PharmacognosyII

Lec. 2 **3rd stage 1st semester** **Year 23-24**

Lecturer: Dr. Jamel Fani

Carbohydrates

Carbohydrates are broadly defined as polyhydroxy aldehydes or ketones and their derivatives or as substances that yields one of these compounds.

• Composed of carbon, hydrogen, and oxygen.

• Functional groups present include hydroxyl groups.

• -ose indicates sugar.

Carbohydrates contained in foods such as pasta and bread provide energy for

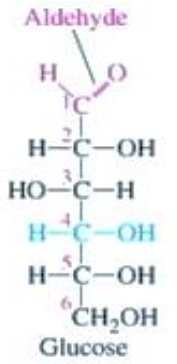
Carbohydrates are the most abundant of all the organic compounds in nature

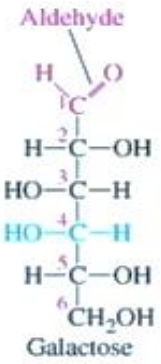
- In plants, energy from the Sun is used to convert carbon dioxide and water into the carbohydrate glucose.
- Many of the glucose molecules are made into long-chain polymers of starch that store energy.
- About 65% of the foods in our diet consist of carbohydrates.
- Each day we utilize carbohydrates in foods such as bread, pasta, potatoes, and rice.
- Other carbohydrates called disaccharides include sucrose (table sugar) and lactose in milk.
- During digestion and cellular metabolism, carbohydrates are converted into glucose, which is oxidized further in our cells to provide our bodies with energy and to provide the cells with carbon atoms for building molecules of protein, lipids, and nucleic acids.

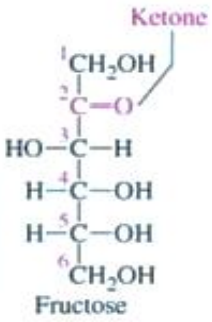
- In plants, a polymer of glucose called cellulose builds the structural framework.
- Cellulose has other important uses, too.
- The wood in our furniture, the pages in your notebook, and the cotton in our clothing are made of cellulose.

Function of Carbohydrates in Cells

- ✓ Major source of energy for the cell
- ✓ Major structural component of plant cell
- ✓ Immediate energy in the form of GLUCOSE
- ✓ Reserve or stored energy in the form of GLYCOGEN







Glucose **Galactose** **Fructose**

Monosaccharides are simple sugars, or the compounds which possess a free aldehyde (CHO) or ketone (C=0) group and two or more hydroxyl (OH) groups. They are the simplest sugars and cannot be hydrolysed further into smaller units. Monosaccharides contain a single carbon chain and are classified on the basis of number of carbon atoms they possess, and as aldoses or ketoses depending upon their groups.

Oligosaccharides

These are compound sugars that yield 2 to 10 molecules of the same or different monosaccharides on hydrolysis. Accordingly, an oligosaccharide yielding 2 molecules of monosaccharide on hydrolysis is designated as a disaccharide, and the one yielding 3 molecules of monosaccharide as a trisaccharide and so on.

Disaccharides - Sucrose, Lactose, Maltose, Cellobiose, Trehalose, Gentiobiose, Melibiose

Trisaccharides - Rhamninose, Gentianose, Raffinose (= Melitose), Rabinose, Melezitose

Tetrasaccharides - Stachyose, Scorodose

Pentasaccharide – Verbascose

The molecular composition of the 3 legume oligosaccharides (viz., raffinose, stachyose and verbascose) is shown below.

α-Galactose (1-6) α-Glucose (1-2) β-Fructose Raffinose

α-Galactose (1-6) α-Galactose (1-6) α-Glucose (1-2) β-Fructose Stachyose

α-Galactose (1-6) α-Galactose (1-6) α-Galactose (1-6) α -Glucose (1-2) β-Fructose Verbascose

$$\text{Maltose} + H_2O \xrightarrow{H^+ \text{ or maltase}} \text{glucose} + \text{glucose}$$

$$\text{Lactose} + H_2O \xrightarrow{H^+ \text{ or lactase}} \text{glucose} + \text{galactose}$$

$$\text{Sucrose} + H_2O \xrightarrow{H^+ \text{ or sucrase}} \text{glucose} + \text{fructose}$$

Polysaccharides

Containing 10 or more monosaccharides units combined together, examples:

Starch-digestible

Glycogen-digestible

Cellulose-indigestible

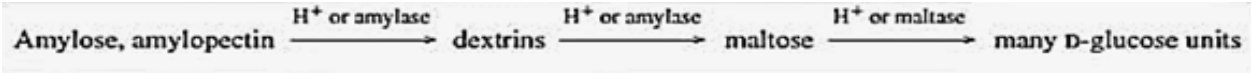
A great majority of carbohydrates of nature occur as polysaccharides

Chemically, the polysaccharides may be distinguished into:

homopolysaccharides, which yield, on hydrolysis, a single monosaccharide and **heteropolysaccharides**, which produce a mixture of monosaccharides on hydrolysis. Based on their functional aspect, the polysaccharides may be grouped under two heads:

(α) **Nutrient** (or **digestible**) **polysaccharides**. These act as metabolic reserve of monosaccharides in plants and animals, e.g., starch, glycogen and inulin.

(b) **Structural** (or **indigestible**) **polysaccharides**. These serve as rigid mechanical structures in plants and animals, e.g., cellulose, pectin and chitin and also hyaluronic acid and chondroitin.



CARBOHYDRATE

1. Agar
2. Acacia
3. Guar Gum
4. Honey
5. Starch
6. Isapgol
7. Tragacanth
8. Sterculia Gum
9. Chitin
10. Pectin
11. Xanthan Gum
12. Tamarind Kernel Powder

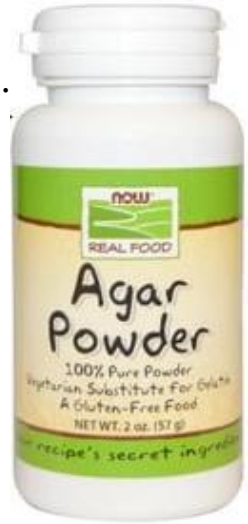
AGAR

1. **Synonym:** Agar-Agar, Chinese agar, Japanese agar, Indian agar.
2. **Biological source:** **Agar** is the dried hydrophilic colloidal polysaccharide complex extracted from various red algae belonging to species of ***Gelidium***, ***Pterocladia*** and ***Gracilaria***. 35% of total agar is obtained from ***Gelidium amansii*** belonging to family **Gelidacea**.
3. **Geographical Source:** Japan, China, India, Korea, Australia

4. **Preparation:**

5. **Chemical constituents:** The 2 principal constituents (polysaccharide) are:

* **Agarose**: A neutral gelling fraction responsible for gel strength.
* **Agaropectin**: A non gelling fraction responsible for viscosity of agar.



6. **Use**

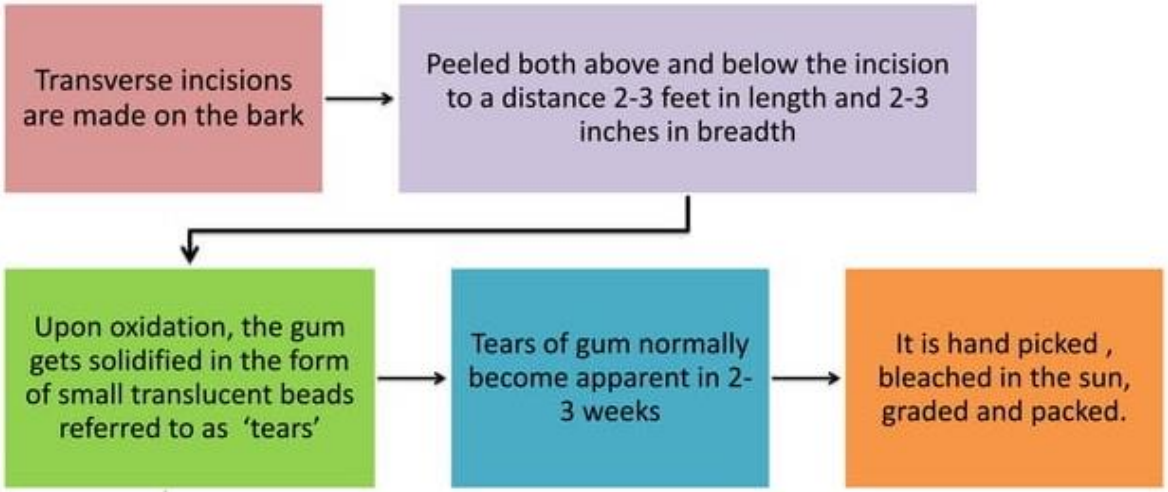
* In Microbiology-used in preparation of culture media.
* Used as emulsifying agent.
* Bulk laxative.
* Thickening agent in food and diary industry

ACACIA

1. **Synonyms:** Indian Gum; Gum Acacia; Gum Arabic.
2. **Geographical source:** India, Arabia, Sri Lanka, Morocco and Africa.

3. **Biological Source:** Acacia is the dried gummy exudation from the stems and branches of ***Acacia senegal*** and ***Acacia arabica*** belonging to family **Leguminosae**.

4. **Cultivation and collection:** Acacia is recovered from wild as well as duly cultivated plants in the following manner,
   such as:



5. **Chemical Constituents:**

Acacia is composed of four chemical constituents, namely:

* (-) arabinose;
* (+) galactose;
* (-) rhamnose and
* (+) glucuronic acid.

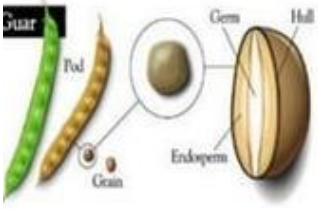
It also contains a peroxidase enzyme.

6. **Use**

• The mucilage of acacia is employed as a demulscent.
• It is used extensively as a vital pharmaceutical aid for emulsification and to serve as a thickening agent.
• Binding agent for tablets e.g., cough lozenges.

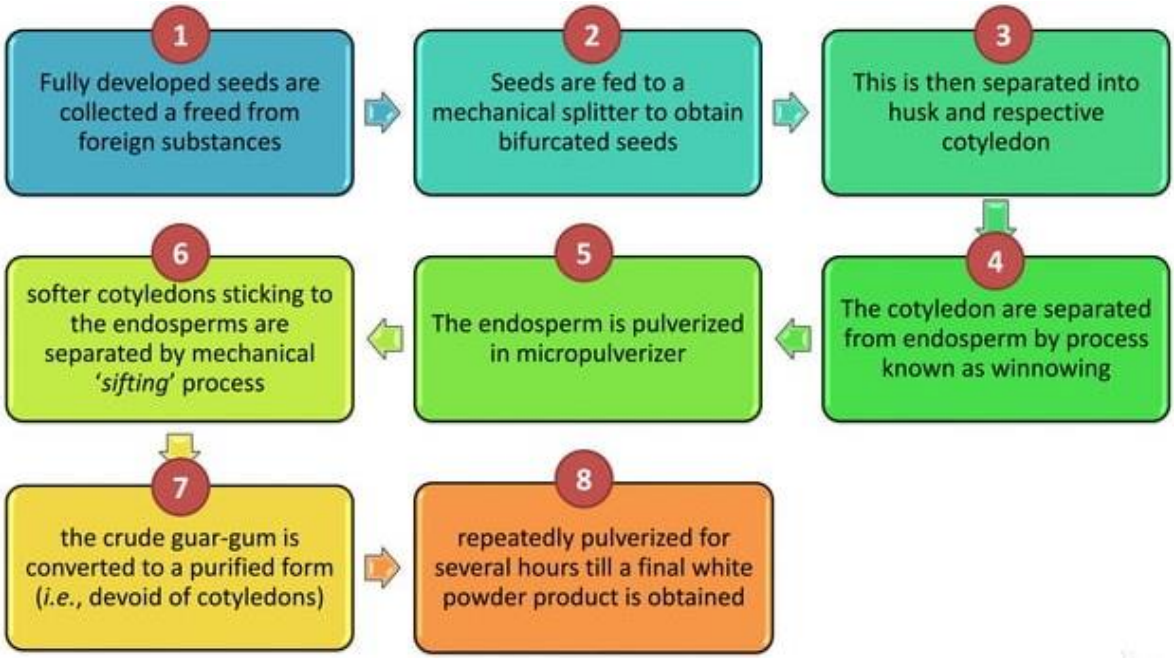
GUAR GUM

1. **Synonyms:** Guar flour; Decorpa; Jaguar; Cyamopsis gum.
2. **Geographical Source:** It grows abundantly in tropical countries like: Indonesia, India, Pakistan and Africa.
3. **Biological Source:** Guar gum is the ground endosperms of ***Cyamopsis tetragonolobus*** belonging to family **Leguminoseae**.
4. **Preparation**



Guar seed is comprised of:

* Endosperm
* Cotyledons
* Husk



5. **Chemical Constituents**

- The water soluble fraction constitutes 85% of Guar gum and is commonly known as **Guaran**.
- The principal constituent of the gum **Guaran** on hydrolysis gives galactose and Mannose.

6. **Uses**

• It is used therapeutically as a bulk laxative.

• It is employed as a protective colloid.

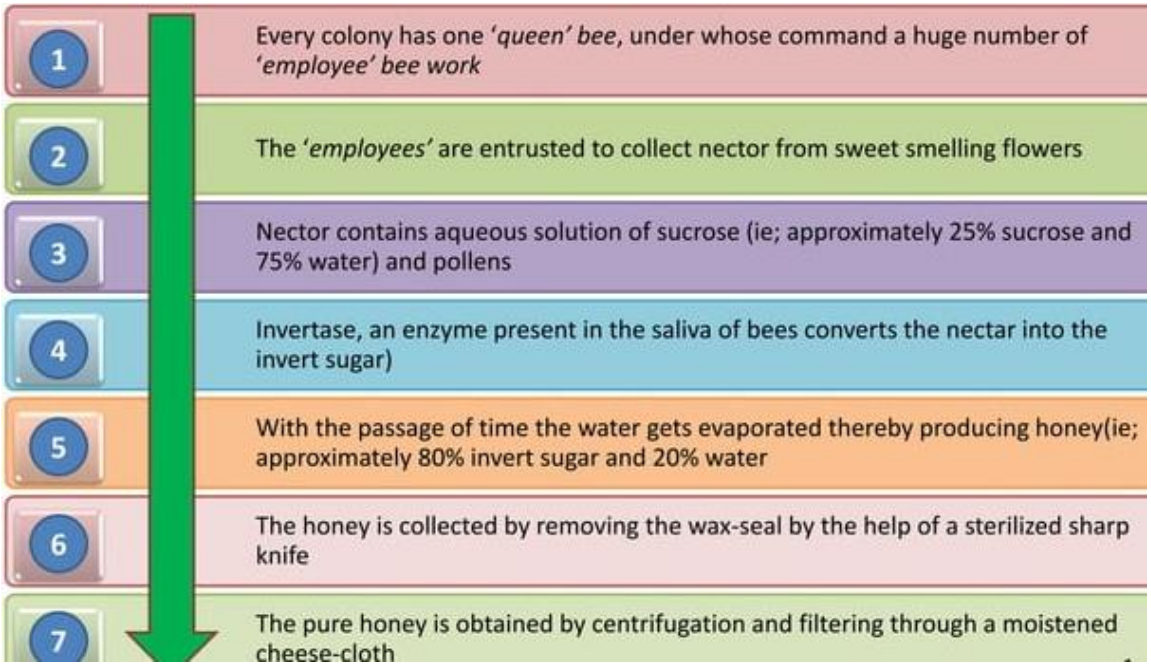
• It is used in pharmaceutical jelly formulations.

• It is widely used in suspensions, emulsions, lotions, creams and toothpastes.

HONEY

1. **Synonyms:** Madhu, Madh, Mel, Honey.
2. **Geographical Source:** Honey is available in abudance in Africa, India, Jamaica, Australia, California, Chili, Great Britain and New Zealand.
3. **Biological Source:** Honey is a viscid and sweet secretion stored in the honey comb by various species of bees, such as: ***Apis dorsata***, ***Apis florea***, ***Apis indica***, ***Apis mellifera***, belonging to family **Apideae**.

4. **Preparation**



5. **Chemical Constituents**

The average composition of honey rangles as follows:

• Moisture 14-24%,

• Dextrose 23-36%,

• Levulose (Fructose) 30-47%,

• Sucrose 0.4-6%,

• Dextrin

• Gums

Besides, it is found to contain small amounts of beeswax, formic acid, acetic acid, succinic acid, maltose, colouring pigments, vitamins and an admixture of enzymes eg; diastase, invertase and inulase.

6. Uses

- It is used as a sweetening agent in food industry.
- Being a demulcent, it helps to relieve dryness and is, therefore, recommended for coughs, colds, sore-throats and constipation.
- Because of its natural content of simple sugars, it is globally employed as a good source of nutrient for infants, elderly persons and convalescing patients.
- Used in cosmetic industry.

STARCH

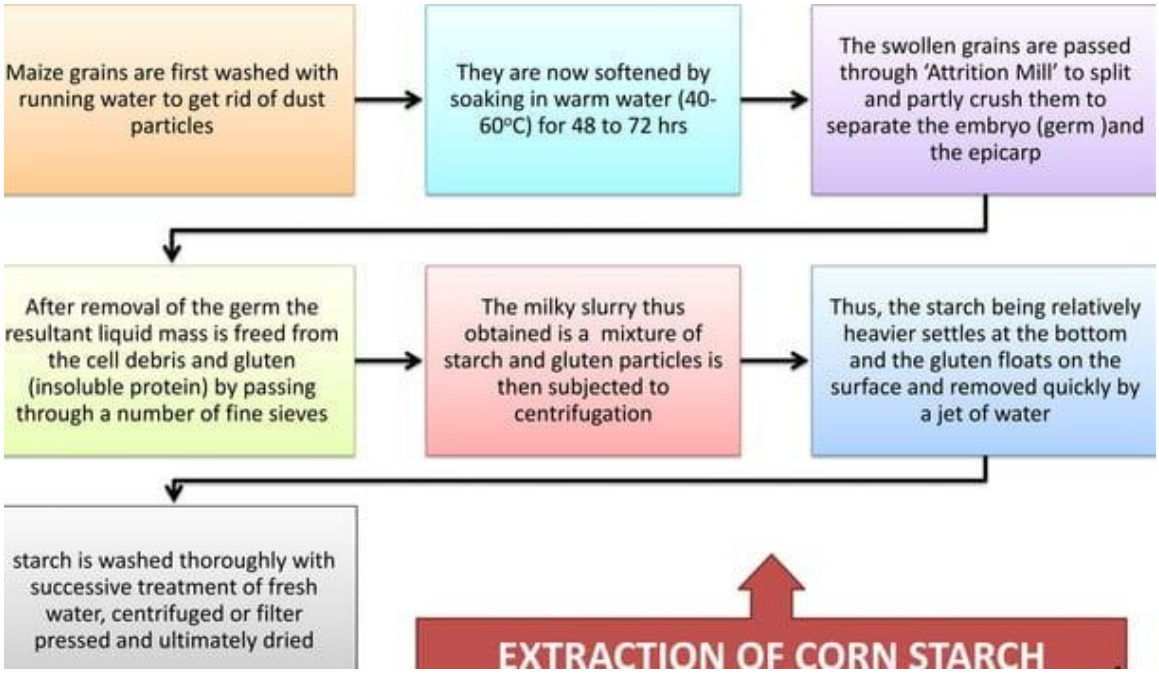
(Corn starch, Potato Starch, Rice Starch, Wheat Starch)

1. **Synonym:** Amylum.
2. **Geographical Source:** USA, Canada, Australia, China, India, Thailand, Indonesia, Vietnam, Pakistan.
3. **Biological Source:** Starch comprises of mostly polysaccharide granules usually separated from the fully grown grains of
   • Corn [***Zea mays*** Linn.];
   • Rice [***Oryza sativa*** Linn.];
   • Wheat [***Triticum aestivum*** Linn.]
   All family Gramineae/ Poaceae

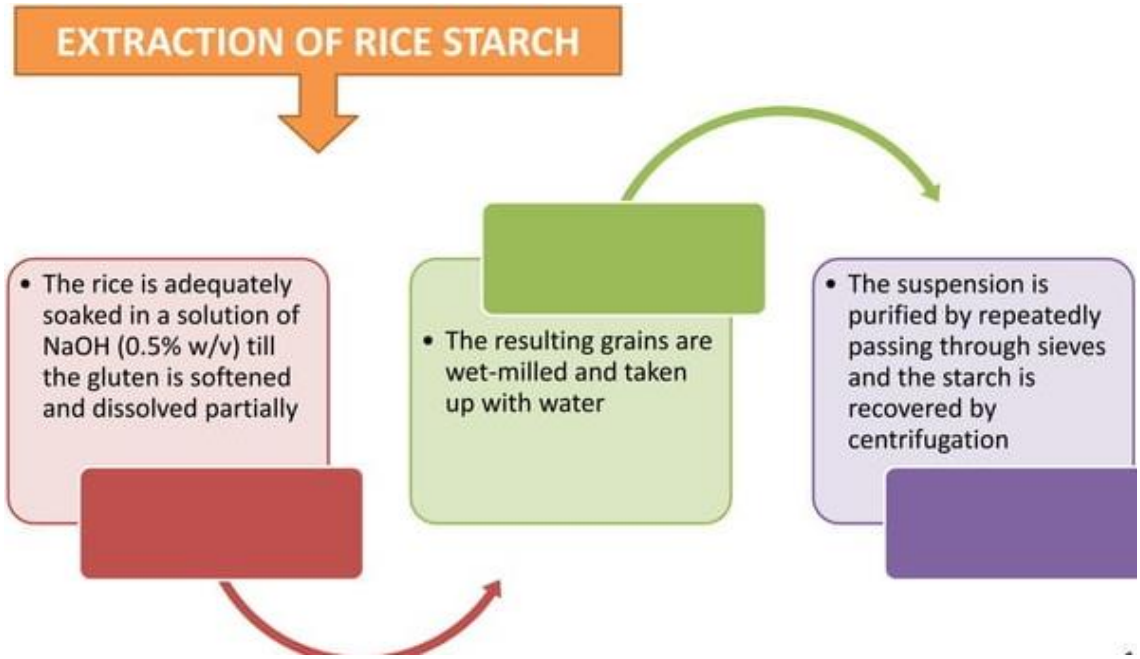
Starch is also isolated from the tubers of Potato [***Solanum tuberosum*** Linn.] family **Solanaceae**.

4. Preparation

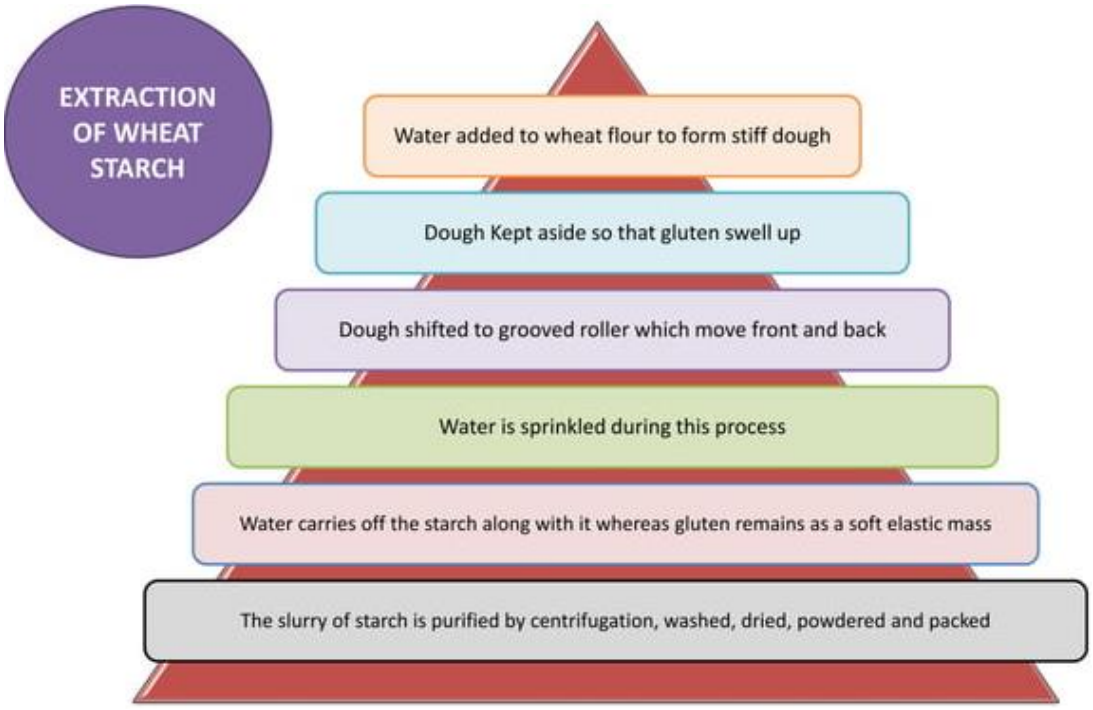
- **Corn Starch:**



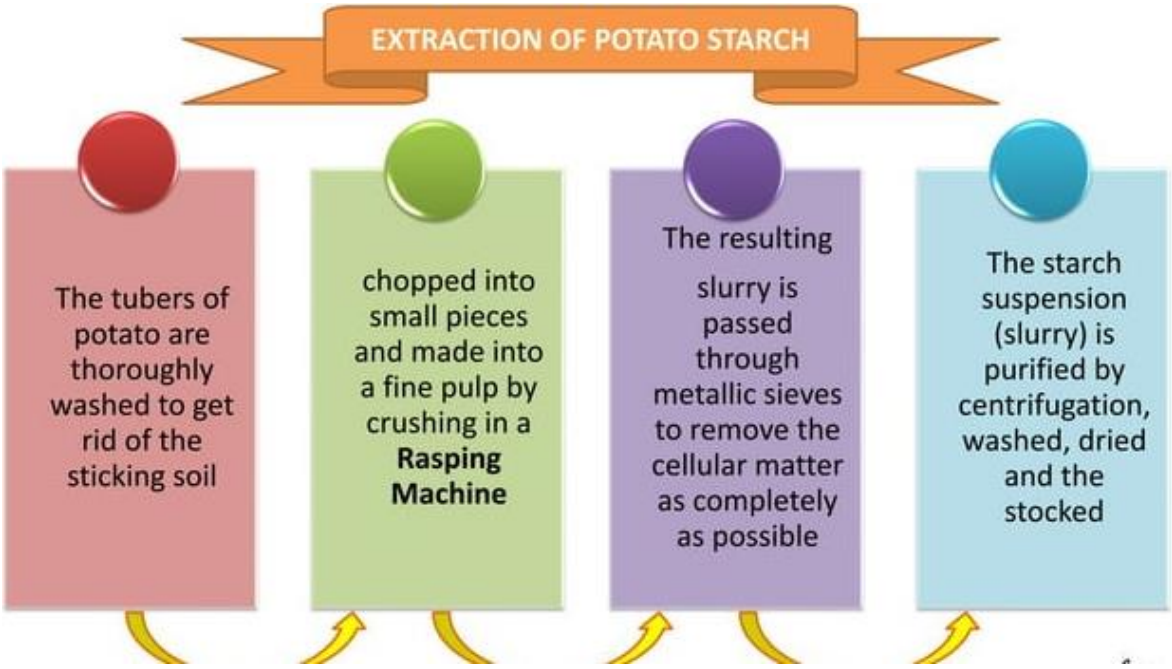
- **Rice Starch:**



- **Wheat Starch:**



- **Potato Starch:**



5. Chemical Constituents

It has been established that starch molecule is essentially made up of two complex polysaccharides, namely:

a) Amylopectin: (α-Amylose)

- **Amylopectin** is insoluble in water and swells in it thereby giving rise to a thick paste upon boiling with water.
- It produces a distinct violet or bluish red colouration with iodine* solution (0.1 N).
- It has a highly branched structure that is composed of several hundred short chains of about 20-25 **D-Glucose units linked by** (1→6).

b) Amylose: (β-Amylose)

- **Amylose** is water soluble.
- It gives an instant bright blue colour with iodine solution (0.1 N).
- Based on the fact that amylose upon hydrolysis yields the only **disaccharide** (+) - **Maltose** and the only **monosaccharide D-(+) – Glucose**.
- Amylose is comprised of chains of a number of D-(+) - glucose units, whereby each unit is strategically linked by an alpha (1→4)

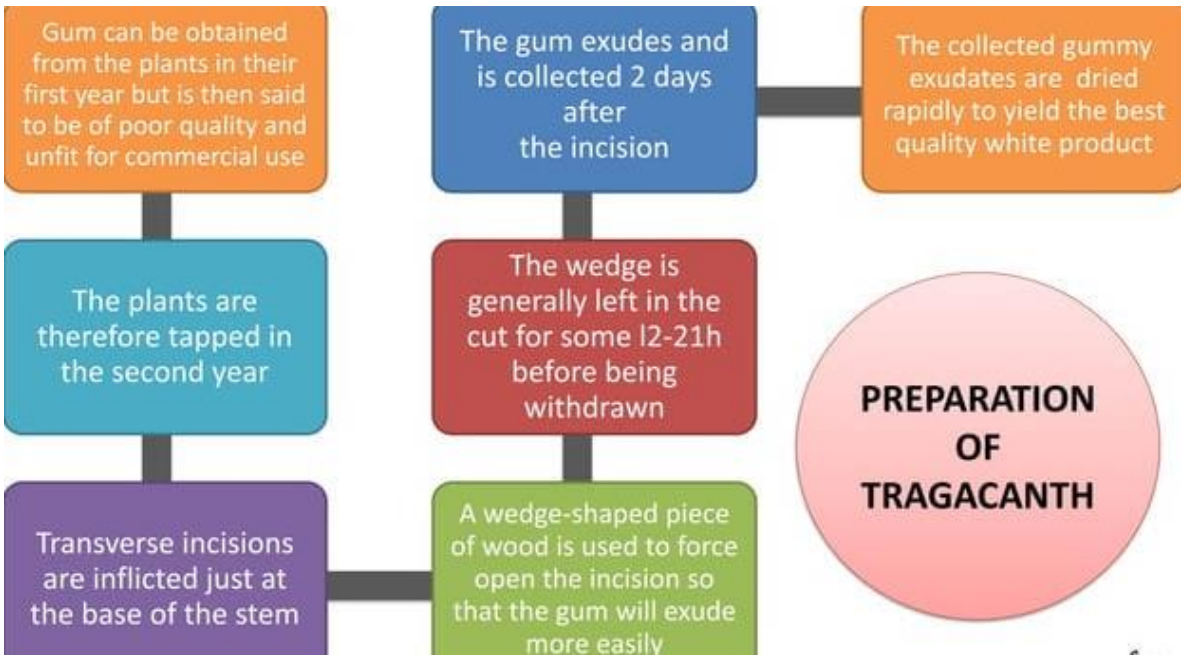
6. Use

- It possesses both absorbent and demulcent properties.
- It is used in the formulation of tablets and pills as a disintegrating agent and a binder.
- It is employed as a diluents (or filler) and lubricant in the preparation of capsules and tablets.
- It is used as an indicator in iodimetric analyses.
- It possesses nutrient properties as a food and in cereal based weaning foods for babies, e.g., **Farex** (Glaxo) and **Cerelac** (Nestle).
- It is used profusely in laundry starching.

TRAGACANTH

1. **Synonym:** Gum Tragacanth.
2. **Geographical Source:** It is naturally found in various countries, viz., Iran, Iraq, Armenia, Syria, Greece and Turkey.
3. **Biological Source:** The dried gummy exudation from ***Astragalus gummifer* Labill** or other Asiatic species of **Astragalus** belonging to the family of **Leguminoseae**.

4. **Preparation**



5. **Chemical Constituents**

- ❖ Interestingly, tragacanth comprises of two vital fractions:
  - * water-soluble fraction termed as **'tragacanthin'** (30-40%).
  - * water-insoluble fraction known as **'bassorin'** (60-70%).
- ❖ Both are not soluble in alcohol.
- ❖ The said two components may be separated by carrying out the simple filtration of a very dilute mucilage of tragacanth.
- ❖ **Bassorin** actually gets swelled up in water to form a gel, whereas **tragacanthin** forms an instant colloidal solution.

6. **Uses**

- It is used as a demulcent in throat preparations.
- It is employed as an emolient in cosmetics (e.g., hand lotions).
- It is used as a pharmaceutical aid as a suspending agent for insoluble and heavy powders in mixtures.
- It is effectively employed as a binding agent for the preparation of tablets and pills.
- It is also used as an emulsifying agent for oils and waxes.

STERCULIA

1. **Synonyms:** Karaya Gum; Kadaya; Katilo; Kullo; Kuteera; Indian Tragacanth; Mucara.
2. **Biological Source:** **Sterculia Gum** is the dried exudate of the tree ***Sterculia urens***; ***Sterculia villosa***; ***Sterculia tragacantha*** and other species of Sterculia, belonging to the family: **Sterculeaceae**.

3. **Geographical Source:**
   It is produced in India, Pakistan and to some extend in Africa.

4. Preparation

5. Chemical Constituents

- **Karaya gum** is partially acetylated polysaccharide containing about 8% acetyl groups and about 37% uronic acid residues.
- It undergoes hydrolysis in an acidic medium to produce:
    * (+)-Galactose,
    * (-)-rhamnose,
    * (+) -galacturonic acid.
    * A trisaccharide acidic substance.
- **Substituent/Adulterant** that is used as a substitute for **gum tragacanth**.

6. Uses

- It is employed as a denture adhesive.
- It is used as a 'binder' in the paper industry.
- It is also employed as a thickening agent for dyes in the textile industry.
- It is widely used as a stabilizer, thickner, texturizer and emulsifier in food.
- It is used as a bulk laxative.
- It finds its usage in lozenges.