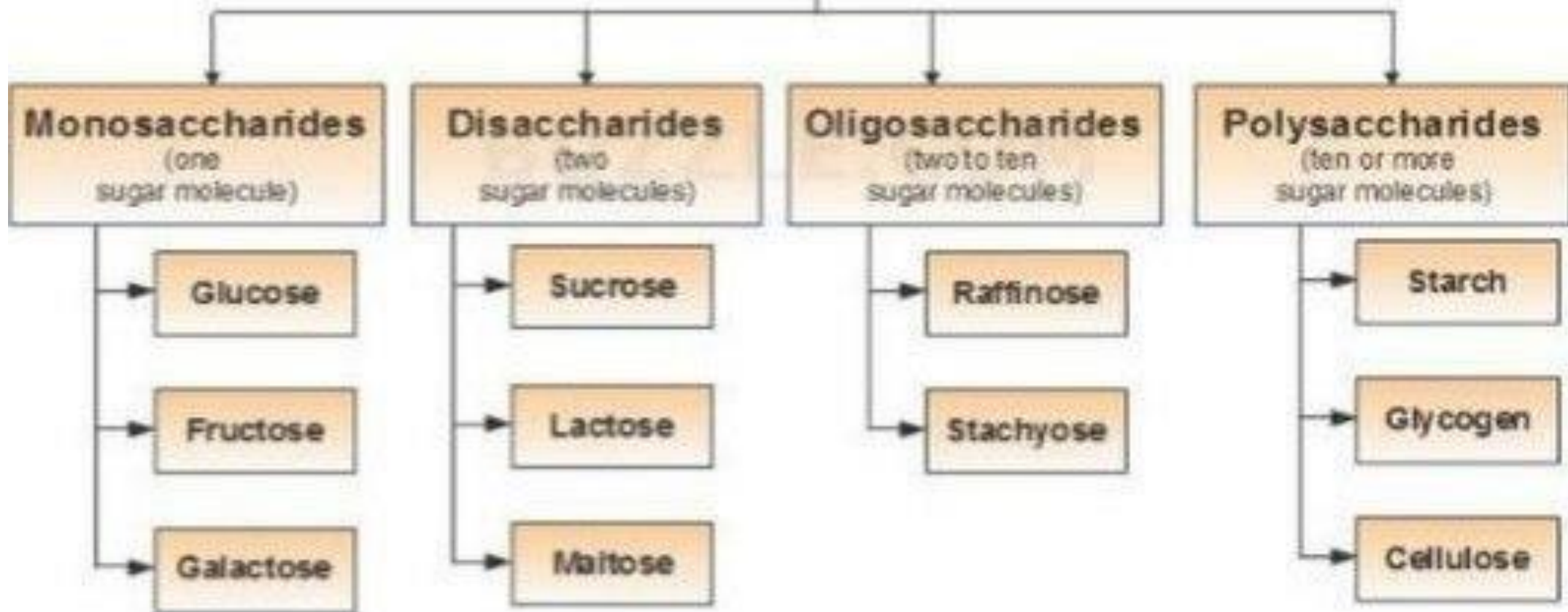
- **Oligosaccharides** contain from 3 to 10 monosaccharide units (e.g., raffinose).



- **Polysaccharides** contain very long chains of hundreds or thousands of monosaccharide units, which may be either in straight or branched chains (e.g., cellulose, glycogen, starch).



Carbohydrates



Functions of Carbohydrates:

- 1 - Source of energy for living beings, e.g. glucose
- 2 - Storage form of energy, e.g. glycogen in animal tissue and starch in plants
- 3 - Serve as structural component, e.g. glycosaminoglycans in humans, cellulose in plants and chitin in insects
- 4 - Non-digestible carbohydrates like cellulose, serve as dietary fibers
- 5 - Constituent of nucleic acids RNA and DNA, e.g. ribose and deoxyribose sugar
- 6 - Play a role in lubrication, cellular intercommunication and immunity
- 7 - Carbohydrates are also involved in detoxification, e.g. glucuronic acid

Carbohydrate metabolism

Carbohydrates are considered the most important source of energy that the body needs to carry out the mechanical, chemical, osmotic and electrical activities of various tissues. There are three paths through which cells obtain large amounts of energy:

- Anaerobic glycolysis or the Embden-Meyerhof pathway.
- Krebs cycle or citric acid cycle.
- Sugar pentose phosphate pathway, also called sugar hexaphosphate monophosphate shunt.

In these three pathways, glucose is considered the starting point, as it represents the most important monosaccharide included in carbohydrates in mammals.

Carbohydrate metabolism

A diet high in simple or refined carbohydrates tends to increase the risk of obesity and diabetes.

If people eat more carbohydrates than they need at that time, the body stores some of these carbohydrates inside the cells (such as glycogen) and turns the rest into fat. Glycogen is a complex carbohydrate that the body can convert into energy easily and quickly.

Muscles use glycogen for energy during periods of intense exercise. The amount of carbohydrates stored in the form of glycogen can provide almost the body's daily calorie requirement. There are a few other body tissues that store carbohydrates in the form of complex carbohydrates that cannot be used to provide energy.

Blood Glucose

- Glucose (sugar) mainly comes from carbohydrates in the food and drinks you consume. It's your body's main source of energy. Your blood carries glucose to all of your body's cells to use for energy.
- Several bodily processes help keep your blood glucose in a healthy range. Insulin, a hormone your pancreas makes, is the most significant contributor to maintaining healthy blood sugar.
- If you have elevated blood glucose levels (hyperglycemia), it usually indicates diabetes. Diabetes develops when your pancreas doesn't make any insulin or enough insulin or your body isn't responding to the effects of insulin properly.

The blood sugar level

The blood sugar level, blood sugar concentration, blood glucose level, or glycemia, is the measure of glucose concentrated in the blood. The body tightly regulates blood glucose levels as a part of metabolic homeostasis. For a 70 kg human, approximately four grams of dissolved glucose (also called "blood glucose") is maintained in the blood plasma at all times. Glucose that is not circulating in the blood is stored in skeletal muscle and liver cells in the form of glycogen; in fasting individuals, blood glucose is maintained at a constant level by releasing just enough glucose from these glycogen stores in the liver and skeletal muscle in order to maintain homeostasis. Glucose can be transported from the intestines or liver to other tissues in the body via the bloodstream. Cellular glucose uptake is primarily regulated by insulin, a hormone produced in the pancreas. Once inside the cell, the glucose can now act as an energy source as it undergoes the process of glycolysis.

Glucose abnormalities

1•Diabetes

is a disorder caused by the body not producing enough insulin or responding normally to insulin, resulting in abnormally high blood sugar (glucose) levels.

Type 1 diabetes

When suffering from type 1 diabetes (formerly called “insulin-dependent diabetes” or juvenile diabetes), the body’s immune system attacks the insulin-producing cells in the pancreas, where more than 90% of them are permanently destroyed.

Therefore, The pancreas produces little or no insulin. Only about 5 to 10% of people with type 1 diabetes have type 1 diabetes. In most people with type 1 diabetes, this condition occurs before they reach the age of 30. Although it may happen later.

Type 2 diabetes

In type 2 diabetes (formerly called non-insulin-dependent diabetes or adult-onset diabetes), the pancreas often continues to produce insulin, sometimes even to levels above normal, especially in the early stage of the disease; The body develops resistance to the effects of insulin, so there is not enough insulin to meet the body's needs. As type 2 diabetes progresses, the pancreas's ability to produce insulin declines.

2•Ketosis

Excessive ketone bodyIt is a complex defect in metabolic processes that is characterized by an increase in the level of blood sugar and ketone bodies in the blood and urine, such that their concentration reaches higher than 5 mEq/L and the blood sugar level is 250 mg/dL

At this stage, glucose production processes increase in the liver due to:

- *The body's inability to use blood sugar due to the lack of insulin
- *Increased breakdown of glycogen stored in the liver
- *Increased decomposition of lipids, which leads to an increase in the concentration of fatty acids in the blood, so that the liver uses these acids in metabolic processes as a source of energy instead of glucose, which leads to the accumulation of acids such as ketones and ketoacids.

These ketone include: acetone, beta hydroxypurate, and acetoacetate.

3•Glycosuria

is the excretion (excretion) of glucose in the urine. Urine usually does not contain glucose; This is because the kidneys work to reabsorb all the glucose that has been filtered in the renal tubular unit into the bloodstream, and glycosuria often occurs as a result of an abnormally high blood sugar level, which often occurs as a result of untreated diabetes. Rarely, this condition is caused by an internal problem with the reabsorption of blood sugar (eg, Fanconi syndrome) and the resulting condition is called nephrotic glucosuria. Glycosuria leads to the excretion of excess water in the urine, leading to dehydration. The process is called osmotic diuresis.

4•Glucose Tolerance

Glucose tolerance is defined as the ability to dispose of a glucose load, and therefore glucose in tolerance is defined as an impaired ability for glucose disposal.