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## A. Carbohydrate

### Definition:

The term carbohydrate often means any food that is particularly rich in the complex carbohydrate starch (such as cereals, bread, and pasta) or simple carbohydrates, such as sugar (found in candy, jams, and desserts).

### Composition:

A carbohydrate is an organic compound with the empirical formula  $C_m(H_2O)_n$ ; that is, consists only of carbon, hydrogen, and oxygen, with a hydrogen:oxygen atom ratio of 2:1 (as in water). Carbohydrates can be viewed as hydrates of carbon, hence their name. Structurally however, it is more accurate to view them as polyhydroxy, aldehydes and ketones.

### Function:

Carbohydrates serve several biochemical functions:

- Monosaccharides are a fuel for cellular metabolism.
  - Monosaccharides are used in several biosynthesis reactions.
  - Monosaccharides may be converted into space-saving polysaccharides, such as glycogen and starch. These molecules provide stored energy for plant and animal cells.
- Carbohydrates are used to form structural elements, such as chitin in animals and cellulose in plants.
- The 5-carbon monosaccharide ribose is an important component of coenzymes (e.g., ATP, FAD, and NAD) and the backbone of the genetic molecule known as RNA. The related deoxyribose is a component of DNA.
  - Saccharides and their derivatives include many other important biomolecules that play key roles in the immune system, fertilization, preventing pathogenesis, blood clotting, and development.

### Classification and names:

- The carbohydrates (saccharides) are divided into four chemical groupings: monosaccharides (e.g glucose, fructose, galactose), disaccharides (sucrose, lactose) , oligosaccharides, and polysaccharides (chitin, cellulose).
- In general, the monosaccharides and disaccharides, which are smaller (lower molecular weight) carbohydrates, are commonly referred to as sugars.
- The word *saccharide* comes from the Greek word *σάκχαρον* (*sákkharon*), meaning "sugar". While the scientific nomenclature of carbohydrates is complex, the names of the monosaccharides and disaccharides very often end in the suffix -ose.
- For example, blood sugar is the monosaccharide glucose, table sugar is the disaccharide sucrose, and milk sugar is the disaccharide lactose.

### Characteristics used to classify monosaccharides:

- number of carbon atoms in the molecule
- location of the carbonyl group

- the chirality of the carbohydrate

**aldose** - monosaccharide in which the carbonyl group is an aldehyde

**ketone** - monosaccharide in which the carbonyl group is a ketone

**triose** - monosaccharide with 3 carbon atoms

**tetrose** - monosaccharide with 4 carbon atoms

**pentose** - monosaccharide with 5 carbon atoms

**hexose** - monosaccharide with 6 carbon atoms

**aldohexose** - 6-carbon aldehyde (e.g., glucose)

**aldopentose** - 5-carbon aldehyde (e.g., ribose)

**ketohexose** - 6-carbon hexose (e.g., fructose)