UNIT-II

Drug of Class

General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites

Alkaloids, Phenylpropanoids and Flavonoids, Steroids, Cardiac Glycosides & Triterpenoids, Volatile oils, Tannins, Resins, Glycosides, Iridoids, Other terpenoids & Naphthaquinones

Dr. Pravin V. Gomase

Associate Professor

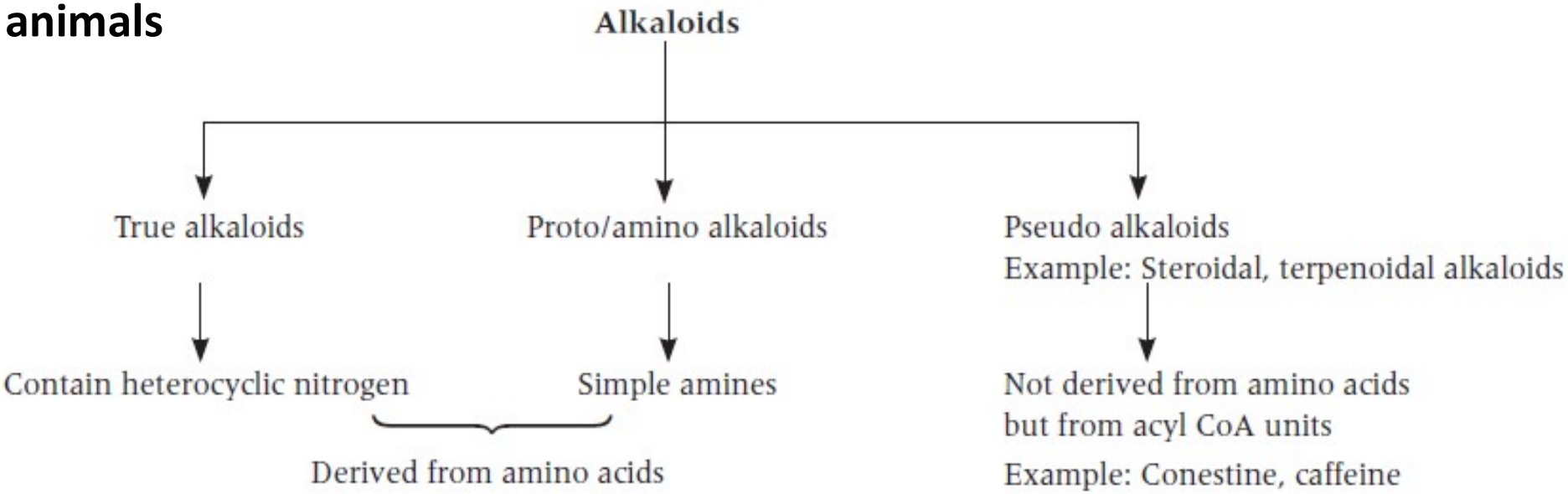
Jijamata College of Pharmacy, Nandurbar

Alkaloids

Definition: **The term "alkaloid" (alkali-like) is commonly used to designate basic heterocyclic nitrogenous compounds of plant origin that are physiologically active and shows pharmacological action in small dose.**

Derived from amino acids. **OR**

These are the organic products of natural or synthetic origin which are basic in nature and contaning one or more nirogen atom normaly of heterocyclic nature and posses pharmacological action in small dose on human and animals



DEVIATION FROM DEFINITION:

- ***Basicity***: Some alkaloids are not basic e.g. Colchicine, Piperine, Quaternary alkaloids.
- ***Nitrogen***: The nitrogen in some alkaloids is not in a heterocyclic ring e.g. Ephedrine, Colchicine, Mescaline.
- ***Plant Origin***: Some alkaloids are derived from Bacteria, Fungi, Insects, Frogs, Animals**.**
- ***Biosynthesis*:** Some alkaloids are not derived from amino acids e.g purine, steroidal alkaloid **.**

QUALITATIVE CHEMICAL TESTS FOR ALKALOIDS

General tests answered by all alkaloids are as follows:

1. ***Dragendorff's test:*** *To 2–3 mL of the alkaloid solution add few drops of Dragendorff's reagent* (potassium bismuth iodide solution). An orange brown precipitate is formed.

2. ***Mayer's test:*** *To 2–3 mL of the alkaloid solution add few drops of Mayer's reagent (potassium* mercuric iodide solution). White brown precipitate is formed.

3. ***Hager's test:*** *To 2–3 mL of the alkaloid solution add few drops of Hager's reagent (saturated* solution of picric acid). Yellow precipitate is formed.

4. ***Wagner's test:*** *To 2–3 mL of the alkaloid solution add few drops of Wagner's reagent (iodine–* potassium iodide solution). Reddish brown precipitate is formed.

Physical Properties:

I- State:

- **Most** alkaloids are crystalline **solids**.
- Few alkaloids are amorphous solids e.g. emetine.
- **Some** are **liquids** that are either:

  Volatile e.g. nicotine and coniine, or

  Non-volatile e.g. pilocarpine and hyoscine.

II- Color:

The **majority** of alkaloids are **colorless** but **some** are **colored** e.g.:

- Colchicine and berberine are yellow.
- betanidine is orange.

III- Solubility:

- Both **alkaloidal bases** and their **salts** are **soluble in alcohol**.
- Generally, the **bases** are **soluble in organic solvents** and **insoluble in water**

  Exceptions:

  – Bases **soluble in water**: caffeine, ephedrine, codeine, colchicine, pilocarpine and quaternary ammonium bases.

  – Bases **insoluble or sparingly soluble in certain organic solvents**: morphine in ether, theobromine and theophylline in benzene.

- **Salts** are usually **soluble in water** and, **insoluble or sparingly soluble in organic solvents.**

  Exceptions:

  – Salts **insoluble in water**: quinine monosulphate.

  – Salts **soluble in organic solvents**: lobeline and apoatropine hydrochlorides are soluble in chloroform

IV- Isomerization:

- Optically active isomers may show different physiological activities.

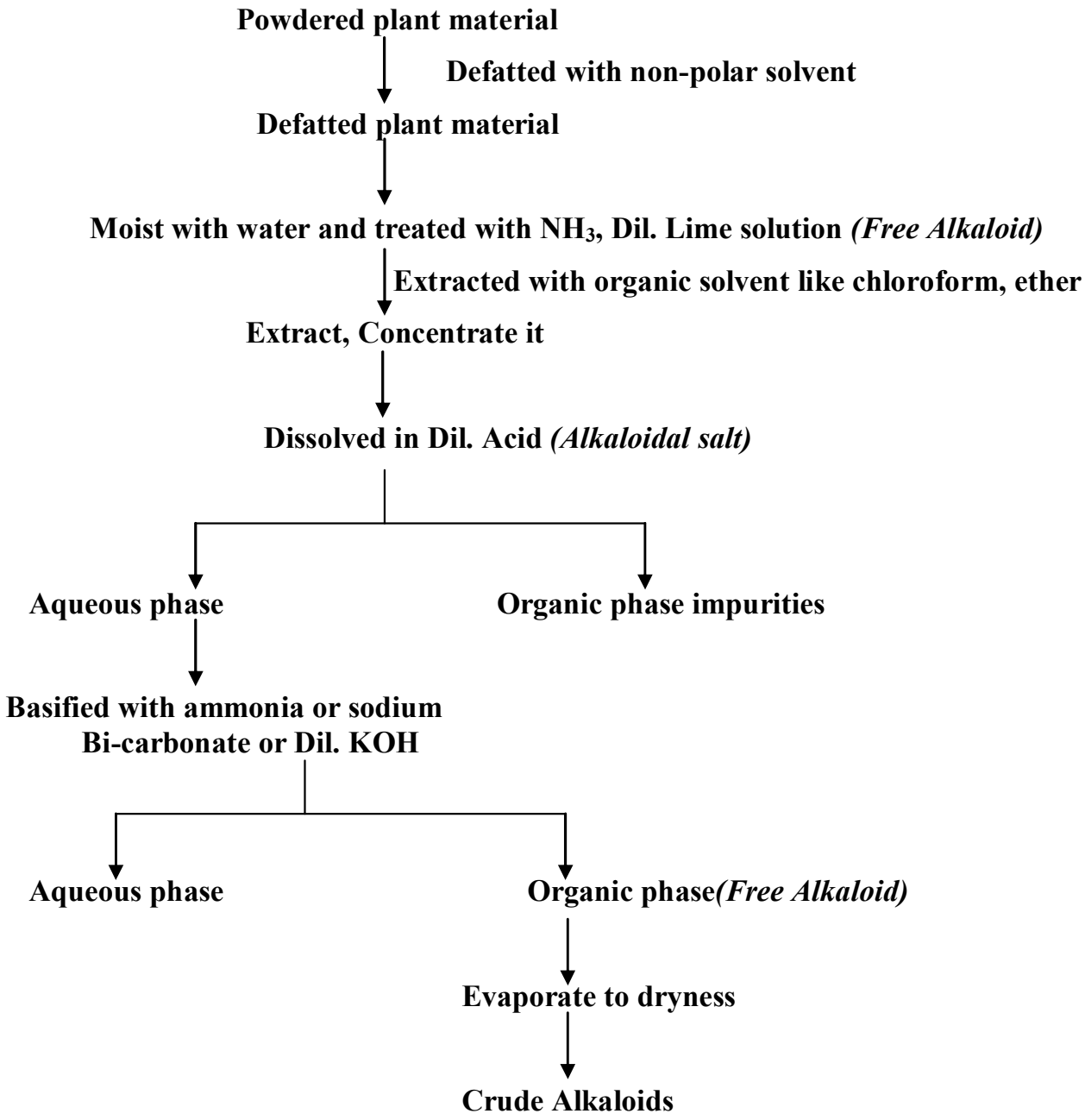
  l-ephedrine is 3.5 times more active than *d*-ephedrine.

  l-ergotamine is 3-4 times more active than *d*-ergotamine.

  d- Tubocurarine is more active than the corresponding *l*- form.
- Quinine (*l*-form) is antimalarial and its *d*- isomer quinidine is antiarrythmic.
- The **racemic (**optically inactive) *dl*-atropine is physiologically active.

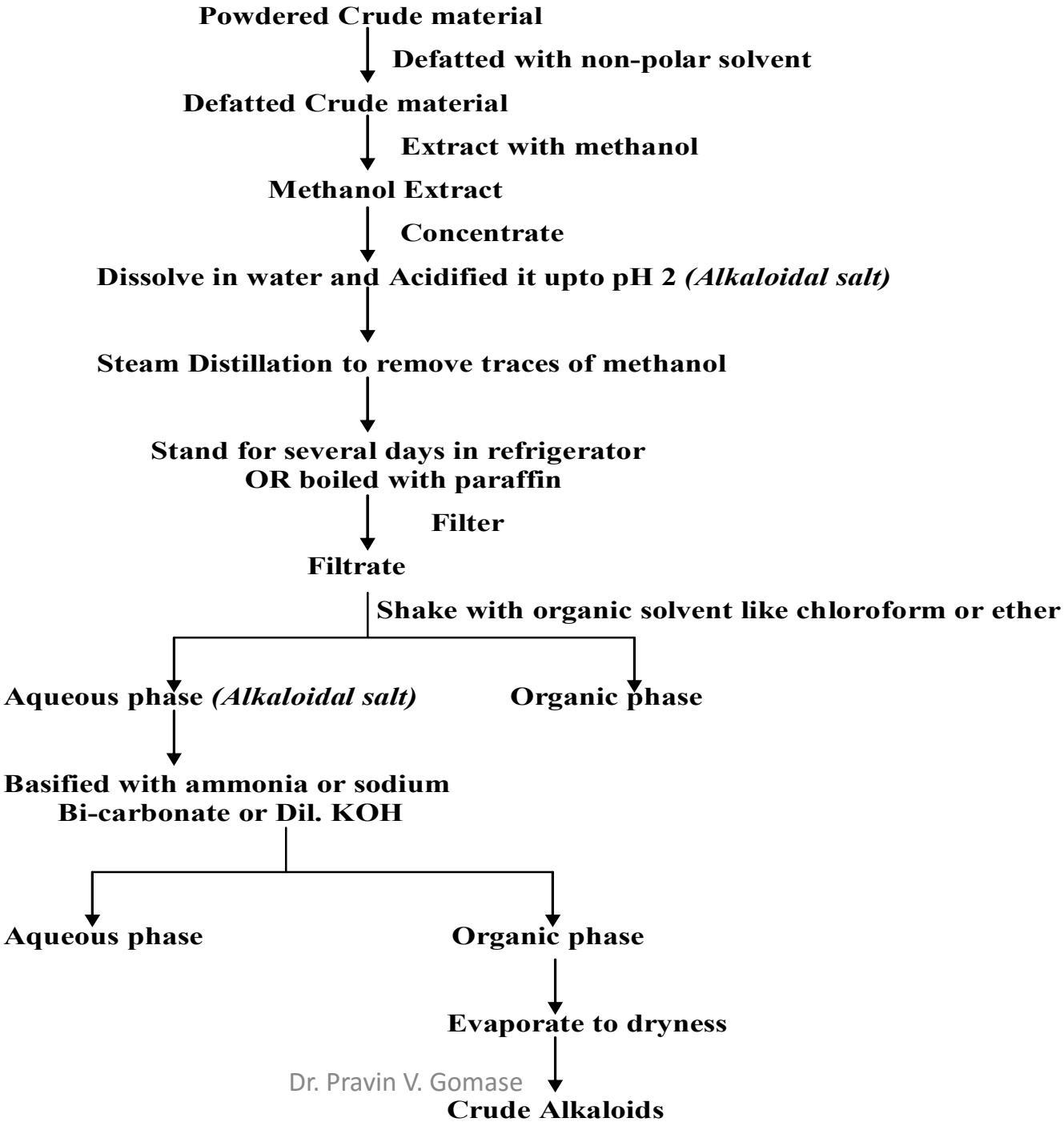
Extraction of alkaloids

1. Stass otto method



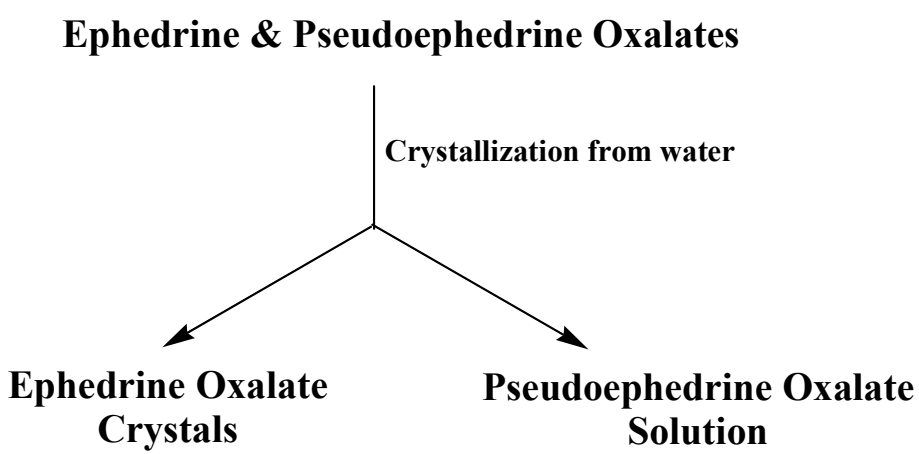
Extraction of alkaloids

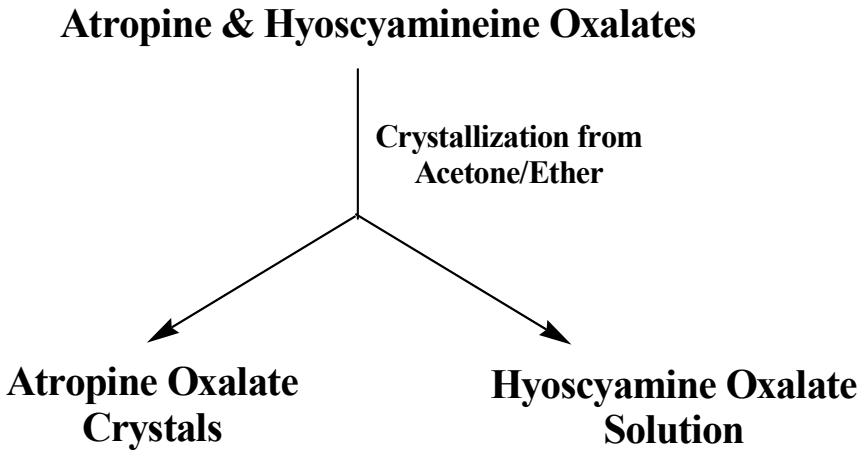
2. Manske's method



Purification of Alkaloids

1. Direct crystallization from solvent
2. Repeated acid base treatment
3. Fractional crystallization

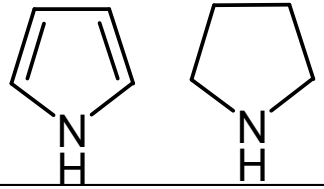
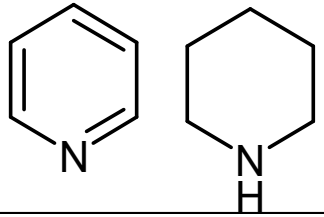
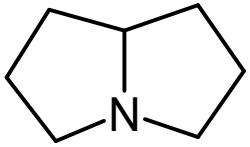
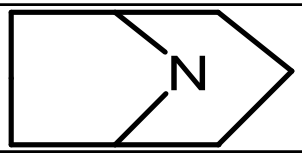
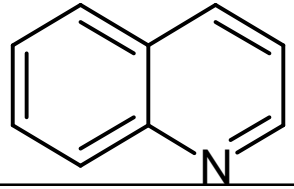
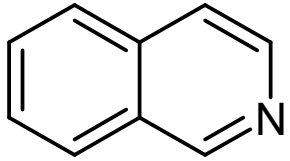


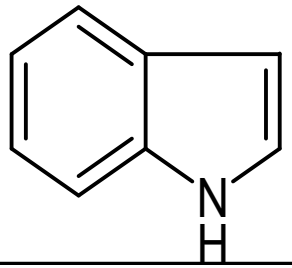
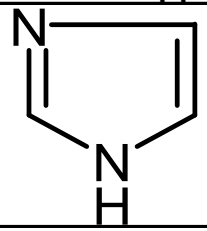
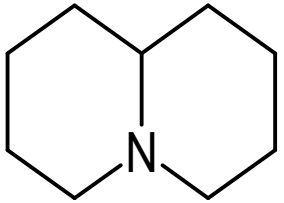
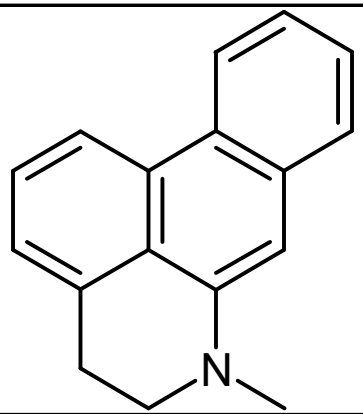


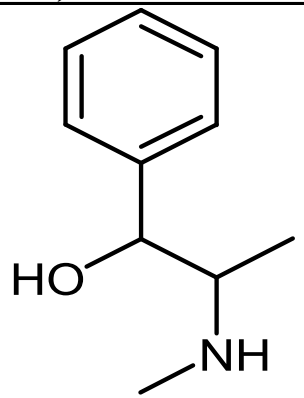
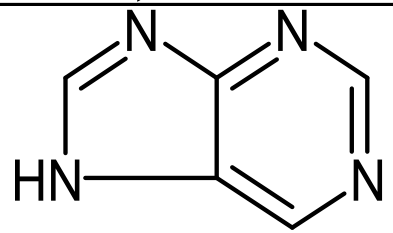
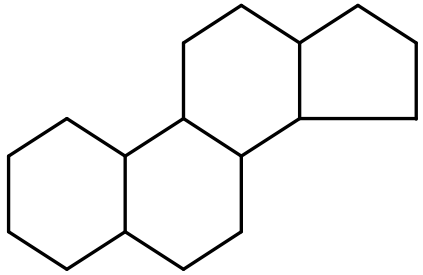
4. Chromatographic techniques
5. Gradient pH technique

Classification of alkaloids

Chemical classification

A) True alkaloids			
Sr. no.	**Type**	**Structure**	**Examples**
1.	Pyrrole and pyrrolidine		e.g. Hygrine, coca species
2.	Pyiridine and piperidine		e.g. Arecoline, anabasine, lobeline, conine, trigonelline
3.	Pyrrolizdine		e.g. Echimidine, senecionine, seneciphylline
4.	Tropane		e.g. Atropine, hyoscine, hyoscyamine, cocaine, pseudopelletirine
5.	Quinoline		e.g. Quinine, quinidine, cinchonine, cupreine, camptothecine
6.	Isoquinoline		e.g.Morphine, codeine, emetine, cephaline, narcotine, narceine, d-tubocurarine

7	Indole		e.g. Erotamine, ergotametriene, reserpine, vincristine, vinblastine, strychnine, brucine
8	Imidazole		e.g. Pilocrpine, isopilocarpine, pilosine
9	Norlupinane		e.g. Cystisine, laburinine
10	Piporphine (reduced isoquinoline napthalene)		e.g. Boldine

		B) PROTOALKALOID	
1.	Alkyalamine		Ephedrine, Pseudoephedrine
		C) Pseudoalkaloid	
1.	Purine		e.g. Caffeine, thophylline, theobromine
2.	Steroidal		e.g. Solanidine, conessine, protoveratrine
3.	Diterpene	$C_{20}H_{32}$	e.g. Aconitine, aconine, hypoaconine

Alkaloids: Vinca, Rauwolfia, Belladonna, Opium,

Phenylpropanoids and Flavonoids: Lignans, Tea, Ruta

Steroids, Cardiac Glycosides & Triterpenoids: Liquorice, Dioscorea, Digitalis

Volatile oils: Mentha, Clove, Cinnamon, Fennel, Coriander,

Tannins: Catechu, Pterocarpus

Resins: Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony

Glycosides: Senna, Aloes, Bitter Almond

Iridoids, Other terpenoids & Naphthaquinones: Gentian, Artemisia, taxus, carotenoids

Alkaloid

Catharanthus (Vinca)

- **Synonyms-** *Vinca rosea, Catharanthus, periwinkle.*
- **Biological Source-** Vinca is the dried entire plant of *Catharanthus roseus Linn., belonging to family Apocynaceae.*

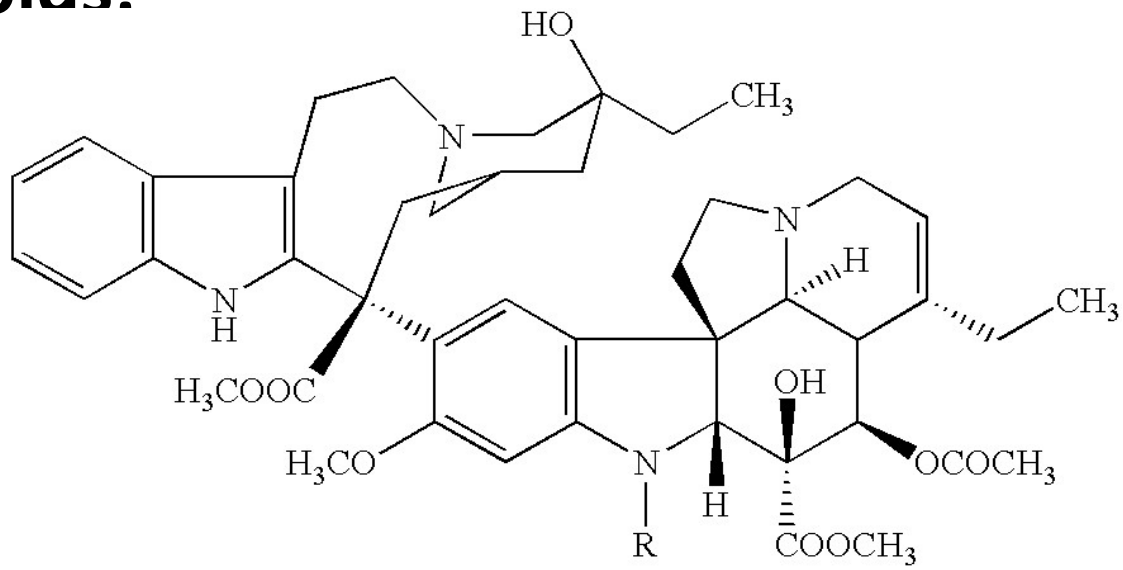
Macroscopical characters:

- **Type** – Annular or perennial herb;
- **Size** – 0.5 to 1 meter length;
- **Leaves** – Ovate, oblong, glossy above glaucous below;
- **Flowers** – 2 to 3 in cymes, axillary and terminal clusters. Bases on flower colour, three varieties are known namely – alba-white, ocillata-white with pink or carmine red eyes and roseus -with rose coloured flowers.
- **Fruit**- a follicle, cylindrical and many seeded.
- **Taste** – Bitter;
- **Odour** – slight

Chemical constituents:

Indole and indoline alkaloids:

- Ajmalicine
- Lochnerine
- Serpentine and



Vinblastine: R = CH_3
Vincristine: R = CHO

Tetrahydroalstonine:

- Dimeric Indole bases of monoterpene type
- Vinblastin
- Vincristin.

Uses

- **Vinblastin** is an antitumour alkaloid used in the treatment of Hodgkin's disease.
- **Vincristine** is a cytotoxic compound and used to treat leukaemia in children.
- Vinca is used in herbal practice for its astringent and tonic properties in menorrhagia and in haemorrhages.
- The flowers of the Periwinkle are gently purgative, but lose their effect on drying.

Rauwolfia

- **Synonyms-** sarpagandha, Chinanmdpodi
- **Biological source:** Rauwolfia consists of the dried roots and rhizomes of ***Rauwolfia serpentina*** *Benth. It contains not less than 0.15% of reserpine belong to Family Apocynaceae.*

Cultivation:

- Its grows spontaneous in tropical forests (temp,10°C to 40°C) which are humid in summer at an altitude up to about 1200 metres.
- Rauwolfia plants cannot tolerate temperature below 50C.
- For cultivation rain must be enough and abundant in summer or it should have good irrigation.
- Propagation is carried out by planting seeds, root-culture or stem-cutting. Seed propagation gives better yield of root inspite of the fact some seeds are weak in germination.

- Therefore cultivation of rauwolfia is usually carried out by seed propagation. Immersing them in saline eliminates sterile seeds.
- Rauwolfia grows well in clays, acidic (pH-4 to 6) and well-manure soil. Ploughing must be deep for facilitating the development of the roots.
- Sterile seeds are light, float and are separated. Fertile seeds sink and are utilized. Fresh seeds germinate more and preferably fresh seeds are used. In vegetative propagation especially in root-cuttings, development of roots is better if growth hormones are used.

Collection:

- They are collected in October-November after hot and dry period.
- In Indian Pharmacopoeia collection of roots of 3 to 4 years old plants is mentioned but in culture it is found that roots of 2 years old plants are equally good.
- For collection of roots plants are dug out, aerial parts are removed and roots are separated.
- Roots are washed and dried in air till moisture is about 10 to 12%. Roots should be stored protected from light.

Macroscopic Characters (Figs. 13.9 and 13.10)

Colour - Root bark is greyish yellow to brown and wood, pale yellow.

Odour - Odourless

Taste - Bitter

Size - About 10 to 18 cm long and from 1 to 3 cm in diameter.

Shape - Roots are sub-cylindrical, slightly tapering, tortuous.

Microscopical characters (T.S.):

- T. S. of the root presents a circular outline with typical stratified cork and other secondary features. Following are the tissues seen from the periphery to the center.

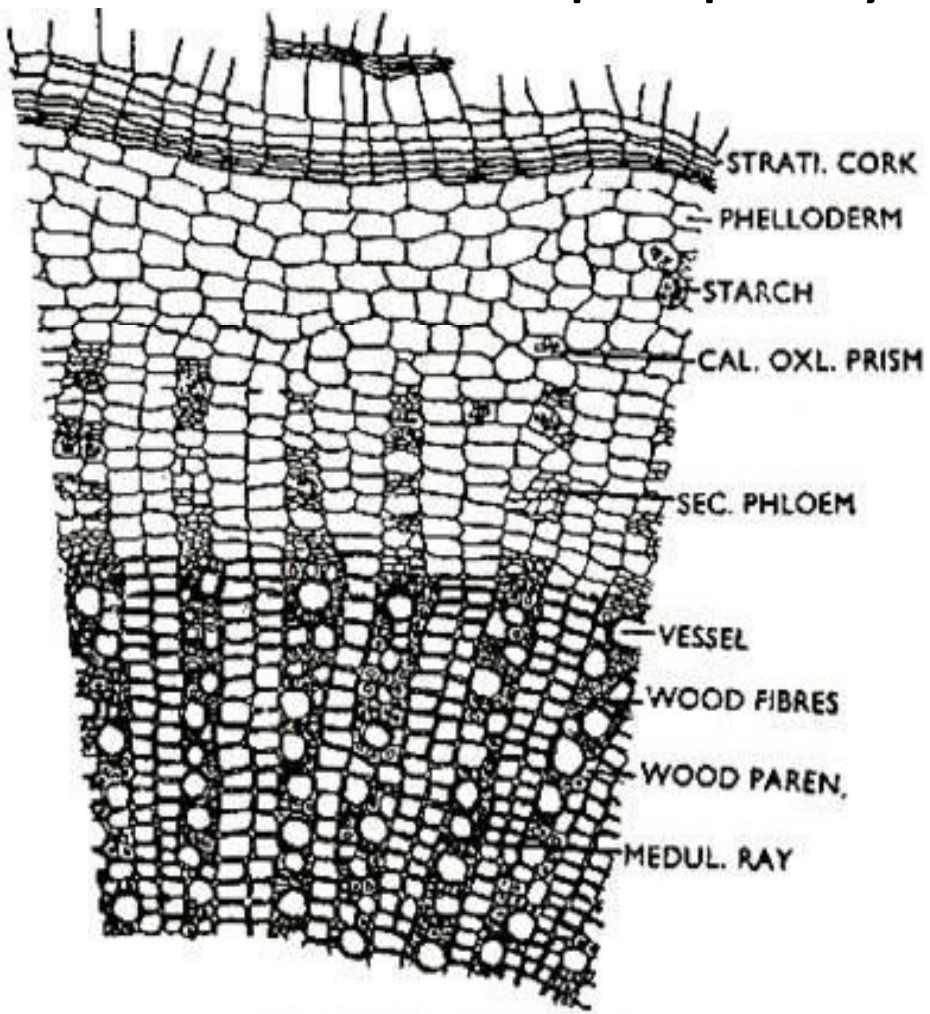


Fig. 12: T. S. of Rauwolfia root

Periderm:

a. **Cork (Phellum):** Stratified, consists of alternating bands- of smaller, suberized and un-lignified cell up to 8 to 10 raw in radial depth- larger, suberized but lignified cell upto 5 to 7 raw in radial depth.

b. **Phellogen:** Indistinct but is seen as a narrow layer of thin walled cells,

c. **Phelloderm:** 5 to 7 layers, immediately below the phloem, cell is arranged in the radial rows whereas away from phloem, cell is oval and has intercullar spaces. Phelloderm contains abundant starch grains (with triradiate hilum) and typical twin prisms of calcium oxalate.

Secondary phloem:

- Is transverse by conspicuous medullary rays. Phloem consists of sieve tubes, companion cells and phloem parenchyma.
- Starch grains and calcium oxalate prism occurs throughout the phloem tissue.

Secondary xylem:

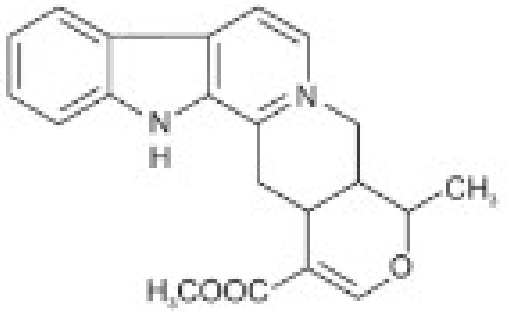
- It is also transverse by well develop medullary rays. Xylem consists of vessels, wood fibres and lignified parenchyma.

Medullary rays:

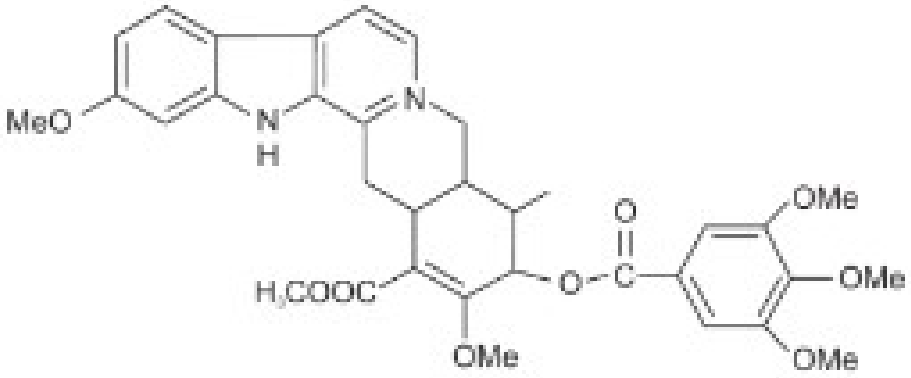
- It runs radially from the center to the cortex through the phloem. Rays in the xylem region are lignified, pitted and are 1 to 5 cells wide although uniseriate rays are prominent. In the phloem region the ray cells are not lignified. Starch and typical oxalate prisms are in the medullary ray cells.

Chemical constituents:

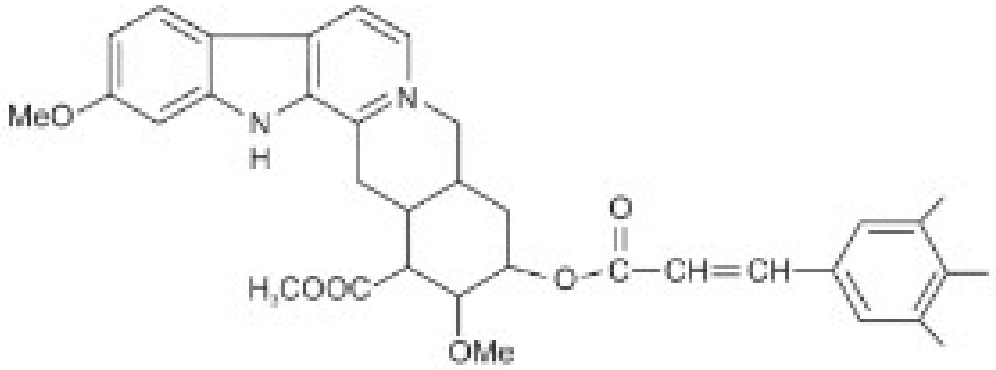
- Alkaloids- Indole alkaloids (1.5 or 3%) present.
- Weakly basic Indole type (pH 7 to 7.5)
- Reserpine group – **Reserpine, Rescinnamine, deserpidine.**
- Tertiary indoline alkaloids (pH-8). Ajmaline group- **Ajmaline and Ajmalicine**.
- Strongly basic anhydronium bases (pH-11).
- Serpentine group – Serpentine, Serpentinine and Alsotonine.



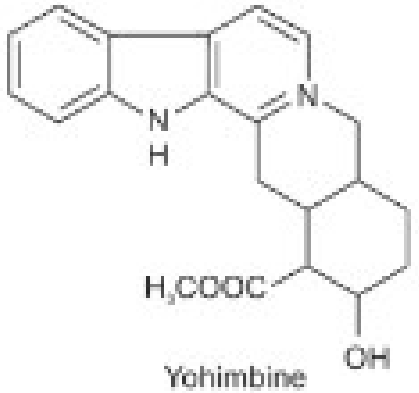
Serpentine



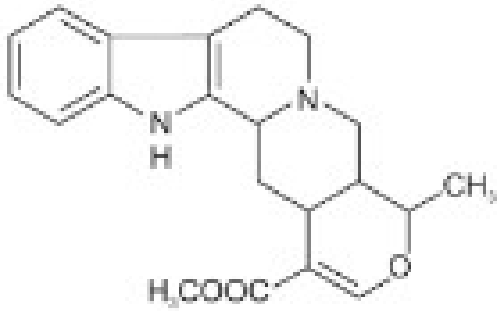
Reserpine



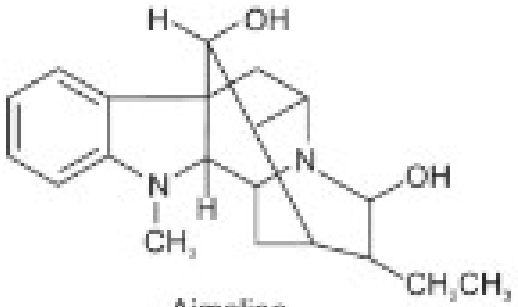
Rescinnamine



Yohimbine



Ajmalicine



Ajmaline

Uses:

1. Rauwolfia is used as hypotensive and tranquillizer.
2. Reserpine being the main alkaloid is responsible for the activity and is used in anxiety condition and other neuropsychoiatric diseases.
3. Sedative – calm down activities and excitement (reserpine group).
4. Stimulates the central of peripheral nervous systems (Ajmaline group).
5. The decoction of root is used to increase uterine contraction in difficult cases.
6. The extract is used for intestinal disorders and as anthelmintic bitter tonic and febrifuge.

Belladonna

Synonym- Belladonna leaf

Biological source-

It consist of dried leaves of or the leaves and the arial part of the plant *Atropa beladona*, belong to family Solanaceae

Morphological characters-

Color- **leaves-** green to brownish green

flower- purple to yellowish brown

Fruits- green to brown

Odour- slight and characterists

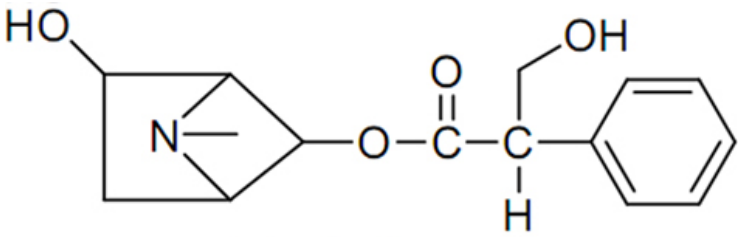
Taste- bitter and acrid

Size- leaves- 5 to 25 cm long and 2.5 to 12 cm widw

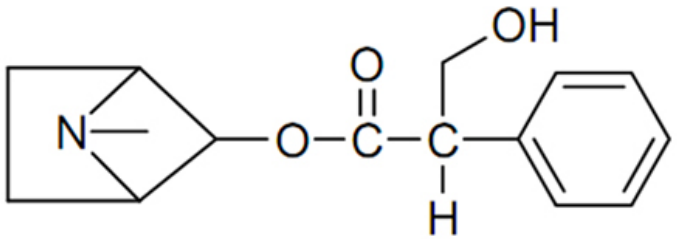
Shape- leaves are ovate

Chemical const-

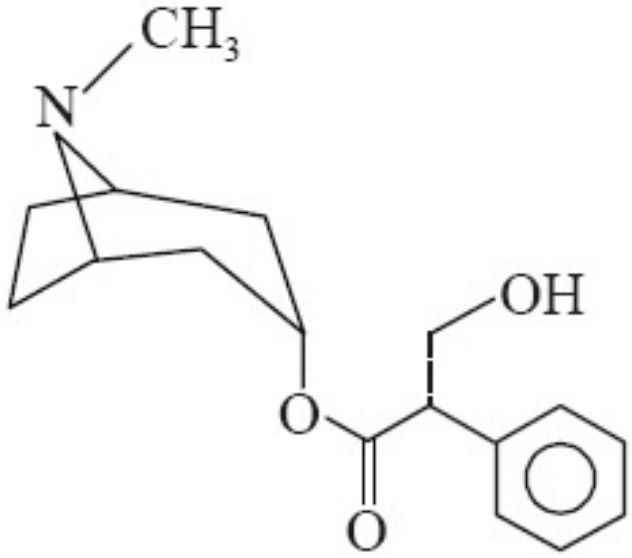
The active agents in belladonna, atropine, hyoscine (scopolamine), and hyoscyamine



Anisodamine



Atropine



Hyoscyamine

- **Uses-**

Belladonna has been used in herbal medicine for centuries as a pain reliever, muscle relaxer, and anti-inflammatory, and to treat menstrual problems, peptic ulcer disease, histaminic reaction, and motion sickness

OPIUM

- **Synonyms: Raw Opium, Crude Opium**
- **Biological Source:**

Opium is the dried milky latex obtained by incision from the unripe capsules of ***Papaver somniferum*, *belonging to family Papaveraceae.***

Characteristics

Opium occurs in rounded or flattened mass which is 8–15 cm in diameter and weighing from 300 g to 2 kg each. The external surface is pale or chocolate-brown, texture is uniform and slightly granular and odour is characteristic; taste is bitter and distinct.

Dried Latex

- Latex is the **milky sap of many plants** that coagulates on exposure to air. It is an emulsion or suspension in which the aqueous phase is composed of mineral salts, proteins, sugars, tannins & alkaloids. The oily phase is composed of oils, resins, etc.
- Latex is usually produced in laticiferous tissues which
- may be:
- Laticiferous cells
- Laticiferous tubes.
- Laticiferous vessels (originate from many cells): e.g. Opium

Source

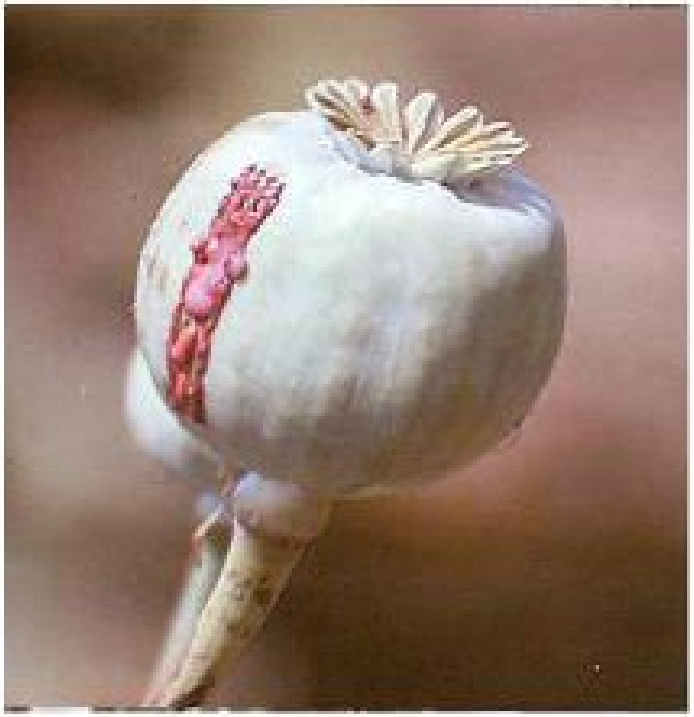
- Raw opium is the dried milky exudation obtained by incising the unripe but fully grown capsules of ***Papaver somniferum*** Family - Papaveraceae .
- The quality of opium is judged by morphine content which is required to be n. l. t. 9.5% by the USP.
- Commercial varieties include **Turkish, Persian, Indian & Yugoslavian** opium.

The sap is extracted by slitting the pod

Cultivation and Collection and Preparation

- The seeds of opium are cultivated in batches. This is to ensure that the entire crop is not affected by climatic conditions like frost or drought.
- The cultivation is done in the months between September and April.
- A gap of 25 cm should be maintained between two consecutive plants.
- Before sowing the seeds, they are mixed with sands properly.
- About five to six capsules appear on each plant and it flowers in the month of May-June.

- After the petals fall from the poppy, the pod, which is about the size of a golf ball, is lanced, and the opium latex is exuded. What you see here is one lancing, made with a special knife which has four blades about 1/16th inch apart, clearly visible in the photo. Initially the latex is pink; later it changes to black.



- Poppies are lanced in the afternoon and the latex is scraped off the next morning.
- Pods ripen (soften) at different times in the field. Each pod can be lanced from 4 to 7 times.
- The lancing takes a great deal of time and attention.
- Several pods can be scraped before the opium is placed into a container.
- So many pods to cut and scrape.

- The opium collected is weighed on a daily basis before an officer of the Narcotics Dept.
- After the latex has been collected, all the peasants from an area take their opium to a weighment center. Their opium has been scraped into standard containers of known weight. One-tenth of a hectare produces small amounts of latex.

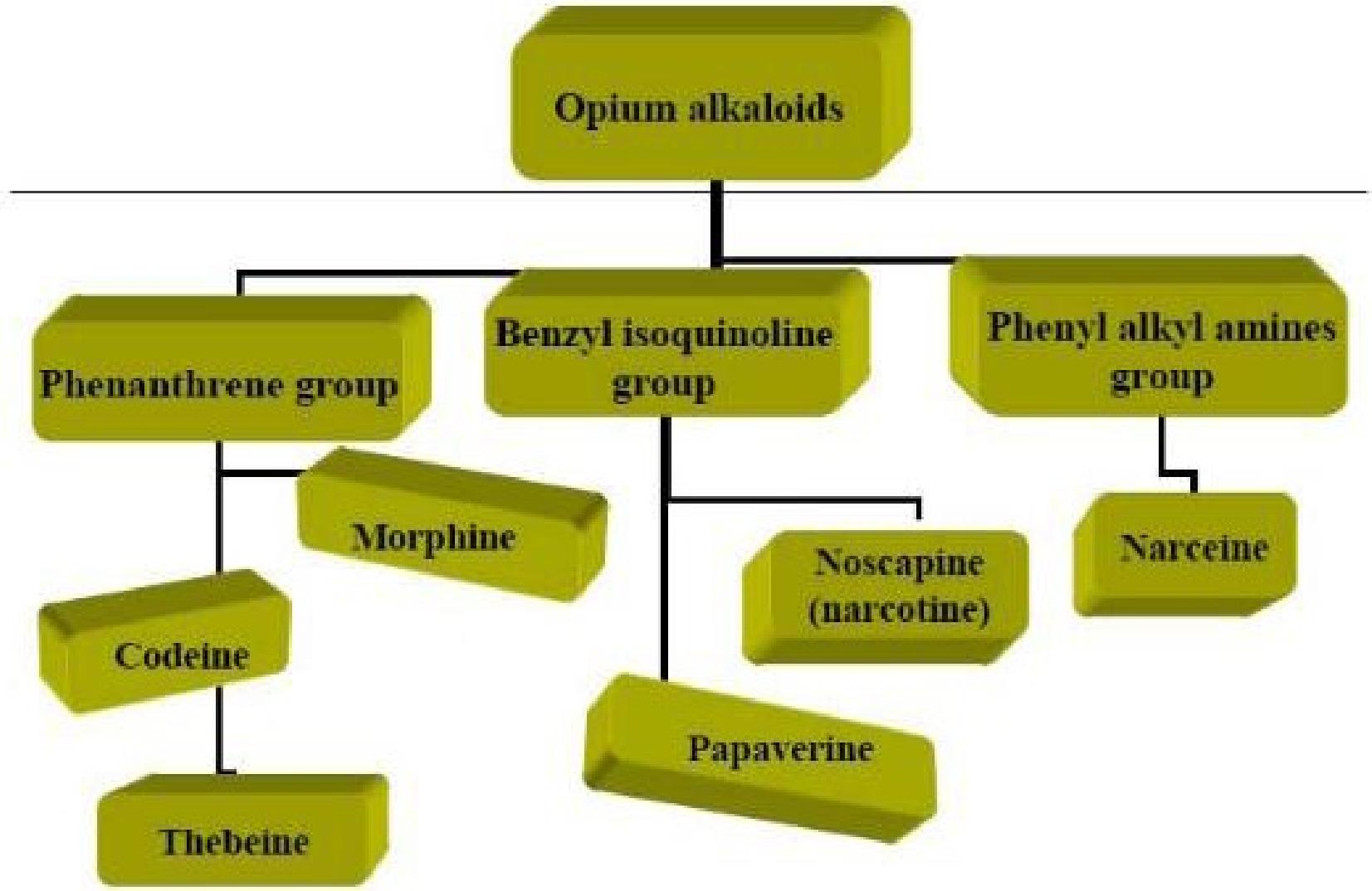
Macroscopic Character

- **Odor:** Strong , characteristic.
- **Taste:** Bitter.
- **Color:** Varies depending on the type of opium. For instance, Indian opium is dark brown while manipulated Turkish opium is chocolate brown in color.

Active constituents

- Opium contains more than 19 alkaloids, some of which are combined with **meconic acid**, others with sulfuric acid and some as free alkaloids.
- There are 3 main classes:
- Phenanthrene.
- Benzyl isoquinoline.
- Phenyl alkyl amine

- **Chemical Constituents**
- Opium contains about 19 alkaloids among which morphine is the most important base. The alkaloids are combined with meconic acid. The other alkaloids isolated from the drug are codeine, narcotine, thebaine. noscapine, narceine and papaverine.


Opium alkaloids
Phenanthrene group
Benzyl isoquinoline group
Phenyl alkyl amines group
Morphine
Codeine
Thebeine
Papaverine
Noscapine (narcotine)
Narceine

Chemical Tests

1. First of all opium is dissolved in water and then ferric chloride solution is added. It results in reddish purple color. The change in color occurs due to presence of **meconic acids** in opium.
2. In another test, when opium is treated with small amount of nitric acid, orange red color is produced. This test occurs due to the presence of **morphine** in opium

Uses

- Opium and morphine have narcotic, analgesic and sedative action and used to relieve pain, diarrhoea dysentery and cough. Poppy capsules are astringent, somniferous, soporific, sedative and narcotic.

Phenylpropanoids and Flavonoids

Lignans

Lignans are compounds found in a variety of plant materials including flaxseed, pumpkin seed, sesame seed, soybean, broccoli, and some berries

Flax Seeds (Linseed **):**

It consist of cultivated fibre from ***Linum usitatissimum*** *belong to* family **Linaceae.**

- **Macroscopical Characters**

The seeds are produced in globular capsules, 10 seeds m each. They are elongated ovoid, flattened and obliquely pointed at one end, about 4 to 6 mm long and 2 to 3 mm broad.

- **Chemical Constituents**

Fixed oil (30 to 40 percent), proteins. (25 percent), mucilage (6 percent) and a small quantity of linamarin (a cyanogenetic glycoside).

Uses

The health benefits of flaxseed lignans are thought to be due to antioxidant activity, also in cancer prevention, Diabetes prevention

Tea

Biological Source:

- It contains the prepared leaves and leaf buds of ***Thea sinensis*** *(Linne) kuntz., belonging to family* ***Theaceae.***

Geographical Source

- It is mainly cultivated in India (Assam), Ceylon, Japan and Java.

Cultivation and Collection:

- Propagation is usually by seed; however, budding, grafting, and cuttings have been used.
- Seed can be sown as soon as it is ripe in a green house.
- The plant prefers light (sandy) and medium (loamy) soils and requires well-drained soil. The plant prefers acid and neutral soils and can grow in very acid soil.
- It requires moist soil and prefers a pH between 5 and 7.
- Stored seed should be presoaked for 24 h in warm water and the hard covering around the micropyle should be filed down to leave a thin covering.

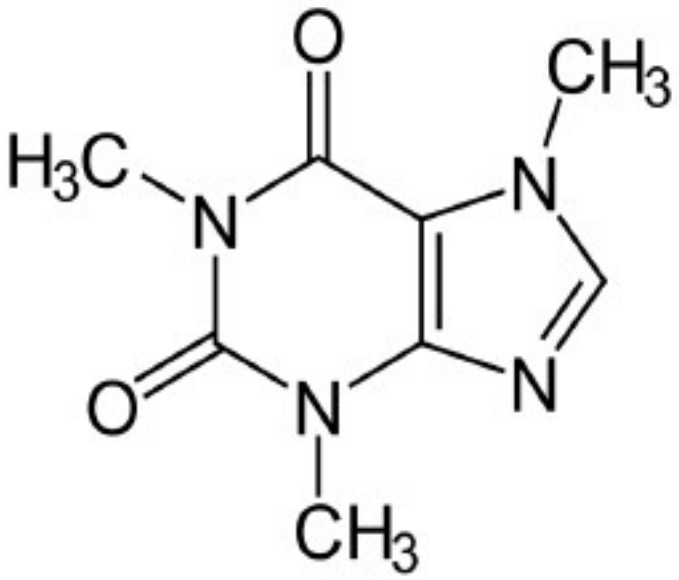
- It usually germinates in one to three months.
- Prick out the seedlings into individual pots when they are large enough to handle and grow them on in light shade in the green house for at least their first winter.
- Plant them out into their permanent positions when they are more than 15 cm tall and give them some protection from winter cold for their first year or three outdoors.
- Seedlings take 4–12 years before they start to produce seed.

Characteristics

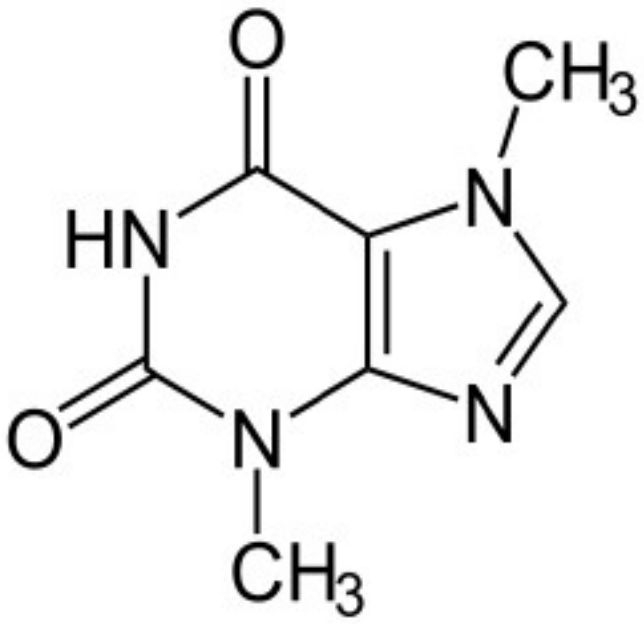
- Leaves are dark green in colour, lanceolate or elliptical, on short stalks, blunt at apex, base tapering, margins shortly serrate, young leaves hairy, older leaves glabrous.

Chemical Constituents

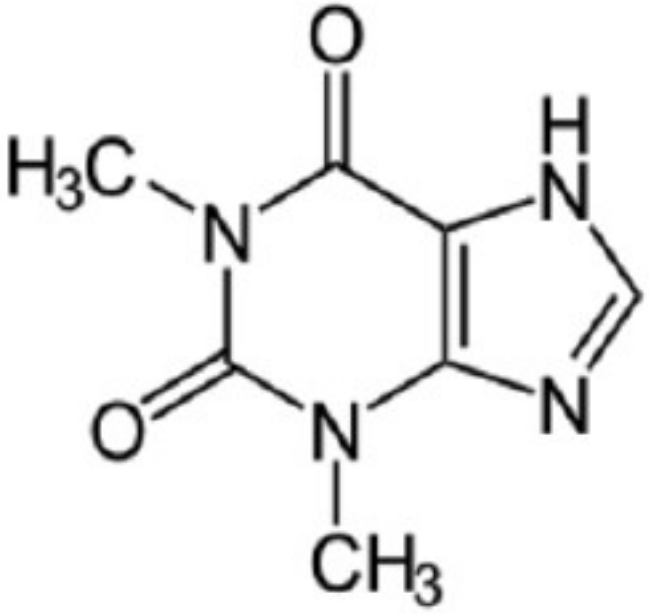
- The leaves are a rich source of caffeine (1–5%). It also contains **theobromine** and **theophylline** in minor quantities. The colour of tea leaves is due to tannin (10–20% gallotannic acid).



Caffeine



Theobromine



Chemical Tests:

1. Caffeine (in a Petridish) +HCL + potassium chlorate crystals ------ heat to dry ------A purple colour is obtained by exposing the residue to vapors of dilute ammonia. In addition of fixed alkali the purple colour disappears.
2. Caffeine also produces white precipitate with tannic acid solution.

Uses

- It is used as stimulant, astringent and also as diuretic.

Rue

Synonym: garden rue, Herby grass,

Biological Source: This consist of dried herb of ***Ruta graveolens*** family Rutaceae

Geographical Sourse: The plant is indiginous to Southern europe and often cultivated in Britain and Indian Garden

Morphological Characters:

- Colour: Leaves are blue green colour
- Odour: Characteristics and strong aromatic
- Taste: Pungent
- Leaves: Leaves are oblang in shape often broken into pieces of 2 X 2 mm
- Flower: Greenish yellow

Chemical Constituents:

- Glycosides, alkaloid, volatile oil and fixed oil
- **Rutin (2 %), graveoline, rutarin**

Uses:

Capillary protectant therapeutically. Antitussive and spasmolytic action.

Steroids, Cardiac Glycosides & Triterpenoids

LIQUORICE

- **Synonyms:** Radix Glycyrrhizae, Sweet liquorice.
- **Biological Source:** Liquorice consists of subterranean peeled and unpeeled stolons, roots and subterranean stems of ***Glycyrrhiza glabra*** Linn, and other species of *Glycytrhiza*, belonging to family Leguminosae.

Morphological characters:

- **Colour** : Externally greyish brown to dark brown and internally tawny yellow
- **Odour** : Faint and characteristics
- **Taste** : Sweet
- **Size** : About 20-25 cm long and about 2 cm diameter
- **Shape** : Cylindrical
- **Fracture :** Fibrous in bark; and splintery in the wood.

Chemical Constituents:

- Liquorice root consist of Glycyrrhizin as a main contain and **Glycyrrhizinic acid.**

Uses:

- It is used as an expectorant and demulcent, antiulcer, sweetening agent for masking undesired flavor.

DIOSCOREA

Synonym: Yam

Biological Source:

Dioscorea consist of dried rhizome and tubers of several species of *Dioscorealike dioscorea villosa*, *Dioscorea prazeri* Prain and Burk; *Dioscorea composite*; *Dioscorea spiculiflora;* ***Dioscorea deltoidea*** and *Dioscorea floribunda*, belonging to family Dioscoreaceae.

Morphological Characters:

- **Colour** : chestnut brown
- **Odour** : Odourless
- **Taste** : Bitter
- **Size** : vary in size

Extra features:

- *D. prazeri:* Stout horizontal creeping, freely branched, branched about 10 cm long; 1.5 to 2 cm wide, grey brown-blackish, fresh white or creamy.

Chemical Constituents:

- Dioscoreacontain diosgenin, a steroidal **sapogenin** and its glycoside smilagenin, epismilagenin and beta isomer yammogenin. It also contains sapogenase (enzyme), phenolic compounds and starch. It also contains Alkaloid dioscorine.

Uses:

- Diosgenin is used as a precursor for the synthesis of many steroidal drugs like corticosteroids, sex hormones and oral contraceptives.It is also used in rheumatism.

DIGITALIS LEAVES

Synonyms: Digitalis, foxglove, finger flower, lady's glove, Foxglove Leaves, Folia Digitalis.

Biological Sources:

Digitalis consists of dried leaves of ***Digitalis purpurea*** Linn., belonging to family **Scrophulariaceae.**



Morphological characteristics:

- **Colour** : Dark greyish green
- **Odour** : Odourless
- **Taste** : Bitter
- **Size** : 10-30 cm long and 4-10 cm wide
- **Shape** : Ovatelanceolate to broadly ovate
- **Extra features:** The upper surface of leaf is hairy, slightly pubescent, dark green and little wrinkled. The lower surface of leaf is hairy, greyish-green and very pubescent.

Chemical constituents:

- *Digitalis purpurea* contains 35 glycosides:

purpurea glycosides A and B. Odoroside H, glucogitaloxin, Verodoxin and glucoverodoxin.

The digitoxigenin, Digitoxin, Gitoxigenin, gitaloxin are also important medicinal compounds.

Uses:

- Digitalis is used as Cardiotonic. It is used in various forms like tablets or capsules in the treatment of congestive cardiac failure, atrial. Diuretic in cardiac edema.

Volatile oils

Mentha pipertia

Biological Source:

The oil is obtained by steam distillation of the fresh flowering tops of the plants known as ***Mentha piperita*** Linn. Lamiaceae.

Geographical sources:

Mentha species are cultivated in various parts of the world.

Chemical constituents

Volatile oil

Menthol

Menthone

Methyl acetate

Cineole

limonene

Uses

- Reduces spasm and pain caused by endoscopy.
- In migraine headache.
- To treat nausea.
- To treat bad breath and reduce dental plaque.
- Azulene reduce inflammation and help to heal ulcer.
- It relaxes muscles of GIT and relieve colon spasm.
- Menthol kill bacteria and parasites.

CLOVE

Synonyms: Clove buds, Clove flowers.

Biological Source: Clove consists of the dried flower buds of ***Eugenia caryophyllus*** Thumb, belonging to family Myrtaceae.

Morphological Characters:

- **Colour** : Reddish-brown
- **Odour** : Strong spicy, aromatic odour
- **Taste** : Pungent and aromatic
- **Size** : About 10 18 mm in length and 4 mm in width and 2 mm thick
- **Shape:** The hypanthium is sub-cylindrical and tapering at the end

Chemical Constituents:

The main component of distilled clove bud oil is **eugenol (60-90%)**

Flavanoids, lipids, carbohydrates and vitamins are also present.

Other constituents like tannins, gums, resins and glucoside sterols are also present in the bud.

Uses:

- Clove is used as a spice and as a carminative. Topically when clove oil is applied it has counter irritant action. It is also used as an analgesic (pain-killing) and antiseptic (bactericidal) in oral health and dentistry.

CINNAMON

Synonyms: Ceylon cinnamon, Kalmi- Dalchini, Cortex cinnamoni, Chinese cassia.

Biological Source:

- Cinnamon is the dried inner bark of the coppiced shoots of ***Cinnamomum zeylanicum*** Nees, belonging to family Lauraceae.

Morphological characters:

Colour : Externally yellowish brown and internally dark yellowish brown

Odour : Fragrant

Taste : Aromatic and sweet followed by warm sensation

Size : About 1 meter in length, 1 cm in diameter and 0.5 mm thickness

Shape : Compound squill

Chemical test:

1. On volatile oil add few drop of ferric chloride solution it gives a pale green colour.
2. Drug with ferric chloride, cinnamic aldehyde give brown colour and eugenol gives blue colour, resulting in the formation of pale green colour.

Chemical Constituents:

- Cinnamon contains about 10% of volatile oil, tannin, mucilage, calcium oxalate and sugar. Volatile oil contains 50 to 65% **cinnamic aldehyde**, along with 5 to 10% eugenol, terpene hydrocarbons and small quantities of ketones and alcohols.

Uses:

- Carminative and flavoring agent in astringent powders and tinctures. It also has aromatic antiseptic and widely astringent properties. It is used as an alternative, aromatic, carminative, flavoring agent, analgesic, antiseptic, antirheumatic, antispasmodic, demulcent, digestive, expectorant, stomachic.

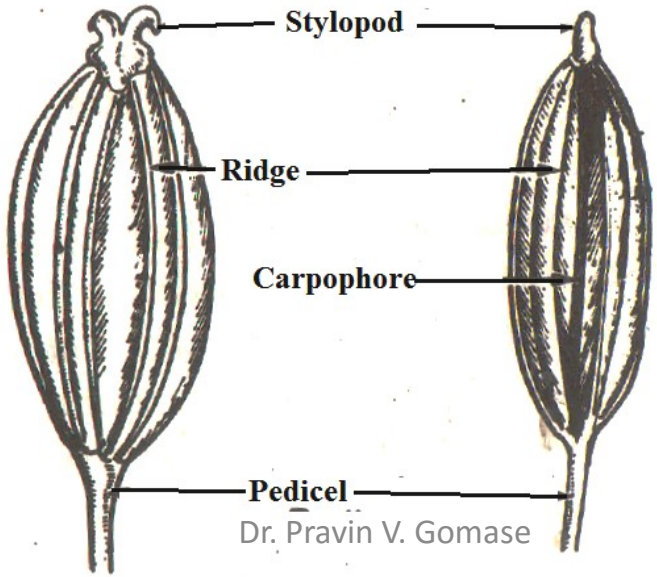
Fennel

- **Synonyms:** Fennel fruit, Fructus foeniculli
- **Biological Source:**

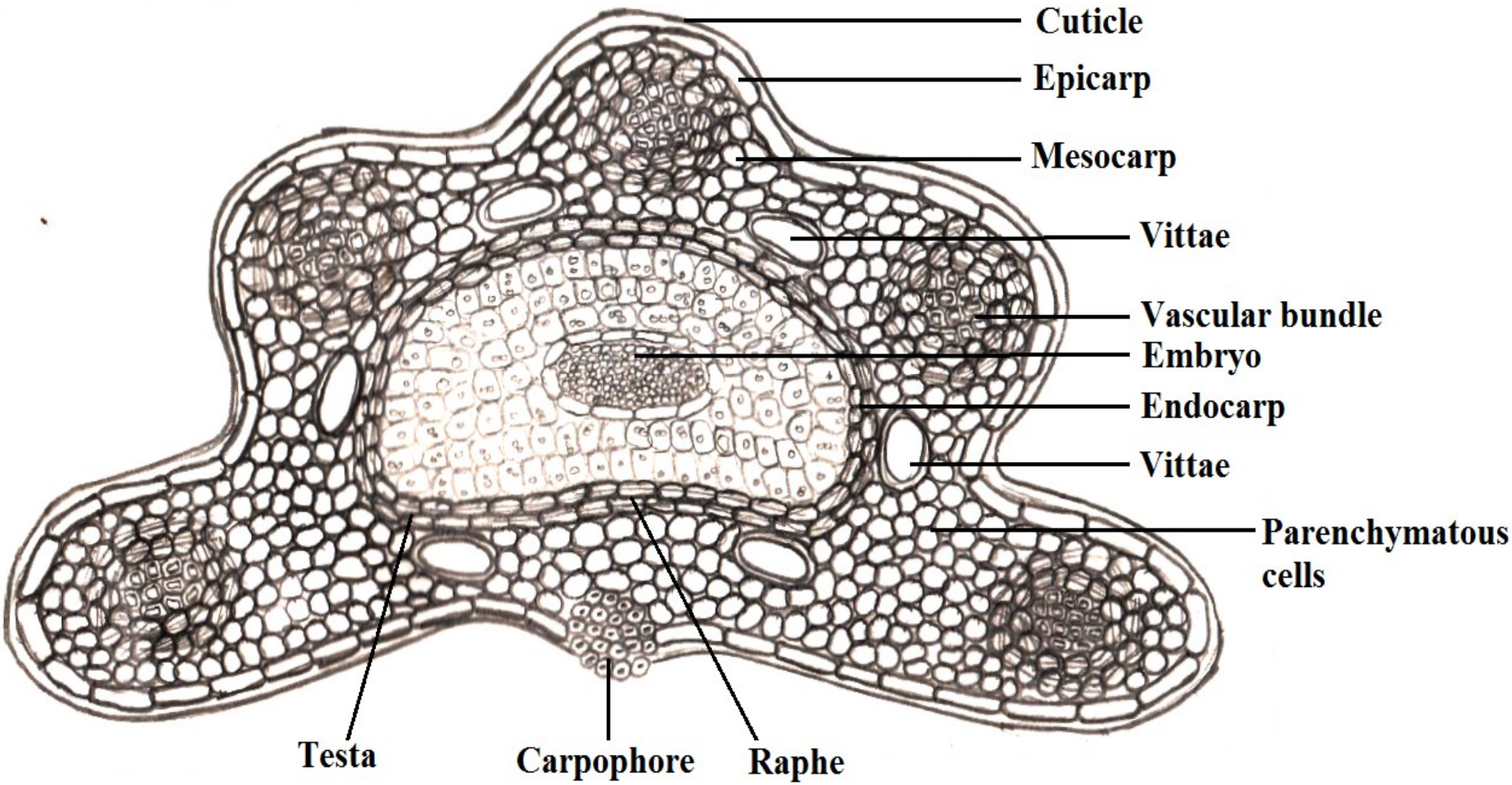
Fennel consists of the dried ripe fruits of ***Foeniculum vulgare*** Miller, belonging to family Umbelliferae.

Morphological Characteristics

- The fruit is an entire cremocarps with pedicels,
- **Colour** : Greenish brown to yellowish brown
- **Odour** : Characteristics
- **Taste** : Sweet
- **Size** : 5 to 10 mm long, 2 to 4 mm broad.
- **Shape** : Oval-oblong or slightly curve



Microscopical characters:



Chemical Constituents:

- The fresh fruit of Fennel contain 3 to 7% of volatile oil which constitute 50 to 60% of **anethole**, a phenolic ester; and 18 to 22% of **fenchone**, a ketone.

Uses:

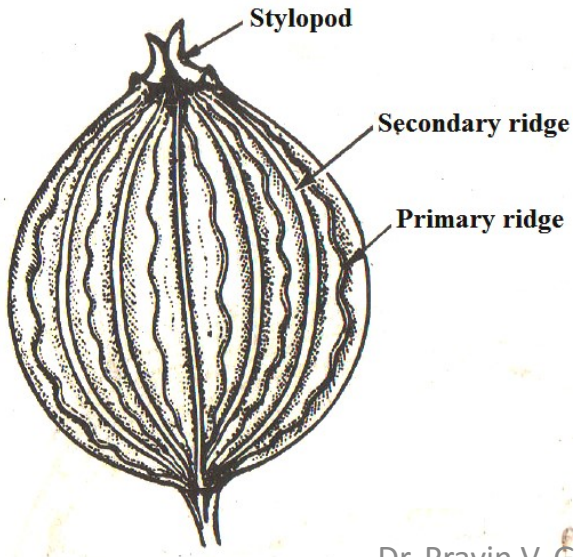
- Fennel is used as stomachic, aromatic and diuretic, carminative, diaphoretic, as a digestive, pectoral, and flavouring agent.

CORIANDER

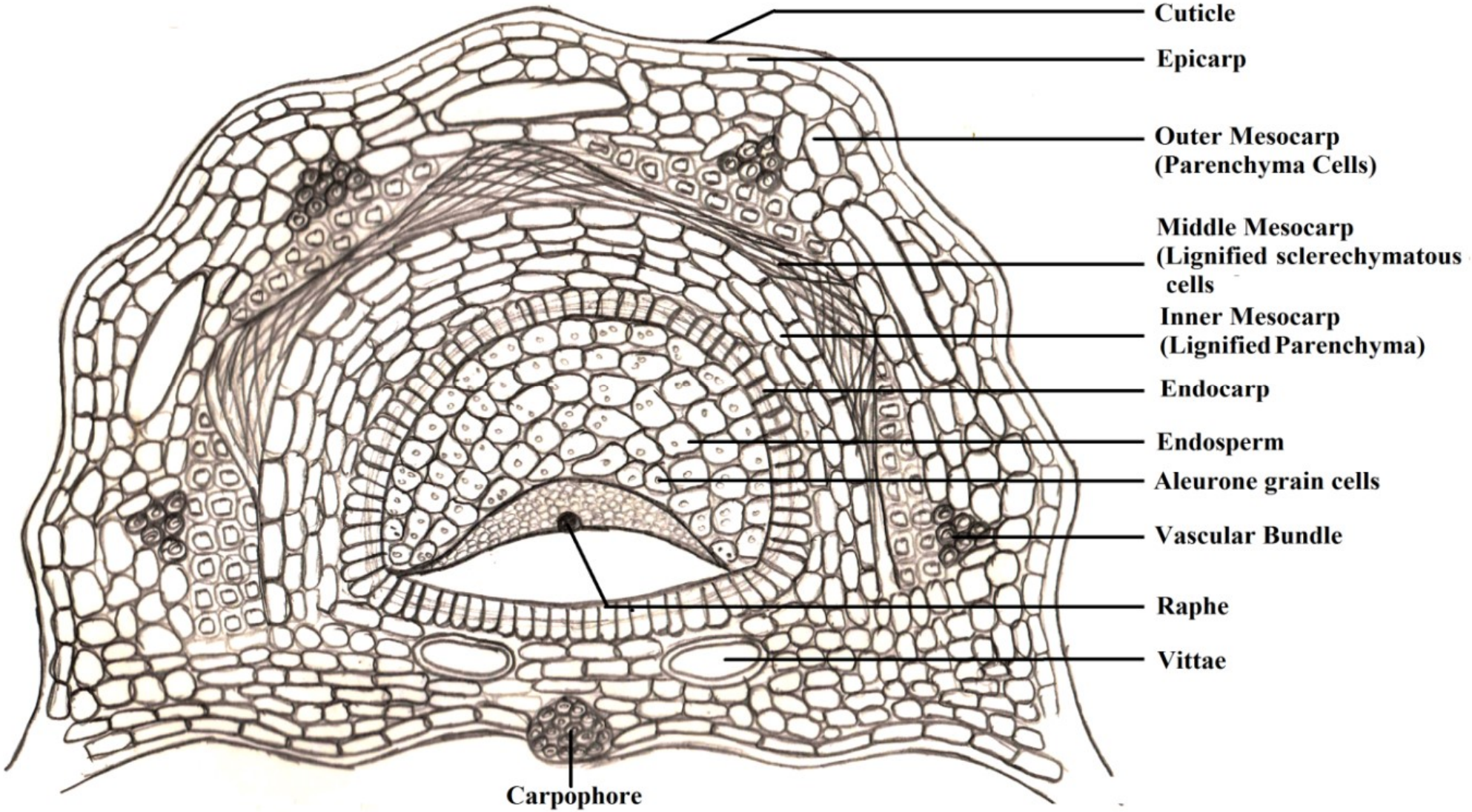
- **Synonyms**: Fructus coriandri, Coriander fruits.
- **Biological Source**:
- Coriander consists of dried ripe fruits of ***Coriandrum sativum*** Linn., belonging to family Umbelliferae.

Morphological characters:

- **Colour** : Yellowish brown in colour
- **Odour** : Aromatic
- **Taste** : Spicy, aromatic taste
- **Size** : Fruit is 3 to 4 mm in diameter
- **Shape** : Sub spherical in shape



Microscopical Characters:



Chemical Constituents:

- Coriander consist of about 1% of volatile oil the chief volatile component is **coriandrol**, along with other constituents like, borneol, p-cymene, camphor, geraniol, limonene, and alpha-pinenes.

Uses:

- Aromatic, carminative, stimulant, alterative, antispasmodic, diaphoretic and flavouring agent.It is also used as refrigerant, tonic and appetizer, diuretic, aphrodisiac, and stomachic

Tannins

Black Catechu

- **Synonyms and regional name:**

Hin-Khair, Kattha; Ben- Khaer; Kan- Cachu; Mar- Khair; Guj- Khato; Mai- Karinali; San- Khadira.

Biological source:

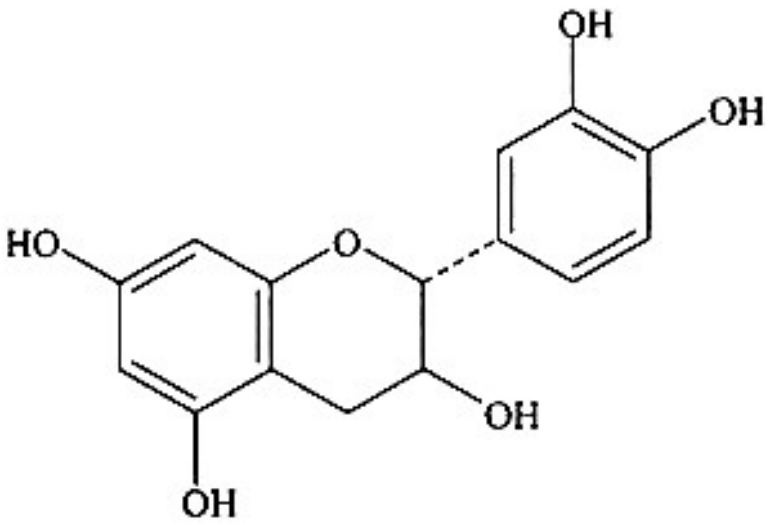
- Black catechu consists of the dried aqueous extract prepared from heart wood of ***Acacia catechu*** willed and ***Acacia chundra*** willd. Belong to family Leguminosae.

Macroscopical Characters:

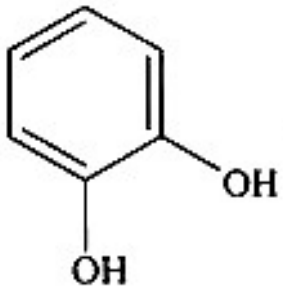
- Colour: Black or dark brown,
- Form- Irregular masses or cubes;
- Surface: Rough, dull or slightly glossy and porous;
- Fracture: Very brittle breaking into powdery mass
- Odour: None
- Taste: Bitter to start with, turns sweet and finally astringent.

Chemical Constituents:

- It contains tannins like catechins, catechu tannic acid
- It is also contains flavonoids like quercetin and it derivatives.
- Others-Catechu red and gum, etc.



Catechin



Catechol

Chemical test:

1. **Match stick test (Catechins test)** a match stick is dipped in aqueous plant extract, dried near burner and moistened with concentrated hydrochloric acid. On warming near flame, the matchstick wood turns pink or red due to formation of phloroglucinol.
2. To an aqueous solution, add solution of ferric ammonium sulphate; dark green colour is formed. Add sodium hydroxide solution, the colour changes to purple.

Uses:

- Astringent
- Cooling and digestive agents.
- It is used in relaxed conditions of throat, mouth and gums.
- It is also used in diarrhoea and in preparation of lozenges.

Resins

Resins

Benzoin

Synonyms and Regional name:

Benzoinum, Sumatra benzoin, Loban (Guj), Hin- Luban, Kan. – Lobana

Biological source:

Benzoin is the balsamic resin obtained from the incised stem of ***Styrax benzoin*** Dryander and ***Styrax parallelloneurus*** Perkins. family Styraceae

Collection:

- Benzoin is a pathological resin, secreted in secretary duct and secretary cells of the tree after injury.
- Fungus also takes part in the production of Benzoin.
- Seeds are sown in rice fields.
- Rice plants grow quicker and give protection to the benzoin trees for one year.
- After harvesting the rice, trees of benzoin are allowed to grow till they are 7 years old.
- Collection of resin is carried out from trees of 7-20years.

Macroscopical characters:

- Reddish brown resinous matrix.
- Odour- balsamic, aromatic and agreeable
- Taste- slightly acrid
- Fracture- brittle.

Chemical constituents:

- It contains 23% free **balsamic acids** containing mainly **Cinnamic acid**.
- It contains 70- 80% resin consisting of triterpenoids acids, siaresinolic acid (19-hydroxy oleanolic acid) and sumaresinolic acid

Chemical test:

- Heat 5 g of coarse Sumatra benzoin with 10 ml of 10% potassium permanganate solution in a test tube slowly. In Sumatra benzoin bitter almond smell of benzaldehyde is produced because of oxidation of Cinnamic acid present in it. This test is negative in Siam benzoin because of very small quantity of Cinnamic acid.

- Digest 0.2 gm of coarse Sumatra benzoin with 5 ml ether for 5 minutes. Pour 1 ml of the ethereal solution in a porcelain dish containing 2 to 3 drops of sulphuric acid and rotate the dish. Sumatra benzoin shoos deep purplish- red colour by this test.

Uses:

- It is used as antiseptic, expectorant, stimulant and healing agent.
- It is used in the preparation of compound benzoin tincture. This tincture contains benzoin, aloe, and storax and tolu balsam and is used as topical protectant, antiseptic and expectorant.
- It is use as inhalation in respiratory disease.

Guggul

- ***Synonym:*** *Scented Bdellium Gum guggul.*
- ***Biological Source:*** *Guggul is the oleo-gum-resin obtained by making deep incision at the basal part of stem bark of* ***Commiphora wightii***, belong to family **Burseraceae.**

Chemical constituents:

Its active components are Z-guggulsterone and E-guggulsterone.

Guggul contains resin, volatile oils, and gum. The extract isolates ketonic steroid compounds known as guggulsterones

Uses:

- In treatment of nervous diseases, leprosy, muscle spasms, ophthalmia and in skin disorders.
- Also used in ulcerative pharyngitis, hypertension, ischaemia, and urinary disorders.

Ginger

Synonyms:

Zinziber; Guj. – Soonth; Hin. – Saunth

Biological source:

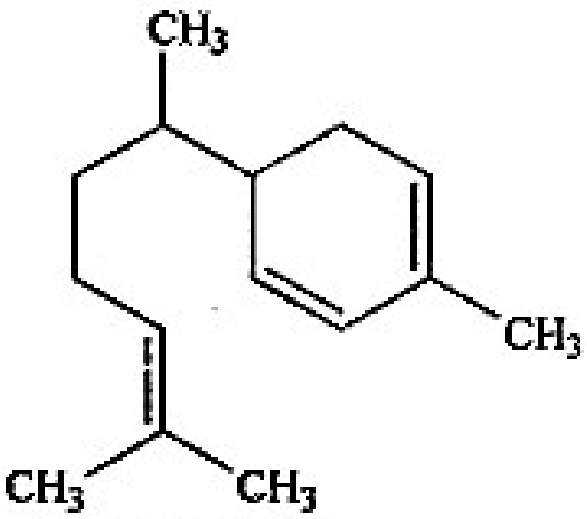
Ginger consists of the rhizomes of ***Zingiber officinale***, Roscose and dried in the sun. Family Zingiberaceae.

Macroscopical characters:

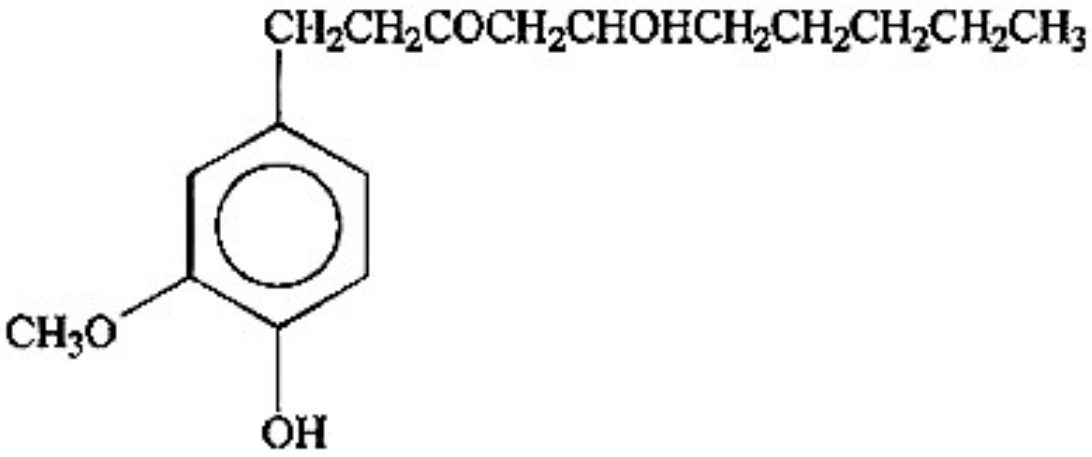
- General appearance: Sympodial branching, horizontal rhizome.
- Size – Length 5-15 cm; width (height) 3 to 6 cm; thickness 0.5 to 1.5 cm.
- Shape – Laterally flattened on the upper side with short flattened oblique, obviate branches or fingers.
- Colour – Buff.
- Odour – Agreeable and aromatic.
- Taste – Agreeable and aromatic.

Chemical Constituents:

- Ginger contains 1 to 2% volatile oil, 5 to 8% pungent principle, resinous mass and starch. Volatile oil is responsible for the aromatic smell and consists of **zingiberene 6%** sesquiterpenes hydrocarbon **zingiberol** a sesquiterpenes alcohol and besaabolene.



ZINGIBERENE



GINGEROL

Uses:

- Ginger is stomachic, stimulant and aromatic carminative.
- It is used more as a spice.
- Ginger oil is used in mouth washes, ginger beverages and liquors.
- It is used as Flavouring agent.
- Ginger powder has been reported to be effective in motion sickness.

Asafoetida

Synonyms

Devil's dung

Biological source:

It is the oleo-gum-resin obtained by incising the living rhizomes and roots of ***Ferula asfoetida*** Family Umbelliferae.

Collection:

- The plant is a perennial branching herb about 3 meters in height.
- Asafetida is present as whitish gummy resinous emulsion in the schizogenous ducts of the cortex of the stem, rhizome and root.
- Drug is usually collected from the rhizome and root.
- Collection is carried out in the end of the March, before flowering.
- Soil of the root removed and crown is cut off.
- Oleo-gum-resin exudes from the cut surface, hardens and is collected.
- The root is sliced successively lower at the end of every week and drug collected as above till no more exudation takes place.
- The drug is dried, packed and exported.

Chemical Constituents:

- It contains 4-15% volatile oil, 45- 65% resin and 20% gum and about 10% ash.
- Volatile oil contains pinene and organic disulphide including isobutyl propenyl disulphide responsible for the alliaceous odour.
- Resin consists of asaresonol ferulate, an ester of asaresinol and **ferulic acid**, free ferulic acid asafetida show combined umbelliferone test.

Chemical Tests:

1. Asafoetida forms an emulsion with water; with alcohol it is partially soluble.
2. When triturated with water, it forms yellowish orange emulsion.
3. On addition of H2S04 to the freshly fracture surface, red or reddish brown colour is produced which changes to violet when washed with water.
4. 0.2 g of powdered asafoetida is added to 5 ml of 90% alcohol and boiled for 2 min. cool and filter. To this is added 0.5 ml of 10% ammonia solution. No blue florescence is obtained because of the absence of free umbelliferone.

Uses:

- As a carminative (relieve excessive collection of gas in the stomach).
- As an expectorant
- As an antispasmodic (a drug that counteracts a sudden, violent, involuntary muscular contraction).
- As a laxative (which induces active movement of bowels).

Myrrh

- **Synonyms:**

Arabian, or Somali Myrrh, Hirabol (Guj.), bol (Hin.)

- **Biological source:**

Myrrh is the oleo resin obtained by incision from the stem of ***Commiphora molmol*** Engler Family Burseraceae.

Macroscopical characters:

- Form – irregular rounded tears or lumps of agglutinated tears
- Colour – reddish yellow or reddish brown;
- Size – variable;
- Surface – rough, covered with fine yellow powder;
- Fracture – brittle, fractured surface brown, shining, oily and with whitish marks
- Odour – Aromatic;
- Taste – bitter.

Chemical constituents:

- Volatile oil (2.5-8%) – Cuminic aldehydes, α-pinene, limonene and sesquiterpenes.
- Resin (25-40%) – Resin acids like-α, β, γ-commiphoric acids.
- Gums (60%) – yield on hydrolysis arabinose, 4-O-methyl glucoronic acid and aldebiuronic acid.

Chemical tests:

- A yellowish brown emulsion is obtained when myrrh is triturated with water.
- An ethereal solution of the drug attains reddish colour when treated with Bromine vapors whereas purple colour when moistened with nitric acid.

Uses:

- Antiseptic.
- Stimulant.
- Used in mouth wash and tooth paste.
- In perfume industry.

Colophony

Synonyms

Long needle pine

Biological source:

Colophony is the solid residue obtained after distilling the oleo- resin from various species of *Pinus*. **Family** Pinaceae.

1. *Pinus palustris*: which is known as long leaf pine
2. *Pinus echinata:* which is known as short leaf pine
3. *Pinus maritime-*. This is found in France.
4. *Pinus longifolia*: This is found in India.

Description:

- Colour – pale or brownish yellow;
- Size – Varies;
- Surface – Smooth;
- Fracture – Brittle;
- Odour & taste – faint turbinthinate;
- Solubility: being a resin, insoluble in water but soluble in alcohol, ether, benzene, glacial acetic acid and light petroleum.

Chemical constituents:

- Resin acids- Resin acid or diterpene acids like **abietic acid**

Chemical test:

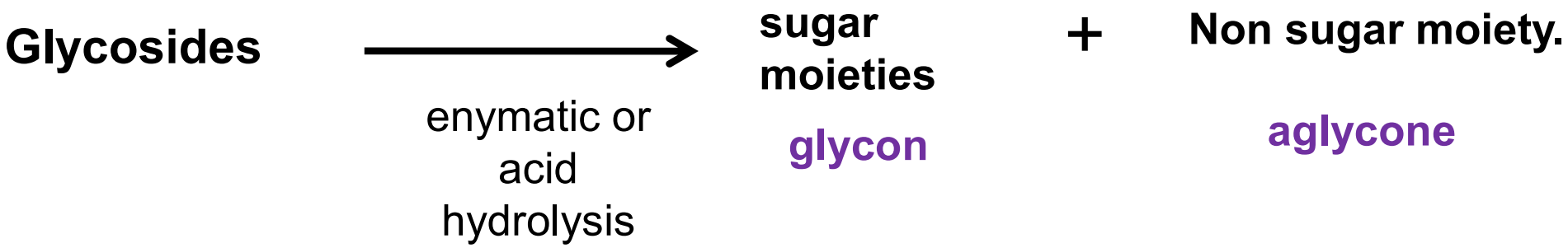
1. 0.1 g of powdered colophony is dissolved in 2-3 ml of acetic anhydride in a test tube and a drop of conc. H_2S0_4 is added whereby purple to violet colour is observed.
2. An alcoholic solution of colophony is acidic to litmus.

- **Uses:**

1. It is used in preparation of like plasters and ointment.
2. It is also used in manufactures of varnishes and disinfecting liquids.

Glycosides

Glycosides is defined as the organic compound from plants and animals sources which on enymatic or acid hydrolysis give one or more sugar moieties along with nonsugar moiety. The former is called as glycon and the latter as aglycones or genin



Glycosides
Senna

Synonyms:

- Indian Senna

Biological source:

Indian Senna (Tinneveley Senna) consists of the dried leaflets of ***Cassia angustifolia*** Vahl Family Leguminaceae.

Morphological Characters:

Colour	Pale greyish green
Taste	Aromatic and sweet followed by warm sensation
Shape	Ovate lanceolate
Size	3–5 cm long, 2 cm wide and about 0.5 mm thick
Margin	Entire margin
Apex	Acute apex with sharp
Base	Asymmetric base

- **Chemical constituents:**
- Senna contains anthraquinones glycoside glycosides as **sennosides A, sennosides B, sennosides-C, sennosides D**, emodin, chrysophenol, Aloe emodin, rhein.
- Two naphthalene glycoside, i.e. 6-hydroxy musizin glycoside and Tinnevellin glycoside.
- It also contains yellow flavinol, colouring matter kaempferol and its glycosides kaempfrin
- Sterol and its glycoside.

Chemical tests:

Borntranger's Test:

Powdered leaves of Senna are boiled with dilute sulphuric acid,

Filtered and cooled.

The filtrate is extracted with chloroform or benzene and dilute ammonia is added to it.

The ammonical layer becomes pink to red due to the presence of anthraquinones derivative.

Uses:

- Used as laxative and cathartic.
- Senna is mixed with carminative drugs due to its gripping action.
- Powder senna is mixed with vinegar and applied externally to cure skin diseases.

Aloes

Synonyms:

Aloe

Botanical source:

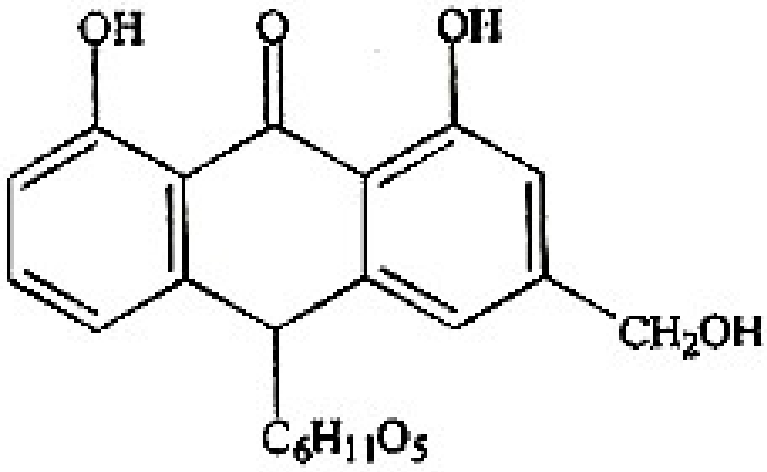
Aloe is the dried juice collected by incision from the bases of the leaves of ***Aloe barbadensis*** and various species of aloe. Family **Liliaceae**

Characters

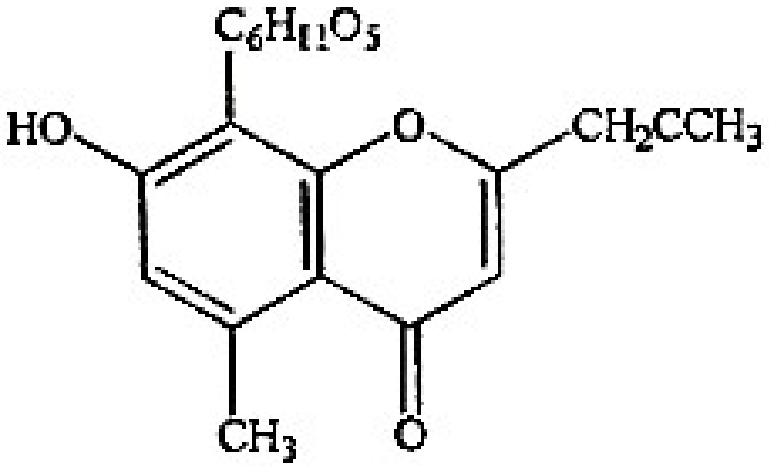
- Shape: Opaque (not transparent)
- Colour: yellow-brown to chocolate-brown.
- Odour: strong odour resembles with Iodoform.
- Taste: Bitter
- Fracture: waxy.

Chemical Constituents:

- Aloe may contain up to 30% **aloin** which is a mixture of three isomers: **barbaloin, β-barbaioin** and **isobarbaloin**.



Barbaloin



Aloe-resin B

Uses:

- Aloe and aloin are strong purgative and in higher doses may act as abortifacient.
- Ointment of aloe gel is used in sunburns, thermal burns, radiation burns, and abrasion and skin irritation and prevents ulceration.

Bitter Almond

- **Synonym:** Amygdala amara
- **Biological Source:**

Bitter almond comprises of the dried ripe kernels of ***Prunus amygdalus*** Batsch. belonging to family *Rosaceae.*

Description

Colour : Brown

Odour : No specific odour

Taste : Bitter

Chemical constituents:

Bitter almond contain about 40 to 50 % of fixed oil., 20 % protein, an enzyme emulsin and colourless crystalline bitter glycosides known as **amygdalin.**

Uses:

- Bitter almonds are employed as sedative due to Hydrocyanic content.
- The fixed oil of bitter almond finds its use as demulscent in skin-lotion.
- It is also employed in the preparation of amygdalin and bitter almond water.

Iridoids, Other terpenoids & Naphthaquinones

Iridoids, Other terpenoids & Naphthaquinones

Gentian

- **Synonyms:**

Gentian root, Yellow gentian root, Bitter root, Kutaki and Karu

- **Biological source:**

Gentian consists of the dried rhizome and root of ***Gentian lutea*** L. Family Gentianaceae

Nil kanthi

Collection and preparation:

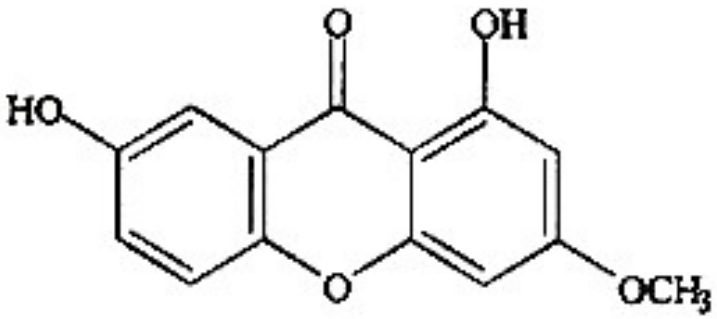
- The plant is a large perennial herb.
- The drug is collected from a 2- 5 years old plant in the autumn (leaves fall).
- Turf (area) is stripped and the rhizomes are dug up.
- After it is washed and cut into suitable length, the drug is dried, first in the open air and then in sheds.

Macroscopical characters:

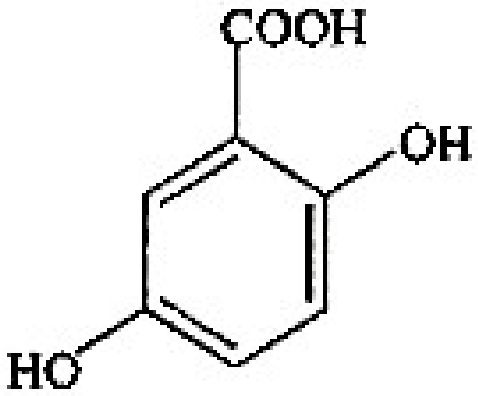
- **Shape:** Cylindrical, sometimes longitudinally split.
- **Colour:** Yellowish brown.
- **Size:** up to 30 cm length and 4 cm thick.
- **Odour:** Characteristic.
- **Taste:** Sweet to start with but later persistently bitter.

Chemical constituents:

- **Bitter principle** : **Gentiopicrin, Amaragentin.**
- **Alkaloids** : **Gentianine.**
- **Xanthine derivatives: Gentisin, Gentioside.**
- **Sugar** : **Gentiobiose and gentianose.**
- **Gentisic acid.**
- **Tannins**
- **Pectin and calcium oxalate**



Gentisin



Gentisic acid

Uses:

- Bitter tonic (increase secretion of bile).
- Anorexia. (Loss of appetite)
- Dyspepsia (indigestion)
- Stomachic for increasing appetite and to cure debility.

Artemisia

- **Synonym-** Sweet wormwood, sweet annie, annual wormwood
- **Biological source-**

It consist of dried aerial parts of plant ***Artemisia annua*** L. belong to Family: **Asteraceae (Compositae)**

Morphological Characters

Colour- light green to dark green

Odour- strongly aromatic

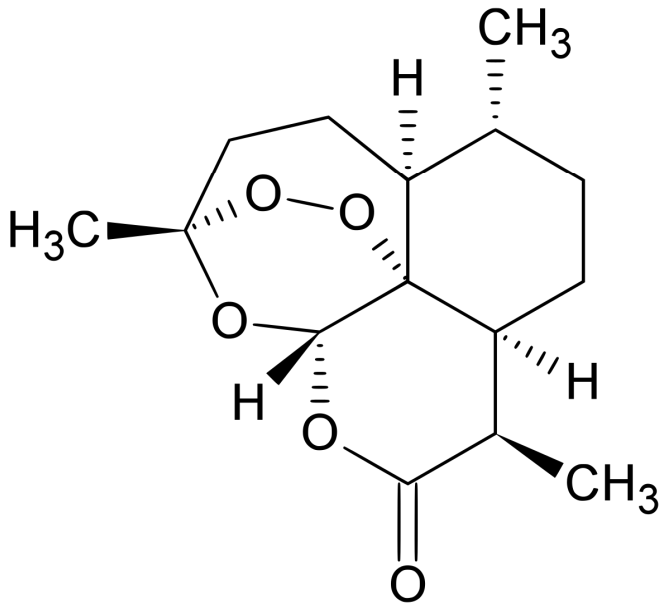
Taste- Strongly bitter

Size- Plant naturally grows to 30–100 cm, leaves 3–5 cm long and 2–4 cm wide

Shape- alveolate-punctate glandular

- The leaves margins are not entire but the base is asymmetrical

- **Chemical Constituents**
- It consists of volatile and non-volatile constituents.
- The main chemical constituents are **sesquiterpenoids**, including
- Artemisinin
- artemisinin I
- artemisinin II
- artemisinin III
- artemisinin IV
- artemisinin V
- artemisic acid
- Artemisilactone, artemisinol



Artemisinin

- **Uses-**

The plant in cure of variety of ailments,

- Antihypertensive activity
- Analgesic–antipyretic effects
- Antimicrobial activity
- Anti-inflammatory activity
- Antimalarial activity

Taxus

- **Synonym-** Yew, Talispatra, Himalayan yew, Birmi
- **Biological source-** It consist of dried leaves, bark & roots of various species of **Taxus,** belonging to family **Taxaceae.**
- The four important species with parts used as,

1. ***Taxus baccata*** mainly leaves
2. ***Taxus brevifolia*** Mainly stem bark
3. ***Taxus canadensis*** leaves & roots
4. ***Taxus cuspidata*** leaves

- **Geographical Source-**
- It is very slow growing evergreen gymnospermous tree.
- It is Found in India, Canada & America.
- It is reported in temperate Himalayan region of India upto an altitude of 2000-3500 mt.

Morphological Characters

- **Leaves**
- Colour :Dark green
- Taste :Bitter
- Size :1-3 cm x 1-2 cm
- Shape :Lanceolate, flat
- **Bark** **:**Thin & scaly brown

Chemical constituents

- Different 40 taxane compounds have been found in plant, all of which are diterpenoid structures.
- Among above mentined 3 most important members are **Taxol, cephalomannine & deacetyl baccatin.**
- Leaves contain deacetyl baccatin III which can be converted to Taxol

- **Uses**
- Taxol is potent anticancer drug
- It has promising role against non-small cell lung carcinoma, gastric and cervical cancer and also carcinomas of head, neck, prostate and colon.
- Taxol also inhibits cell migration thus, preventing spread of metastatic cancer cells

Carotenoids

- Carotenoids also called **tetraterpenoids**, are **yellow**, **orange**, and **red** organic pigments that are produced by plants and algae, as well as several bacteria, and fungi.
- Carotenoids give the characteristic color to pumpkins, carrots, corn, tomatoes.
- Carotenoids can be produced from fats and other basic organic metabolic building blocks by all these organisms.

- Carotenoids are plant pigments responsible for bright red, yellow and orange hues in many fruits and vegetables.
- These pigments play an important role in plant health. People who eat foods containing carotenoids get protective health benefits as well.
- Carotenoids are a class of **phytonutrients ("plant chemicals")** and are found in the cells of a wide variety of plants, algae and bacteria.
- Carotenoids also act as **antioxidants** in the human body. They have strong cancer-fighting properties.

- They are produced from **8 isoprene** molecules and contain **40 carbon atoms.**
- In general, carotenoids absorb wavelengths ranging from 400 to 550 nanometers (violet to green light).
- This causes the compounds to be deeply colored yellow, orange, or red.
- Carotenoids that contain unsubstituted beta-ionone rings (including beta-carotene, alpha-carotene, beta-cryptoxanthin, and gamma-carotene) have vitamin A activity (meaning that they can be converted to retinol).

Thank You