UNIT-5

Biological source, chemical constituents and therapeutic efficacy of crude drug (PART I)

Points to be covered in this topic

- ❑ LAXATIVE
  - ❖ Aloe, Castor oil, Ispaghula, Senna
- ❑ CARDIOTONIC
  - ❖ Digitalis, Arjuna
- ❑ CARMINATIVE AND GI REGULATOR
  - ❖ Coriander, Fennel, Cardamom , Ginger, Clove , Black pepper , Asafoetida, Nutmeg, Cinnamon

LAXATIVE

5.1 LAXATIVE

Any medication used to relieve constipation and encourage stool evacuation is referred to as a laxative. Laxatives work through a number of different methods. Saline purgatives, fecal softeners, contact purgatives, and bulk laxatives are the four primary categories of laxatives.

5.1.1. Aloe

Aloe

Synonyms: Aloe, Musabbar, Kumari.

Biological Source: Aloes is the dried juice obtained from **various species** of **aloe, mainly from *Aloe barbadensis*** Miller (Curacao aloes), ***Aloe ferox*** Miller (**Cape aloes**), Socotrine, and Zanzibar varieties of ***Aloe perryi.***

Family: Liliaceae.

Geographical Source: Indigenous to eastern and southern Africa. Also cultivated in Europe and many parts of India.

Microscopic Characteristics of Aloe Leaf:

- The outermost cuticle, followed by epidermis, palisade tissue, and mucilaginous parenchymatous mesophyll, are visible in the leaf's T. S.
- Vascular bundles are enclosed by mesophyll and have pericyclic layer on top of them. There are a few big, elongated, thin-walled aloeitic cells inside the pericycle. High viscosity, yellow juice (aloe gel) is found in these aloeitic cells.

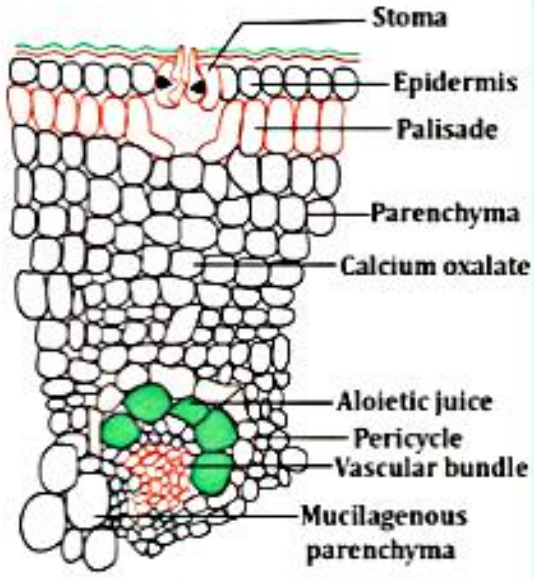


Fig:- T.S. of Aloe leaf

- A few calcium oxalate crystals are present in the parenchyma.

Microscopic Characters of Aloe Powder

Lactophenol is used to study the microscopic characteristics because it gradually solubilizes the particles, allowing for the quick and easy

observation of crystals

i. **Curacao aloes:** It consisting of a large number of very small needles or slender prisms.
ii. **Cape aloes:** This variety appears as transparent, brown, angular or irregular fragments.
iii. **Socotrine aloes:** It is characterized by fragments consisting of quite large prisms either present in group or in dispersed form.

Curacao Cape Socotrine Zanzibar

Chemical Constituents

Barbaloin

- The principle active composition of aloe is **aloin**, a combination of glucosides in which **barbaloin** (Aloe-emodin anthrone C-10 glucoside) is the chief component of aloe, and it is water-soluble.
- **Curacao aloes** contain about **22%** of **barbaloin**, and the Indian variety, generally **Aloe vera**, contains a very low quantity of barbaloin, about 3.5–4%.
- Along with barbaloin, aloes also contain isobarbaloin, β-barbaloin, aloe-emodin, and resins.

Chemical Tests

(a) General Tests:

(1) Bromine test: Freshly prepared bromine solution is added to a small quantity of aloe filtrate. The test gives a pale-yellow precipitate of tetrabromalin.

(2) Schoenteten's reaction (Borax test): Little quantity of aloe filtrate is treated with borax and shaken.

Few drops of this solution are added to a test tube filled with water, appears a green fluorescence.

(a) Specific Tests:

(1) Nitrous acid test (This test is used for isobarbaloin): Crystals of **sodium nitrite,** along with **acetic acid,** are added to an aqueous solution of aloes. The observations are as follows:

- Curacao aloes - Sharp pink to carmine colour
- Cape aloes - Faint pink colour
- Socotrine and Zanzibar aloes - very less change in colour

(2) Nitric acid test: This test is carried out either by directly applying **nitric acid** to drug or to its aqueous solution. The observations are as follows:

- Curacao aloes - Deep brownish-red colour
- Cape aloes - Brownish colour changing to green
- Socotrine aloes - Pale brownish - yellow colour
- Zanzibar aloes - Yellowish brown colour

(3) Cupraloin test (Klunge's isobarbaloin test): Add a drop of saturated copper sulfate solution, sodium chloride, and an excess of 90% alcohol to a very weak aloe aqueous solution.

- Curacao aloes - Wine red colour persisting four hours
- Cape aloes - Faint colouration rapidly changing to yellow
- Socotrine aloes - No colour
- Zanzibar aloes - No colour

(4) Modified borntrager's test: Add two ml of a 5% ferric chloride solution and two ml of diluted hydrochloric acid to 0.1 g of the medication. Heat over a boiling waterbath for five minutes, then let cool and gently shake with benzene. After removing the benzene layer, apply the same amount of diluted ammonia. All types of aloes create a pinkish-red color.

Uses

- Aloes is used as a **purgative**. It has a stronger purgative action in the series of all crude drugs with **anthracene glycosidal** content.
- To counter effect the gripping action, it is given with carminatives.

5.1.2. Castor oil

Ricinus communis plant and their seed

Synonyms: Ricinus oil.

Biological Source Castor oil is obtained by the cold expression of the **seeds** of ***Ricinus communis.***

Family: Euphorbiaceae

Geographical Source: **India** is the second largest producer of castor seeds in the world, **Brazil,** Thailand, U.S.A. and Romania are other countries producing this drug on large scale.

Preparation: Castor oil can be prepared by two different methods:

1. Crushing whole or decorated seeds in hydraulic presses powered by electricity.
2. Ghani and involves manually operating screw presses powered by bullocks.

The first approach is used for extraction in commercial settings.

The method of preparation of castor oil is as follow.

- **Cleaning** - The seeds are cleaned of contaminants and evaluated.
- **Decorticated-** The hulls are scraped off and the seeds are decorticated. [Decorticating the seeds increases the oil's colour and aids in regulating its acidity, making it ideal for therapeutic use].
- **Extract** - The hydraulic press used to press decorated seeds helps to extract 30% of the oil that is naturally present in them at room temperature. This is known as Cold drown oil.
- **Elimination** - The lipase enzyme and ricin (toxic protein) are then eliminated by steaming the cold soaked oil at 80°C.
- The free fatty acid is then removed after it has been bleached and deacidified with sodium carbonate.
- To eliminate the contaminant's, activated charcoal is applied at last.

Morphological character

It is a viscous and transparent liquid.

CHARACTERISTIC	DESCRIPTION
Colour	Pale yellow or almost colourless liquid.
Odour	Slight and characteristic.
Taste	First bland but afterwards slightly acrid.

Chemical Constituents

- Castor seeds contains 35-50% of castor oil.
- Chiefly contains triglyceride of ricinoleic acid (about 80%).
- Other glycerides are also present which are isoricinoleic, linoleic, stearic and isostearic acids.
- The viscosity of the castor oil is due to ricinoleic acid.

Uses

- Castor oil is cathartic due to irritant action of ricinoleic acid.
- It is used in preparation of paints, enamel, varnishes, grease, polishes, printing ink, hydraulic and brake spirit with little modifications.

5.1.3. Ispaghula

Synonyms: Isabgol, Indian Psyllium.

Biological Source: Isapgol consists of **dried seeds** of the plant known as ***Plantago ovata.*** In the pharmaceutical field, the seeds and the dried seed coats, known as isapgol husk, are used.

Plantago ovata plant and their seed

Family: Plantaginaceae

Geographical Source: The plant is cultivated largely in Gujarat, Punjab and South Rajasthan. The factory for preparation of husk is located at **Gujarat.**

Macroscopic Characters

CHARACTERISTIC	DESCRIPTION
Colour	Pinkish-grey to brown
Odour	None
Shape	Ovate cymbiform

The convex surface of the seeds is smooth, translucent, and firm, and in the center is an oval mark that may be reddish brown or grey.

Chemical Constituents of Seed and Husk

- Isapgol husk and seeds contain **mucilage** present in the epidermis of the seeds.
- It consists of pentosans and **aldobionic acid.**
- The products of hydrolysis are xylose, arabinose, galacturonic acid and rhamnose.
- Swelling factor is the criterion for purity of Isapgol.

Chemical Tests

1. Swelling factor is determined by putting 1 g of the drug in 20 ml water with occasional shaking. The volume occupied by the seeds after 24 hours of wetting is measured.

1 g of the drug + 20 ml water $\xrightarrow[\text{Allow to stand for 24 hours}]{\text{Occasional shaking}}$ Volume occupied by the seeds after wetting is measured

2. Isapgol gives **pink colour** with the solution of **ruthenium red** due to the mucilage.

Isapgol + ruthenium red $\longrightarrow$ Pink colour(due to the mucilage)

Uses:

- Ispaghula seeds are used as Laxative and Emollient
- It has pharmaceutical applications as enteric coating material, tablet disintegrator and also used in the sustained release drug formulations.

5.1.4. Senna

Synonyms: Alexandrian senna, Tinnevelley senna, Folia sennae.

Biological Source: Senna leaf consists of the **dried leaflets** of ***Cassia acutifolia*** (Alexandrian senna) and of ***Cassia angustifolia Vahl.*** (Tinnevelley senna).

Senna

Family: Leguminosae

Geographical Source:

- Alexandrian senna is indigenous to South Africa. Middle and upper Nile territories, tropical Africa, and especially Sudan.
- Indian or Tinnevelly senna is cultivated largely in India. Madurai and Ramnathpuram districts of Tamil Nadu.

Macroscopic Characteristics:

- **Morphology:** It shows an acute apex, an entire margin, and asymmetric base.
- **Shape:** lanceolate to ovate lanceolate.
- **Lamina:** Pubescent lamina is found on both the surfaces.
- **Colour:** Leaves show a greyish - green colour for Alexandrian senna and yellowish - green for Tinnevelly senna.
- **Organoleptic nature:** Odour of leaves is slight but characteristic and the taste is bitter, mucilagenous.

Microscopy

With very few exceptions, Senna's features are nearly the same on both of its leaf surfaces.

- **Epidermis**: The transverse section of a leaf displays the upper and lower epidermis, which are composed of cells with straight walls, a small number of mucilage-containing cells, and Paracytic stomata.
- **Trichomes and Stomata:** Epidermis has unicellular, conical, thick walled **warty trichomes.**
- **Palisade parenchyma:** Palisade parenchyma is present in a single layer on both sides, although it discontinues at the lower epidermis midrib region due to a region of collenchymatous tissues.
- **Crystals of calcium oxalate:** Spongy mesophyll, which contains vascular filaments and calcium oxalate crystals prisms, follows palisade.
- **Pericyclic fibers -** The midrib's vascular bundle, which consists of xylem and phloem, is nearly entirely surrounded by **lignified pericyclic fibers.**

Chemical Constituents:

- Senna contains mainly two anthraquinone glycosides called as **sennoside A** and **sennoside B** (both account for Purgative property).
- In sennoside B the aglycone is in meso form, and in sennoside A, it is dextro-rotatory.
- They also contain **sennosides C and D,** aloe-emodin, rhein, and kaempferol

Chemical Tests

Borntrager test is used for detection of -C-O- glycosides.

Boil the powdered leaves with dilute sulphuric acid. Filter immediately, separate the filtrate and cool. Mix the filtrate carbon tetrachloride. Shake it well and separate the organic solvent layer. To the layer of organic solvent, add equal quantity of dilute ammonia. The presence of anthraquinone derivatives is indicated by the ammoniacal layer turning pink and then crimson.

Uses

- Senna leaves are used as Laxative.
- It causes griping effect due to emodin content

UNIT-5

Biological source, chemical constituents and therapeutic efficacy of crude drug (PART II)

Points to be covered in this topic

- ❑ ASTRINGENTS
  - ❖ Myrobalan, Black catechu , pale catechu
- ❑ DRUG ACTING ON NERVOUS SYSTEM
  - ❖ Hyoscyamus, Belladonna , Ephedra, Opium , Tea leaves , Coffee seed , Coca
- ❑ ANTI- HYPERTENSIVE
  - ❖ Rauwolfia
- ❑ ANTI- TUSSIVE
  - ❖ Vasaka, Tolu balsam

UNIT-5

Biological source, chemical constituents and therapeutic efficacy of crude drug (PART II)

Points to be covered in this topic

- ❑ ANTI- RHEUMATICS
  - ❖ Colchicum seed
- ❑ ANTI- TUMOUR
  - ❖ Vinca , Podophyllum

ASTRINGENTS

5.4. ASTRINGENTS

Astringents are substances that cause bodily tissues to contract or shrink. It is frequently used in medicine to arresting haemorrhages and reduce mucous secretion and blood serum discharge by precipitating proteins.

5.4.1. Myrobalan

Myrobalan

Synonyms: Chebulic myrobalan, Harde.

Biological Source:

Myrobalan is the mature **dried fruits** of ***Terminalia chebula.***

Family: Combretaceae.

Geographical Source Myrobalan tree is found in the sub-Himalayan tracks from Ravi to West Bengal, Assam and in all deciduous forests of India.

Morphological Characters:

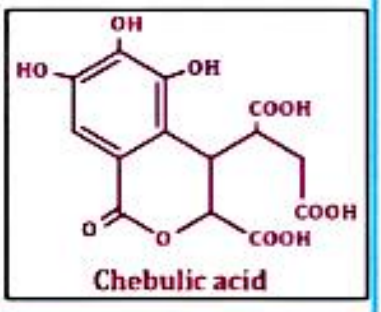
CHARACTERISTIC	DESCRIPTION
Colour	Fruits are yellowish-brown
Odour	Odourless
Taste	Astringent, slightly bitter and sweetish at the end
Shape	Ovate and wrinkled longitudinally

Chemical Constituents:

Myrobalan contains hydrolysable tannins (Pyrogallol type), which yield **chebulic acid and D-galloyl glucose** on hydrolysis. It contains free tannic acid, gallic acid, ellagic acid, chebulagic acid, and chebulinic acid.

Uses:

- Myrobalan is used mainly as an astringent, laxative, stomachic, and tonic, anthelmintic.
- It is an ingredient in the ayurvedic preparation **'Triphala'**, used for the treatment of variety of ailments.



Chebulic acid

- Myrobalan is also used in the treatment of piles and external ulcers.

5.4.2. Black catechu

Black catechu

Synonyms: Cutch, Kattha

Biological Source

Black catechu is the **dried aqueous extract** prepared from the heartwood of ***Acacia catechu.***

Family: Leguminosae

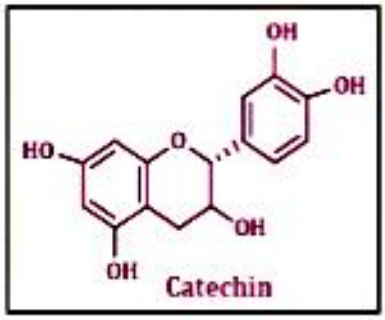
Geographical Source

It is common throughout the tract from Punjab to Assam ascending to an altitude of 300 m.

Morphological Characters:

CHARACTERISTIC	DESCRIPTION
Colour	Light brown to black
Odour	Odourless
Taste	Very astringent
Shape	Cube or irregular fragments of broken cubes or brick shaped pieces

Chemical Constituents



Catechin

Black catechu contains about 10 per cent of **acacatechin (acacia catechin)** which undergoes oxidation to produce catechutannic acid in presence of water. Catechu red, quercetin, gum and quercitrin are also present

Uses

- As an astringent, cutch is used in medicine. It treats throat conditions, diarrhea, and oral issues.
- It also increases appetite.

Chemical test

1. Because of the presence of **catechin,** black catechu gives **pink or red colour with vanillin**
2. **Green colour** is produced when ferric ammonium sulphate is added to dilute solution of black catechu.

5.4.3. Pale catechu

Pale catechu

Synonyms: Gambier, Catechu.

Biological Source:

Gambier or pale catechu is a **dried aqueous extract** produced from the leaves and young twigs of ***Uncaria gambier***.

Family: Rubiaceae

Geographical Source

It was originally from Malaya. It can grow up to 150 meters above sea level and is grown in Singapore, Sumatra, Borneo, Indonesia, Malaysia.

Morphological Characters:

CHARACTERISTIC	DESCRIPTION
Colour	Dull reddish brown colour externally and pale brown to buff colour internally.
Odour	Odourless
Taste	Astringent, slightly bitter and sweetish at the end.
Shape	Strips, flakes or coarse powder

Chemical Constituents:

- The drug contains condensed tannins in the form of **catechins, catechutannic acid** and **catechu red**.
- The drug also contains quercetin and gambier fluorescin.

Chemical Tests

1. **Gambier fluorescin test:** Gambier fluorescin, present in pale catechu, gives the fluorescence. To its alcohol extract, sodium hydroxide is added and shaken with petroleum ether. The petroleum ether layer shows green fluorescence. Black catechu gives a negative test.
2. **Matchstick test:** Same as described above in black catechu.

Uses

- It is used as a local astringent in the form of lozenges and as an astringent in the treatment of diarrhea.
- Pale catechu is mostly employed in the tanning and dyeing industries

5.5 DRUG ACTING ON NERVOUS SYSTEM

Drugs acting on the nervous system are a class of drugs that affect the central or peripheral nervous system. These drugs can be used to treat a variety of conditions, such as anxiety, depression, and pain.

Drugs that affect the central nervous system (CNS) include anesthetics, anticonvulsants, antiemetics, antiparkinson agents, CNS stimulants, muscle relaxants, narcotic analgesics (pain medications), nonnarcotic analgesics (such as acetaminophen and NSAIDs), and sedatives.

5.5.1. Hyoscyamus

Synonyms: Henbane, Hyoscyamus herb.

Biological Source It consists of the dried leaves, or leaves and flowering tops of ***Hyoscyamus niger* Linn.**

Family: Solanaceae

Geographical Source Hyoscyamus is indigenous to Western Asia, North Africa, Europe and India and cultivated in Russia, Belgium, Hungary and India.

Hyoscyamus

Morphological character

CHARACTERISTIC	DESCRIPTION
Colour	Pale greyish green in colour
Odour	Characteristic and strong odour
Taste	Bitter and acrid
Shape	The shape of leave is ovate- oblong to triangular ovate

Microscopic Characters:

- A dorsiventral leaf present.
- **Trichomes:** Epidermis has a lot of glandular trichomes, smooth cuticle covering it.

- **Stomata:** Anisocytic stomata are found in the epidermal layer.
- **Calcium oxalate crystals**: Palisade cells are contained in a single layer, calcium oxalate prismatic or cluster crystals are present in every cell.
- **Idioblasts** with microspheroidal crystals are occasionally observed in proximity to the veins. Bicollateral vascular bundles with an arc shape are densely packed throughout the midrib.

Chemical Constituents:

The main component in henbane leaves is the alkaloid **hyoscyamine**, together with smaller quantities of Atropine and Hyoscine, also known as Scopolamine

Uses:

- It is used as antispasmodic, hypnotic and mild diuretic.
- The leaves are used as narcotic medicine.
- It is used to relieve the griping caused by drastic purgatives.

5.5.2. Belladonna

Belladonna

Synonyms: Belladonna Leaf, Deadly night shade leaf.

Biological Source:

Belladonna consists of **dried leaves** and flowering tops of ***Atropa belladonna*** Linn. (European Belladonna), ***Atropa acuminata*** (Indian belladonna)

Family: Solanaceae.

Geographical Source: Cultivated in United States, Canada, UK, Germany and India.

Morphological characters

CHARACTERISTIC	DESCRIPTION
Colour	Leaves - Green to brownish-green Flowers - Purple to yellowish-brown
Odour	Slight and characteristic
Taste	Bitter and acrid
Shape	Ovate, lanceolate to broadly ovate, with acuminate apex, decurrent lamina, entire margin

Microscopic Characters

There are upper and lower epidermis visible in the transverse section of an Atropa belladonna leaf. The epidermal cells have wavy walls and a striated cuticle. There are few **anisocytic stomata** on the upper epidermis and many on the lower epidermis.

Some of the trichomes are uniserate, 2-4 celled. Some are similar to these but have a **unicellular glandular** head; however, the third type of trichomes has a multicellular glandular head with a short pedicel and contains sand-sized **microsphenoidal** calcium oxalate crystals. The Palisade ratio is 5 to 7.

Chemical Constituents

Main alkaloids are **l-hyoscyamine** and its racemic form is atropine. The leaves also contain a **fluorescent substance α-methylaesculetin (Scopoletin),** belladonine, hyoscine, pyridine and N-methyl pyrroline.

Uses

- It is the parasympatholytic drug with anticholinergic properties.
- Reduce the secretions such as sweat, saliva and gastric juice.
- It is used as antidote in opium and chloral hydrate poisoning.

5.5.3. Ephedra

Synonyms: Ma Huang.

Biological Source: Ephedra consists of the dried aerial parts of

Ephedra gerardiana Wall, ***Ephedra sinica*** Stapf, ***Ephedra nebrodensis*** Tineo and other ***Ephedra species.***

Family: Gnetaceae

Geographical Source: It is mainly found in China, India, Nepal, Turkey, Pakistan and Bhutan.

Ephedra

Cultivation, collection and preparations

- Ephedra can be cultivated at an **altitude of 2500 to 3000 m.**
- It can be propagated by layers or divisions of the root stock.
- Seeds are sown early in the **spring** at a distance of 5 cm, keeping the distance of one meter between two rows.
- The plants are collected after attaining the age of **4 years for the extraction of alkaloid.**
- The alkaloidal content of the drug varies from season to season. It is found to be **maximum in autumn**; when plants and twigs are dark in colour.
- Twigs are generally dried in sun or even by artificial ways.

Morphological character

Colour – Greenish-yellow

Odour - Aromatic and pine like

Taste - Astringent

Shape – Cylindrical, elongated, nodes, internodes and stipulate leaves.

Microscopic character

- The T.S. of ephedra shows the following characteristics:
- Unicellular epidermis made up of quadrangular cells along with thick-walled cuticle.
- Vertical rows of **sunken stomata** and papillae on the ridges. Chlorenchymatous cortex is present.
- Below ridge Non lignified, hypodermal fibres. Lignified pericyclic fibres are present
- Crystals of calcium oxalate are present in the cortex
- Parenchymatous brown coloured pith

Chemical Constituents

Ephedra contains the amino alkaloids. They are ephedrine, n-methyl ephedrine, pseudo-ephedrine. **and** is soluble in water, alcohol, organic solvents and oils.

Chemical Test

To the drug dissolved in water then dilute HCl, copper sulphate solution and sodium hydroxide solution are added, the liquid gives violet.

Uses

Ephedra's alkaloids have sympathomimetic properties. As a result, it is used to treat allergic diseases, including hay fever as well as asthma as a bronchodilator.

5.5.4. Opium

Opium

Synonyms: Raw Opium, Afim.

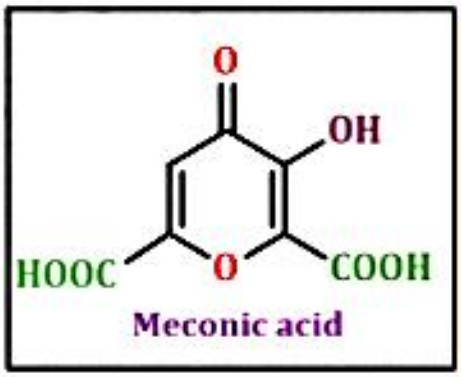
Biological Source: Opium is the air-dried, milky latex obtained by incision from the **unripe capsules** of ***Papaver somniferum* Linn.**

Family: Papaveraceae.

Geographical Source: It is mainly found in Turkey, Russia, Yugoslavia, Tasmania, India, Pakistan, Iran, Afghanistan, China, Burma, Thailand.

Chemical Constituents:

There are over 25 alkaloids in opium. can either have a **benzisoquinoline ring system** or a **phenanthrene nucleus**. The alkaloids found in opium are **meconic acid salts**. The other alkaloids isolated from the drug are codeine, narcotine, thebaine, noscapine, narceine, and papaverine (0.5–2.5%). Morphine contains a phenanthrene nucleus.



Meconic acid

Chemical Tests

1. Extract of Opium with $FeCl_3$ solution gives deep reddish purple colour which persists on addition of HCl. It indicates the presence of meconic acid.
2. Morphine gives dark violet colour with conc. H_2SO_4 and formaldehyde.

Uses:

- Opium and morphine have narcotic, analgesic and sedative action and used to relieve pain, diarrhoea dysentery and cough.
- Codeine relieves local irritation in the bronchial tract and as an antitussive used in various cough medicines.

5.5.5. Tea leaves

Tea leaves

Synonyms: Camellia thea.

Biological Source: Tea obtained from the prepared leaves and leaf buds of ***Thea sinensis.***

Family: Theaceae.

Geographical Source: It is mainly cultivated in India (Assam), Ceylon, Japan and Java, Shri Lanka, China.

Morphological character:

CHARACTERISTIC	DESCRIPTION
Colour	Dark green
Odour	Characteristic
Taste	Bitter and Astringent
Shape	Lanceolate or elliptical, acumunate at apex, margin is serrate.

Chemical Constituents:

Caffeine

- The main constituent of tea leaves are **caffeine.**
- It also has trace amounts of **theophylline** and **theobromine**.
- Distinctive color of tea leaves is due to Gallotannic acid.
- The presence of a yellow volatile oil causes the pleasant smell.
- Tea leaves contains an enzyme called **thease.**

Chemical Tests:

1. **Murexide test -** Caffeine gives murexide colour reaction. Caffeine is taken with hydrochloric acid and potassium and heated to dryness. A purple colour is obtained by exposing the residue to vapours of dilute ammonia. In addition of fixed alkali, the purple colour disappears.
2. Caffeine also produces white precipitate with tannic acid solution.

Uses

Tea is useful as a CNS stimulant in the form of beverage besides, it is a diuretic as well.

5.5.6. Coffee seed

Coffee seed

Synonyms: Coffee bean.

Biological Source

It is the dried ripe seed of ***Coffea arabica* Linne**.

Family: Rubiaceae

Geographical Source

It is indigenous to Vietnam, Mexico, Guatemala, Ethiopia, Brazil, India, Indonesia and Sri Lanka.

Chemical Constituents

- The main constituents of coffee bean are caffeine (2 - 3 %). It contains **chlorogenic or caffeotannic acid**.
- Sugars present in the form of dextrin, glucose, etc.
- In the seeds, caffeine is present as a salt of chlorogenic acid.

Uses:

- It is used as stimulant and diuretic.
- It is a source of caffeine.
- Sometime used to combat toxic effect of CNS depressant drug.

5.5.7. Coca

Coca

Synonyms: Java coca, Bolivian coca

Biological Source

Coca consists of the **dried leaves** of ***Erythroxylon coca* (Bolivian coca)** and ***Erythroxylon truxillense* (Peruvian coca).**

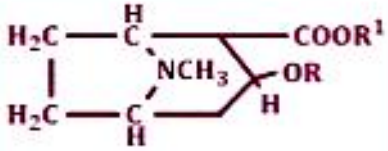
Family: Erythroxylaceae.

Geographical Source

It is mainly found in Bolivia, Peru, Indonesia, Ceylon, Java and India.

Chemical Constituents:

Coca leaves contain the alkaloids Cocaine, Cinnamyl Cocaine, and α-Truxilline. Truxillo or Peruvian leaves contain more alkaloids than the Bolivian.



Ecgonine

- **Java Coca** contains tropocaine and four yellow crystalline glucosides in addition to the other constituents.

The different bases liberate Ecgonine in following way

Cocaine ⟶ **Ecgonine + Methyl alcohol + Benzoic acid**

Cinnamyl cocaine ⟶ **Ecgonine + Methyl alcohol + Cinnamic acid**

α- truxilline ⟶ **Ecgonine + Methyl alcohol + α-truxillic acid**

Uses

- Cocaine is used as a local anesthetic.
- Coca leaves are used as stimulants and also in convulsions.
- Due to the hallucinogenic and addictive effects of cocaine, it has become the drug of abuse.

UNIT-5

Biological source, chemical constituents and therapeutic efficacy of crude drug (PART III)

Points to be covered in this topic

- ❑ ANTI- DIABETICS
  - ❖ Pterocarpus, Gymnema
- ❑ DIURETICS
  - ❖ Gokhru, Punarnava
- ❑ ANTI-DYSENTERIC
  - ❖ Ipecacuanha
- ❑ ANTISEPTICS AND DISINFECTANTS
  - ❖ Benzoin, Myrrh , Neem , Turmeric
- ❑ ANTIMALARIALS
  - ❖ Cinchona, Artemisia
- ❑ OXYTOCIC
  - ❖ Ergot

UNIT-5

Biological source, chemical constituents and therapeutic efficacy of crude drug (PART III)

Points to be covered in this topic

- ❑ **VITAMINS**
  - ❖ Cod liver oil, Shark liver oil

ANTI- DIABETICS

Diabetes is a chronic condition brought on by either insufficient insulin production by the pancreas or inefficient insulin utilization by the body. A hormone called insulin controls blood sugar levels.

5.10.1. PTEROCARPUS

Pterocarpus

Synonyms: Malabar kino, Bijasal, Indian kino tree.

Biological Source: It is a dried juice obtained by making vertical incisions to the stem bark of the plant ***Pterocarpus marsupium*** Linn.

Family: Leguminosae.

Geographical Source: In India it is found in Gujarat, Uttar Pradesh, Bihar, Madhya Pradesh, and Orissa.

Morphological character:

CHARACTERISTICS	DESCRIPTION
Colour	Dried juice is Ruby-red
Odour	Odourless
Taste	Astringent
Shape	Angular grains

Chemical Constituents:

- Kino contains kinotannic acid (70 - 80 %), kino-red, k-pyrocatechin (catechol), resin and Gallic acid.
- Kino-red is an anhydride of kinoin.

Chemical Tests:

1. When the drug solution is treated with alkali like KOH violet colour is obtained.
2. When drug solution is treated with mineral acid, the precipitate is obtained.

Uses:

- Kino is used as a powerful astringent.
- Used in the treatment of diarrhoea and dysentery.

5.10.2. GYMNEMA

Gymnema

Synonyms: Madhunashini, Gudmar.

Biological Source: It is obtained from the leaves of a perennial woody climber plant known as ***Gymnema sylvestre.***

Family: Asclepiadaceae.

Geographical Source: It is a woody climber found commonly in India (Deccan-peninsula).

Macroscopic character:

CHARACTERISTIC	DESCRIPTION
Colour	Green
Odour	Pleasant and aromatic odour
Taste	Tasteless
Shape	Elliptic or ovate shape with acute or acuminate apex

Chemical Constituents:

- It consists of pentriacontane, hentriacontane and phytin, α and β chlorophylls, resin, tartaric acid.
- Other compounds include formic acid, butyric acid, mucilage inositol, d-quercitol.
- Gymnemic acids which is an anti-sweet compound.
- The mixture of triterpene saponines and anthraquinone derivatives.

Uses:

- It functions as a diuretic, laxative, stimulant, anti-diabetic, and stomachic.
- These medication's antidiabetic formulations are offered over the counter. The indirect stimulation of the pancreas's release of insulin is what causes the hypoglycemic effect.
- Gymnemic acids are effective at preventing dental plaque and cavities.
- It has ability to reduce weight.

DIURETICS

Drugs that promote urine output are known as diuretic drugs. Diuretics refer only to those agents that directly act on kidneys. These drugs primarily increase the excretion of water and ions like Na+ or Cl- from the body.

5.11.1 GOKHRU

Gokhru

Synonyms: Tribulus, Puncture vine.

Biological source: It consists of dried ripe fruits of the plant ***Tribulus terrestris* Linn.**

Family: Zygophyllaceae

Geographical source: It is widely distributed in India, Tibet and Sri Lanka.

Morphological characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Greenish to grey
Odour	Odourless
Taste	Characteristic
Size	1.0 to 1.5 cm
Shape	Fruits are globose, consisting of 5 to 10 woody cocci, each with two pairs of hard and sharp divergent spines.

Chemical constituents:

- They contain saponins Teresterosin A, Teresterosin E and Tribulosin, which on hydrolysis yield, steroidal sapogenins.
- The drug contains traces of alkaloids, harmine and harman.

Therapeutic efficacy:

(a) Diuretic, aphrodisiac, gout, tonic, demulcent, treatment of kidney stone.

(b) It is also used in painful urinary discharge and it is a common ingredient of some preparations like Chyawanprash and Dashmoolarishta.

5.11.2. PUNARNAVA

Punarnava

Synonyms: Hog weed, Rakta Punarnava.

Biological source: It is obtained from the fresh and dried herb ***Boerhaavia diffussa*** Linn.

Family: Nyctaginacae

Geographical source: The plant is grown throughout India, China, Sri Lanka, and Africa. In India, it is found in the Himalayan region.

Morphological characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Leaves – green (upper surface) and whitish (lower surface) Stems - greenish purple Flowers - pink
Odour	Odourless
Taste	Bitter

Chemical constituents:

- Punarnava contains about (0.04-0.1%) of alkaloid. The main alkaloid is punarnavine, Punernavoside, boeravinone A, B, C and D.
- It also contains about 6 per cent of potassium nitrate, an oily substance, and ursolic acid.

Uses:

- Diuretic, stomachic, expectorant, abdominal pains, jaundice, liver tonic, loss of digestive power.

ANTI-DYSENTERIC

Dysentery is an infection of the intestine that causes diarrhoea containing blood or mucus. It is commonly caused by bacterial or parasitic infections, such as Salmonella, Shigella, or amoebic dysentery.

Antidysentric is the drug used to treat dysenteric.

5.12.1. IPECACUANHA

Synonyms: Ipecac.

Biological source: Ipecac obtained from the dried root or rhizome of ***Cephaelis ipecacuanha*** (Brazilian Ipecacuanha) or ***Cephaelis acuminata*** (Panama Ipecacuanha).

Family: Rubiaceae.

Geographical source: It is found in Burma, Brazil, Malaysia, Panama, Singapore and India.

Morphological characteristics:

CHARACTERISTIC	BRAZILIAN IPECACUANHA	PANAMA IPECACUANHA
Colour	Dark brick red to brown	Greyish brown to reddish brown
Odour	Faint	Faint
Taste	Bitter	Bitter
Size	Up to 150 mm in length and 6 mm in thickness	large size upto 9 mm in thickness
Shape	Roots are present in tortuous pieces	Cylindrical

Microscopic characteristics:

Roots:

- **Cork layer:** Show the presence of cork layer, which has brown contents.
- **Phelloderm:** Cork layer is followed by phelloderm, Phelloderm is made up of thin-walled parenchyma, full of calcium oxalate crystals and grains of starch.
- **Xylem:** Tracheids and tiny vessels make up the xylem.

- There are further secondary medullary rays with starch grains.

Rhizomes:

- **Pericycle:** Protoxylem, thick-walled sclereids, and spiral vessels make up the pericycle.
- The only thing that sets the Columbian type apart is that the starch grains are bigger, measuring up to 22 microns.

Chemical constituents:

- Ipecacuanha contains isoquinoline Alkaloids which are **emetine, cephaeline**, emetamine, psychotrine and O-methyl psychotrine.
- It also contains glycoside- Ipecacuanhin and also contains ipecacuanhic acid, calcium oxalate and starch.

Chemical tests:

- Emetine is treated with sulphuric acid and sodium molybdate (Frohde's reagent) giving bright green color.
- To the Powder drug add HCl and water. Shake and filter it. To the filtrate add a small amount of potassium chlorate. Yellow colour is produced which change.

Uses:

- Ipecacuanha is expectorant in small doses and emetic in higher doses.
- Cephaeline has more emetic and less expectorant action.
- Emetine hydrochloride is used as an antiprotozoal.
- Emetine is also used in anti-tumour.

ANTISEPTICS AND DISINFECTANTS

An antiseptic is a substance that stops or slows down the growth of microorganisms.

They're frequently used in hospitals and other medical settings to reduce the risk of infection during surgery and other procedures.

An antiseptic is applied to the body, while disinfectants are applied to nonliving surfaces.

5.13.1. BENZOIN

Synonyms: Loban, Sumatra benzoin.

Biological source: It is a balsamic resin obtained from ***Styrax benzoin*** **(Sumatra benzoin)** and ***Styrax tonkinesis*** **(Siam benzoin).**

Styrax benzoin

Family: Styraceae

Geographical source:

1. **Sumatra benzoin** is produced from trees grown in southeastern Asia, mainly Sumatra. It is also cultivated in Borneo and Java.
2. **Siam benzoin** is produced from trees grown in Vietnam and Thailand.

Morphological characteristics:

CHARACTERISTIC	SUMATRA BENZOIN	SIAM BENZOIN
Colour	Greyish brown or grey	Yellowish brown to rusty brown
Odour	Aromatic and Characteristic	Agreeable and vanilla like
Taste	Sweetish and Slightly acrid	Sweetish and Slightly acrid

Chemical constituents:

- Sumatra benzoin contains free balsamic acids which are **benzoic and cinnamic acids.**
- The major constituent of Siam benzoin is an ester coniferyl benzoate contains about 76 %.

- Summaresinolic and Siaresinolic acids are also present which are triterpenoid acids.

Chemical tests:

1. Heat the benzoin in a test tube with covering openings then cool the contents and examine the glass plate under a microscope. The crystals of cinnamic acid will be observed.
2. Add potassium permanganate to benzoin and warm. In the case of Sumatra benzoin odour of benzaldehyde is produced.
3. To benzoin add 10 ml ether, shake it well and pour this extract into a porcelain dish, add 2 to 3 drops of H_2SO_4. A deep purplish red colour is obtained (for Siam benzoin) and A deep brown colour is obtained (for Sumatra benzoin).

Therapeutic efficacy:

- Antiseptic, protective, mild disinfectant, carminative and diuretic in the treatment of upper respiratory tract infection

5.13.2. MYRRH

Commiphora molmol

Synonyms: Bol, Myrrha, Gum Myrrh

Biological source: It is an oleo gum resin obtained from ***Commiphora molmol*** and from other ***Commiphora species.***

Family: Burseraceae

Geographical source: It is indigenous to north east Africa, especially Somalia island. It is also found in Saudi Arabia, Iran and Thailand.

Macroscopical characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Externally reddish brown and internally brown
Odour	Aromatic and agreeable
Taste	Aromatic and agreeable
Size	About 1.5 to 3.0 cm in diameter
Shape	It is obtained in the form of rounded/irregular tear.

Chemical constituents:

- It contains volatile oil, resin, gum, **α, β and γ commiphoric acids.** α and β heerabomyrrholic acids. Terpenes, cuminic aldehyde, eugenol etc.
- The disagreeable odour of the oil is due to mainly the disulphide.

Uses:

- It is used as a Stimulant, antiseptic, protective.
- Used as stomachic, diuretic, anthelmintic, astringent.
- Also used in mouth washes, gargle.
- It also used as Expectorant.

5.13.3. NEEM


Neem

Synonyms: Margosa

Biological source: Neem is obtained from aerial parts of the plant known as ***Azadirachta indica.***

Family: Meliaceae

Geographical source: It is found in India, Pakistan, Bangladesh, Shri Lanka, Malaysia, Thailand, South Africa and East Africa.

Morphological characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Green (leaves), Brown (bark)
Odour	Characteristic
Taste	Bitter
Size	Leaflets 5-10 cm in length

Chemical constituents:

It has been discovered that neem has a variety of compounds that could be used to control pests. A substantial portion of the compounds that were separated from the plant are diterpenes.

(a) Seeds

- Nimbin, Nimbidin - Antiviral action
- Azadirachtin - Insect repellant

(a) **Flowers:** Nimbosterol, Myricitin, Kaempferol – Insecticidal

(b) **Fruits:** Deacetyl azadirachtinol - Paralyzes insects swallowing mechanisms

(c) **Bark:**

- Nimbin, Nimbinin, Nimbidin – Antiviral
- Margolone, Margolonone - Antibacterial

(a) **Roots:** Excellent for reforestation.

The neem oil contains bitters (2%), which are sulphur containing compounds (Nimbin, Nimbidin, Nimbinin and Nimbidol).

Uses:

- Antimicrobial properties, bitter tonic, astringent, anthelmintic, leprosy, insect repellant, antifeedant, spermicidal activity, malarial fever.

5.13.4. TURMERIC


Turmeric

Synonyms: Indian Saffron, Curcuma, Haridra, Haldi.

Biological source: It is obtained from of dried and fresh rhizomes of the plant known as ***Curcuma longa* Linn.**

Family: Zingiberaceae

Geographical source: It is cultivated in India, China, Italy, Thailand, Malaysia and north Australia. In India, it is cultivated in Andhra Pradesh and Tamil Nadu.

Macroscopical characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Yellowish brown
Odour	Characteristic
Taste	Pungent and bitter

Microscopic Characters:

- **Cork cell**: The outermost 4 to 6 layers of brick-shaped parenchymatous cork are visible in the transverse cut of the turmeric rhizome, followed by cork cambium.

- **Cortex:** The cortex is made up of rounded parenchymatous cells which are thin walls and dispersed vascular bundles.
- In the ground tissue, oleo resin cells with a brownish interior can also be seen.
- The cell walls of oil cells have suberized.
- **Vascular bundles:** Vascular bundles are present in the cortex and are collateral.

Chemical constituents:

- It contains volatile oil and resin and mainly contain curcuminoids (yellow colour substance).
- The chief component of curcuminoids is curcumin and other related curcuminoids such as Demethoxy curcumin and Bis Demethoxy curcumin are present which also attribute to its yellow colour.

Chemical Tests:

1. Turmeric powder on treatment with concentrated sulphuric acid forms red colour.
2. On addition of alkali solution to Turmeric powder red to violet colour is produced.

Uses:

- It is used as Condiment, antiseptic, anti-inflammatory.
- It is also used in Antiarthritic agents, cough, duodenal ulcer, hepatitis, jaundice, and rheumatism.

ANTIMALARIALS

Malaria is a life-threatening disease caused by parasites transmitted to humans through the bites of infected female Anopheles mosquitoes. Antimalarial drugs can effectively treat malaria and alleviate malarial symptoms such as fever, chills, headache and fatigue. It occurs due to infections by species of a protozoan - Plasmodium. The species known to cause this disease in humans are *Plasmodium malariae*, *Plasmodium vivax*, and *Plasmodium falciparum.*

5.14.1 CINCHONA

Synonyms: Peruvian bark, Cinchona bark, Jesuit's bark.

Biological source: Cinchona is obtained from the dried bark of the cultivated trees of ***Cinchona calisaya* Wedd., *Cinchona ledgeriana* Moers, *Cinchona officinalis* Linn,** and ***Cinchona succirubra* Pav. ex-klotzsch.**

Cinchona

C.calisaya	*C. succirubra*	*C. officinalis*	*C. ledgeriana*
			
Diameter is from 12-25 mm and thickness from 2-5 mm	Diameter is from 20-40 mm and thickness from 2-5 mm	Diameter is upto 12 mm and thickness is upto 1.5 mm	Diameter is 12-25 mm and thickness varies from 2-5 mm

Family: Rubiaceae

Geographical source: It is found in India, Sri Lanka, Indonesia, Columbia, Bolivia, Ecuador, Peru, Tanzania and Guatemala, In India, it is cultivated in Annamalai hills and Nilgiri hills, in Tamil Nadu.

Macroscopical characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Dull brown grey or grey (outer surface), Yellowish brown to deep reddish brown (inner surface)
Odour	Characteristic
Taste	Bitter and astringent
Shape	In form of Quills and Curved Piece

Microscopic Characters:

- Cinchona displays the typical bark histological characteristics.
- **Cork cells:** Thin-walled Cork cells are followed by Phelloderm.
- **Medullary rays:** Radially organized cells can be found in the medullary rays.
- **Idioblast:** Cinchona bark's distinctive feature is idioblast of calcium oxalate.
- **Starch grains:** In the parenchymatous tissues, starch grains can be seen.

Chemical constituents:

- Cinchona bark contains about 25 alkaloids which belong to the quinoline group.
- The important alkaloids present are **quinine, quinidine, cinchonine and cinchonidine.**
- Quinine and Quinidine are stereoisomers of each other.
- Quinidine is also obtained commercially by the bark known as cuprea bark i.e. (*Ramijia pedunculata*)or by isomerization of quinine.
- Cinchonine and cinchonidine are also isomers of each other.
- Apart from alkaloids, cinchona also contains quinic acid and cinchotannic acid.

Chemical tests:

1. **Thalleoquin test:** To the extract of cinchona powder add one drop of dilute sulphuric acid and 1 ml of water. Add bromine water dropwise till the solution acquires permanent yellow colour and add 1 ml of dilute ammonia solution, emerald green colour is produced.
2. Cinchona bark, when moistened with sulphuric acid and observed under ultraviolet light shows a blue fluorescence due to the methoxy group of Quinine and quinidine.

Uses:

- It is mainly used as an Antimalarial.
- It is a Bitter stomachic and antipyretic.
- Also used to prevent arrhythmias, tachycardia, prevention of atrial fibrillation.

5.14.2. ARTEMISIA

Synonyms: Worm weeds, Sweet annie.

Biological source: It is obtained from the herb ***Artemisia annua.***

Family: Asteraceae

Geographical source: It grows wild in Europe and America also cultivated in Vietnam, China, Iran, Turkey and Australia.

Artemisia

Macroscopical characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Dark green
Odour	Aromatic
Taste	Bitter

Chemical constituents:

- It consists Artemisinin (antimalerial effect), deoxyartemisinin.
- It is a sesquiterpene lactone with an internal peroxide linkage.
- It also contains Artemisinic acid, arteannuin A and B.
- Amyrin, luteolin, ß-sitosterol, stigmasterol are also present.

Uses:

- Artemisinin has antimalarial activity (rapid blood schizonticidal activity) it has also shown anti-HIV activity.
- Artemisic acid has antibacterial and cytotoxic, anti-inflammatory actions.

OXYTOCIC

Oxytocic are drug that stimulate the contraction of smooth muscles of the uterus.

These contractions are essential during labor and delivery, as well as for the management of postpartum bleeding.

In early pregnancy, the uterus is not as responsive to oxytocic drugs, and higher doses are often needed to initiate contractions. As the pregnancy progresses and the uterus becomes more sensitive to oxytocin, lower doses are usually sufficient to achieve the desired contractions.

5.15.1. ERGOT

Synonyms: Ergota, Ergot of Rye.

Biological source:

It is the dried sclerotium of a fungus, ***Claviceps purpurea*** **Tulasne** (Clavicipitaceae), developed in the ovary of rye plant, ***Secale cereale*** **Linn.** (Graminae).

Ergot of rye

Geographical source: It is cultivated in Yugoslavia, Hungary, Switzerland and Czechoslovakia.

Macroscopical characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Dark violet to black (externally) whitish or pinkish white (internally)
Odour	Faint and disagreeable
Taste	Unpleasant
Size	The sclerotia are 1-3 cm in length and 1-5 mm in width
Shape	Sclerotia are fusiform, triangular and usually tapering on both the ends

Collection and preparation of ergot:

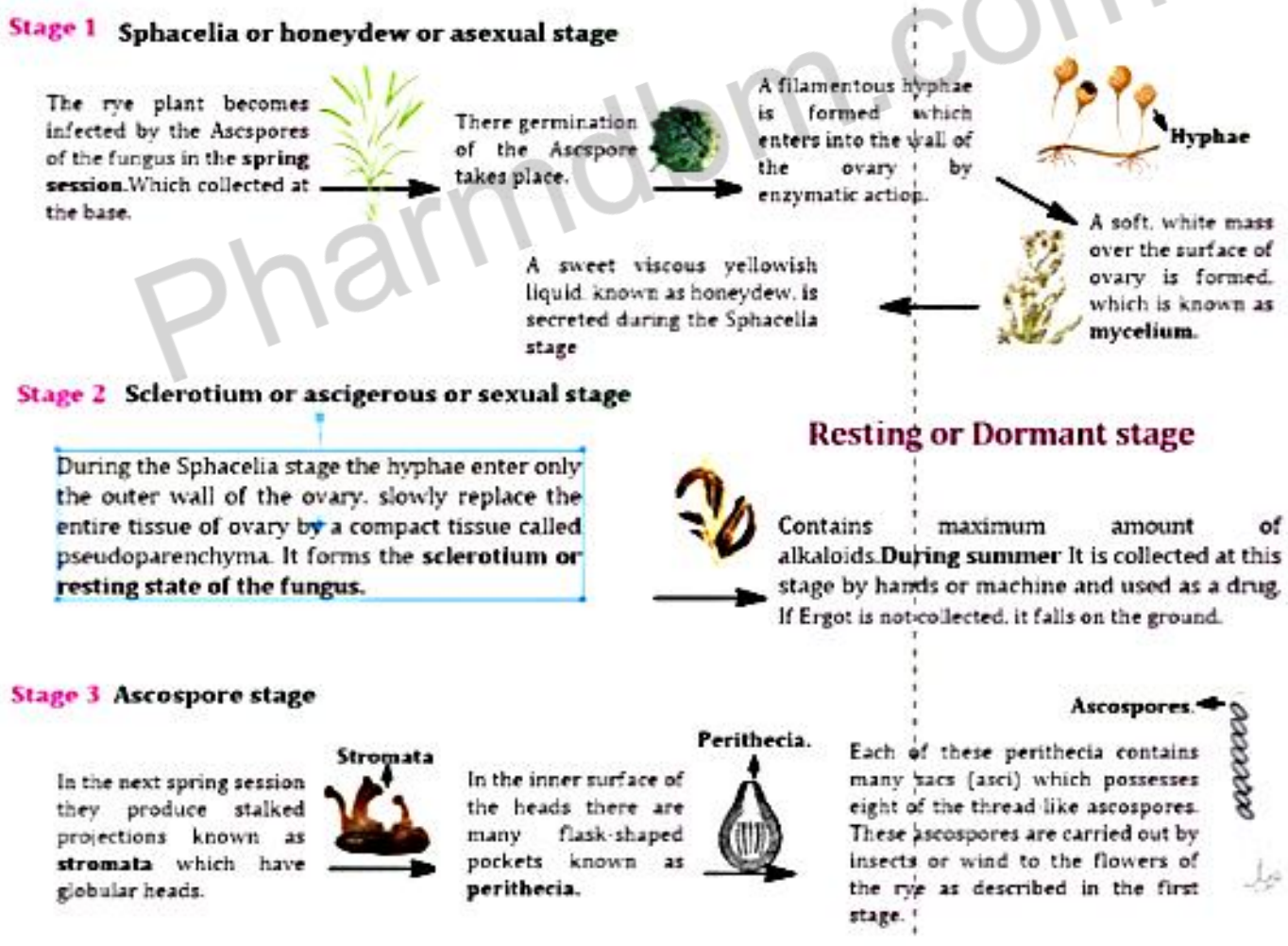
Ergot is produced by either natural way i.e., cultivation of rye plants and subsequently infected with this fungus or by artificial way i.e., saprophytic production.

It is essential to understand the various stages of fungal development, or more specifically, the life cycle of ergot, for a methodical investigation.

Life Cycle of Ergot-

The life cycle of the fungus, *Claviceps purpurea*, which is a parasite, passes through the following characteristic stages:

1. Sphacelia or honeydew or asexual stage
2. Sclerotium or ascigerous or sexual stage and
3. Ascospore stage.



Chemical constituents:

- Ergot contains potent indole alkaloids, which are **derivatives of lysergic acid, present in its peptide derivative** (6 isomeric pairs) dextrorotatory and laevorotatory (active) forms of alkaloids.
- The six pairs of alkaloids are broadly grouped into water soluble and water insoluble categories.

  Water-soluble group - Contains **Ergometrine** and its dextro part as **Ergometrinine.**

  Water insoluble group - further divided into **Ergotamine** and **Ergotoxine** groups.

(-) Laevorotatory alkaloids	(+) Dextrorotatory alkaloids
Water-Soluble	
Ergometrine	Ergometrinine
Water insoluble	
Ergotamine	Ergotaminine
Ergosine	Ergosinine
Ergocorinine	Ergocorninine
Ergocristine	Ergocristinine
Ergocryptine	Ergocryptinine

Chemical tests:

1. Ergot under UV light shows a red-coloured fluorescence.
2. Ergot powder is treated with p- dimethylaminobenzaldehyde. A deep blue colour is produced.

Uses:

- Ergometrine is oxytocic and used in delivery.
- Analgesic in treatment of migraine.
- Possesses psychomimetic action.
- Used in psychiatry, obstetrics.

VITAMINS

Vitamins are organic compounds that are essential for the normal functioning of the body. They are micronutrients that are required in small amounts for various metabolic processes in the body. Vitamins play a crucial role in maintaining good health, growth and development.

Cod liver oil and Halibut liver oil are the sources of vitamins A and D, shark liver oil and carrots, in the form of carotene are the richest source of vitamin A, while amla contains vitamin C and yeast contains vitamin B complex.

5.16.1.COD LIVER OIL

Synonyms: Oleum morrhi.

Biological source: It is obtained from the fresh liver of cod fish, ***Gadus morrhua*** and other species of ***Gadus.***

Family: Gadidae

Geographical source: It is prepared in Iceland, Germany, Denmark, Norway, Scotland and Britain.

Macroscopic characters:

Gadus morrhua

CHARACTERISTICS	DESCRIPTION
Colour	Pale yellow
Odour	Slightly fishy
Taste	Slightly fishy
Solubility	Readily soluble in ether and chloroform

Method of preparation:

- **Washed and Steamed:** The healthy livers free from gall bladders are washed, minced and steamed in steam-jacketed vessels or 'kars' at a temperature not exceeding 85°C for half an hour.
- **Cooling:** Cooled and buried in snow for several days. Special barrels are used for this cooling process, which leads to the separation of stearin.
- **Steaming of oil:** This steaming of oil destroys lipase enzyme.
- **Packing:** The medicinal oil after filtration is kept in well-closed air-tight containers in a cool place protected from light.

Chemical constituents:

- The oil contains **Vitamin A and Vitamin D.** (1 g of oil contain not less than 255 mcg of vitamin A & 2.1225 mcg of vitamin D)
- Cod liver oil also contains eicosapentaenoic acid and olecosohexanoic acid (Both of them are omega-3 fatty acids).
- The oil also contains glyceryl esters of oleic, linoleic, gadoleic, myristic, palmitic and other acids.

Uses:

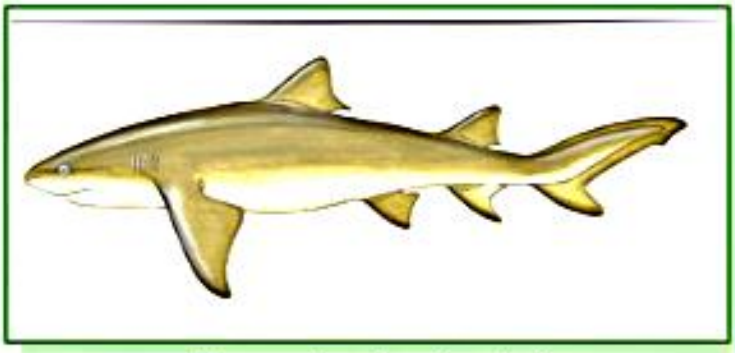
- The oil is used as a source of vitamins, as a nutritive.
- Used in the treatment of Rickets and TB.
- It is also used in veterinary preparation.

5.16.2. SHARK LIVER OIL

Synonyms: Oleum Selachoids.

Biological source: Shark liver oil is the fixed oil obtained from the fresh and carefully preserved livers of various species of shark, mainly ***Hypoprion brevirostris***.

Family: Carcharhinidae



Hypoprion brevirostris

Geographical source: In India, this oil is obtained on commercial scale in Maharashtra, Tamil Nadu and Kerala.

Characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Pale yellow to brownish yellow liquid.
Odour	Characteristic fishy but not rancid
Taste	Bland or fishy
Solubility	Soluble in ether light petroleum and chloroform and insoluble in water

Chemical constituents:

- Shark liver oil contains **vitamin A.**
- The concentration of vitamin A in the oil varies from 15000 - 30000 International Units/g.
- It also contains squalene and omega-3-fatty acids- (DHA & EPA).

Chemical test:

1. Mix shark liver oil with chloroform and treat with H_2SO_4. It acquires a light violet colour changing to purple and finally to brown.
2. Dissolve the shark liver oil in $CHCl_3$ and treat with saturated solution of antimony trichloride in chloroform then shake, a blue colour is obtained.

Uses:

- It is used in the deficiency of vitamin A.
- It is used to treat xeropthalmia.
- It is also used as a nutritive and tonic.
- It is used in burn and sunburn ointments.

UNIT-5

Biological source, chemical constituents and therapeutic efficacy of crude drug (PART IV)

Points to be covered in this topic

- ❑ **ENZYMES**
  - ❖ Papain, Diastase, Pancreatin, yeast
- ❑ **PHARMACEUTICAL AIDS**
  - ❖ Kaolin, Lanolin, Bees wax, Acacia , Tragacanth , Sodium alginate , Agar, Guar gum , Gelatin
- ❑ **MISCELLANEOUS**
  - ❖ Squill , Galls , Ashwagandha, Tulsi, guggul

ENZYMES

Enzymes are proteins produced by living organisms that act as biological catalysts.

They speed up chemical reactions in the body without being consumed or used up in the process. The enzymes show maximum activity between 35°-40°C.

Mechanism of enzyme activity

They work by binding to their substrate, forming an enzyme-substrate complex. The enzyme then facilitates the conversion of the substrate into a different molecule, called the product.

The substrate is typically a small molecule that fits into a specific active site on the enzyme, where the reaction takes place. Each enzyme has a specific substrate that it binds.

to and acts upon, which allows for the specificity of enzyme-catalyzed reactions in cells.

Enzymes lower the activation energy required for a reaction to occur, allowing it to happen more quickly and efficiently

The enzymes are classified into the following categories:

- Hydrolases: catalyze hydrolytic reactions.
- Transferases - transfer chemical groups from one molecule to another.
- Oxidoreductases - catalyse the oxidation-reduction reactions.
- Lyses - catalyse the addition of groups to double bonds or vice-versa.
- Isomerases - for intramolecular rearrangements.
- Synthetases - catalyse the condensation of two molecules.

5.17.1. PAPAIN

Carica papaya

Synonyms: Papayotin, vegetable pepsin.

Biological source: It is a mixture of proteolytic enzymes which is obtained from the latex of the unripe fruit of tree ***Carica papaya.***

Family: Caricaceae

Geographical source: The plant is cultivated in Hawaii, Sri Lanka, Tanzania, and India, Florida.

Method of Preparation:

- The latex of papain is collected in aluminium trays.
- To the collected latex, potassium metabisulphite is added.
- The extraneous matter is removed by passing through sieves and latex is dried (in a vacuum shelf drier at 55 – 60^{0}C).
- This dried latex is called papain.

Macroscopical characteristics:

CHARACTERISTIC	DESCRIPTION
Color	White or light brown
Odour	Characteristic
Taste	Characteristic
pH	5-6

constituents:

- The different proteolytic enzymes present in papain are a mixture of chymopapain and papain.

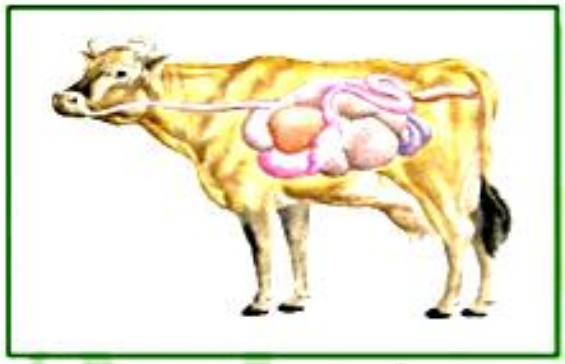
Identification test:

1. It decolourises aqueous potassium permanganate solutions.
2. It causes curdling of milk due to Proteolytic activity.

Uses:

- It is used as Anti-inflammatory agent.
- Papain is a popular ingredient in meat tenderizer.
- It is also used in the clarification of beverages.
- Used in cheese manufacture as a substitute of renin.

5.17.2. DIASTASE



Synonyms: Amylase

Biological source:

It is one of the amylolytic enzymes present in salivary diastase or ptyalin and **pancreatic diastase or amylopsin**, found in the **digestive tract of animals (animal diastase)**.

It is also formed during the germination of barley grains which is known as **Malt diastase**.

Geographical Source: It is widely cultivated throughout the world. The major producers are Russia, Canada, India, United States and Turkey. It is also cultivated in the highlands of China and Tibet.

Morphological characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Yellowish white
Odour	Characteristic and faint
pH & temperature	6 -7 Diastase is active between temperature 35^0C- 40^0C
Solubility	Forms a colloidal solution with water, it precipitates in alcohol.

Uses:

- They are used as digestants.
- It is also used in the production of predigested starchy foods.

5.17.3. PANCREATIN

Biological source: Pancreatin is a digestive enzyme extracted from the pancreas of certain animals like hog, ***Sus scrofa*** (Family - Suidae) or Ox, ***Bos taurus*** (Family - Bovidae).

Bos taurus

Characteristics:

CHARACTERISTIC	DESCRIPTION
Color	White
Odour	Faint and Characteristic
Solubility	Soluble in water and insoluble ether and alcohol

Chemical constituents:

- It contains amylase, lipase, and protease.

Therapeutic efficacy:

- It is used to treat pancreatic deficiency and fibrocystic deficiency of the pancreas.
- It is also used as a digestive aid. Used for preparing predigested food.

5.17.4. YEAST

Synonyms: Baker's yeasts, Brewer's yeast

Biological source: It is obtained from the unicellular fungal microorganism ***Saccharomyces cerevisiae***.

Family: Saccharomycetaceae

Characteristics:

Saccharomyces cerevisiae

CHARACTERISTIC	DESCRIPTION
Color	Whitish powder
Odour	Characteristic
Taste	Slightly bitter

Chemical constituents:

- In yeast glycogen, fat, vitamins, nitrogenous compounds (proteins) and ash are present. Vitamins present are from the Vit B group (thiamine, folic acid, biotin, riboflavin, nicotinic acid, pantothenic acid etc).
- The enzymes diastase, Zymase, invertase and maltase are also present.

Therapeutic efficacy:

- It is used as a source of vitamin D.
- It is used as a source of protein.
- It is used in the manufacturing of wine and beer.

PHARMACEUTICAL AIDS

Pharmaceutical aids are those substances that do not have any direct pharmacological or physiological action on the body and have little or no therapeutic value but are used in the manufacturing or compounding of various pharmaceutical products.

These substances may serve various purposes such as improving the stability, solubility, or appearance of the medication, as well as aiding in the manufacturing process itself.

Examples of pharmaceutical aids include binders, disintegrants, lubricants, fillers, preservatives, and colouring agents.

5.18.1. KAOLIN

Synonyms: China clay, Porcelain clay

Biological source: Kaolin is a purified, native aluminium silicate freed from most of its impurities by elutriation and drying. The native clay is derived from the decomposition of the **feldspar (potassium aluminosilicate)** or **granite rock** and contains silica (47%), alumina (40%) and water (13%).

Geographical Source: It is mainly found in South Eastern United States, France, England and India.

Characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	White
Odour	Odourless
Taste	Tasteless
Size	10μ - 60μ
Solubility	Insoluble in mineral acid and water

Chemical constituents:

- Chemically kaolin is anhydrous aluminium silicate.
- Silicon dioxide, iron oxide, titanium dioxide, aluminium oxide, calcium oxide, magnesium oxide, sodium oxide, potassium oxide, and water.

Uses:

- Adsorbent, in treatment of diarrhoea, dysentery and in food poisoning,
- Used as a dusting powder and clarifying agent.
- It is also used in cosmetics, insecticides etc.

5.18.2. LANOLIN

Synonyms: Hydrous wool fat.

Biological source:

Hydrous wool fat is obtained from the **wool** of the **sheep *Ovis aries* Linn.**

Family: Bovidae

Geographical Source: It is manufactured in Australia, USA. and India.

Ovis aries

Method of Preparation:

- Raw wool contains wool fibres (31%), suint or wool sweat which is chemically potassium salts of fatty acids) and other earthy matter (32 %) and wool grease (about 25 %) or crude lanolin.
- **Washing:** Crude lanolin is separated by washing with H_2SO_4 or organic solvent or soap solution.
- **Bleaching:** It is further purified and bleached. The product is known as anhydrous lanolin or wool fat.
- **Hydration:** The hydrous wool fat is then produced by mixing wool fat with 30 % of water.

Characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Whitish yellow
Odour	Characteristic and faint
Taste	Bland
Solubility	Soluble in solvent ether and chloroform Insoluble in water

Chemical constituents:

- It contains high molecular weight alcohol and fatty acids.
- It chiefly contains esters of cholesterol and isocholesterol with myristic, palmitic, lignoceric, carnaubic, oleic and lanopalmitic acids.

Chemical test:

- Dissolve lanolin in chloroform and add 1 ml of acetic anhydride and two drops of sulphuric acid. A deep green colour is produced, indicating the presence of cholesterol.

Uses:

- It is commonly used as a base in water absorbable ointment.
- It is also used as an emollient and in cosmetic preparations.

5.18.3. BEES WAX

Synonyms: Yellow bees wax

Biological source: Yellow bees wax is obtained by melting the walls of the **honey comb** of the **bees *Apis mellifica***.

Family: Apidae

Geographical Source: It is processed and commercially prepared in West Africa, Jamaica, France, Italy and India.

Characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Yellow to yellowish-brown
Odour	Agreeable and honey like
Solubility	Soluble in chloroform, ether and insoluble in water

Chemical constituents:

- It contains esters of straight-chain monohydric alcohols with straight chain acids.
- The chief constituent of the bees wax is **myricin** (myricyl palmitate).
- Also contain Free cerotic acid, melissic acid and cerolein (aromatic substance), lactones.

Chemical test:

- **Saponification claud test:** Boil bees wax with aq. caustic soda solution for 10 minutes, then cool it. No turbidity will appear.

Uses:

- Beeswax is used in the preparation of ointments (for hardening purposes), plasters and polishes.
- It is used in the manufacture of candles, moulds and in dental and electronic industries.
- It is also used in cosmetics for the preparation of lipstick and face creams.

5.18.4. ACACIA

Synonyms: Indian gum, Gum acacia, Gum arabic.

Biological source:

Indian gum is the dried gummy exudation obtained from the **stem** and **branches** of wild ***Acacia arabica***.

Gum acacia

Family: Leguminosae

Geographical Source: The plant is found in India, Sudan, Morocco, Sri Lanka and Africa. In India, it occurs in Punjab, Rajasthan and Western Ghats.

Morphological characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Tears are cream-brown to red in colour and powder is light brown in colour
Odour	Odourless
Taste	Mucilaginous
Shape and Size	Irregular brown tears of varying size

Chemical constituents:

- It consists mainly of **arabin** (a complex mixture of magnesium, calcium, and potassium salts of Arabic acid).
- Arabic acid on hydrolysis yields L-rhamnose, L-arabinose, D-galactose and D-glucuronic acid.
- It also contains an enzyme oxidase and peroxidase.

Chemical test:

Resin + solution of lead sub acetate - Gelatinized the aqueous solution

Resin + ruthenium red - Do not produce pink colour

Uses:

- Acacia is used as demulcent.
- It is also used in haemolysis.
- It is a good emulsifying agent.
- It is used as a suspending agent.
- It is a good binding agent and is used in the preparation of lozenges, pastilles and compressed tablets.

5.18.5. TRAGACANTH

Synonyms: Gum Tragacanth

Biological source:

It is the dried gummy exudation obtained by incision from stems and branches of ***Astragalus gummifer*** **Labill** and other species of ***Astragalus***.

Tragacanth

Family: Leguminosae

Geographical Source: It is indigenous to Iran, Greece, Turkey, Iraq and Syria. In India, tragacanth is found in Garhwal, Kumaon and Central Punjab.

Macroscopical characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	White or pale yellowish white
Odour	Odourless
Taste	Mucilaginous
Shape and size	Thine, curved, flattened, ribbon shaped flakes
Solubility	Partly soluble in water, insoluble in alcohol

Chemical constituents:

- Tragacanth contains water-soluble and water-insoluble portions. The water-soluble fraction is known as tragacanthin and the Water-insoluble fraction is known as bassorin.
- Tragacanth contains a methoxy group which swells in water.

- Tragacanth on hydrolysis yields galactouronic acid, L-arabino-rhamnose, D-galactopyranose and D-xylopyranose.

Uses:

- It is used as a demulcent and as an emollient in cosmetics.
- Tragacanth is used as a suspending, thickening and emulsifying agent.
- Tragacanth powder is used as an adhesive.
- It is also used as a stabilizer for ice cream and also in sauces.
- Mucilage of tragacanth h is used as a binding agent in the tablets.

5.8.6 SODIUM ALGINATE

Synonyms: Algin, Sodium polymannuronate

Biological source: It is obtained from the algal growth of the species of ***Macrocystis pyrifera***, ***Laminaria hyperborea***, ***Laminaria digitata*** and ***Ascohyllum nodosum.***

Sodium Alginate Powder

Family: Phaeophyceae

Geographical Source: It is found in Atlantic and Pacific oceans, particularly in coastal lines of Japan, the USA, Canada, India, Australia, and Scotland.

Morphological characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	White or buff colour
Odour	Odourless
Taste	Tasteless

Chemical constituents:

- It is a **Carbohydrate-sodium salt of alginic acid.** Alginic acid is a long chain polyuronide composed of 1-4 linkage residues of D-mannuronic acid and L-glucuronic acids.

Chemical tests:

- When aqueous solution of algin treated with calcium chloride solution obtained copious precipitate.
- When 1% solution of algin in water treated with dilute H_2SO_4 forms a heavy gelatinous precipitate.

Uses:

- It is used in the preparation of paste, creams and suspending, thickening, stabilizing, binding and disintegrating agents.
- In food industry, it is used for the preparation of jellies, ice cream, etc.

5.18.7. AGAR

Synonyms: Agar-agar, Vegetable gelatin, Japanese-Isinglass.

Biological source:

Agar is the dried **gelatinous** substance obtained from ***Gelidium amansii*** and other species of red algae.

Family: Gelidaceae

Agar

Geographical Source: Agar is produced commercially in New Zealand, USA, Japan, Australia and India.

Morphological characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Yellowish grey or white to nearly colourless
Odour	Odourless
Taste	Mucilaginous
Shape	It is found in various forms like sheets, strips, flakes or coarse powder.

Chemical constituents:

- Agar consists of two different polysaccharides named agarose (responsible for gel strength) and agaropectin (responsible for viscosity).
- Agarose is composed of D-galactose and L-galactose units. It contains cellulose and nitrogen substances.
- Agaropectin is sulphonated polysaccharide in which galactose and uronic acid units are partly esterified with sulphuric acid.

Chemical tests:

1. When 0.2% solution of agar in water reacts with tannic acid, no precipitate is produced.
2. When treated with **ruthenium red**, acquires **pink** colour.

Uses:

- Agar is used as an emulsifying agent.
- It is also used in the treatment of constipation and preparation of jellies, confectionery items and in microbiology.
- It is also used in the preparation of bacteriological culture medium.

5.18.8. GUAR GUM

Synonyms: Jaguar gum, Guar flour

Biological source:

Guar gum is the powder of the endosperm of the **seeds** of ***Cyamopsis tetragonolobus*** **Linn.**

Family: Leguminosae

Geographical Source: It has been grown for centuries in India, Pakistan and USA. In India, it is cultivated in Maharashtra, Gujrat, Karnataka and Rajasthan. **Morphological characteristics:**

CHARACTERISTIC	DESCRIPTION
Colour	Pale yellowish white to nearly colourless
Odour	Characteristic
Taste	Gummy

Chemical constituents:

- It consists of water-soluble and water-insoluble parts. The water-soluble fraction is called guaran (high molecular weight hydro-colloidal polysaccharide).
- Guaran on hydrolysis gives galactose and mannose.

Chemical tests:

1. It does not acquire an olive green colour with a weak solution of iodine.
2. If a 2% solution of lead acetate is treated with the solution of guar gum it gives precipitate.
3. With the solution of ruthenium red, the gummy solution does not acquire pink colour (distinction from agar and Sterculia gum).

Uses:

- It is used as a stabilizer, protective colloid, thickening agent, binding agent, disintegrating agent, emulsifying agent and film-forming agent.

5.18.9. GELATINE

Synonyms: Gel foam, Gelatina, Puragel.

Biological source:

Gelatin is a protein extracted by partial hydrolysis **of animal collagenous tissue** like skins, tendons, ligaments and bones within boiling water.

Morphological characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Fainty yellow to amber
Odour	Characteristic
Taste	Slight

Method of preparation:

- **Defatted and Decalcified:** For the manufacture of gelatin, the bones are to be defatted and decalcified with organic solvent and mineral acid respectively.
- **Treatment with water:** The material obtained by this treatment is treated with water at 85°C, by which collagen dissolves into gelatin.
- **Bleached and Concentrated:** It is further bleached and concentrated under reduced pressure to specific gelatin content (allow to set).
- Such moulded gelatin is dried.

Chemical constituents:

- Gelatin mainly consists of protein **gluten.** It is also containing nitrogenous substances.
- It contains amino acids lysine.

Chemical tests:

1. When it is treated with trinitrophenol and a solution of tannic acid it precipitates, but when treated with alum, lead acetate or acids it does not precipitate which indicates that it does not contain chondrin.

2. When it is treated with mercuric nitrate, it gives a white precipitate and on warming turns to a brick red colour.

Uses:

- Gelatin is mainly used in the manufacture of hard and flexible capsule shells.
- It is also used for the treatment of brittle fingernails.

- It is also used for preparing pastes, pessaries, pastes and suppositories.
- Gelatin is employed for microencapsulation of drugs.
- Gelatin is also used in the preparation of bacteriological culture media.

MISCELLANEOUS

5.19.1 SQUILL

a) European squill

Urginea maritima

Synonyms: Scilla, White squill, Squill bulb.

Biological source: Squill obtained from the sliced and **dried** scaly **leaves** from the bulbs of ***Urginea maritima*** **(Linn.) Baker.**

Family: Liliaceae

Geographical Source: It is indigenous to the countries near the Mediterranean region like France, Spain and Greece.

Morphological characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Yellowish white
Odour	Slight
Taste	Bitter and acrid

Chemical constituents:

(a) Squill contains the cardiac glycosides of the **bufadienolide** type. The most important alkaloid found is **scillaren A** and scillaren B is also present.

(b) The hydrolysis of scillaren A exhibits that it is biglycoside (containing 2 sugars; glucose and rhamnose).

(c) The drug also contains other cardiac glycosides in small amounts like

Glucoscillaren A: Scillarenin A+ rhamnose + glucose

Proscillaridin A: Scillarenin A+ rhamnose

Uses:

- It is used as a cardiotonic.
- It is also used in chronic bronchitis as an expectorant (small doses) while causing vomiting (higher doses).

b) Indian squill

Urginea indica

Synonyms: Jangli pyaz, Sea onion.

Biological source: Urginea obtained from dried slices of the bulbs of ***Urginea indica*** Kunth.

Family: Liliaceae

Geographical Source: It is found in India and also grown in Italy, Spain, Greece, France and Algeria.

Macroscopic Characters:

CHARACTERISTIC	DESCRIPTION
Colour	Slightly yellowish to white
Odour	Slight and characteristic
Taste	Bitter, mucilaginous and acrid
Shape	The slices of the Indian squill - are united in groups of 4 to 8, which are curved

Chemical Constituents:

- Indian squill contains about 0.3 % of cardiac glycosides.
- Scillaren A and scillaren B are the main glycosides found in the drug.
- Scillaren A on hydrolysis by the enzyme scillarenase gives proscillaridin A.

Uses:

- It is cardiotonic, stimulant and also an expectorant.
- It is a diuretic in small doses.
- In large doses, it is emetic and cathartic.

5.19.2 GALLS

Synonyms: Tannic acid.

Biological source: Galls are pathological out growth formed on young twigs of ***Quircus infectoria*** (Oak tree).

Oak tree

Family: Fagaceae

Geographical Source: Galls are obtained mainly from Greece, Turkey, Syria and Iran.

Morphological characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Olive green or bluish green
Odour	Odourless
Taste	Astringent followed by sweet
Size	Galls are 10-30 mm
Shape	Sub spherical

Chemical constituents:

- Galls contain tannic acid (50-70%).
- Galls contain tannins known as gallotannic acid.
- It also contained gallic acid, ellagic acid, sitosterol, calcium oxalate, starch, and sugar.

Uses:

- It is useful for sore throats and receding gums because it is an astringent for mouth and throat mucous membranes.
- It works well to cure piles when administered as a suppository.
- Alkaloids, heavy metals, and certain glycoside poisoning can all be treated with tannic acid as an antidote.

5.19.3 ASHWAGANDHA

Withania somnifera

Synonyms: Withania root, Winter cherry.

Biological source: Ashwagandha is obtained from dri roots and stem bases of ***Withania somnifera*** **(Linn).**

Family: Solanaceae

Geographical Source: It is also found in India, Congo, Egypt, Morocco, Jordan, South Africa, Pakistan and Afghanistan. In India, it occurs in Madhya Pradesh, Uttar Pradesh, Gujarat and Rajasthan.

Macroscopical characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Buff to grey yellow
Odour	Similar to urine of horse
Taste	Bitter
Size	Length and thickness of roots varies according to the age
Shape	Root is straight, unbranched, conical

Microscopic character:

- **Cork:** The transverse section of the root shows exfoliated cork (non-lignified) with 2-4 layers of **phellogen** and about 15-20 rows of **phelloderm.**

- **Vascular tissue:** It prominently shows parts of vascular tissue like cambium, (3-5 layers of tangentially elongated cells), phloem region with parenchyma, sieve tubes and companion cells.
- **Secondary xylem:** The secondary xylem is hard which forms a continuous vascular ring interrupted by medullary rays.
- **Pith:** The transverse section of the stem base shows a pith.
- **Pericyclic fibres:** Pericyclic fibres xylem with tracheids, fibres, and starch grains.

Chemical constituents:

- The main constituents of ashwagandha are alkaloids and steroidal lactones.
- **Withanine** is the main constituent.
- Two acyl steryl glucosides viz Sitoindoside VII and sitoindoside VIII have been isolated from roots.
- The leaves contain steroidal lactones, which are commonly called "withanolides".

Uses:

- Ashwagandha has sedative and hypnotic effects.
- It acts as a mood stabilizer to revive the mind and body.
- It has hypotensive, respiratory, stimulant actions along with bradycardia.
- It is an immuno-modulatory agent.
- It possesses anti-stress activity.
- This drug prevents degenerative changes in arthritic conditions.
- It is also used in the treatment of rheumatism, gout, hypertension, and skin diseases nervine and is widely used as a sex stimulant and rejuvenator.

5.19.4 TULSI

Synonyms: Holy basil, Sacred basil

Biological source: Tulsi consists of fresh and dried leaves of ***Ocimum sanctum*** **Linn.**

Family: Lamiaceae

Geographical Source: This plant is found throughout India.


Tulsi

Macroscopic characteristics:

CHARACTERISTIC	DESCRIPTION
Colour	Green
Odour	Aromatic
Taste	Slightly Pungent
Shape	Leaves are oblong, acute apex, entire or serrate margin and pubescent on both side

Chemical constituents:

- Tulsi leaves contain volatile oil (0.1-0.9 %).
- It contains approximately eugenol (70%), carvacrol (3%) and eugenol-methyl-ether (20 %).
- It also contains caryophyllin.

Uses:

- Tulsi has expectorant and anti-inflammatory properties and good immuno-modulatory agent.
- It possesses antibacterial and insecticidal activity.
- It also has stimulant, aromatic, stomachic, spasmolytic, and diaphoretic, antiperiodic skin diseases and cures earache activity.

5.19.5 GUGGUL

Synonyms: Gum guggul, Commiphora.

Biological source: Guggul is the oleo-gum-resin obtained by making deep incisions at the basal part of the stem bark of ***Commiphora weightii***.


Guggul

Family: Burseraceae

Geographical Source:

Guggul plant is native to Africa, especially in its arid zones like Kenya, Ethiopia, Somalia and Zimbabwe and also found in India mainly in Rajasthan.

Chemical constituents:

- The gum-resin portion of guggul contains steroids, diterpenoids, carbohydrates and aliphatic esters.
- Resin does not contain free cinnamic acid, benzoic acid or their esters.
- Steam distillation of guggul gives volatile oil (containing terpenes like myrcene and caryophylline).
- Guggul contains Z- guggulosterone, E- guggulosterone and three new sterols like guggulosterol I, II and III.

Uses;

- It is used as aromatic, nervine tonic, anti-inflammatory, antiseptic, digestive, anti-rheumatic, hypolipidemic and hypo-cholesteremic drug.