

Study of cell wall constituents and cell inclusions:

Non-living inclusions of the cell:

cell contents are divided into two parts -

i) Living inclusions.

ii) Non-living inclusions.

i) Living inclusions → All the cell organelles like nucleus, ER, chloroplasts, mitochondria etc.

ii) Non-living inclusions → The organic or inorganic substances that are metabolic by products of the cell - also called non-protoplasmic inclusions or Engastic Substances.

① cell inclusions of non-living components found in the cytoplasm. These include vacuoles, engastic substances, and calcium oxalate crystals.

② The cell inclusions belong to three categories:

1. Reserve food: carbohydrates, inulin, starch, cellulose, Sugars, glycogen, proteins, amino acids, fats and oil.

2. Excretory: Alkaloids, Glycosides, Tannins, resin, latex, Volatile oil, Mineral crystals.

3. Secretory products: Enzymes, coloring matter, nectar, Vitamin, Hormones.

① Reserve Food Materials:

① These are substances manufactured by the plants from CO_2 and water and stored in the plant cells as food materials.

② They break down to release energy and are used for various metabolic reactions of the cell.

③ when produced in excess they are stored in the form of reserve food materials.

(2)

Reserve food - they are of four main type -

Starch, Glycogen, Fat droplets, Aleurone grains,

- ① Starch grains occur in plant cells.
- ① The grains are found in chloroplasts and amyloplasts.
- ① As such they are insoluble.
- ① The grains may occur singly when they are called Simple.
- ① They are called compound starch grains when two or more of them occur in amyloplasts.

① Starch:

- ① Most of the living cells of stem and root contain starch grains.
- ① It is a long chain polysaccharide formed of glucose units.
- ① Two types of glucose polymers are present - Alpha-amylase.
- ① Unbranched water soluble - β amylase.
- ① Branched and water insoluble.
- ① Starch occurs in the form of variously shaped grains.
- ① Stains bluish black with iodine.
- ① Each starch grain has a central portion called the hilum.
- ① Starchy materials are arranged around the hilum as various striations, sometimes they are deposited in the form of concentric rings and hence called concentric starch grains.

Eg - Rice, Pea.

- ① Starch is deposited in the leucoplast in cells.
- ① Depending upon the position of hilum, a starch grain may be concentric or eccentric.

① Proteins:

- ① They are complex nitrogenous compounds containing carbon, hydrogen, oxygen and nitrogen, sometimes also containing sulphur.
- ① Present either dissolved in the cell sap or in the form of crystal like bodies called aleurone grains.
- ① Aleurone grain is a solid ovate or rounded body usually enclosing a crystal like body called crystalloid and a rounded body called globoid.
- ① Crystalloid is prismatic and globoid is a double phosphate of calcium and magnesium.

Proteins in plants:

1. Fibrous proteins - Insoluble in water. Serve as structural parts of cells.

2. Globular proteins - Soluble in water.

These proteins are two type -

- a. Simple - Made up of amino acids only.
- b. conjugated - Made up of amino acids and a non-protein

Substance.

Eg - Lipoprotein.

① Lipids (Fats and oils)

- ① Compounds containing carbon, hydrogen and very less amount of oxygen.
- ① They are glycerides of fatty acids.
- ① Insoluble in water, soluble in organic solvents.
- ① Occurs as minute globules in the protoplasm or in organelles called chloroplasts or sphaerosomes.
- ① Found in fruits and oily seeds like ground-nut, coconut, castor seed, sunflower, olive fruits etc.
- ① Solid at ordinary temperature - Fats.
- ① Liquids at ordinary temperature - Oils.

Secretory products:

- ① Engastic substances without any food value.
- ① Secreted by the protoplasm and helps reactions in cells.
- ① Sometimes secreted in special sacs or glands.
- ① It is of three type -
Pigments, Enzymes, Nectar.

Pigments:

- ① pigments secreted by plants are responsible for the various colour of leaves, flowers and fruits.
- ① chlorophyll and anthocyanins are important plant pigments.
- ① chlorophyll is secreted by the chloroplasts - responsible for photosynthesis.
- ① It is a combination of chlorophyll a, chlorophyll b, Xanthophyll and carotene.
- ① Anthocyanin is a water soluble pigment in the cell sap of vacuoles responsible for blue, violet and pink colours.
- ① phycobilins are pigments present in algae for photosynthesis.

Enzymes:

- ① Organic catalysts in the protoplasm.
- ① colloidal in nature and capable of breaking down complex food materials into simpler ones.
- ① Enzymes play a major role in all physiological processes like photosynthesis, respiratory, protein synthesis.
- ① Also present in digestive glands of insect feeding plants.

Nectar:

- ① Sweet in taste and secreted by the floral parts of many plants Nectaries.
- ① Nectaries contain sucrose, glucose and fructose.
- ① Nectaries vary greatly in morphology and anatomy.
- ① Floral nectaries may be located in many floral parts such as stamens or at the base or on top of the ovary.

Excretory products: (Metabolic by products)

- ① Useless to plants and hence excreted through leaves, stem, bark, fruits and seeds.

It is classified into two type -

- i) Nitrogenous waste products.
 - ii) Non nitrogenous waste products.
- Alkaloids, Tannin, Gums, Resins, Essential oils, Mucilage, latex, Mineral crystals.

Alkaloids:

- ① They are complex compounds of amino acids.
- ① Many of these alkaloids have medicinal properties which are used to cure diseases in humans.
- ① Nicotine - Tobacco.
- ① Caffeine - coffee.
- ① Strychnine - strychnos.

Tannin:

- ① Bitter substances in the cell sap, cell walls and barks of woody plants.
- ① present in young fruits and quantity decreases with ripening.
- ① Some tannins are used to produce ink.
- ① Some of these are medicinal.
- ① They protect plants from the attack of insects and parasites.

Gums:

- ① It consist of Ca, Mg and K salts of polyuronides.
 - ① Gums have the common property of swelling in water to form either gels or viscous, sticky solutions.
 - ① Exuded from stems and twigs of many plants.
- Eg - Acacia, Gum arabic.

Uses →

- ① Stabilizer in emulsion.
- ① It has demulcent properties and so it is used in

cough, diarrhoea and throat medicinal preparations.

- ① Suspending agent, adhesive and binder in tablet granulation.

Resins:

- ① 'Resin' applies to product which is more or less solid with a complex chemical nature. When heated, they will often soften and melt.
- ① Resins produced mainly by coniferous trees.
- ① Resins are insoluble in water and in petroleum spirit but will dissolve more or less completely in alcohol, chloroform and ether.

Eg- Turpentine.

Essential oils:

- ① Volatile oils found in special cells or glands.
- ① Responsible for the fragrant odours of flowers, fruits, bark and wood.
- ① Found in the petals of rose, Jasmine and some flowers.
- ① Lavender oil from Lavendula, cinnamon oil from cinnamomum, Zeylanicum, peppermint oil from peppermint.
- ① Used in the preparation of various perfumes and soaps.

Mucilage:

- ① Mucilages are generally normal products of metabolism formed within the cell.
- ① It is a polymer of galactan which swells and forms a slimy solution with water.
- ① It is secreted by mucilage cavities or ducts.
- ① Some trichomes also secrete mucilage.

Function →

- ① Storage material.
- ① Water storage reservoir.
- ① protection for germination. Seeds mucilage is often found in Epidermal leaf cells, seed coats, Roots, Barks.

Latex:

Latex is a milky fluid is commonly composed of both organic (alkaloids, rubber particles and inorganic substances in an aqueous phase.

- ① Occurs in specialized cells or ducts called laticifers.
- ① often milky or colourless.
- ① contains nutritive substances like starch, proteins, sugar etc. and also waste products like resins, gums, tannin and alkaloid.
- ① Rubber - *Hevea brasiliensis*.
- ① Latex in *Carica papaya* contains enzyme papain.
- ① Latex is abundant in plants belonging to *Euphorbiaceae*.

Laticifers:

Latex is a white secretion which contains carbohydrates, organic acids, alkaloids etc.

- ① cell or tissues responsible for secreting latex called laticifers. It is two types -

- ① Non-articulated - latex cells originate from single cells which are capable of growing for a long time and forms tube like structures.

Articulated - Latex vessels formed by articulations of a number of elongated cells placed end to end.

Mineral crystals:

- ① Mineral crystals are formed by the reaction between acids produced by plants and the alkaline matters like calcium, magnesium and potash.
- ① Most important crystals in plants - calcium oxalate - calcium carbonate crystals - Silica crystals.
- ① They lie loose in the cell or may aggregated into groups and found hanging from cell walls.

Significance:

- ① They give protection to the plants against birds and animals.

- ① They have great diagnostic value.
- ① presence and absence of crystals, type of crystals and dimensions are useful in correct identification of crude drugs.

① Detection of adulterants.

Microspheroids (crystal sand):

calcium carbonate crystals:

- ① calcium carbonate crystals form grape like clusters hanging from a stalk like projection into the cell cavity from the wall and crystals are deposited on this stalk.

① This is called a cystolith.

① The ~~cr~~ cystolith is an extension of the cellulose cell wall with calcium carbonate deposited in the form of granules. found in *Ficus benghalensis*.

① A pair of cystolith is seen together in *Momordica* - called double cystolith.

crystals of silica:

① Silica is a constituent of the cell wall of many plants.

① They are embedded in the cell wall or forms an encrustation on the cell wall.

① The silica deposition makes the leaves and stems rough.

① Found in grasses, wheat, sugarcane, rice etc.

Study of Natural pesticides

Pest:

pest is any animal, plant, or micro-organism that causes trouble, injuries or destruction to plants or crops.

① The common pests includes. Insects, bacteria, fungi, rats and weeds.

Pesticide:

A pesticide is any toxic substance used to kill animals or plants that causes economic damage to crop or ornamental plants.

Methods of pest control:

There are two methods for the control of a pest.

1. Natural control.
2. Artificial control.

1. Natural control:

Topographical influence of the seasons changes, changing temperatures, rainfall, soil, atmospheric humidity and other natural factors also shows their effect on insects and their hosts.

2. Artificial control:

- ① Artificial control of pest have been developed by man.
- ② These methods can be categorized as -
- Mechanical, Agricultural, chemical and Biological methods.

Mechanical control:

By using manual labour as well as mechanical devices for collection or destruction of pest like hand picking, burning, trapping are employed for the destruction of

eggs, larvae and adult insects.

Agriculture control:

- ① It is the oldest method.
- ② It includes deep ploughing for eradication of weeds and early stages of insects.
- ③ Alternative crop rotation of changing environmental conditions are some methods which lead to obstruction of the life cycle of pests.

Chemical control:

- ① chemical agents are used for killing pests or for protecting crops, animals or other properties against the attack of the pest. Like DDT, BHC, Alderin, Endrin.

Biological control:

- ① Biological control by using plant or animal materials for controlling many harmful pests.
- ② Like insect hormones.
- ③ Insects are eaten by birds.

classification of pesticides:

① Insecticides (Ants, mites, and cockroaches)

② Herbicides (weeds)

③ Fungicides (control fungal diseases)

④ Rodenticides (Rats)

Mechanism of action of pesticides

Broad categories - As

1. Stomach poisons:

Kill by being taken into stomach, absorbed in the blood and leads to the death of the pest due to the toxic action.

2. contact insecticides:

Kill by direct or indirect contact with the insect or sometimes it penetrates inside the body and causes oxidation and suffocates the insect.

3. Fumigants:

Can be applied only in enclosed areas where it surrounds the insect, enters their breathing pores and kills.

Advantages:

1. They are cheap
2. They are less harmful to the human beings and more effective against pest.
3. They are more stable and can be kept for prolonged period.
4. They can be used to control the carriers of vector borne diseases like malaria, sleeping sickness and dengue fever.

Dis-advantages:

- ① The onset of action is slow.
- ① The quantity of pesticide required may be more due to crude components.

Key points:

- ① certain plants contain components that are toxic to insects.
- ① Insecticidal components are extracted from the plants and applied over infected crops are termed as natural pesticides.
- ① Natural pesticides are usually classified according to the type of the organism against which they are effective.
- ① Insecticides, rodenticides, herbicides, fungicides, molluscicides.

① The use of herbicides accounts for the largest share in the agrochemical market followed by insecticides and fungicides.

Ideal characteristics:

- ① It should be easily available at an affordable cost.
- ① It should be non toxic towards warm blooded animals.
- ① It should be easy as well as safer to use.
- ① It should be non inflammable.
- ① It should ~~be~~ no show any residual effect of pesticides.
- ① It should not show the residual effects of pesticides.
- ① It should cause very little or no harm to the foliage on livestock.

What are Botanical insecticides?

- => i) Insect toxins derived from certain plants.
- ii) Quick action on target pests.
 - iii) Broad spectrum action.
 - iv) Do not persist in the environment.

Natural pesticides:

Pyrethrum flower.

Neem leaves and oil.

Tobacco leaves.

Nuxvomica seed.

Sabadilla seeds.

Ryania root and stem.

Derris root and rhizome.

① Natural pesticides are usually classified according to the type of the organism against which they are effective.

② Insecticides, herbicides, fungicides, and other natural pesticides.

Pyrethrum:

Synonyms:

Natural pyrethrum, insect flowers.

Biological Source:

pyrethrum consists of dried flower heads of more or less fully expanded flower heads of *chrysanthemum cinerarifolium*. Belongs to family *compositae*.

Geographical Source:

It is cultivated in Yugoslavia, Japan, Brazil, Kenya, Zaire, Tanzania and India.

Morphology:

Colour: Cream to straw coloured.

Odour: characteristic, aromatic.

Taste: bitter followed by numbness.

Size: 10-15 mm in diameter.

Shape: flower head is flat with convex receptacle.

Chemical constituents:

The main constituents are pyrethrum pyrethrin I and II.

It also contains cinerin I and II, Jasmoline I and II.

Active constituents are pyrethrins, which are organic esters, chemicals made up of carboxylic acid and keto alcohols.

The insecticidal principles are located in the oleosin secretion of floral parts of partially open or closed flowers.

Mechanism of action:

It acts as contact poison.

It paralyzes the insect in short time.

It shows rapid toxicity towards different pests, but has very low toxicity in mammals.

- ① pyrethrum was earlier used in the form of powder or extracted with kerosene.
- ① Now a days extracts containing about 20% of pyrethrins are used in the form of dust, wettable powder, emulsion concentrate, kerosene solution and aerosol.
- ① Many pyrethrins are mixed with other insecticides which enhance the action of pyrethrum by synergistic effect.
- ① Some of them are sulfoxides, piperonyl butoxide, Sesamin.

Uses:

1. Used as insecticide
 2. contact poison.
- ① It paralyses in short time, used in the form of wettable powder, emulsion concentrate, kerosene solution
 - ① Many a time, pyrethrum extract is mixed with other insecticides which increase the action of pyrethrum.

Tobacco:

Synonyms: Tamaku.

Biological Source:

Tobacco consist of the dried leaves of *Nicotiana glauca* and *Nicotiana rustica* belongs to family - Solanaceae.

Geographical Source:

China, US and India. Brazil, Russia, Turkey and Italy. In India mainly in Andhra Pradesh, Gujarat, Karnataka, Orissa, Bihar.

Macroscopic characters:

Colour: Green and slightly brown

Odour: Characteristic to nicotine.

Taste: Bitter.

Size: 60-80 cm in length, 35-45 cm in width.

Shape: ovate, elliptic or lanceolate.

The leaves are usually sessile, sometimes petiolate and with frilled wing.

chemical constituents:

- ① It contains pyridine and piperidine alkaloids. The main constituent is Nicotine, Nicotynine, Nicotimine, Anabasine, Anatabine.
- ② It also contains carbohydrates - Sucrose, starch, pectin, cellulose, lignins and pentoses.

Uses:

- ① Sedative
- ① Antispasmodic.
- ① Veterinary anthelmintic.
- ① Useful in smoking and agriculture insecticide.
- ① Manufacture of nicotinic acid and nicotinamides.

Mechanism of action:

- ① Nicotine exerts stimulant effect on heart and nervous system.
- ① It is not used medicinally.
- ① It is powerful quick acting poison.
- ① Even 40mg of the dose orally is fatal to human.
- ① Rectified tobacco seed oil is used as edible oil in European countries.
- ① Nicotine is used in manufacture of nicotinic acid and nicotinamide.
- ① Tobacco and nicotine are known insecticides for last three centuries.

Neem:

Synonyms → Margosa.

Biological Source:

It consists of all aerial parts of the plant known as *Azadirachta indica*. belongs to family *Meliaceae*.

Geographical Source:

India, Pakistan, Bangladesh, Sri Lanka, Thailand, Malaysia, Mauritius, Fiji, South Africa, East Africa.

Macroscopic characters:

Leaves: Alternate, exstipulate, imparipinnate leaflets 20-25 cm in length lanceolate closely clustered towards the end of branches. Serrate margin, green, bitter.

Bark: It is moderately thick, rough, brown in colour longitudinally and obliquely furrowed. Internally starch white, laminated with characteristic smell of neem and bitter in taste.

Chemical constituents:

Leaves - Azadirachtin, Melianthoid.

Seeds - Nimbin

Nimbidin.

Azadirachtin.

Salanin

Flowers - Nimbosterol, myricetin, Kaempferol.

Fruit - Deacetyl azadirachtin

Bark - Nimbin, nimbinin, nimbidin, Mangolone.

Uses:

- ① The bark of neem tree is a good bitter tonic used in malarial fever, and in skin diseases, used as an insect repellent.
- ② Insecticide nematocidal and antimicrobial, seed oil spermicidal. Propanthol possesses - activity.

Dennis:

Biological Source:

- ① It consists of dried root and rhizomes of *Dennis elliptica* and *dennis malaccensis* belongs to family - Leguminosae.

chemical constituents:

- ① It contains isoflavonoid derivative rotenone, Tephrosin, Toxicanol, degnelin.

Uses:

1. contact poison form of spray for killing.
2. Used in the vegetable insects during harvesting time such as leaf hopper.

Sabadilla:

Biological Source:

- ① It consist of dried ripe seeds of *Schoenocaulon officinale* belongs to family Liliaceae.

chemical constituents:

It contains sabadine, cevadine, Enatridine, Sabadiline and cavadine.

uses:

- ① It is an insecticide used to kill house flies and bugs in the form of spray or dust.

Ryania:

Biological Source:

It consists of dried root and stems of *Ryania speciosa*. belongs to family Flacountiaceae.

chemical constituents:

Alkaloid such that Ryanodine.

uses:

Insecticide.

Nux Vomica:

Biological Source:

It consist of the dried, ripe seeds of *strychnos nuxvomica* belongs to family *Loganiaceae*.

chemical constituents:

- ① It contains about 1-5% of bitter alkaloids.
- ① The chief constituents of alkaloids are strychnine, Brucine, vomicine, pseudostychnine, glycoside - Monoterpene, glycoside - loganin, fixed oil - 2-4%.

Uses:

- ① Spinal cord stimulant.
- ① In cases of neurasthenia.
- ① As a circulatory stimulant.
- ① Nerve and sex tonic.
- ① Bitter stomachic.

Carbohydrates and related products

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

- ① Composed of carbon, hydrogen and oxygen.
- ① Functional groups present include hydroxyl groups.
- ① -ose indicates sugar.
- ① Each carbohydrate consists of the function group like
OH group (alcoholic hydroxy group)
C=O group (Keto group) or CHO
- ① General formula of carbohydrates is $C_m(H_2O)_n$
m and n may be same or different.

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

- ① In plants, energy from the sun is used to convert carbon dioxide and water into the carbohydrate glucose.
- ① Many of the glucose molecules are made into long-chain polymers of starch that store energy.
- ① About 65% of the foods in our diet consist of carbohydrates.
- ① Each day we utilize carbohydrates in foods such as bread, pasta, potatoes, and rice.
- ① Other carbohydrates called disaccharides include sucrose and lactose in milk.
- ① During digestion and cellular metabolism, carbohydrates are converted into glucose.
- ① 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.

① In plants, a polymer of glucose called cellulose, has other important uses too.

② The wood in our furniture, the pages in your notebook, and the cotton in our clothing are made of cellulose.

Classification:

1. Simple Sugars (Saccharides)

a) Monosaccharides.

b) Disaccharides.

c) oligosaccharides.

2. polysaccharides.

Function of carbohydrates in cells:

① Major source of energy for the cell.

② Major structural component of plant cell.

③ Immediate energy in the form of glucose.

④ Reserve or stored energy in the form of glycogen.

Monosaccharides:

They are Simple Sugars, or the compounds which possess a free aldehyde (CHO) or ketone (C=O) 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.

Classification by carbon atoms:

Sugar	Structure formula	Example.
Triose	$C_3H_6O_3$	Glyceraldehydes.
Tetroses	$C_4H_8O_4$	Erythrose Threose.
Pentoses	$C_5H_{10}O_5$	Xylose Ribose Arabinose.
Hexoses	$C_6H_{12}O_6$	Glucose Galactose Mannose.

Glucose →

- ① The essential energy source for all body functions.
- ② A component of each disaccharide.
- ③ Other names: Dextrose and blood sugar.

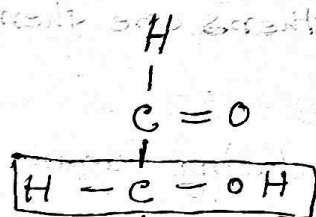
Galactose →

- ① Seldom occurs freely in nature.
- ② Binds with glucose to form sugar in milk lactose.
- ③ Once absorbed by the body, galactose is converted to glucose to provide energy.

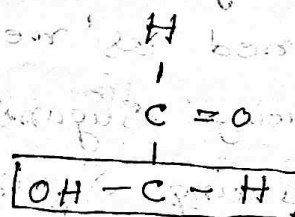
Fructose! →

- ① The sweetest of all sugars.
- ② Occurs naturally in fruits and honey, the fruit sugar.

Stereochemistry:



D-glyceraldehyde.



L-glyceraldehyde.

Properties of monosaccharides:

1. Mutarotation:

When a monosaccharide is dissolved in water, the optical rotatory power of the solution gradually changes until it reaches a constant value.

2. Glucoside formation:

When D-glucose solution is treated with methanol and HCl, two compounds are formed, these are α and β -D glucosides. Thus, formed glucosides are reducing sugar and also does not show phenomenon of mutarotation.

3. Reducing power:

Sugars having free or potentially free aldehyde or Ketone group have an ability to reduce the cupric copper to cuprous.

4. Oxidation / Reduction:

The alcoholic OH, aldehyde (COH) or keto (C=O) group are oxidized to carboxyl group with certain oxidizing agents. The oxidation may be brought under mild or with vigorous oxidizing condition.

Carbohydrates with free carbonyl groups or in hemiacetal form give positive test to Benedict's and Fehling's reagents. Without having been hydrolyzed are referred as 'reducing' sugar others are then 'non-reducing' sugars.

Reducing Sugar

1. Carbohydrates with a free aldehyde or a free ketone group.
2. They are in hemiacetal or hemiketal form.

Non-reducing Sugar

1. Aldehyde or ketone group is not free but instead utilized in bond formation.
2. They are in acetal or ketal form.

- 3. Do exhibit mutarotation.
- 4. Do form osazones with phenyl hydrazine.
- 5. Do form oximes with hydroxylamine
- Ex- Glucose, Fructose, Lactose, Maltose, cellobiose.

- 3. Do not exhibit mutarotation.
- 4. Do not form osazones.
- 5. Do not form oximes.

Ex - Sucrose, glycogen, Inulin.

Oligosaccharides

These are compound sugars that yield 2 to 10 molecules of the same or different monosaccharides on hydrolysis.

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:

- ① Composed of 2 monosaccharides.
- ① cells can make disaccharides by joining two monosaccharides by biosynthesis.
- Glucose + Fructose = Sucrose.
- ① Table Sugar.
- ① Found naturally in plants - Sugar cane, sugar beets, honey, maple syrup.
- ① Sucrose may be purified from plant sources into brown, white and powdered sugars.
- Glucose + galactose = lactose.
- ① The primary sugar in milk and milk products.
- ① Many people have problems digesting large amounts of lactose.
- Glucose + glucose = Maltose.
- ① produced when starch breaks down.
- ① used naturally in fermentation reactions of alcohol and beer manufacturing.

Trisaccharides:

composed of three monosaccharide.

Ex - Raffinose.

Tetrasaccharides:

Ex - Stachyose.

Polysaccharides:

containing 10 or more monosaccharide units attached together.

Ex - 1. Starch - digestible

2. Glycogen - digestible.

3. Fiber - indigestible.

- ① Cellulose gives structure to plants, fiber to our diet
- ① Glycogen is an energy storage sugar produced by animals
- ① Liver cells synthesize glycogen after a meal to maintain blood glucose levels.

Chemically, the polysaccharides may be distinguished into two type -

① homo polysaccharides.

① Hetero polysaccharides.

Homo polysaccharides → which yield, on hydrolysis, a single monosaccharide.

Hetero polysaccharides → which produce a mixture of monosaccharides on hydrolysis.

Based on their functional aspect, the polysaccharides may be grouped -

- i) Nutrient polysaccharides.
- ii) Structural polysaccharides.
- i) Nutrient polysaccharides → These act as metabolic reserve of monosaccharides in plants and animals.

Ex - Starch, glycogen and inulin.

- ii) Structural polysaccharides → These serve as rigid mechanical structures in plants and animals.

Eg - cellulose, pectin and chitin and also hemic acid.

Types of polysaccharides:

- ① Starch
- ① cellulose
- ① Glycogen

① Starch:

- ① The major digestible polysaccharide in our diet.
- ① The storage form of carbohydrate in plants.
- ① Sources: wheat, rice, corn, rye, barley, potatoes, tubers, yams, etc.

① Two types of plant starch:

- ① Amylose
- ① Amylopectin.

① Amylose:

It is in the form of straight chain linked together with α -1,4. It is water soluble and gives blue colour with iodine.

① Amylopectin:

It contains beside straight chain several branched chains which are arranged in α -1,4 and β -1,6 linkage units. It is insoluble in water and gives purple colour with iodine.

① cellulose:

Form cell walls in plant cells.

- also called fiber or raffage.
- indigestible by humans.

① Glycogen:

- ① The storage form of glucose in the body.
- ① Stored in the liver and muscles.
- ① Found in tiny amounts in meat sources. Not found in plants.
- ① Not a significant food source of carbohydrate.

HONEY

Synonyms → Madhu, honey purified, mel shehad, asal.

Biological Source → Sugar secretion, deposited in honey comb by bees, *Apis mellifera*, *Apis dorsata* and other species of *Apis*.

Family → Apidae.

Geographical Source → Africa, Australia, New Zealand, California, India.

Preparation:

- ① The nectar of the flower is a watery solution containing 25% sucrose and 75% water.
- ② The worker bee sucks this nectar through its hollow tube of mouth and deposits in honey-sac located in abdomen.
- ③ The enzyme invertase present in saliva of the bee converts nectar into invert sugar, which is partially utilized by the bee.
- ④ And the rest is deposited into honey comb.
- ⑤ Honey comb is smoked to remove the bees and honey is obtained by applying the pressure to it or allowing it to drain naturally.
- ⑥ The honey of commerce is heated to 80°C and allowed to stand.
- ⑦ The impurities which float over the surface are skimmed off and liquid diluted with water to produce honey of 1.35 density.
- ⑧ Natural honey has the density of 1.47.
- ⑨ Many a time, honey is extracted from the comb by centrifugation.
- ⑩ It must be free from foreign substances.
- ⑪ Honey is liable to fermentation, unless it is suitable

Processed.

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- ① Honey is heated to 80°C before it is sent to the market, so as to avoid fermentation.
- ① It should be cooled rapidly or else it darkens in colour on keeping.
- ① If necessary (and if not prepared by centrifugation method), honey is required to be filtered through wet cloth of flannel.

Description:

- ① pale yellow - yellowish brown.
- ① Charming and pleasant odour.
- ① Sweet and faintly acid taste.
- ① $\text{Wt/m} - 1.35$
- ① $\text{S.R} - +3 \text{ to } -10$
- ① Ash: $0.1 \text{ to } 0.8\%$.
- ① Pass limit test Cl and SO_4
- ① Syrupy liq. Translucent - Fresh.
- ① Opaque and granular on keeping - crystallisation of glucose.
- ① Sol - water, Insol - alcohol.

Chemical constituents:

- ① It is an aqueous solution of -
 - ✓ Glucose 35%
 - ✓ Fructose 45%
 - ✓ Sucrose about 2%
- ① Maltose, gum, traces of succinic acid, acetic acid, dextrin, formic acid.
- ① Coloring matters, enzymes and traces of vitamins.
- ① proteins and pollen grains from various flowers.

Fiche's test:

- ① It does not give instant red colour with resorcinol in HCl .
- ① If it gives instant red colour it is an adulterant of honey which contains furfural artificial

Invert Sugar.

① No anomalous taste and smell of natural honey.

Uses:

- ① Demulcent,
- ① Sweetening agent
- ① Nutrient - Infants and patients.
- ① Antiseptic - burns and wounds.
- ① common ingredient - cough mixture, cough drops and vehicle for ayu. prpn.
- ① Prp - creams, lotions, soft drinks, candies.

Detailed Study Carbohydrates containing drugs (11 drugs)

1. Isabgol:

Synonyms → Ispaghula, Ispagal, Ishabgula, Spongel seeds.

Botanical Source → Ispaghula consist of dried seeds of *Plantago ovata* Forskal, belonging to family plantaginaceae.

Geographical Source → Ispaghula is an annual herb cultivated in India in Gujarat, Maharashtra, Punjab and in some parts of Rajasthan and Sindh province of Pakistan. It is cultivated extensively around Sidhpur in north Gujarat.

Chemical constituents:

- ① Ispaghula seeds contain about 10% mucilage which is present in the epidermis of testa.
- ② Mucilage consists of two complex polysaccharides, of which one is soluble in cold water and the other soluble in hot water.
- ③ Chemically it is pentosan and aldobionic acid. Pentosan on hydrolysis yields xylose and arabinose and aldobionic acid yields galacturonic acid and rhamnose.
- ④ Protein and fixed oil are present in endosperm and embryo.

Uses:

- ① Seeds are used as an excellent demulcent and bulk laxative in chronic constipation.
- ② The laxative activity of ispaghula mucilage is purely mechanical. It is also useful in dysentery, chronic diarrhoea, in case of duodenal ulcers and piles.
- ③ It works effectively as a soothing agent.
- ④ Ispaghula husk is also used for similar purpose.

Morphology:

colour pinkish grey to brown.

odour None.

Taste - mucilaginous.

Shape - ovate, boat shaped, cymbi form size 1.5-3.5 mm long 1-1.8 mm wide.

Weight - 100 seeds 0.15-0.19 g.

Appearance seeds are hard, translucent and smooth, the dorsal consist of a small elongated glossy reddish brown spot at the centre while the ventral has a cavity having rim unconvex with a thin whitish membrane.

Physillum Husk:

Synonyms → Isaphulac husk.

Biological Source → It consists of dried seed coats of Isabgol seeds obtained from plantago ovata.

Family → plantaginaceae.

Morphology →

colour - white to pale buff.

odour - odourless.

Taste - mucilaginous.

Size - length 2-3 mm.

width - 0.5-1 mm.

Shape - Boat shape, lanceolate or oval shape flakes.

swelling factor 20.

2. Acacia:

Synonym → Gum acacia, gum arabic, acacia.

Biological Source → Indian gum is the dried gummy exudation obtained from the stem and branches of Acacia arabica belonging to family Legum.

Chemical constituents:

- ① Major c.c is anabin which is mixture of calcium, magnesium potassium salts of anabic acid.
- ① Acacia was originally thought to be composed only of four chemical constituents, namely, arabinose, galactose, rhamnose and gluco glucuronic acid.
- ① on Subjecting the gum acacia to hydrolysis with 0.01 N H_2SO_4 helps in removing the combined product of arabinose and - galactose, whereas the residue consist of the product: galactose and - glucuronic acid. These two products are formed in the ratio 3:1.

Uses:

- ① The mucilage of acacia is employed as a demulcent.
- ① It is used extensively as a vita pharmaceutical aid for emulsification and to serve as a thickening agent.
- ① It finds its enormous application as a binding agent for tablets. eg - cough lozenges.
- ① It is used in the process of 'granulation' for the manufacture of tablets. It is considered to be the gum of choice by virtue of the fact that it is quite compatible with other plant hydrocolloids as well as starches, carbohydrates and proteins.
- ① It is used in conjunction with gelatin to form ~~cons~~ conservates for microencapsulation of drugs.
- ① It is used extensively in making of candy and other food products.

Macroscopy:

colour → Tears are usually white, pale-yellow and sometimes creamish-brown to red in colour. The Power has an off-white, pale-yellow or light-brown in appearance.

Odour:

Odourless (There is a close relationship between colour and flavour due to the presence of tanning)

Taste:

Bland and mucilaginous.

Shape and size:

Tears are mostly spheroidal or ovoid in shape and having a diameter of about 2.5-3.0 cm.

Appearance:

Tears are invariably opaque either due to the presence of cracks or fissures produced on the outer surface during process of ripening. The fracture is usually very brittle in nature and the exposed surface appears to be glassy.

collection:

- ① The gum is produced as a result of injury to the plant. After the rainy season, bark is tapped and transverse cuts are given to stem and branches to expose cambium and newly formed phloem.
- ② Within 20-30 days, the tears are collected and made free from bark pieces and organic matter.
- ③ It is collected and dried in sun.
- ④ Acacia is almost soluble in water and it is viscous and acidic.
- ⑤ Gum arabic is most soluble of the gums.
- ⑥ Acacia is insoluble in alcohol and other organic solvents.

In pharmaceuticals, it is used as a stabilizer for emulsions, a binder and coating for tablets and as an ingredient in cough drops and syrup.

Gum arabic is used in cosmetics as an adhesive for face masks and powders and to give a smooth feel to lotions.

3. Tragacanth:

Synonym $\rightarrow$ Gum Tragacanth.

Biological Source $\rightarrow$ The dried gummy exudation from *astragalus gummifer* Labill.

On other Asiatic species of *astragalus* belonging to the family of Leguminosae.

Geographical Source $\rightarrow$

It is naturally found in various countries viz, Iran, Iraq, Armenia, Syria.

① Greece and Turkey. A few species of *astragalus* are located in India viz, Kumaon, Garhwal and Punjab. Persian Tragacanth are exported from Iran and north Syria, whereas the Smyrna Tragacanth from the ~~at~~ Smyrna port in Asiatic Turkey.

Chemical constituents:

- ① Tragacanth comprises of two vital fractions, first, being water soluble and is termed as 'tragacanthin'.
- ② Being water-insoluble and is known as 'bassorin'.
- ③ Both are not soluble in alcohol.
- ④ The said two components may be separated by carrying out the simple filtration of a very dilute mucilage of Tragacanth and are found to be present in concentrations ranging from 60-70% for bassorin and 30-40% for tragacanthin.
- ⑤ Bassorin actually gets swelled up in water to form a gel, whereas tragacanthin forms an instant colloidal solution.
- ⑥ It has been established that no methoxyl groups are present in the tragacanthin fraction, whereas the bassorin fraction comprised of approximately 5.38% methoxyl matches R.
- ⑦ gums having higher methoxyl content such that possessing higher bassorin contents, yielded the most viscous mucilages.
- ⑧ Tragacanth gum is composed mainly of sugars and uronic acid units and can be divided into three types of constituents.

- ① The acidic constituents tragacanthic acid on hydrolysis yields galactose, xylose and galacturonic acid.
- ② A neutral polysaccharide affords galactose and arabinose after its hydrolysis while a third type is believed to be steroidal glycoside.

Uses:

1. It is used as a demulcent in throat preparations.
2. It is employed as an emollient in cosmetics (Eg- hand lotions)
3. It is used as a pharmaceutical aid as a suspending agent for insoluble and heavy powders in mixtures.
4. It is effectively employed as a binding agent for the preparation of tablets and pills.
5. It is also used as an emulsifying agent for oils and waxes.
6. A substantial amount find its application in calico printing and in confectionary.
7. It is used in making medical jellies.
Eg- Spermicidal jelly.
8. A 0.2 - 0.3% concentration is frequently used as a stabilizer for making ice-creams and various types of sauces. Eg- Tomato Sauce, mustard sauce.
9. It is used to impart consistence to troches.
10. The mucilages and pastes find their usage as adhesive.
11. Tragacanth powder is used as an adhesive. It is also used in lotions for external use and also in spermicidal jellies. It is also used as a stabilizer for ice cream in 0.2 - 0.3% concentration and also in sauces.
12. Tragacanth has been reported to inhibit the growth of cancer cells in vitro and in vivo.

Description:

colour $\rightarrow$ white or pale.

odour $\rightarrow$ odourless.

Taste $\rightarrow$ Tasteless.

Shape $\rightarrow$ curved or twisted ribbon-like flakes marked with concentric ridges that is indicative of successive exudation and solidification. Fracture is normally short and horny.

Size $\rightarrow$ Flakes are usually $25 \times 12 \times 12$ mm.

Appearance: Translucent.

Toxicology:

① Tragacanth is generally recognized as safe (GRAS) in the United States for food use. There is no indication that dietary supplementation for up to 21 days has any significant adverse effects in man. Tragacanth is highly susceptible to bacterial degradation and preparations contaminated with enterobacteria having been reported to have caused fetal deaths when administered intraperitoneally to pregnant mice.

4. Agar:

Synonym $\rightarrow$ Agar, vegetable gelatin, Japanese Isinglass.

Biological Source $\rightarrow$ Dried gelatin substance from gelidium amansii and several other species of red algae like Gracilaria.

Geographical Source $\rightarrow$

It is produced commercially in Japan, Australia, New Zealand, USA and India, it is produced in the coastal region of Bay of Bengal.

Chemical constituents $\rightarrow$

Agarose $\rightarrow$ responsible for gel strength
Agaropectin $\rightarrow$ responsible for the viscosity of agar solution.

Uses:

- ① As a bulk laxative.
- ② As a culture medium in bacteriology.
- ③ used as an emulsifying agent.

Description:

- ① colour → Depending upon the shape and the form, it is yellowish - grey or white to nearly colourless.
- ② odour → odourless.
- ③ Taste → mucilaginous.
- ④ Shape → Found in various form like strips, sheets, flake or coarse powder.

Preparation:

- ① Sea weeds are scrapped from the bamboos.
↓
- ② To remove foreign materials like shells, sand, etc.
↓
- ③ The entire material is taken to the high altitudes where it is washed and bleached by sun.
↓
- ④ Boiled for 5 to 6 hrs with large quantity of dil. Acidified water.
↓
- ⑤ This extracts is then strained while that through the cloth.
↓
- ⑥ Transferred to wooden troughs.
↓
- ⑦ on cooling, jelly is produced.
↓
- ⑧ Rectangular solid pieces of jelly are then passed through the netting under pressure.
↓
- ⑨ Narrow strips, thus formed are allowed to melt during the day time in the sun which removes the excess of water.
↓

⑩ This operation is continued for several days.

↓
⑪ Final product.

5. Sterculia:

Synonyms:

Indian tragacanth, sterulia gum, Kanaya gum Bassora tragacanth, Kadaya, mucana, kadira, katila, kullo.

Biological Source:

- ① Gum Kanaya is a dried, gummy exudates obtained from the tree *sterculia unes* (Roxburgh), *sterculia villosa* (Roxburgh), *sterculia tragacantha* (Lindley) or other species of *sterculia*, belonging to family Sterculiaceae

Geographical Source:

- ① The *S. unes* is found in India - especially in the Gujarat region and in the central provinces.

Chemical constituents:

- ① Kanaya gum is partially acetylated polysaccharide containing about 8% acetyl groups and about 37% uronic acid-residues.
- ① It undergoes hydrolysis in an acidic medium to produce D-galactose, L-rhamnose, D-galacturonic acid and a trisaccharide acidic substance.
- ① It contains a branched heteropolysaccharide moiety having a major chain of 1,4 linked α -D galacturonic acid along with 1,2 linked L-rhamnopyranose units with a short D-glucopyranosyluronic acid containing the side chains attached 1-3 to the main chain.

Uses:

- ① Kanaya gum is not digested or absorbed systemically.
- ① Medically, Kanaya gum is an effective bulk laxative as gum particles absorb water and swells to 60-100

times their original volume.

- ① The mechanism of action of it is an increase in the volume of the gut contents. Kanaya gum should be taken with plenty of fluid and it may take a few days for effects to be noticeable.
- ① It also has been used as an adhesive for dental fractures and ostomy equipment and as a base for salicylic acid patches.
- ① The demulcent properties of the gum make it useful as an ingredient in lozenges to relieve sore throat.
- ① A protective coating of Kanayagum applied to dentures has been shown to reduce bacterial adhesion by 98%.
- ① The use of Kanaya gum as a carrier for drugs with different solubility in aqueous medium has been investigated.

② Morphology:

① Colour white, pink or brown in colour.

① Odour Slight odour resembling acetic acid.

① Taste Bland and Mucilaginous.

① Shape and size Irregular tears or vermiform pieces.

Collection and preparation:

- ① The gum is obtained from the *Stenocilia* species by making incisions and thereafter, collecting the plant exudates usually after a gap of 24h.
- ① The large irregular masses of gums which weigh between 250 g to 1 Kg approximately are hand picked and dispatched to the various collecting centres.
- ① The gum is usually tapped during the dry season

- ① Each healthy fully grown tree yields from 1 to 5 Kg of gum per year, and such operations may be performed about five times during its lifetime.
- ② In short, the large bulky lumps (tears) are broken into small pieces to cause effective drying.
- ③ The foreign particles, for example, pieces of bark sand particles and leaves are removed.
- ④ Thus, purified gum is available in two varieties - namely -
 - a) Granular or crystal gum. Having a particle size ranging between 6 to 30 mesh and b) powdered Gum. Having particle size of 150 mesh.

Sterculia gum characteristics →

Good quality gum occurs in irregular, almost - colourless, translucent striated masses.

Adulterant and substitutes:

It is used as a substitute for gum tragacanth.

6. GUAR GUM:

Synonyms →

Guar gum, Taguar gum, Guan flour and Decorpa.

Biological Source →

Guar gum is a seed gum produced from the powdered endosperm of *Cyamopsis tetragonoloba* Linn belonging to family leguminosae.

Geographical Source →

Guar or cluster bean is a drought-tolerant annual legume that was introduced into the United States from India in 1903.

The major world suppliers are India, Pakistan and the United States, Australia and Africa.

Chemical constituents:

- ① The water-soluble part of guar gum contains mainly of a high molecular weight hydrocolloidal polysaccharide, that is galactomannan, which is commonly known as guaran.
- ② Guarman consist of linear chains of β -mannopyranosyl units with α -D-galactopyranosyl units attached by linkages.
- ③ The ratio of D-galactose to D-mannose is 1:2.
- ④ The gum also contains about 5-7% of proteins.

Uses:

- ① Guar gum is used as a protective colloid, a binding and ~~dis~~ disintegrating agent, emulsifying agent, bulk laxative, appetite depressant and in peptic ulcer therapy.
- ② It is used in paper manufacturing, printing, polishing, textiles and also in food and cosmetic industries.
- ③ Guar gum is extensively used as flocculent in overdressing and treatment of water. Guar gum has been shown to decrease serum total cholesterol levels by about 10-15% and low density lipoprotein cholesterol by up to 25% without any significant effect on triglycerides or high-density lipoprotein cholesterol.
- ④ The ability of guar to affect gastrointestinal transit may contribute to its hypoglycemic activity.
- ⑤ Guar reduces postprandial glucose and insulin levels in both healthy and diabetic subjects and may be a useful adjunct in the treatment of noninsulin-dependent diabetes.
- ⑥ Guar gum remains important ingredient in over-the-counter weight loss preparations.
- ⑦ Even in the absence of weight loss guar

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Supplementation for 2 weeks reduced blood pressure by 9% in moderately overweight men.

Morphology:

① colour it is colourless or pale yellowish-white coloured powder.

① odour characteristic.

① Taste Gummy.

cultivation, collection and preparation:

① The plant of guar gum is draught resistance and quite handy in its constitutions.

① It is generally sown in May-June and harvested in September-October.

① At the stage of full maturity, the plant yields 600-800 lb of seeds per acre under un-irrigated conditions but the production nearly doubles under irrigated conditions.

① First of all the fully developed white seeds of guar gum are collected and freed from any foreign substances.

① The sorted seeds are fed to a mechanical 'splitter' to obtain the bifurcated guar seeds which are then separated into husk and the respective cotyledons having the embryo.

① The gum is found into the endosperm. Generally, the guar seeds comprise the endosperm 35-40%, germ 45-50% and husk 14-17%.

① The cotyledons having a distinct bitter taste are separated from the endosperm by the process called winnowing.

① The crude guar gum, that is, the endosperm is subsequently pulverized by means a 'micro-pulverizer' followed by grinding.

① The relatively softer cotyledons sticking to the endosperm are separated by mechanical 'sifting' process.

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- ① Thus, the crude guar gum is converted to a purified form, which is then repeatedly pulverized and sifted for several hours till a final white powder or granular product is obtained.

Toxicology:

- ① In the colon, guar gum is fermented to short chain fatty acids.
- ② Both guar and its resultant by-products do not appear to be absorbed by the gut. The most common adverse effects therefore, are gastrointestinal including gastrointestinal pain, nausea, diarrhoea and flatulence.
- ③ Approximately half of those taking guar experience flatulence this usually occurs early in treatment and resolves with continued use.
- ④ Starting with doses of about 3g three times a day, not to exceed 15g per day, can minimize gastrointestinal effects.
- ⑤ Guar gum may affect the absorption of concomitantly administered drugs. Bezafibrate, acetaminophen, digoxin, glipizide or glyburide are generally unaffected by concomitant administration.
- ⑥ The ingestion of more than 30g of guar per day, diabetic did not adversely affect mineral balances after six months.

Marketed product:

- ① Ascenta omega Smooth orange sensation by Ascenta Health Ltd.

① Write the Source, chemical constituents method of Preparation and tests for honey.

⇒ Source → It is Sugar Secretion, deposited in honey comb by bees, *Apis mellifera*, *Apis dorsata* and other species of *Apis*. Family → *Apidae*.

Chemical constituents →

Glucose, Fructose, Sucrose, Formic acid, Succinic acid, Acetic acid, vitamins, minerals, pollen grains, invertase.

Method of preparation →

- ① Flower contains Sugar Secretion.
- ② 75% H_2O , 25% Sucrose.
- ③ Sucrose (invert sugar) → glucose + Fructose.
- ④ Hollow tube (mouth of honey bee)

↓
Stone → Abdomen secretion of bee.

Smoke → Pressure / Allow to drain / centrifuge.

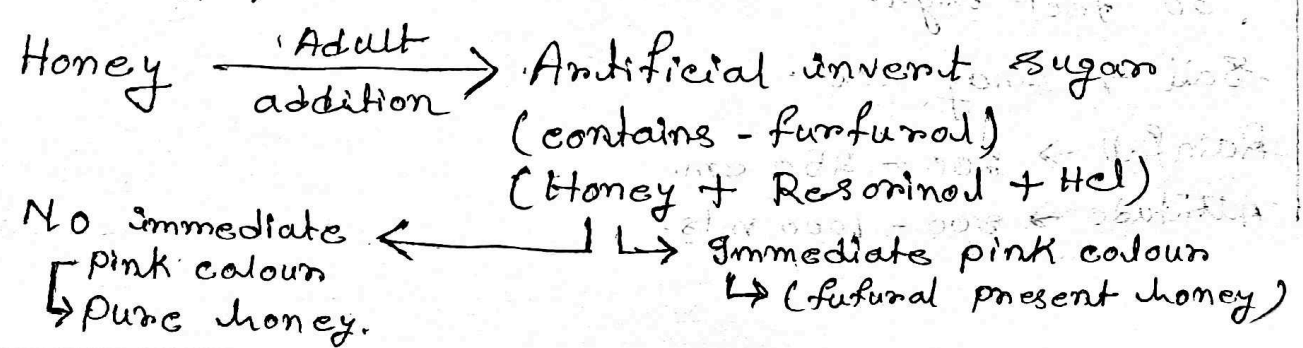
↓
Allow it to stand and skin the foam.

↓
Cool it immediately ← Heat $80^\circ C$

↓
No darkening of colour. ↓
Avoid fermentation, crystallization

Test →

Fiebis test →



② Explain the method of cultivation and collection of cassia cinamon?

⇒ Biological Source →

Cassia is the dried stem bark of *Cinnamomum cassia* blume, belonging to family Lauraceae.

Chemical constituent →

1 to 2% volatile oil, 80% cinnamyl acetate, cinnamic acid, caryophyllene, phenylpropyl acetate, orthocumarin, aldehyde, coumarin, tannic acid and starch.

Uses →

Alterative, Aromatic, Carminative, Flavouring agent, analgesic, antiseptic antirheumatic, expectorant, antibacterial etc.

Cultivation and collection cinnamon →

① It is cultivate by seed propagation method about four to five seeds are placed in each hole at 2m distance between the plants or can be propagated by planting the cutting and layers commercially.

② The tree grows best in almost pure requiring only 1% of vegetable substance.

③ It prefers shelter and constant rain of 75" to rainfall.

④ cinnamon is an evergreen tree grows from 20 to 30 feet high.

Soil → Sandy soil.

Rainfall → 200 - 250 cm.

Altitude → 800 - 1000 mts.

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③ Write the Source, chemical constituents, Tests and uses of Tragacanth?

⇒ Biological Source →

The dried gummy exudation from *Astragalus gummifer* ~~tabida~~ belonging family Leguminosae.

chemical constituents →

○ It is a polysaccharide.

○ It has two major fraction.

i) Tragacanthin (8-10%)

ii) Bassorin (70-80%).

Test →

Partially solubility odour

Tragacanth + FeCl_3 $\xrightarrow{\text{Boil}}$ deep yellow ppt.

Tragacanth + Lead acetate $\xrightarrow{\text{white}}$ ppt.

Tragacanth + Ruthenium Red $\rightarrow$ No.

Uses →

Binding agent

Emulsifying agent.

Thickening agent.

Demulcent.

Sudor agent.

Tragacanth + Iodin soln $\rightarrow$ Green colour.

Fehling's soln $\rightarrow$ Red ppt

Drug soln + lead acetate $\rightarrow$ white ppt

Tragacanth powder + 5% aqueous $\rightarrow$ coronary yellow colour.

④ Explain the method of cultivation and collection of Fennel.

⇒ Biological Source →

It consist of dried ripe fruits of *Foeniculum Vulgare*, belongs to family Umbelliferae.

chemical constituent →

Volatide oil → Anethole, d-fenchone, Fixed oil, Proteins.

uses →

① Anethole used as anti-cancer, anti-inflammatory.

② Carminative, anti-oxidant, anti-coagulant effect.

Cultivation

This seeds can be directly sown in the main field.

Direct Sowing →

Sowing time → 10-12 Kg/ha (Direct sowing)

Spacing → 45-60 cm (row-row)

Transplanting → Seedling are raised during June or July 7-8 weeks old transplanted in field.

Sowing time → Sown from Sept-Nov.

⇒ Hill area May-June is best.

→ 45-60°C

Soil → It can be grown on all type of soil.

Rain → 150-300 mm.

Climate → cool season crop well distributed rainfall is ideal for flowering.

Collection →

① Fennel requires abundance sunlight.

② It is adapted to dry in sunny situations.

③ cultivated by dibbling method.

④ Fennel is propagated by seeds.

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- ④ Most of the branches bearing leaves cut into the very finest of segments.
 - ④ The fruit are collected by cutting the stems in September, when the fruits are ripe.
 - ④ The stems are dried on sheaves under sun and later beaten to separate the fruits.
 - ⑤ Give the Source, chemical constituents, uses of Rauwolfia and clove.

⇒ Biological Source Rauwolfia:

It consists of dried roots and rhizomes of ~~Rau~~ Rauwolfia serpentina benth family Apocynaceae.

Chemical constituents:

Alkaloids, Reserpine, Reserpinamine, Ajmaline, Serp Serpentine.

Uses → Antihypertensive
Tranquillizing agent.

Clove

Biological Source →

It consists of dried flower buds of eugenia caryophyllus sprange fam. belonging to family → Myrtaceae.

Chemical constituents →

Volatile oil, → Eugenol, isoeugenol, methyl and dimethyl furfural.

Uses →

Carminative, aromatic, stimulant, antiseptic, flavouring agent, dental analgesic oil.

⑥ Write the source, chemical constituent, method of Preparation and identification tests for guar gum.

⇒ Biological Source →

It is dried seed of *Cyamopsis tetragonoloba* belong to family Leguminosae.

chemical constituent →

guar gum, ~~major~~ B-D mannopyranose, α -D galactopyranose, D-galactose to D-mannose.

Preparation →

Angiosperm → i) Monocot
ii) Dicot.

i) Monocot → wheat, rice, barley, corn.

① Guar gum prepared by the white seed containing,

① 35-40% of endosperm.

① 15% of embryo.

① The seed of guar is very hard. And part of the seed are separated husk and cotyledons, the husk contain the fibre matters.

① Gum is located in the endosperm.

① The endosperm is very hard then the cotyledon the portion of the germ cotyledon and hearing to the endosperm using micropulveriser.

Identification test:

Weak soln bark + lead acetate → lead (precipitated)

Weak soln of the guar + H_2O + benzidine → No blue colour.
benzidine from acid.

(7) Write the chemical tests to differentiate Agar and acacia?

⇒ Agar:

chemical test →

- ① Agar + Ruthenium red → pink.
- ① Agar + H_2O $\xrightarrow{\text{boil}}$ Stiff gely.
- ① Agar + dil HCl $\xrightarrow{\text{Microscope}}$ Sharp spines

Acacia →

- ① Ruthenium red (Swelling factor) → 10.0 g seed in 25 ml graduated cylinder.

+ 20 ml H_2O

↓
10-14 ml ↑ in the

① Solubility → H_2O .

① Aqueous soln of acacia → Acidic blue litmus changes to pink.

① Aqueous soln of acacia → Red ppt.

① Acacia + borax → Stiff translucent Jelly.

① Acacia + lead acetate → Thick white ppt.

(8) Explain the method of cultivation and collection of clove.

⇒ Biological Source →

It consists of the dried flower buds of *Eugenia caryophyllus*, belonging to family Myrtaceae.

Chemical constituent →

volatile oil, eugenol, tannins, resin, chromone, galotannic acid.

Uses →

antiseptic, stimulant, carminative, aromatic, flavouring agent.

cultivation :

climate →

Temp → It needs warm and humid climate and grows well in vicinity of sea.

Soil → loamy soil.

Rain → 150 - 250 cm.

Altitude → it thrives best in the locations.

- ① The seed are sown in Aug to Oct.
- ① The seed are placed in the nursery beds at a distance of 10 cm.
- ① It takes from 4-5 weeks for seed germination.
- ① The seedlings of the clove are slender and delicate with poor growing rate.
- ① After 6 months they are transplanted.
- ① Then they are transplanted to field.
- ① They can also be grown with arecanut.

Collection:

- ① clove buds change the colour.
- ① At the start of the rainy season long greenish buds appear.
- ① The buds are collected during dry weather on the tree or by using some ~~ladders~~ ladders or with the help of mobile.
- ① In some places tree are even beaten using bamboo sticks for collection bud.
- ① The drugs which are collected are then separated from the stalks and then placed on coconut mats for drying under sun. Then dried clove graded and packed.

(51)

① Explain with a neat labelled diagram the microscopy and powder microscopical characters of fennel.

⇒ Microscopy:

In Microscopy fennel has two parts -

i) Pericarp.

ii) Seed.

i) Pericarp:

Pericarp is divided into 3 parts -

a) Epicarp. (outer layer)

b) Mesocarp. (middle layer)

c) Endocarp. (inner layer and outer layer of seed)

a) Epicarp:

A layer of quadrangular to polygonal cells, with smooth cuticle.

b) Mesocarp:

Reticulate, lignified parenchyma surrounding the vascular bundles. In mesocarp vascular bundles and vittae present.

c) Endocarp:

consist of narrow elongated cells having a parquet arrangement.

ii) Seed:

Seed is divided into two parts -

a) Testa. / Seed coat.

b) Endosperm.

a) Testa:

Single layered, yellowish brown in colour.

b) Endosperm:

Thick walled, polygonal, cellulosic parenchyma containing oil ~~glob~~ globules, aleurone grains.

Raphe → A single ridge of vascular strands.

Carpophore → With very thick walled sclerenchyma in 2 strands.

Powder Microscopy character:

Mesocarp → ① Lignified, reticulate parenchyma.

① composed of Ovoid or elongated, subrectangular cells, usually occur in groups.

Endocarp → ① paracety arrangement of the cells.

Endosperm → polygonal thick walled cells with oil globules and aleurone grains. Micronosette calcium oxalate crystals are also present.

Vitae → yellowish brown fragments composed of thin walled cells.

Fibro vascular tissue → composed of lignified small fibres, vessels with reticulate thickening.

(53)

2) Explain with a neat labelled diagram the microscopy and microscopical characters of *Cassia cinnamom*.

⇒ Microscopy:

In Microscopy there are two part -

i) Pericycle (stone cell layers)

ii) Secondary phloem.

i) pericycle:

It produce the light coloured wavy, longitudinal lines on the outside of the bark. There are two part -

a) pericyclic fibres.

b) Scleroides.

a) Pericyclic fibres →

Small groups of about six to fifteen

pericyclic fibres occur in intervals.

b) Scleroides →

Three to four layers of pitted scleroides, thickened lignified walls, isodiametric, with starch grains.

ii) Secondary phloem:

Few cells contain acicular calcium oxalate crystals and starch grains. In secondary phloem divide 4 part -

a) Medullary ray.

b) phloem fibers.

c) Mucilage cells

d) oil cells.

- a) Medullary rays → Narrow at inner side, widen in the scleride band side, contains starch.
- b) phloem fibres → Single, isolated, circular, lignified with stratification.
- c) Mucilage cells → It can be identified after staining with Ruthenium red.
- d) oil cells → Big, isolated.

Microscopical character:

- i) phloem fibres → Stratified thick lignified wall and narrow lumen.
- ii) Stone cells → U-shaped, lignified structures with one side thin.
- iii) Starch grains → Present in the parenchymatous cells of phloem and medullary ray.
- iv) Calcium oxalate crystals → Small acicular raphides from the Parenchyma and medullary rays.
- v) oil cells → Big and isolated, entire or fragments.

3) Explain with a neat labelled diagram the microscopy and powder microscopical characters of *Guassia*.

⇒ Microscopy:

In Microscopy of *Guassia*, there are 4 types part -

Xylem fibres.

Xylem parenchyma.

vessels.

Medullary rays.

Xylem fibres → Thick walled, pitted, arranged in radial rows.

Xylem parenchyma → Small, polygonal, less thickened pitted walls few cells contain calcium oxalate prisms.

vessels → Big either single or in groups of few.

Medullary ray → Prominent, radially elongated, pitted contain few starch grains and calcium oxalate prisms.

Microscopy character:

i) wood fibres → Xylem fibres crossing at right angles the medullary rays.

ii) Xylem vessels → Numerous, bonded, pitted thickening Frequently associated with other Xylem elements.

iii) Medullary rays → Biseriate to tetraseriate medullary rays.

iv) calcium oxalate prisms → Present isolated or in Xylem parenchyma.

(56)

4) Explain the method of cultivation and collection of clove.

⇒ Biological Source →

It consists of the dried flower buds of *Eugenia caryophyllus* belonging to family Myrtaceae.

Chemical constituent →

Volatile oil, eugenol, eugenol acetate, tannins, resin, chromone, eugenin gallatannic acid.

Uses →

Antiseptic, Stimulant, carminative, aromatic, flavouring agent.

Cultivation →

Temp → ~~Warm and humid climate.~~

Soil →

5. Explain with a neat labelled diagram the anatomy of *Rauwolfia*.

⇒ Microscopy →

i) Periderm

ii) Secondary xylem.

iii) Periderm →

In periderm divided 4 part -

a) Cork

b) Phellogen.

c) Phellogen.

d) Secondary phloem.

- a) cork $\rightarrow$ One to seven layers of small cells, one to three layers of larger cells stratified cells in alternating bands of unlignified cells and lignified cells.
- b) phellogen $\rightarrow$ Indistinct.
- c) phelloderm $\rightarrow$ 10 to 12 rows of tangentially elongated to isodiametric parenchyma cells. Few cells containing starch grains and calcium oxalate crystals.
- d) Secondary phloem $\rightarrow$ Companion cells and phloem parenchyma with starch grains and calcium oxalate crystals.

ii) Secondary Xylem:

In Secondary Xylem, there are 4 parts -

- Xylem vessels.
- Xylem fibres.
- Xylem parenchyma.
- Medullary rays.

Xylem vessels $\rightarrow$ Few lignified, simple or bordered

Xylem fibres $\rightarrow$ Highly thickened with pointed or pits. bifurcated ends, in tangential bands and radial rows.

Xylem parenchyma $\rightarrow$ Moderately thick lignified, pitted walls, containing starch.

Medullary rays $\rightarrow$ Run radially from the centre to the cortex through the phloem, one to five cells.

6. Explain the anatomy of Nux-vomica with labelled diagram.

⇒ Microscopy:

It is divided into two parts -

~~Testa~~ ⇒ i) Testa.

ii) Endosperm.

i) Testa:

In testa divided into 3 parts -

Lignified trichomes.

Epidermal cell.

collapsed parenchyma.

Lignified trichomes → Thick walled, bent and twisted
lignified trichomes. immersed from epidermis,
parallel in one direction.

Epidermal cell → Single layer, forms lignified
trichomes, large thick walled with oblique limen
pits.

collapsed parenchyma →

2 layers, flattened parenchyma.

ii) Endosperm:

Thick walled, cellulosic parenchymatous cells.

plasmodesma →

Fine protoplasmic strands between the walls
of endoplasmic cells.

Aleurone grains → only globoids are present.

Oil globules → Fixed oil as small oil drops droplets
in the cells.

Adultration

Substitution of similar - looking substances.

Partially / wholly with original drug.

later in either free from chemical / therapeutic property.

Type of adultration:

a) Intentional adultration

b) unintentional adultration.

b) unintentional adultration →

① Lack of knowledge.

① Different geographical source.

① Similarly looking plants.

a) Intentional adultration →

i) Substitution of artificially manufactured substances.

Artificially manufactured substances are added into original drug.

Ex - ① Coloured paraffin wax used instead of beeswax.

① Compressed chicory coffee.

① Cat, coloured basswood used instead of Nutmeg.

① Coloured spend dargin used ergot.

① Artificially inverted sugar for honey.

ii) Substitution of commercially inferior variety of substance:

Ex - ① Dog Senna / pathe Senna for Indian Senna

① capsicum minimum for capsicum annum.

① Kutki for gentian.

iii) Substitution with exhausted drug!

It is usually commonly employed for volatile oil containing drugs.

They exhaust the action of the plant drug.

Ex - Exhausted clove buds.

Exhausted Gention → Add aloe for bitterness.

Saffron is Recoloured by artificial dyes.

iv) Substitution with Similar inferior Substances!

Due to similarity of the morphology drug authentic drug is replaced.

Ex - Belladonna leaves $\xrightarrow[\text{by}]{\text{replaced}}$ Aklanthus leaves.

v) Substitution with vegetative part of the same plant!

Bank - lichens, Mosses, epiphytes

leaves - Stems, flannels, pods.

Ex - Senna leaves $\xrightarrow{\text{with}}$ Stem.

Cinchona / cascarina → epiphytes

bank.

vi) Substitution with toxic substances!

Substitution harmful substance use to destroy the plant.

Ex - Adulterant Substance are toxic in nature.

Big Mass stones → liquorice root.

lead shots → In opium

- ① Line stone piece in Anabotida.
- ① Rodent faecal matter in condomm.
- ① BaSO_4 in colchinal.
- ① white oil with coconut oil
- ① Amber coloured glass piece with colophany

vii) Substitution with powder drugs:

Adultration with powder for entire drugs.

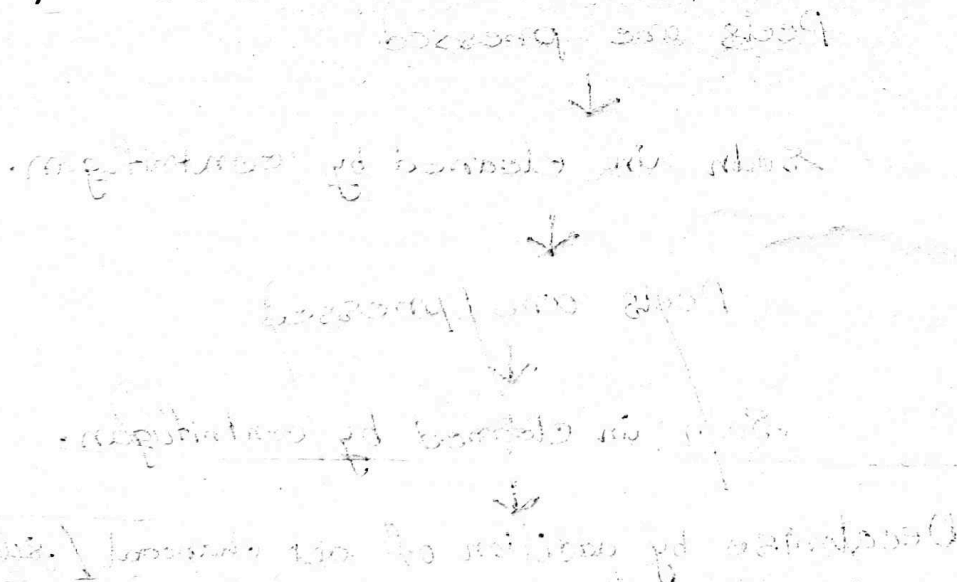
Ex - ① Brick powder - cinnamon powder / bark powder.

- ① Dextrin is added pecaahuana.
- ① Red sandin in added capsium powder.
- ① exhausted Ginger ginger powder.

viii) Substitution with synthetic principles:

Synthetical prepared pharmaceutical principle are used for market and thenapeutic value.

- ① Sistral to lemon oil.
- ① Benzyl benzoate added to balsam of Pressure.



(62)

7. Write the Source, chemical constituents, method of Preparation and tests for pectin.

⇒ Biological Source →

Pectin is a purified carbohydrate product obtain by acid hydrolysis from inner portion of rind of citrus fruit, citrus aurantium family - Rutaceae.

Chemical constituents →

Oeglactone, methyl alcohol, galactose, Ananinose.

Uses →

Thickening agent, suspending agent.

Method of preparation →

Depending on the methoxy group and raw material the process of manufacture is variable.

Lemon peel (fresh)

+

Water.

30 min ↓ 90°C.

pH is adjusted to 3.5 - 4 by addition of citric tartaric acid.

↓

Peels are pressed

↓

Soln is cleaned by centrifugation.

↓

Peels are pressed

↓

Soln is cleaned by centrifugation.

↓

Decolorise by addition of act charcoal / suitable salt



Protein and enzyme are removed by enzymatic hydrolysis.



Pure pectin is obtained by ppt out by using water soluble organic solvent.

Test:

Pectin with 1 ml of 2% solution of KOH and subsequently setting aside the mixture at an ambient temp 15 min. The resulting gel on acidification with dilute HCl and brisk shaking yields a voluminous and gelatinous colourless precipitate.

2 Marks

① Give the Source and uses of drug containing vitamin A.

⇒ Source → Cheese, eggs, oily fish, fortified low-fat spreads.

Uses → ① vitamin A is used to treat vitamin A deficiency.

② vitamin A is possibly effective in preventing cataracts.

③ protect eyes from Night blindness and Age-related decline.

② Write the chemical test for identification of carbohydrates.

⇒ Molisch test, Benedict's test.

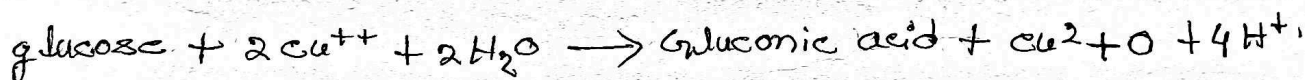
↳ 0.1 ml test soln + 2 drops of α -naphthol.

① mix well.

② add conc. H_2SO_4 down the side of the tube to form the ring at the interface of the two layers.

Benedict's test:

Reducing sugars give positive benedict's test due to their free aldehyde.



③ Define Saponification value and ester value.

⇒ Saponification is the hydrolysis of an ester with NaOH or KOH to give alcohol and Sodium or potassium salt of the acid.



Ester value →

The ester value is the number of mg of potassium hydroxide required to saponify the ester in 1.0 g of the substance.

④ Name the drugs containing mucilage and write the identification tests for mucilage.

⇒ *Salvia hispanica*, *Talinum triangulare*, *Plantago major*.

⑤ What is gelatin and write it's the uses.

⇒ gelatin is a translucent, colorless, flavorless food ingredient, commonly derived from collagen taken from animal body parts. It is brittle when dry and gummy when moist.

Uses →

- ① Supports skin, hair, and nail growth.
- ① Good for joints and it help joint recovery.
- ① It can help tighten loose skin.

⑥ Write the mode of action of neem as a pesticide.

⇒ Growth Regulator.

- ① Adulthood Impairment
- ① Reproduction Suppressor.
- ① Egg laying Reduction.
- ① Egg Hatching Reduction.
- ① Larval fitness.
- ① Feeding inhibitor.

⑦ What are the exhausted drug, example.

⇒ Some plant material is mixed, which is having no active medicinal components as they have already been extracted out. This practice is most common in case of volatile oil containing materials like clove, fennel etc.

Ex -

⑧ Define coppicing and felling.

⇒ Coppicing → Coppicing is a traditional method of woodland management which exploits the capacity of many species of trees to put out new shoots from their stump or roots.

felling →

⑨ What do u mean by garbbling and crude drug.

⇒ Garbbling → It is the final step in the preparation of a drug. It consist of the removal of extraneous matter, such as other parts of the plant, dirt, and added adulterants.

crude drug → Crude drugs are vegetable or animal drugs that contain natural substances that have undergone only the processes of collection and drying. / It may be ~~various~~ derived from various natural sources like plant, animals, minerals and micro.

⑩ Define pharmacognosy and crude drug.

⇒ pharmacognosy:

~~pharma~~ It is the study of medicines or crude drugs produced from natural sources such as plants, microbes and animals. The study of the physical, chemical, biochemical and biological properties of drugs.

⑪ Give the chemical test for identification of proteins.

⇒ The presence of protein is tested by the biuret test for proteins.

The biuret reagent made of Sodium hydroxide and Copper sulphate helps in determining the presence of protein in a sample.

⑫ List out cell wall components in plants.

⇒ Cellulose, Hemicellulose, lignin, pectin, suberin, cutin, Mucilage.

⑬ Scope of pharmacognosy.

⇒ ① WHO has emphasized the utilization of Indigenous systems of medicine based on folklore and locally available plant materials.

② Large scale scientific cultivation of some of the medicinal important plants is necessary.

(14) Define iodine value and its significance.

⇒ Iodine value:

Iodine value is to determine the amount of unsaturation contained in fatty acids. This unsaturation is in the form of double bonds which react with iodine compounds.

Significance →

The iodine value in chemistry is the mass of iodine in grams that is consumed by 100 grams of a chemical substance. Iodine members are often used to determine the amount of unsaturation in fats, oils and ~~was~~ waxes.

(15) Give the source, chemical constituents and uses of Liquorice.

⇒ Source:

Liquorice is the dried, peeled or unpeeled, roots, rhizome or stolon of *Glycyrrhiza glabra* Linn. Family - Leguminosae.

Chemical constituent:

It contains glycyrrhizin, sucrose, white crystalline powder, ~~consisting~~ calcium and potassium salt of glycyrrhizic acid.

Uses:

① Antiemetic ② Antinausea, ③ Antifungal ④ Anti-septic ⑤

(16) Write the significance of moisture content and its control in crude drug.

⇒ Moisture determination is one of the most important and most widely used measurements in the processing and testing of foods. It contains, moisture content, moisture content is of direct economic.

(17) Define ester value and hydroxy value.

⇒ Ester value → The ester value is the number of milligrams of potassium hydroxide required to saponify the esters present in 1g of the substance.

Hydroxy value → The hydroxyl value is defined as the number of milligrams of potassium hydroxide

required to neutralize the acetic acid taken up on acetylation of one gram of a chemical substance that contains free hydroxyl groups.

(18) Classify carbohydrate with suitable example.

⇒ Disaccharide - Sucrose → Glucose + Fructose

Trisaccharide - Raffinose → G + F + Galac.

Polysaccharide - Mucilage → Normal physiological product

(19) Write a note on collection on bark.

⇒ collection is usually in spring or early summer when the cambium is active and after a rainy season, the bark is most easily collected.

(20) Give the chemical constituents and uses of sesame oil.

⇒ ① Gingelly oil contains glycerides of higher fatty acids mainly oleic, linoleic, palmitic, stearic and arachidic acids.

② It also contains lignin derivatives, sesamin and sesamol.

uses → cooking, antibacterial, constipation relief, Hair and scalp nourishment.

2019

① Name the different type of phytoconstituents present in plants.

⇒ Flavonoids, phenolic acids, isoflavones, curcumin, isothiazanone and carotenoids.

② List out different ergastic substances with example.

① Reserve food material

→ Carbohydrates, proteins, lipids.

② Secretory.

→ Nectar, Enzyme, colouring.

③ Excretory -

Alkaloids, Glycosides, Tannins.

③ Explain the scope of pharmacognosy

⇒ Same as (13)

④ Define polenske value and ~~reichant~~ reichant meissl value.

⇒ The polenske value is a value determined when examining fat. The polenske value is an indication of how much volatile fatty acids can be extracted from fat through saponification.

Reichant meissl value:

The Reichant value is a value ~~on Reichant Meissl~~ determined when examining fat. The Reichant value is an indication of how much volatile fatty acids can be extracted from fat through ~~sp~~ saponification.

⑤ Give the Significance of processing and storage of crude drugs.

⇒ Which needs attention over here is the type of drugs to be harvested and pharmacopical standards which it needs to achieve.

Storage → Preservation of crude drugs sound knowledge of their physical and chemical properties.

⑥ What do u mean by deliberate and indeliberate adulteration.

⇒ Deliberate →

Deliberate adulteration are normally commercial mainly with the intention of enhancement of profits.

Indeliberate adulteration →

Indeliberate adulteration are normally naturally occurring accidental, careless or by ignorance and non harmful.

⑦ Define acid value, give it Significance.

⇒ The acid value is defined as the number of milligrams of potassium hydroxide required to neutralize the free fatty acids present in one gram of fat.

Significance:

⑧ Give the source of any two drug containing mucilage.
⇒ Tragacanth → Dried gummy exudants of the Astragalus
gummifer. F - Leguminosae.

~~Acacia~~ → Dried gummy exudants obtain by incision
Acacia on stems branches of acacia arabica
F → Leguminosae.

⑨ Give the chemical constituents and uses of castor oil.

⇒ Chemical constituents:
80% Ricinoleic acid, Isonicinoic acid, Linoleic acid,
Linoleic acid, Stearic acid, Isostearic acid.

Uses:

- ① A powerful laxative.
- ① A Natural moisturizer.
- ① Impressive Anti-inflammatory effects.
- ① Reduces Acne.

⑩ Give the general chemical test for proteins.

⇒ Same as ⑪

⑪ Give the general test for identification of
carbohydrate.

⇒ Same as ②

⑫ Explain the cell wall components and their significance
⇒ cellulose, Hemi-cellulose, lignin, pectin, Suberin,
cutin, Mucilage.

Significance:

cell components are the complex biomolecules and
structures of which cells and thus living organisms are
composed. cells are the structural and functional units
of life.

⑬ What is pharmacognosy, mention the present status of
pharmacognosy.

⇒ Same as ⑩

(14) Give the source of uses of drug containing vitamin A.
 ⇒ vitamin A also called retinol is found in animal product, good sources are fortified milk, eggs, meat, cheese, liver, halibut fish oil, cream and kidneys.

(15) what are gibrellins, write their role in plants.

⇒ Gibrellins are plant hormones, that regulate various developmental processes, including stem elongation, germination, dormancy, flowering, flower development.

Role → It regulate various development processes including stem elongation, ~~germination~~ dormancy, flowering, flower development and leaf and fruit senescence.

(16) Give the function of stomata and trichomes.

⇒ Stomata →

① These stomata naturally allow water to evaporate out.

① prevent excess water loss through transpiration.

① Allow gas exchange for photosynthesis.

trichomes →