

CARBOHYDRATES

1. ACACIA

Synonyms: gum acacia, gum arabic, Indian gum.

Biological source: Acacia is the dried gummy exudate from the stems and branches of *Acacia Senegal* or of other related species of Acacia like *Acacia arabica*.

Family: *Leguminosae*

Geographical source

- The tree *Acacia Senegal* grows wild in **sudan** central and west Africa.
- *Acacia arabica* (babul tree) grows wild in **india** particularly in the states of Punjab, Rajasthan and on western ghats.
- In general the trees are found in india and sri lanka .
- India produces 85% of gum arabic and the world supply is from sudan.

COLLECTION

- The gum is produced as a result of injury to the plant.
- After the rainy season the bark of the wild growing trees is tapped and transverse cuts are given to the stem and branches to expose cambium.
- As a result of injury tears of gum get collected on the cambium and newly formed phloem.
- Within 20 -30 days the tears of gum which have formed on the surface may be picked up made free of bark pieces and foreign organic matter.
- The material thus collected may be dried in the sun which helps in the removal of moisture.
- During the process of sun drying numerous cracks appears on the surface of lumps of tears and the gum is bleached.

MORPHOLOGICAL CHARACTERS

- Acacia occurs in the form of tears.
- Which may be round or irregular in shape having glossy surface and break with difficulty.
- The colour varies from pale yellow to light brown.
- The acacia gum from sudan and other African countries is comparatively more yellow and pinkish in colour.
- The tears appears more transparent.
- The powdered gum acacia is light brown in colour having mucilaginous taste and no odour.
- Acacia is almost completely soluble in the equal weight of water. The watery solution is viscous and acidic.
- The acidity of the solution increases on keeping. Acacia is insoluble in alcohol and other organic solvents.

CHEMICAL CONSTITUENTS

- Major component of acacia is **Arabin** which is a complex mixture of calcium, magnesium and potassium salts of Arabic acid.
- **Arabic acid** is a branched poly saccharide which on hydrolysis with dilute sulphuric acid yields D-Galactose, D-Glucoric acid, L-arabinose and L-Rhamnose.
- Acacia also contains enzymes like oxidase, peroxidase and pectinase.
- The presence of these enzymes sometime causes problems in certain pharmaceutical formulations.

CHEMICAL TESTS

Prepare 10%w/v solution of acacia in distilled water and perform the following tests for identity;

- 1.** To the aqueous solution add a few drops of dilute solution of lead acetate no precipitate are formed indicating the absence of tragacanth and agar.
- 2.** To the aqueous solution of acacia add a drop of solution of iodine no colour should appear showing the absence of starch and dextrin.
- 3.** Addition of a drop of solution of ferric chloride to the aqueous solution of acacia should not give any precipitate. This indicates absence of tannins.

4. To 5ml of the aqueous solution of acacia add 0.5ml of hydrogen peroxide 10% and 0.5ml of 1% solution of benzidine in alcohol 90%.

- Shake and allow to stand.
- The formation of blue colour shows the presence of peroxidase enzyme.
- (This is a distinction from tragacanth which does not contain this enzyme).

5. To the acacia solution add few drops of lead sub acetate solution white precipitate produced shows the presence of acacia.

6.Hydrolyse 5ml of the aqueous solution of acacia by boiling in a test tube in presence of 1ml of dilute hydrochloric acid.

- Cool the hydrolysed solution and to this add Fehlings solution (solutions A and B in equal proportion are mixed before addition) and heat.
- Red precipitate indicate the presence of reducing sugars produced on hydrolysis

USES

- Acacia is used as a **suspending agent** for the administration of insoluble drugs.
- It is an excellent **emulsifying agent**.
- Binding property of acacia assists in the **preparation of lozenges and pastilles**.
- Acacia possesses useful **demulcent** and **emollient** properties and thus it is used as an **adhesive** and **binder** in making granules for the manufacture of tablets.
- Its demulcent properties are useful in various formulations for cough, diarrhea and throat troubles.

ALLIED DRUGS OR ADULTERANTS

- **Gum ghatti** is an exudate from *Anogeissus latifolia* (**Family- Combretaceae**) .
- The tests of this gum vary in colour and the outer surface is dull with comparatively fewer cracks than the natural acacia.
- With lead sub acetate solution very slight precipitates are formed in aqueous solution of this gum.
- **Starch, tragacanth, sterculia gum and dextrin** are the adulterants found in acacia.

2.HONEY

Synonyms: Madhu

Biological source: Honey is a sugary substance deposited in the honey comb by the hive bee *Apis mellifera* and other species of *Apis*

Family : *Apidae*

Geographical source: Honey is produced in india and the major produce comes from the states of Himachal Pradesh. Other chief sources of supply are Newzealand, Australia, Africa, West indies and California (USA).

COLLECTION AND PREPARATION

- Nectar from the flowers of certain plants is taken by the worker bee with the help of a long hollow tube formed from the maxillae and labium.
- The nectar mainly contains sucrose but as it passes through the oesophagus in to the honey sac of the worker bee it comes in contact with an enzyme invertase present in the salivary secretion.
- This enzyme hydrolysis sucrose of the nectar in to invert sugar.
- When the worker bee arrives at the hive it delivers the contents of the honey sac in to the cells of the honey comb which storage of this saccharin substance honey.

- Removal of the bees from the honey is necessary to obtain honey.
- Thus the honey comb is smoked to remove bees and honey is separated from the cut comb by drainage or by centrifugation or by expression.
- The honey obtained by applying pressure is liable to contamination with the bees wax present in the comb.
- Honey obtained from the comb is heated to 80°C so that the impurities floating on the surface are removed and the density adjusted between 1.35-1.37.
- After heating and removal of impurities honey should be cooled rapidly otherwise the colour darkens on storage.

DESCRIPTION

- Freshly prepared honey is a translucent syrupy thick liquid.
- **Colour** - Pale yellow to yellowish brown
- **Odour** - Pleasant
- **Taste** - Sweet taste.
- **On storage** honey becomes opaque and granules may be formed due to crystallization of sugar.
- It is soluble in water and in soluble in alcohol and +0.6 to 0.3.

CHEMICAL CONSTITUENTS

- Honey contains **glucose**(30-40%) **fructose**(40-50%) and small quantities of **sucrose**, **dextrin** and **formic acid**.
- The amount of sugars may vary depending upon the source of the nectar and the activity of the invertase enzyme responsible for converting nectar in to honey.
- Traces of **enzymes**, **vitamins**, **proteins** and colouring matter are also present.

TESTS FOR IDENTITY

Prepare a solution by taking 1 part of honey and 5 parts of water and use this solution for performing the following tests;

1.Reduction of Fehlings solution: To 1ml of the solution of honey add 1ml of fehlings solution in a test tube and warm on a water bath brick red colour formed.

2.Test for Artificial invert sugar(Fiehes test)

To 5ml of the honey solution add 2.5ml of di ethyl ether. Mix it well. Separate the ether layer in china dish and evaporate completely and to the residue add 1 drop of a 1%w/v resorcinol solution and conc. Hcl .Pure honey should not give cherry red colour but Artificial honey gives cherry red colour due to furfural.

USES

- Honey is used as a ingredient of certain linctus and **cough mixtures**.
- In the BPC Preparation of oxymel and squill oxymel honey is employed.
- In the traditional systems of medicine it is added as a vehicle for many Ayurvedic formulations and is prescribed to infants and patient as a nutrient.

ADULTERANTS

- Artificial invert sugar it gives cherry red colour in fiehes test due to the presence of furfural.
- Commercial liquid glucose and sucrose are also used as adulterants.

3.AGAR

Synonyms: Agar-Agar, Japanese isinglass

Biological source: Agar is the dried hydrophilic colloidal concentrate obtained from decoction of *Gelidium cartilaginum*, *Gelidium amansil*, *Gelidium conferooides*, *pterocladia lucida*, *pterocladia capillacea*.

Family – *Gelidiaceae*

Geographical source: These marine plants grow on the sea bottom. It is found in eastern coast of Asia, North America and Europe. Most of the commercial supply comes from Japan, Spain, Korea, Portugal, Mexico, New Zealand, South Africa and USA. In India it is found in Bay of Bengal.

COLLECTION AND PREPARATION

- For the quick and vigorous growth of the red algae some support is required in the sea.
- Long bamboos are planted in the sea and the algae grow around this support.
- During the months of May and October these poles are taken out and the algae is scrapped off.
- This algae is dried in sun and impurities are removed. This bleached material is boiled with acidified water for 5-6 hours and the decoction is filtered in cloth while hot.
- On cooling it becomes jelly which is passed through netting to form strips of agar.

DESCRIPTION

Colour – white or pale yellow

Taste – mucilaginous

Nature- strips, flakes or coarse powder

Solubility – insoluble in cold water, with hot water it forms a jelly on cooling.

TESTS FOR IDENTITY

The following tests may be performed:

1.On warming a little of agar in solution of potassium hydroxide canary yellow colour is produced.

2.Prepare 1% w/v of solution of agar in boiling water. Cool 2ml of this solution in a test tube it sets in to a jelly(Distinction from acacia and gelatin)

3.Hydrolyse 4ml of 1% aqueous solution of agar with 0.5 ml of conc.Hcl for 30 minutes on a water bath divide this solution in to 2 parts, 1 part add 20%NaOH and Fehlings solution gives red precipitate. 2nd part add barium chloride, white precipitate formed indicate the presence of sulphate ions.(Distinction from acacia and tragacanth).

- 4.** Agar powder takes pink colour on treatment with a solution of Ruthenium red indicating mucilage.
- 5.** Agar gives deep crimson colour with N/20 solution of iodine(Distinction from acacia and tragacanth)
- 6.** A 0.2% solution of agar does not give precipitates with an aqueous solution of tannic acid (Distinction from gelatin)
- 7.** Incinerate agar to ash add a drop of conc Hcl and observe fragments of diatoms under the microscope.

CHEMICAL CONSTITUENTS

- Agar contains heterogenous poly saccharides consisting of 2 components namely **Agarose** and **Agaro pectin**.
- The structures of these components have not been fully established.
- Agarose is a natural galactose polymer free from sulphate and is primarily responsible for the gel strength of agar.
- Agaropectin is a sulphonated poly saccharide having galactose and uronic acid.
- Agaropectin is responsible for the viscosity of agar solution.

USES

- Agar acts as a **bulk laxative** as it hydrates to form a smooth non irritating bulk which favors normal peristalsis.
- In the preparation of **vaginal capsules** and **suppositories** agar is used.
- Applications of agar as an **emulsifier** and **suspending agent** are of industrial importance.
- Agar is also used for the preparation of **nutrient media** for bacteriological cultures.

4. TRAGACANTH GUM

Synonym: Tragacanth

Biological source: Tragacanth is the dried gummy exudate obtained by giving incisions to the stems and branches of *Astragalus gummifer* and other species of *Astragalus kurdicus*, *Astragalus adscendens* and *Astragalus strobiliferous*.

Family: *Leguminosae*

Geographical source: Major production of tragacanth is in iran, Iraq, turkey, Syria and Afghanistan.

- In india *Astragalus* species grow wild in state in Kumaon and gharwal.

COLLECTION

- Unlike acacia, tragacanth is physiologically produced in the plant cells as a result of transformation of hemicellulose and pectic acid components of the cells of the pith and medullary rays into gummy material.
- This change is termed as **gummosis** and the gum thus formed absorbs water and considerable pressure is set up in the stem.
- When a cut is given the gum comes out and solidified.
- The exuded material is collected from the plant 2 days after the incision are made and constitutes the gum tragacanth.

DESCRIPTION

- The best quality of tragacanth comes from Persia but persian tragacanth is difficult to get in the commercial market.
- **Nature**-Flattened, ribbon like flakes
- **Colour** – white or colourless
- **Odour** – odourless
- **Taste** – mucilaginous in taste
- **Solubility** – in water it swells to form a gelatinous mass.

CHEMICAL CONSTITUENTS

- Tragacanth contains both water soluble component termed as **tragacanthin** and water insoluble component named as **bassorin**.
- Both tragacanthin and bassorin are high molecular weight polysaccharides.
- Tragacanthin constituting 8-10% on hydrolysis yields arabinose and uronic acid.
- The principle which merely swells in water constitutes approximately 60 – 70 %.
- Higher the amount of bassorin present better is the quality of tragacanth.
- starch and protein are also present in small quantities.

TESTS FOR IDENTITY

1. Tragacanth swells in to a gelatinous mass when placed in water and only small portion dissolves. Tragacanthin (water soluble component) and bassorin(swelling material) may be separated by ordinary filtration and estimated.
2. Tragacanth when boiled with solution of potash gives brown colour (Indian tragacanth gives canary yellow colour)
3. Scrap some powder from tragacanth fragment and put a drop of Ruthenium red. Tragacanth should not give pink colour where as sterculia gum stains pink colour.
4. Tragacanth should not give positive test for the presence of peroxidase enzyme un like acacia.

USES

- Tragacanth is used as a **suspending agent** for insoluble powders in mixtures.
- It is used as an **emulsifying agent** for oils.
- Tragacanth is employed in a number of cosmetic formulations like hand lotions.
- It is used as a **demulcent** and an **emollient**.
- Tragacanth is also used in confectionary and food industry.

ADULTERANTS AND SUBSTITUENTS

Tragacanth like acacia has been adulterated and substituted.

- Karaya gum (Indian tragacanth)
- Chitral gum (***Astragalus strobiliferous***)
- Ghatti gum
- Commercial starches

5.STARCH

Synonym: Amylum

Biological source: Starch of pharmaceutical use consists of polysaccharide granules separated from the mature grains of **maize (*zea mays*)** mature grains of **wheat (*Triticum oestivum*)** grains of **rice (*oryza sativa*)**.

Family: *Graminae*

Tubers of **potato (*solanum tuberosum*)**

Family : *Solanaceae*

Geographical source: commercially produced in tropical and sub tropical countries. In india it is produced 1,60,000 tonnes per year.

PREPARATION

- The removal of soluble protein and the large quantity of in soluble proteins (gluten) is essential but for preparing potato starch removal of vegetable tissues and soluble proteins is desired.

PREPARATION OF MAIZE STARCH

- Maize grains are soaked in water for 3-4 days in presence of sulphurdioxide which prevents fermentation.
- The swollen grains are passed through a mill addition of water separates the embryo (germ) which floats on the surface of water.

- The separated embryo on expression yields corn oil.
- And the water separated after soaking the grains contains minerals and soluble proteins this is used for the production of antibiotics like penicillin.
- The starch material left behind still contains gluten and is removed by sieving and washing.
- The starch being heavier settles down and repeated washings with water and centrifugations separates starch which is dried and suitably packed.

PREPARATION OF POTATO STARCH

- Washed potatoes are crushed in to a slurry which is filtered to remove vegetable tissues.
- After filtration the milky slurry is centrifuged.
- The residual material thus obtained is washed with water and dried.

PREPARATION OF RICE STARCH

- Broken pieces of rice are soaked in 0.4% aqueous solution of sodium hydroxide.
- This causes softening of the grains and dissolution of the insoluble protein gluten.
- The softened grains are ground and the dilute suspension is centrifuged to separate starch which after washing with water is dried.

PREPARATION OF WHEAT STARCH

Dough prepared from wheat flour is kept for sometime to allow the insoluble proteins , gluten to swell. The mass is shaken constantly with water on rollers. The suspension coming out is dried.

DESCRIPTION

Colour- white(rice and maize starch)

Shape – according to the type of starch it varies in shape

Taste – mucilaginous

Solubility – insoluble in cold water and alcohol

Maize starch is neutral,wheat and potato starch is acidic,rice starch is alkaline in nature.

CHEMICAL CONSTITUENTS

- Starch is generally a mixture of 2 polysaccharides which are structurally different.
- One component is **Amylose (25%)** which is more water soluble than the second component **Amylopectin(75%)** the gelatinizing property of starch is due to amylopectin content.

CHEMICAL TESTS

1. Boil 1gm of starch with 15ml of water on cooling it forms a jelly.
2. To a portion of above jelly add a drop of dilute iodine solution immediate blue colour is produced. The blue colour disappears on warming and re appears on cooling.

USES

- Because of its absorbent properties starch is an important ingredient of all **talcum powders**.
- In the manufacture of tablets it is used as a **disintegrant**.
- Glycerin of starch is used as **emollient** and as a base for **suppositories**.
- In the commercial manufacture of glucose, dextrose and dextrin.
- A starch suspension may be swallowed as an anti dote for iodine poisoning.
- Mucilage of starch BPC, Zinc starch dusting powder BPC and zinc oxide paste IP are the official preparations of starch.