

Metabolites

Metabolites

- **Metabolism** is a set of chemical reactions that occur in the cells of living organism to sustain life.
 - Provide energy for vital process for synthesizing new organic material
- **Metabolites** are micro as well as macro biomolecules that are the intermediates or products of metabolism
- Categorized as
 - primary and
 - Secondary metabolites

Metabolites...

□ Primary metabolites

- Directly involved in the growth, development, and reproduction.
- Made by photosynthesis, respiration, etc. using CO_2 , H_2O , and NH_3 as a starting material.
- As they are essential to the organism, primary metabolites are present in **almost all living organisms** in larger quantity.
- They are a part of the basic molecular structure of an organism.
- They are identical in most organisms
 - Includes: carbohydrates, proteins, amino acid, lipids, nucleic acids

Metabolites...

❑ Secondary metabolites

- They are biosynthetically derived from primary metabolites.
- Have more limited distribution & restricted to a limited taxonomic group
- They are not involved in the growth and development of the organism
- They are **not essential to sustain** the life of cells.
- They do have an important role in the **interaction** of the plant with its environment.
- Their absence does not cause bad effects to the plants.
- Are produced during the non growth phase of the organism
- They are unique in different species.

Metabolites...

- They are usually produced in small quantity in the plant.
- Produced by plants as defense chemicals against predators, attractive features (color, odor, taste) for pollinators.

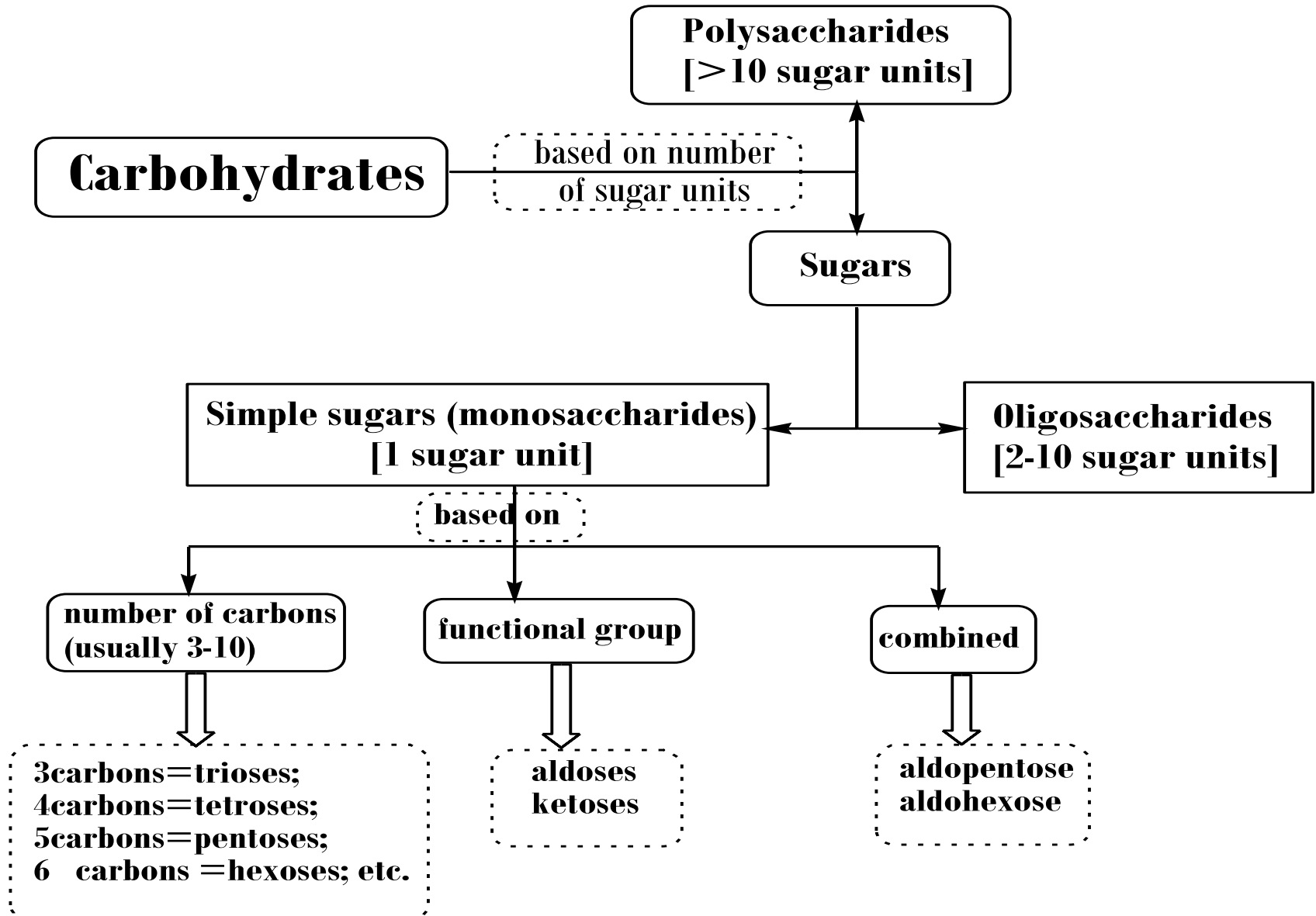
Secondary metabolites

- Are involved in chemical adaptation to environmental stress
- Serve as defensive, protective, or offensive chemicals against micro-organisms, insects or herbivorous animals.
- They include most of the **pharmacologically active** natural plant products. E.g: alkaloids, phenolics, steroids, essential oils, lignins, resins, and tannins, etc.

Carbohydrates

- Carbohydrates are polyhydroxy aldehyde or polyhydroxy ketones or compounds that can be hydrolyzed to them
- Carbohydrates are among the first products of photosynthesis
- Are the most abundant organic compounds in the plant world
- Have a basic composition of $(\text{CH}_2\text{O})_n$ or $\text{H} - \overset{\text{I}}{\underset{\text{I}}{\text{C}}} - \text{OH}$
 - However; **formaldehyde**, **lactic acid**, and **acetic acid** have such formula but they are not carbohydrates
 - Deoxy-ribose don't have this formula but it is a carbohydrate

Classification



Carbohydrates ...

Glucose - "blood sugar", immediate energy source for cellular respiration.

- The end product of digestion of starch, sucrose, maltose and lactose.
- Found in fruits, vegetables, honey, corn syrup and molasses
- After meal it is converted to glycogen and excess is converted to triacyl glycerol and stored.

Galactose - milk sugar as it is found in milk (and yogurt),

- It is not found free in nature
- Produced in the body during digestion of lactose
- During lactation glucose is converted to galactose so that milk can be produced.

Fructose - known as levulose or fruit sugars

- Found in fruits and honey, is the sweetest of all sugars.
- Produced during digestion of sucrose and is found in nectar of flowers, honey and molasses.

Disaccharides

Sucrose — common table sugar

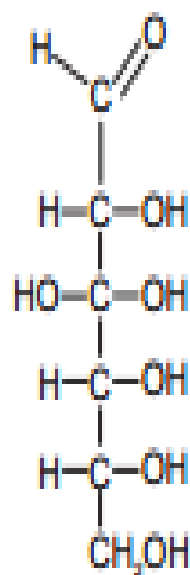
- Is made up of one glucose unit and one fructose unit.
- Found in maple syrup, molasses, sorghum and corn syrups

2. Lactose — major sugar in milk = glucose + galactose

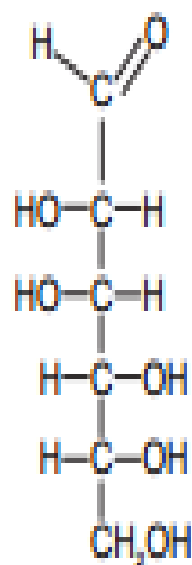
- Only found in milk
- When hydrolyzed yields galactose and glucose.

3. Maltose — product of starch digestion = glucose + glucose

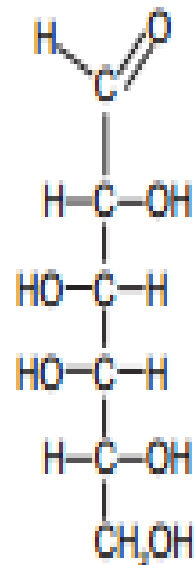
- ✓ Maltose(malt sugar) is found in sprouts and sweetening agents
- ✓ Is formed in the body as an intermediate product of starch digestion.
- ✓ Is found in beer, infant formulas and malted breakfast cereals



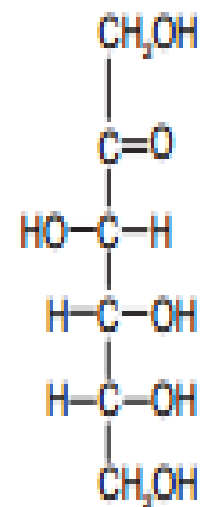
D-(+)-glucose



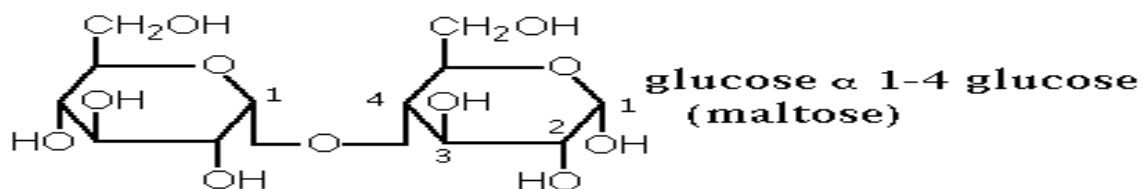
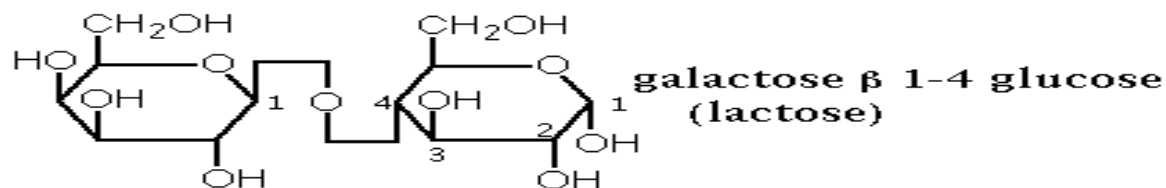
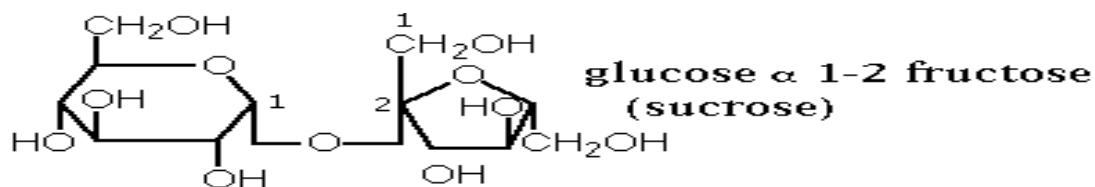
D-(+)-mannose



D-(+)-galactose



D-(-)-fructose



Polysaccharides

- Polysaccharides: are insoluble in water, includes:
 - Starch
 - Glycogen
 - Dietary fiber = Non starch polysaccharide (cellulose, hemicelluloses, pectins, gums, and mucilages).

❑ *Starch*

- Provides 80% of dietary calories in humans worldwide
- Major storage carbohydrate in **higher plants**. Occur in two forms:
 - ✓ *Amylose* – long straight glucose chains ($\alpha 1-4$)
 - ✓ *Amylopectin* – branched every 24-30 glucose residues ($\alpha 1-6$)

Polysaccharides...

❑ *Glycogen*

- Major storage carbohydrate in **animals**
- Long straight glucose chains (α 1-4)
- Branched every 4-8 glucose residues (α 1-6)
- More branched than starch

❑ *Cellulose*

- Composed of glucose units joined by β -1, 4 linkages
- Structural constituent of plant **cell wall**.
- Humans **do not** have the enzymes to digest cellulose.

- The recommended dietary carbohydrate allowance is 45 to 65% of your daily calorie. If you take 2000 calories per day the RDA for carbohydrate is set at 130g per day??????.
- **Added sugars** are sugars added during food preparation or manufacturer processing.
 - Obtained from Soft drinks, pastries, candy, and other sweets
 - Corn syrup, brown sugar, white sugar, fructose and dextrose are the common added sugars.
 - Limit your intake of added sugars to **no more than 25%** of your total daily calorie

- The healthiest carbohydrates come from unprocessed or minimally processed sources
 - Whole grains, fruits, vegetables, beans, and other legumes are healthy carbohydrate sources.

Fiber

- Non-digestible form of carbohydrate
- I. **Soluble fiber:** found in oatmeal, nuts, beans, lentils, and apples
 - Lower cholesterol and glucose level
- II. **Insoluble fiber:** found in brown rice, legumes, cucumber and carrot
 - Soften and provide bulk to stool promoting regularity
- RDA: **≤ 50 years old:** 38 grams for men, 25 grams for women:
 - > 50 years old:** 30 gram for men, and 21 gram for women

Functions

- Act as **store houses** of chemical energy (glucose, starch, glycogen)
- Serve as components of **supportive structures** in plants (cellulose) and connective tissues in animals (acidic polysaccharides)
- Are essential components of nucleic acids (D-ribose and 2-deoxy-D-ribose).

Gums and Mucilages

- *Both gives a mixture of sugars and uronic acids.*

Gums

- Pathological products formed by injury, unfavorable condition, breakdown of cell walls
- Amorphous translucent substances **insoluble in alcohol & organic** substances but **soluble in water** to give viscous sticky solution
- Some gums swollen by absorbing water forming a jelly like mass
- Contains Ca, K, and Mg salts of polyuronides
- Found in trees and shrubs of different families

Gums and Mucilages ...

Mucilages

- are produced under normal metabolism formed within the cell
- Serve as: storage materials, water reservoirs, protectors to germinating seeds
- Found in epidermal leaf cells, seed coats, stem, and barks

Drugs containing carbohydrates

1. Acacia gum

- Dried gummy exudate of the stems and branches of *Acacia senegal* L. and other *Acacia* species.
- White, pale-yellow and sometimes creamish-brown to red in colour.
- **Synonym:** Somali gum, Yellow thorn, Indian Gum, Gum Senegal, Gum Arabic, etc.

Drugs containing carbohydrates ...

Chemical constituents of Acacia

- Arabin, the principal constituent, is a mixture of calcium, magnesium and potassium salts of arabic acid.
- Arabic acid is a branched polysaccharide that yields L-arabinose, D-galactose, D-glucuronic acid and L-rhamnose on hydrolysis.
- Acacia contains 12–15% of water and several occluded enzymes such as oxidases, peroxidases and pectinases.
- The total ash content should be in the range of 2.7–4.0%.

Drugs containing carbohydrates ...

□ Uses

- It is employed as a demulcent.
- Emulsifying, thickening, binding, and colloidal stabilizer agent.
- Manufacturing of candy and other food products.
- Administered intravenously in haemodialysis.
- Production of adhesives and ink, and as a binding medium for marbling colours.

Drugs containing carbohydrates ...

Toxicology

- ❑ It is essentially nontoxic when ingested.
- ❑ Allergic reactions such as respiratory problems and skin lesions reported to the gum and powdered forms of acacia
- ❑ If peroxidase enzyme is not inactivated by simple heat,
 - it forms coloured complexes with certain amines and phenols
 - ✓ thereby leading to destruction of alkaloids and readily oxidizable compounds
 - ✓ E.g some vitamins.

Drugs containing carbohydrates ...

2. Guar gum

- Synonyms: Guar gum, Jaguar gum, Guar flour and Decorpa
- It is a seed gum from *Cyamopsis tetragonolobus* Linn belonging to family Leguminosae.
- The water-soluble part contains mainly of a high molecular weight hydrocolloidal polysaccharide, galactomannan commonly known as guaran.
- Guaran consists of linear chains of mannopyranosyl units with galactopyranosyl units at a ratio of 1: 2.
- The gum also contains about 5–7% of proteins.

Drugs containing carbohydrates ...

Uses of Guar gum

- **Pharmaceutical:** as a protective colloid, a binding, disintegrating agent, emulsifying agent, and flocculent in ore-dressing
- **Medical:** bulk laxative, appetite depressant and peptic ulcer therapy.
- It reduce serum total cholesterol by 10–15% and LDL by up to 25% without any effect on triglyceride and HDL.
- It also reduce blood sugar and blood pressure.
- **Industrial:** paper manufacturing, printing, polishing, textiles, and food and cosmetic industries.

Drugs containing carbohydrates ...

Toxicology Guar gum

- ❑ **Gastrointestinal** disturbances such as
 - ✓ *gastrointestinal pain, nausea, diarrhea and flatulence* are the most common adverse effects.
- ❑ It may affect the absorption of concomitantly administered drug
- ❑ Occupational **asthma** has been observed among those working with guar gum.

Drugs containing carbohydrates ...

3. Honey

- Madhu, Madh, *Mel*, Purified Honey.
- Honey is a viscid and sweet secretion stored in the honey comb
- Produced by various species of bees, such as *Apis mellifera*, *Apis dorsata*, *Apis florea*, *Apis indica*, and other species of *Apis* that belonging to family Apidaeae.
- **Preparation:** the worker bee sucks the flower nectar (containing 25% sucrose and 75% water).
 - It deposit the nectar in the honey-sac located in abdomen.
 - The enzyme invertase present in saliva of the bee converts nectar into invert sugar,
 - which is partially utilized by the bee and the remaining is deposited into honey comb.

Drugs containing carbohydrates ...

- The collected honey is heated at 80 °C & cooled
 - To avoid its fermentation during storage

Chemical constituents of honey

- Moisture 14–24%, Dextrose 23–36%, Levulose (Fructose) 30–47%, Sucrose 0.4–6%, Dextrin and Gums 0–7%, and Ash 0.1–0.8%.
- Small amounts of essential oil, beeswax, pollen grains, formic acid, acetic acid, succinic acid, maltose, dextrin, colouring pigments, vitamins and enzymes like diastase, invertase and inulase.
- Its sugar contents varies with variation in the source of nectar and enzymatic activity that control the conversion into honey.

Drugs containing carbohydrates ...

Uses of honey

- Have mild laxative, bactericidal, sedative, antiseptic activity.
- Treats cold, cough, fever, sore eye and throat, tongue and duodenal ulcers, liver disorders, constipation, diarrhea and others.
- Component of cosmetics and cough preparations

Adulteration

- Honey is adulterated with artificial invert sugar or simply with cane-sugar syrup.

Drugs containing carbohydrates ...

Toxicology

- Honey is generally safe.
- However, it is harmful to infants as it may contain spores of *Clostridium botulinum*

Drugs containing carbohydrates ...

4.Tragacanth

- Synonyms: Goat's thorn, gum dragon, gum tragacanth, hog gum
- It is air dried gummy exudates of the stems and branches of *Astragalus gummifer* Labill and certain other species of *Astragalus*, belonging to family Leguminosae

Drugs containing carbohydrates ...

Fractions of tragacanth

❑ Tragacanthin

- **Water soluble**, 30–40% of total tragacanth
- forms an instant colloidal solution
- no methoxyl groups present

❑ Bassorin

- **water insoluble**, from 60% to 70% of total tragacanth
- gets swelled up in water to form a gel
- Comprises 5.38% methoxyl moieties
- *Responsible for the viscous nature of mucilages*

Drugs containing carbohydrates ...

Uses of tragacanth

- Demulcent in cough and cold preparations, emollient in cosmetics
- Thickening, suspending, emulsifying, and binding agent.
- Stabilizer for ice cream
- Inhibit the growth of cancer cells

Drugs containing carbohydrates ...

5. Carrageenan

- It is sulphated polysaccharide from the red algae *Chondrus crispus* Linn., belonging to family Gigartinaceae.
- Uses
 - ✓ emulsifying, stabilizing, solubilizing and viscosity builder in food products.
 - ✓ Preparation of tooth paste, creams, lotions and other cosmetic product
 - ✓ *Induction of inflammation on experimental model animal.*

THANK YOU!