Shree H.N.Shukla institute of Pharmaceutical Education & Research Rajkot

B.Pharm

Semester V

Subject Name: Pharmacognosy and Phytochemistry II
Subject code: BP503TP

Chepter 2

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

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

Topic 1 : Alkaloids

VINCA

Synonyms:

Vinca rosea, Lochnera rosea, Sadaphuli, Rattanjot Billaganneru; Hindi- Sadabahar; Beng.- Nayantara.

Biological source:

It is dried whole plant of *Catharanthus roseus*.

Family:

Apocynaceae

Geographical source:

It is indigenous to Madagascar. This plant is cultivated as an ornamental plant and found in tropical regions like Africa, Australia, Eastern Europe, South Florida, India, Taiwan and Thailand.

Macroscopical characters:

(i) Type – Annular or perennial herb;

(ii) Size – 0.5 to 1 meter length;

(iii) Leaves – Ovate, oblong, glossy above glaucous below;

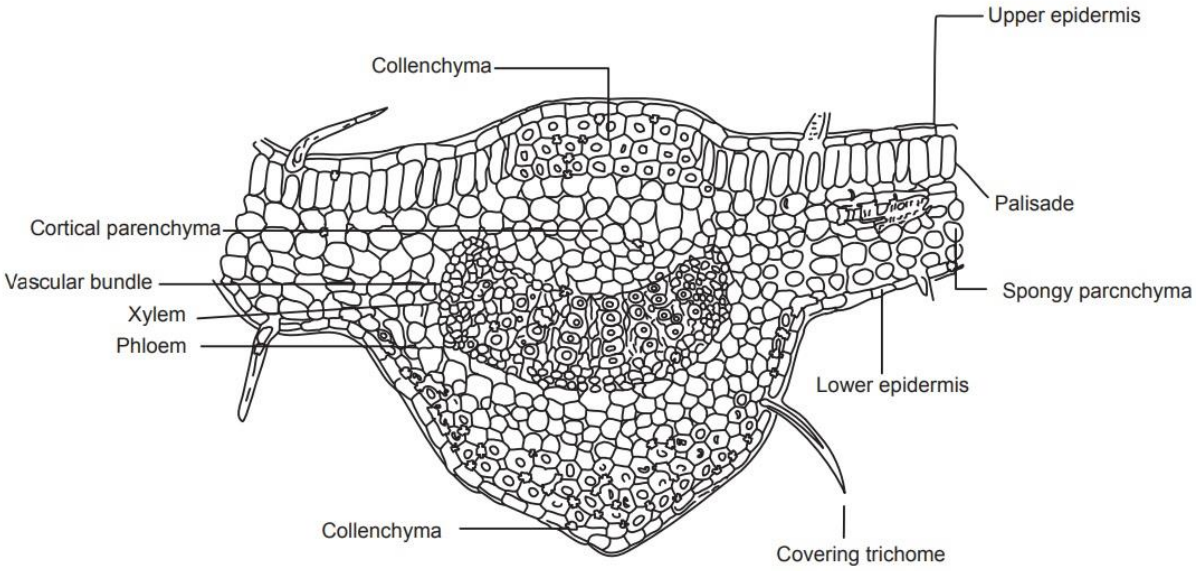
(iv) Flowers – 2 to 3 in cymes, axillary and terminal clusters. Bases on flower colour, three varieties are known namely – alba-white, ocillata-white with pink or carmine red eyes and roseus -with rose coloured flowers.

(v) Fruit- a follicle, cylindrical and many seeded.

(vi) Taste – Bitter;

(vii) Odour – slight.

Microscopical characters:



The transverse section of Vinca leaf

- Lamina:
- Upper epidermis:

Single layered with more or less rectangular cells, the outer walls of which are circularized. Only covering trichomes are unicellular, long and dagger shaped, warty and with a bulbous base. Sometimes very short trichomes are also seen. A few stomata are seen on the upper epidermis.

- Mesophyll:

Mesophyll is differentiated into palisade and spongy parenchyma.

- Palisade:

Single layered cells elongated and compact.

- Spongy parenchyma:

5-9 layered, loosely arranged with intercellular spaces. Calcium oxalate crystals of any kind are totally absent. Vascular strands are seen here at times.

- Lower epidermis:

Same as upper epidermis but the number of stomata are more.

- Midrib:

Epidermal layers of lamina are continuous in the midrib region also. Strips of collenchyma appear below the upper epidermis and above the lower epidermis. This is followed by cortical parenchyma. A well developed vascular bundle is seen in the center of midrib.

- **Chemical constituents:**

1. Indole and indoline alkaloids:

(i) Ajmalicine

(ii) Lochnerine

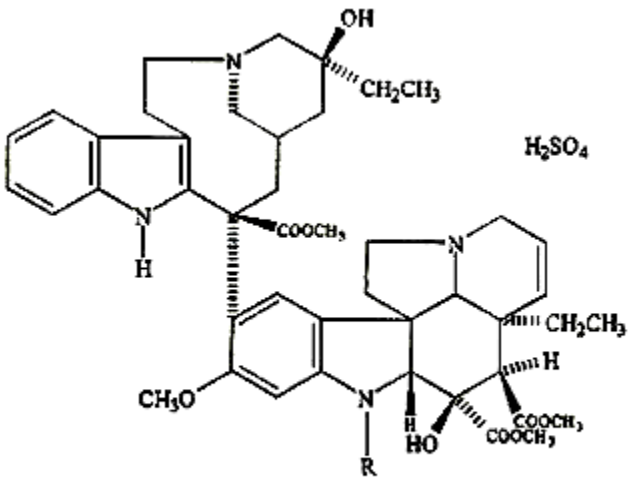
(iii) Serpentine and

2. Tetrahydroalstonine:

(i) Dimeric Indole bases of monoterpene type

(ii) Vinblastin

(iii) Vincristin.



R= CH_3 Vinblastine sulphate
R= CHO Vincristinesulphate

Uses:

(i) Antineoplastic (antimitotic= Cytostatic = anticancer antitumour).

(ii) In the treatment of Hodgkin's disease.

(iii) In the treatment of leukemia in children.

(iv) Vinca is used in hypertension.

Rauwolfia

Synonyms and vernacular name:

Bengali – sarpagandha; Tamil – Chinanmdpodi;

Sans Chhota-chand; Hindi – Chandrika; Bihar- Pagla ki dawa

Biological source:

Rauwolfia consists of the dried roots and rhizomes of ***Rauwolfia serpentina*** Benth. It contains not less than 0.15% of reserpine.

Family:

Apocynaceae

Geographical source:

It is widely distributed in West land and in shady forests in Punjab eastward to Nepal, Sikkim, and Assam in India; Bhutan, Pakistan, Java and Thailand, etc.

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.
- 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.
- 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.
- 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 tears 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.

: **Macroscopical characters**

Rauwalfia root

(i) External features of roots and rhizomes are nearly similar but rhizomes can be made out by the presence of small central pith.

(ii) Drug consists of mostly small pieces, which are 2 to 15 cm long and 3 to 22 mm diameter.

(iii) Pieces are cylindrical, slightly tapering and tortuous.

(iv) Outer surface is greyish yellow, pale brown or brown.

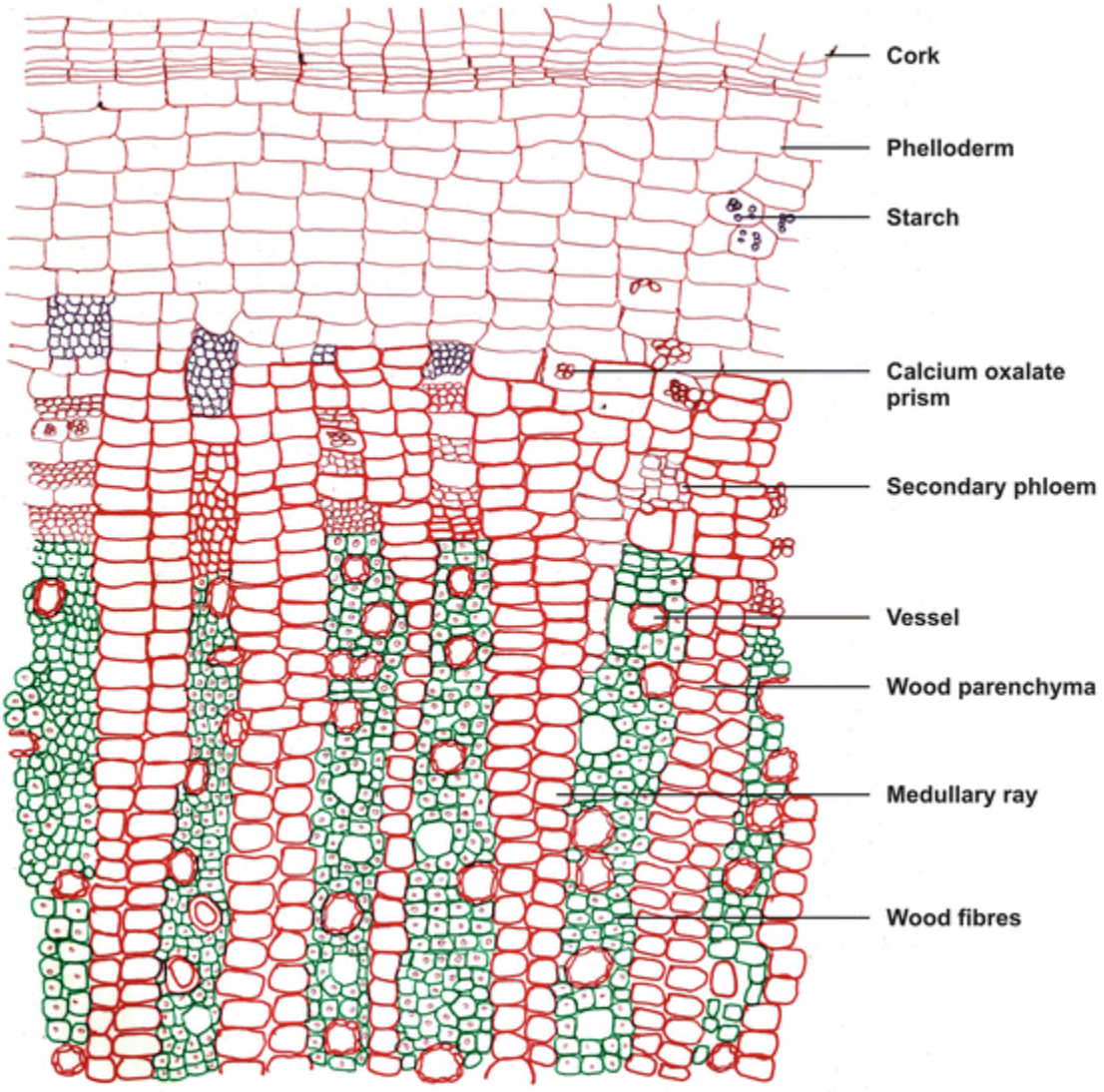
(v) Fracture short.

(vi) Fracture surface show yellowish to brown bark and dense pale yellow radiating wood with 2 to 8 annular rings occupying nearly three fourth of the diameter.

(vii) Odour Odourless

(viii) Taste bitter.

Microscopical characters (T.S.):



T. S. of Rauwolfia root

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.

1. 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.

2. 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.

3. Secondary xylem:

It is also transverse by well develop medullary rays. Xylem consists of vessels, wood fibres and lignified parenchyma. The vessels appear rounded, polygonal or at times radially elongated and occurs inner single or in pairs. Xylem fibres appear as rounded and polygonal structure with thick lignified walls. Typical oxalate prism and starch grains resembling those of the phelloderm and phloem occur freely in the wood parenchyma.

4. 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:

i. Alkaloids- Indole alkaloids (1.5 or 3%) present.

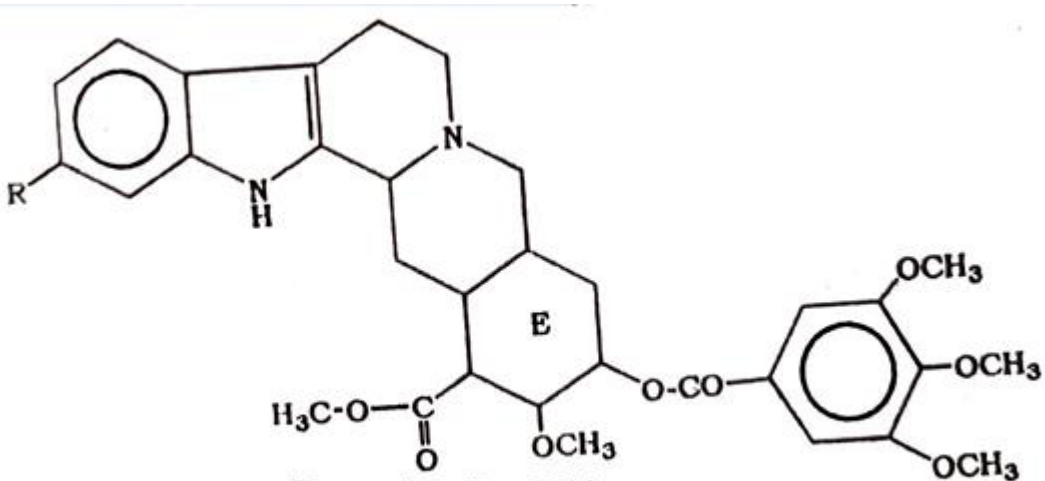
ii. Weakly basic Indole type (pH 7 to 7.5)

iii. Reserpine group – Reserpine, Rescinnamine, deserpidine.

iv. Tertiary indoline alkaloids (pH-8). Ajmaline group- Ajmaline and Ajmalicine.

v. Strongly basic anhydronium bases (pH-11).

vi. Serpentine group – Serpentine, Serpentinine and Alsotonine.



Reserpine (R=-CH_3)
Deserpidine (R=-H)

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.

Substitutes and adulterants:

The following species of rauwolfia are substituted for genuine drug.

- R. vomitoria- this can be distinguished from the official drug on the basis of Sclereids which are present here in abundance.
- R. canescens: Here again the stone cells are present but the characteristic stratified cork is totally absent
- R micrantha: show both stratified cork and stone cells.
- All these do contain reserpine and other less important alkaloids in small quantities.
- Adulterants:

- R. densitiflora and R. perakensis do not contain reserpine. They do have stratified cork and stone cell.

Powder analysis of Rauwolfia:

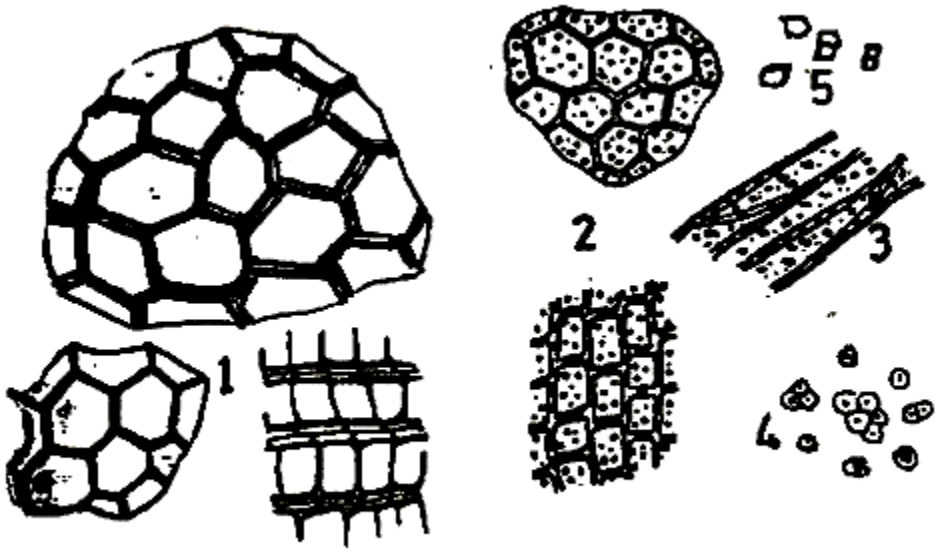


Fig. 13: Identifying characters of Rauwolfia powder

Cork:

Stratified cork in several layers appearing like benzene rings

Parenchyma:

Pitted and lignified parenchymatous cells of the xylem parenchyma and medullary ray cells.

Wood elements:

Vessels few, long and with oblique end walls and perforations.

Starch granules:

Largely simple but compound ones are also known to occur. Granules are fairly large, possessing a distinct hilum in the form of a star or a split.

Calcium oxalate:

Crystals in the form of prisms but not many in number.

Belladonna

Rauwo
lfia

Rauwo
lfia

Synonyms:

Folia belladonnae, Belladonna herb, Belladonna leaves, deadly nightshade leaves, Sag-angur Patti (Hindi)

Botanical source:

It consists of dried leaves and flowering tops of ***Atropa belladonna*** Linn (European belladonna) or *Atropa acuminata* Linn Royle ex Lindlej (Indian belladonna).

Family:

Solanaceae

Geographical source:

Plant is a native of Central and Southern Europe. It is cultivated in England, Germany, Balkan countries, America and India.

Cultivation:

- For sowing the seeds are selected which would produce strong sturdy plants, rich in leaves is containing high percentage of alkaloids.
- Seeds are sown ill nurseries and seedling is transplanted deep in well-drained, moist, calcareous and loamy soil in April.
- Water clogging is harmful to the plants.
- Addition of farmyard manure has favourable effect on the growth of plants weeds are removed.
- **Collection:**
- The leaves are collected in dry weather in late summer.
- Next year plain reaches a height of 4ft. and during the flowering season, from 15th June to 15 July, plants are cut few inches above the ground and leaves and flowering tops are separated.

- From the cut plants second harvest is made in August September and some time again third harvest in October.
- In the second and third year two to three harvests similar to first year are made. In the fourth year after harvesting, roots art dug out, which form separate article.
- After four years new plantation is undertaken after collection the drug is dried completely in dark shed at 40 to 50°C, which requires about two days.
- Completely dried drug decomposes and librates ammonia.
- Belladonna is stored in airtight containers protected from light and moisture.
- Sometimes belladonna is attacked by the fungus Phytophthora belladonna.
- Such infected plants are dug out from soil and burnt to prevent further infection.
- Belladonna is liable to be attacked by flea beetle, which eats mostly old and large leaves.
- By harvesting two to three times, as stored above, large leaves are not left in the plant. Thus protection from flea- beetle is obtained.

Macroscopical characters:

Leaves:

(i) Type- Simple;

(ii) Form-Broadly ovate;

(iii) Color- yellowish-green;

(iv) Arrangement – alternate, arranged in pairs on the upper stems, each pair with a large and a small leaf;

(v) Size- 5-25 cm length, 2, 5-12 cm broad;

(vi) Margin- acuminate;

(vii) Surface- slightly hairy; Petiolate, petiole 4cm length

Flower:

(i) Colour- purple;

(ii) Size- 2.5 cm length, 1.2 cm wide;;

(iii) Arrangement of flower- born singly upon short, drooping pedicels arising in

(iv) the axils of the pairs of leaves;

(v) Corolla- campanilate;

(vi) Calyx- 5 lobed, stemns-5, epipetalous;

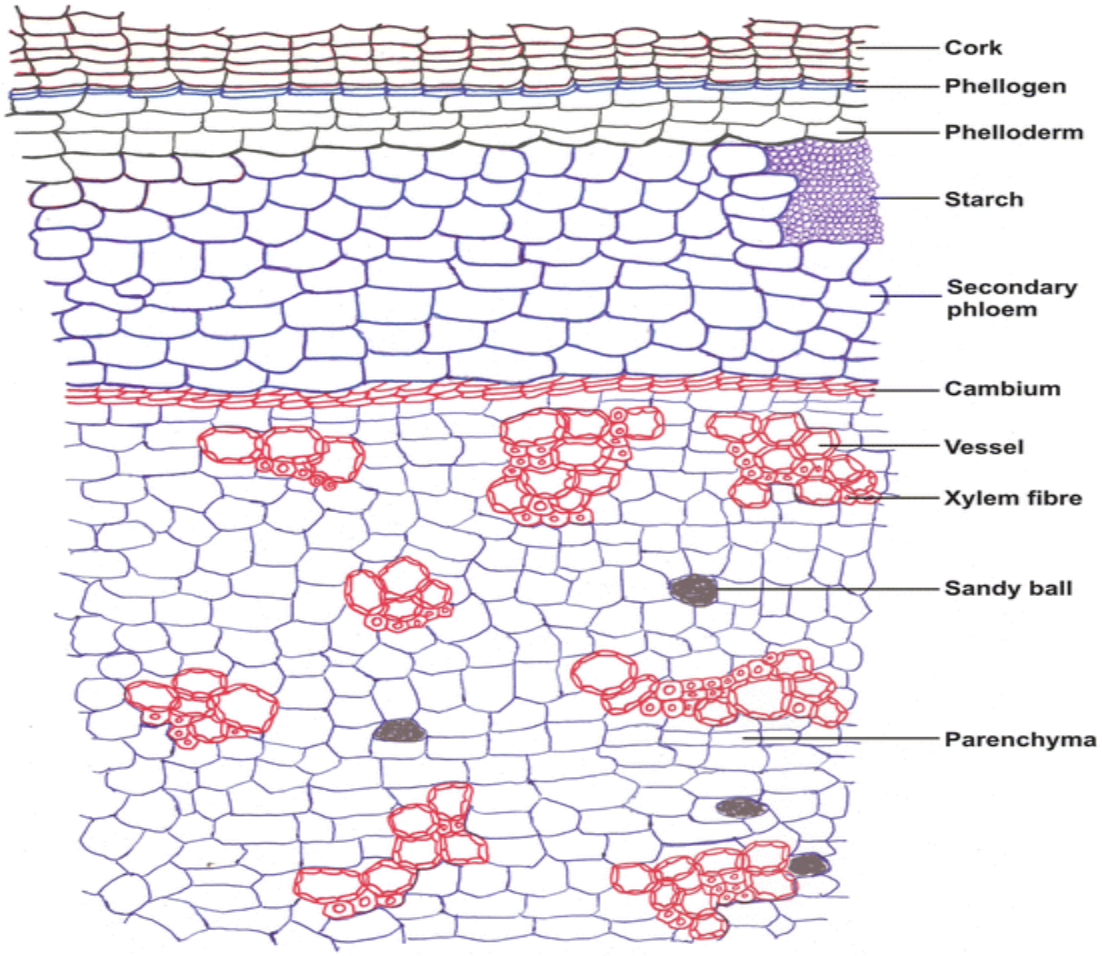
(vii) Ovary- superior, bilocular with numerous ovules and axile Placentation

Fruits:

(i) Colour- green to dark purplish black,

(ii) Type- berry.

Microscopical characters of belladonna root:



T. S. of Belladonna root

Periderm:

Periderm is distinguishable into Phellogen and Phelloderm

Cork:

Cork few layers, cells tangentially elongated and arranged in radial rows.

Phellogen:

Phellogen is not distinguishable through a faint layer can be made out.

Phelloderm:

Phelloderm few layers, cells tangentially elongated and contain starch and yellowish matter.

Secondary Phloem:

Several layers of starch bearing parenchyma with groups of sieve elements. Phloem fibres absent. Numerous sandy bails, a characteristics feature of belladonna root and leaf, are seen scattered throughout in the phloem tissue.

Cambium:

It is represented in the form of a ring containing 4 to 5 layers of rectangular cells arranged in radial rows.

Secondary xylem:

Secondary xylem forms the bulk of the root and occupied a large area. Secondary xylem consists of largely starch bearing parenchyma with several scattered groups of vessels (3 to 10), associated with tracheids, fibres and Cellulosic parenchyma. The groups of vessels are more towards the cambium. Primary xylem forming the central mass shows distinct diarch nature.

Chemical constituents:

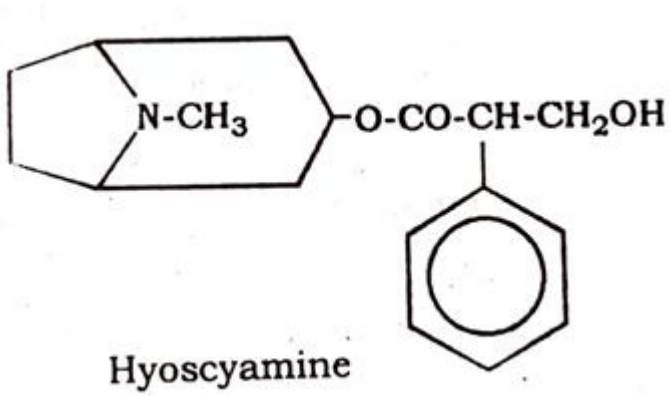
1. Tropane alkaloids (0.2-0.5%):

i. L-hyoscyamine (90%),

ii.D, L- hyoscyamine(Atropine)

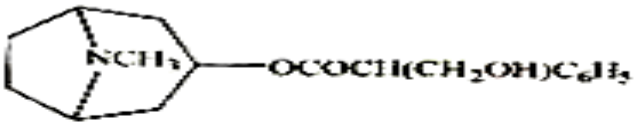
iii. Scopolamine (10%),

iv. Apoatropine,

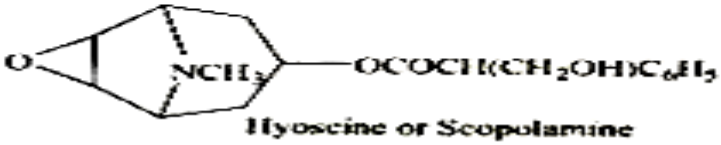


Hyoscyamine

iv. Belladonnine (+).



Hyoscyamine or Atropine



Hyoscine or Scopolamine

Uses:

i. Mydriatic (dilation of the pupil).

ii. Antispasmodic (a drug that counteracts a sudden, violent, involuntary muscular contraction)

iii. Antimuscarinic effect (acts peripherally to produce parasympathetic inhibition).

iv. Antisialagogue (a drug that arrest the flow of excess of saliva)

v. Cerebral sedative (reduce excitement)

Chemical Test:

Vitali Test:

A drop of fuming HNO_3 is added it a small portion of a extract of any Solanaceous drug like species of Atropa, Hyoscyamus and Datura or the Tropane alkaloids themselves and then

evaporated to dryness on a water bath. Thereafter it is cooled and on addition of 2 drops of 5% alcoholic potassium hydroxide solution, purple colour is formed indicating the presence of Tropane alkaloids.

Substitute and adulterants:

Belladonna is compared along with two common adulterants.

Powder analysis of Belladonna leaves:

1. Calcium oxalate crystals:

Fragments of mesophyll tissue containing sandy balls particularly in the vicinity of vascular strands.

2. Stomata:

Anisocytic or cruciferous type meaning thereby that the stomal pore is surrounded by β epidermal cells of which one is invariably smaller than the other two.

3. Epidermal cells:

Walls of the epidermal cells are wavy and striations are seen on the cuticle.

4. Trichomes:

Rare but both covering and glandular trichomes appears to occur.

5. Organoleptic characters:

Colour:

Dark green colour powder

Odour:

Faint.

Taste:

Slightly bitter

Medicinal uses

Scopolamine and atropine

Belladonna contains chemicals used to treat conditions such as irritable bowel syndrome.

- Belladonna contains two chemicals used for medicinal purposes.
- The first chemical is scopolamine, which is used primarily for reducing body discharges. It is also helpful in reducing stomach acid, which can help with both nausea and acid reflux.
- Scopolamine is also used for controlling the heart rate and relaxing muscles.
- The second compound extracted from belladonna is atropine. Similar to scopolamine, atropine can be used to help reduce bodily discharge, but it is not as effective as scopolamine when used as a muscle relaxant and in heart rate control.
- Also, atropine can be used to dilate the eyes. In some cases, atropine works as an antidote to insect poison and chemical warfare agents.
- Once extracted, one or both chemicals are combined with other medications to help treat some diseases and conditions.
- Blurred vision and hallucinations are potential side effects of belladonna.

Marketed Products

- It is one of the ingredients of the preparation known as Belladona plaster (Surgi Pharma) for backache, stiffness of muscles and boil, swollen joints.

Opium

Synonyms

Crude Opium; Raw Opium; Gum Opium; Afin; Post.

Biological Source

Opium is the air dried milky latex obtained by incision from the unripe capsules of *Papaver somniferum* Linn, or its variety *P. album* Decand., belonging to family Papaveraceae. Opium is required to contain not less than 10% of morphine and not less than 2.0% of codeine. The thebaine content is limited to 3%.

Geographical Source

It is mainly found in Turkey, Russia, Yugoslavia, Tasmania,India, Pakistan, Iran, Afghanistan, China, Burma, Thailand and Laos. In India, Opium is cultivated in M.P. (Neemuch) and U.P. for alkaloidal extraction and seed production.

Cultivation and Collection

- Opium is cultivated under license from the government.
- Its seeds are sown in October or March in alluvial soil.
- After germination of seeds snow falls. In spring the thin plant attains the height of 15 cm. Fertilizers are used for better crop.
- The poppy of first crop blossoms in April or May and the capsule mature in June or July.

- When the capsules are about 4 cm in diameter, the colour changes from green to yellow;

- they are incised with a knife about 1 mm deep around the circumference between midday and evening.

- The knife, known as a 'nushtur' bears narrow iron spikes which are drawn down the capsule to produce several longitudinal cuts.

- The incision must not penetrate into the interior of the capsule otherwise latex will be lost.

- The latex tube opens into one another. The latex, which is white in the beginning, immediately

- coagulates and turns brown.

- Next morning it is removed by scrapping with a knife and transferred to a poppy leaf. Each capsule is cut several times at intervals of two or three days.

- After collection the latex is placed in a tilted vessel so that the dark fluid which is not required may drain off. By exposure to air the opium acquires a suitable consistency for packing.

- The dried latex is kneaded into balls, wrapped in poppy leaves and dried in shade. The principal commercial varieties of Opium are Turkish Opium, Indian Opium, Chinese Opium, Yugoslavian Opium and Persian Opium.

Characteristics

Opium poppy (*Papaver somniferum* capsules)

Opium occurs in rounded or flattened mass. It is plastic like when fresh and turns hard and brittle after sometime.

Size: 8–15 cm in diameter and weighing from 300 g to 2 kg each.

Color: pale or chocolate-brown,

Texture: uniform and slightly granular. Fragment of poppy leaves are present on the upper surface.

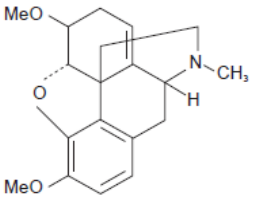
Internal surface :coarsely granular, reddish-brown, lustrous;

Odor: characteristic;

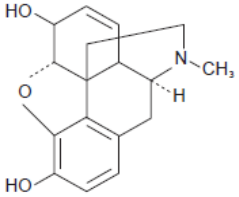
taste: bitter and distinct.

Opium is intended only as a starting material for the manufacture of galenical preparations and is not dispensed as such.

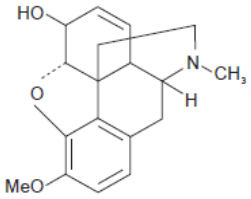
Chemical Constituents



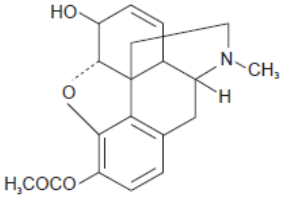
Thebaine



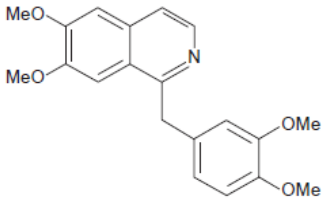
Morphine



Codeine



Heroin



Papaverine

Opium contains about 35 alkaloids among which morphine (10–16%) is the most important base. The alkaloids are combined with meconic acid.

The other alkaloids isolated from the drug are codeine (0.8–2.5%), narcotine, thebaine (0.5–2%). noscapine (4–8%), narceine and papaverine

(0.5–2.5%). Morphine contains a phenanthrene nucleus.

The different types of alkaloids isolated are:

1. *Morphine Type:* Morphine, codeine, neopine, pseudo or oxymorphine, thebaine and porphyroxine.

2. *Phthalide Isoquinoline Type:* Hydrocotarnme, narcotoline,1-narcotine, noscapine, oxynarcotine, narceine, and 5'-O-demethyl-narcotine.

3. *Benzyl Isoquinoline Type:* Papaverine, dl-laudanine, laudanidine, codamine and laudanosine.

4. *Cryptopine Type:* Protopine, cryptopine.

5. *Unknown Constituents*: Aporeine, diodeadine, meconidine, papaveramine and lanthopine.

Chemical Tests

1. Aqueous extract of Opium with FeCl3 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. H2SO4 and formaldehyde.

Uses

- Opium and morphine have narcotic, analgesic and sedative action and used to relieve pain, diarrhea dysentery and cough.
- Poppy capsules are astringent, somniferous, soporific, sedative and narcotic and used as anodyne and emollient.
- Codeine is mild sedative and is employed in cough mixtures.
- Noscapine is not narcotic and has cough suppressant action acting as a central antitussive drug. Papaverine has smooth muscle relaxant action and is used to cure muscle spasms. Opium, morphine and the diacetyl derivative heroin, cause drug addiction.

PHENYLPROPANOIDS

- Phenylpropanoids are group of organic compounds with six-carbon, aromatic phenyl and a three-carbon propene tail of coumaric acid.
- They are synthesized by plants from the group amino acids phenylalanine and tyrosine via shikimic acid pathway.
- compounds constitute a broad range of structural cyclic substances.
- They are formed as a result of deamination of the amino acid phenylalanine by the enzyme phenyl alanine-ammonia lyase (PAL).Phenylpropanoids can be structurally different due to hydroxylation, glycosidation,alkylation, prenylation, sulfation, and methylation.
- They are ingredients of essential oils obtained from anis, cinnamon bark, and clove and are used for fragrances and aromatherapy.

CLASSIFICATION

There is still no generally accepted classification of this group of compounds. Classification is based on current impression of the biosynthesis of phenolic comp Phenylpropanoids can conveniently be treated as a large class of natural comp consisting of the following groups

1. Simple phenylpropanoids:

a) Cinnamyl alcohols and their derivatives (ethers, glycosides);
b) Cinnamic acids and their derivatives (esters, glycosides, other derivatives)
c) Cinnamamides;
d) Cinnamaldehydes;
e) Phenylpropanoids.

II Complex phenylpropanoids:

a) Phenylpropanoid glycosides based on phenylethanes;
b) Oxidative coupling products (lignoid):flavonolignans;coumarinolignans; alkaloidolignans, neolignans; lignans (dimers and oligomers of phenylpropanoids).

III Biogenetically related phenylpropanoids (flavonoids, coumarins, etc.).

ISOLATION AND PURIFICATION OF PHENYLPROPANOIDS

- Many phenylpropanoids, especially lignan glycosides and conjugated phenylethanoids, are non crystalline compounds so they require examination. Therefore, additional effort is needed to isolate them.
- Refined preparative methods of isolation, chromatography (HPLC), preparative HPLC.
- Fractionation by various organic solvents is also effective for seperating phenylpropanoids
- The use of column chromatography is also effective method for isolation of phenylpropanoids

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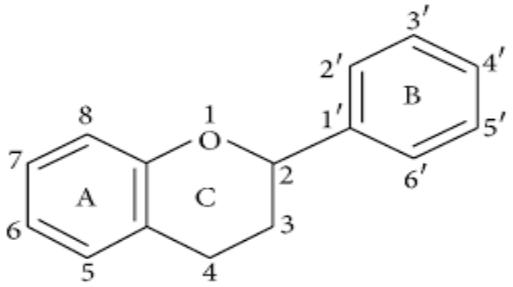
FLAVONOIDS

INTRODUCTION

- Flavonoids (or bioflavonoids) (Latin word flavus meaning yellow) are secondary metabolite of Plants and fungus.
- Chemically, flavonoids contain 15-carbon skeleton, which consists of two phenyl rings(A and B) and a heterocyclic ring (a three carbon bridge, C). This carbon structure can be abrivated C6-C3-C6.



Flavonoid structure

FUNCTIONS OF FLAVONOIDS IN PLANTS

To attract pollinator animals flavonoids play important role as plant pigments for flower coloration, producing yellow or red/blue pigmentation in petals.

Flavonoids in higher plants involved in UV filtration, nitrogen fixation and floral pigmentation.

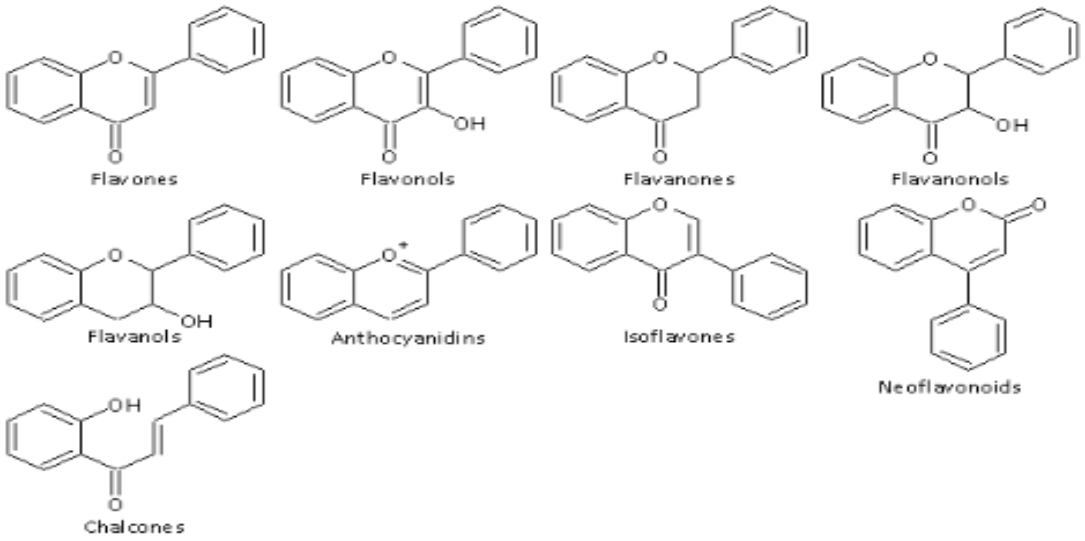
- They may also act as chemical messengers, physiological regulators, and cell cycle inhibitors.
- Flavonoids in combination with Rhizobia living in soil can lead to root hair deformation and several cellular responses such as ion fluxes and the formation of a root nodule.

CLASSIFICATION

Flavonoids can be subdivided into different subgroups depending on the carbon of the C ring on which the B ring is attached and the degree of unsaturation and oxidation of the C ring. Flavonoids in which the B ring is linked in position 3 of the C ring are called isoflavones. Those in which the B ring is linked in position 4 are called neoflavonoids, while those in which the B ring is linked in position 2 can be further subdivided into several subgroups on the basis of the structural features of

the C ring. These subgroups are:davones, flavonols, flavanones, flavanonols, flavanols or catechins, anthocyanins

Chalcones.



1) Flavones

Ring A is substituted by two phenolic hydroxyl group at C-5, C-7. They have a double between positions 2 and 3 and a ketone in position 4 of the C-ring. These represents majority of flavonoids.

Flavones are widely present in leaves, flowers and fruits as glucosides Celery, red peppers, chamomile, mint and ginkgo biloba are among the major sources of flavones Examples: Apigenin, Luteolin, Parsley-Apin. Buchu: Diosmin

2) Flavonols

Compared with flavones, flavonols have a hydroxyl group in position 3 of the C ring Which may also be glycosylated .Flavonols are flavonoids with a ketone group. They are

Building blocks of proanthocyanidins.

Examples: Buck wheat-Rutin, Ring (Crataegus oxycantha)-Quercetin.

3) Flavanones

Flavanones, also called dihydroflavones, have the C ring saturated, therefore unlike flavones, the double bond between positions 2 and 3 is saturated and this is structural difference between the two subgroups of flavonoids.

Examples: Lemon, sweet orange Hesperidin, Bitter orange

4) Flavanonols

Flavanonols, also called dihydroflavonols, are the 3-hydroxy derivatives of flavanones they are highly multisubstituted subgroup

Examples: Taxifolin (dihydroquercetin), dihydrokaempferol

5) Isoflavones

As anticipated, isoflavones are a subgroup of flavonoids in which the B ring is a position 3 of the C ring

Examples: Sharpunkha-Tephrosia.

6) Flavanols

Flavanols are also referred as catechins as well flavan-3-ols. In flavanols hydroxyl group is almost always bound to position 3 of C ring

Examples: Catechin, Epicatechin VID

7) Anthocyanidins

Anthocyanidins are the aglycones of anthocyanins; they use the flavylium phenylchromenylium) cations. Sugar units are bound mostly to position 3 of the C ring and they are often conjugated with phenolic acids, such as ferulic acid.

8) **Chalcones**

Chalcones and dihydrochalcones are flavonoids with open structure; they are classified as flavonoids because they have similar synthetic pathways.

Examples:Safflor red-carthamin

CHEMICAL TESTS

1) Shinoda test

To dry powder or extract, add 5 ml of 95% ethanol few drops of concentrated hydrochloric acid and four pieces of magnesium turnings.

A pink or red colour indicates the presence of flavonoid Colours varying from orange to indicated flavones, red to crimson indicated flavonoids, crimson to magenta indicated flavonones.

2) Sodium hydroxide test

About 5 mg of the compound is dissolved in water, warmed and filtered 10% aqueous sodium hydroxide is added to 2 ml of this solution. This produces a yellow coloration. A change in color from yellow to colorless on addition of dilute hydrochloric acid is anindication for the presence of flavonoids.

3) p-Dimethylaminocinnamaldehyde test

A colorimetric assay based upon the reaction of A-rings with the chromogen p dimethylaminocinnamaldehyde (DMACA) has been developed for flavanoids.

ISOLATION OF FLAVONES AND FLAVONOLS:

- The powder plant material is extracted with boiling water.
- Then above mixture is treated with lead acetate to remove tannins as lead salts
- Further filter it and dilute filtrate with water, acidified with hydrochloric acid and boiled for some hours so that sugar free flavones or flavonols are precipitated
- Separation of precipitated flavones or flavonols is extracted with alcohol.
- Isolation and purification is done by fractional crystallization of their acetates or by

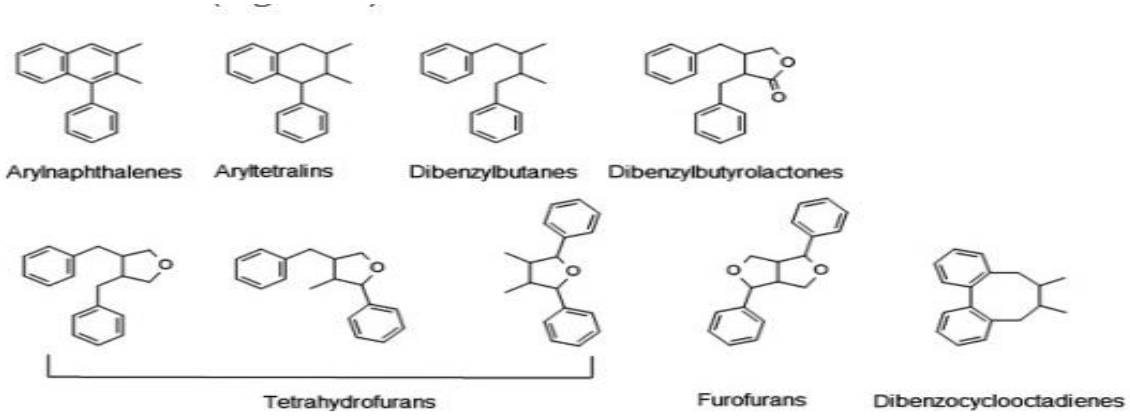
- re-crystallization from some organic solvents like benzene, carbon disulfide,alcohol, etc.

INTRODUCTION

- The lignans are a subgroup of non-flavonoid polyphenols found in plants.
- They are derived from phenylalanine by shikimic acid biosynthetic pathway.
- They are not present in the free form in nature, but linked to other molecules, mainly as glycosylated derivatives Examples: Flaxseed (linseed) that contains mainly secoisolariciresinol (SECO).
- Their basic chemical structure consists of two phenylpropane units linked by a C-C bond between the central atom of the respective side chains (position 8 or β)
- Lignans serve an antioxidant role in the plant defense against biotic

CLASSIFICATION

Based on their carbon skeleton, cyclization pattern, and the way in which oxygen is incorporated in the molecule skeleton, they can be divided into 8 subgroups:



1. Furans,

2 Furofurans,

3. Dibenzyl Butane, 4. Dibenzyl Butyrolactone,

5 Dibenzocyclooctyne, 6. Dibenzyl Butyrolactone,

7. Aryltetralins And

8. Aryl Naphthalene

Identification Test

High-performance liquid chromatography (HPLC) with photodiode array detector (PDA) and tandem mass spectrometry (MS) has facilitated qualitative and quantitative evaluation of lignans

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

- It is an evergreen shrub growing to 4 m by 2.5 m at a slow rate.

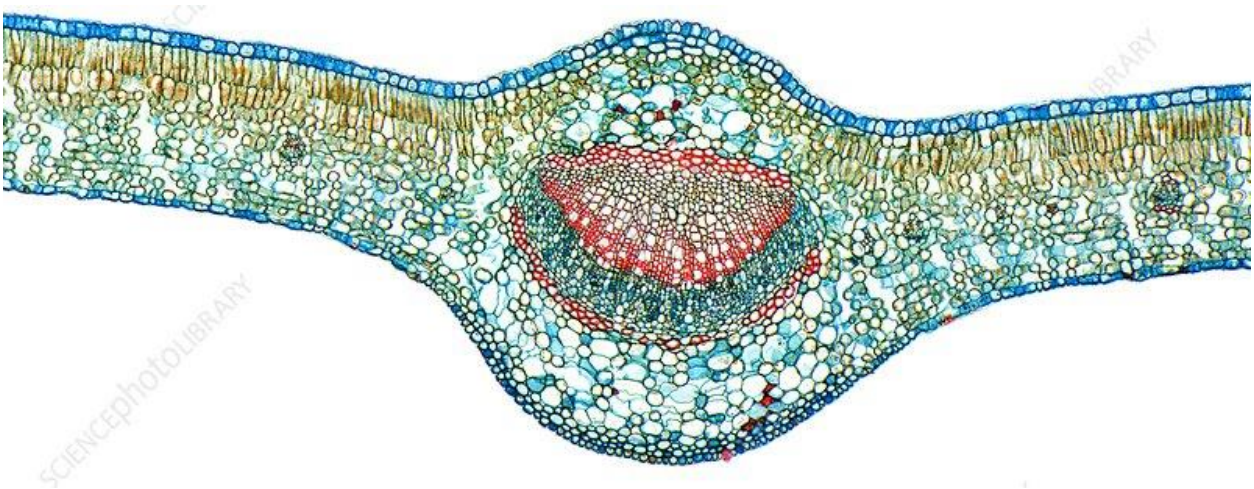
- The plant prefers light (sandy) and medium (loamy) soils and requires well-drained soil.
- The plant prefers acid and neutral soils and can grow in very acid soil.
- It can grow in semishade (light woodland).
- It requires moist soil and prefers a pH between 5 and 7.
- Prefers the partial shade of light woodland or a woodland clearing.
- It is reported to tolerate an annual rainfall of 70–310 cm, an average annual temperature range of 14–27°C and a pH in the range of 4.5–7.3.
- It prefers a wet summer and a cool but not very frosty dry winter.
- Seed can be sown as soon as it is ripe in a green house.
- 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

colour :Leaves are dark green

Shape: lanceolate or elliptical, short stalks, blunt at apex, base tapering, margins shortly serrate, young leaves hairy, older leaves glabrous.

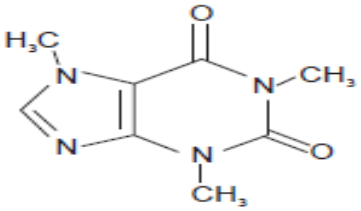
Microscopy



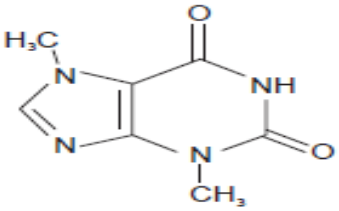
- The epidermal cells are made of polygonal cells which are slightly wavy walls.
- It consist on itself stomata and trichomes.
- The trichomes are thick walled, uni-cellular, conical (covering) which arise on the lower surface and in large number in young leaves.
- The mesophyll region consist of two rows of palisade parenchyma cells and large lignified sclereids which arise at some intervals and are extended across the mesophyll from one epidermis to the other.
- Cluster crystals of calcium oxalate are scattered in phloem and in parenchyma. In the midrib area a prominent ridge is present both above and below. Vascular bundle consisting of xylem and phloem are present; the entire region being covered by slightly lignified band of pericyclic fibres.
- The pericyclic fibres are up to four fibres in width at the widest region. The remaining portion is covered with spongy parenchyma with scattered lignified sclereids.

Chemical Constituents

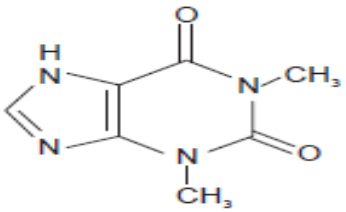
The leaves are a rich source of caffeine (1–5%). It also contains theobromine and theophylline in minor quantities. The colour of tea leaves is due to tannin (10–20% gallotannic acid). The agreeable odour is due to presence of a yellow volatile oil. Tea leaves also contain protein,wax, resin and ash.



Caffeine



Theobromine



Theophyline

Chemical Tests

1. Caffeine and other purine alkaloids, gives murexide colour reaction. Caffeine is taken in a petridish to which hydrochloric acid and potassium chlorate are added 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

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

RUTA

Synonyms*:* Rue, Sadab

Biological Source:

It consist of fresh and dried leaves of *Ruta graveolens* L., is a strongly odoriferous evergreen herbs or a small shrub, belonging to the
family Rutaceae

Geographical source : *Ruta graveolens* is cultivated as a medicinal and ornamental herb in many countries including India./

Morphological characters

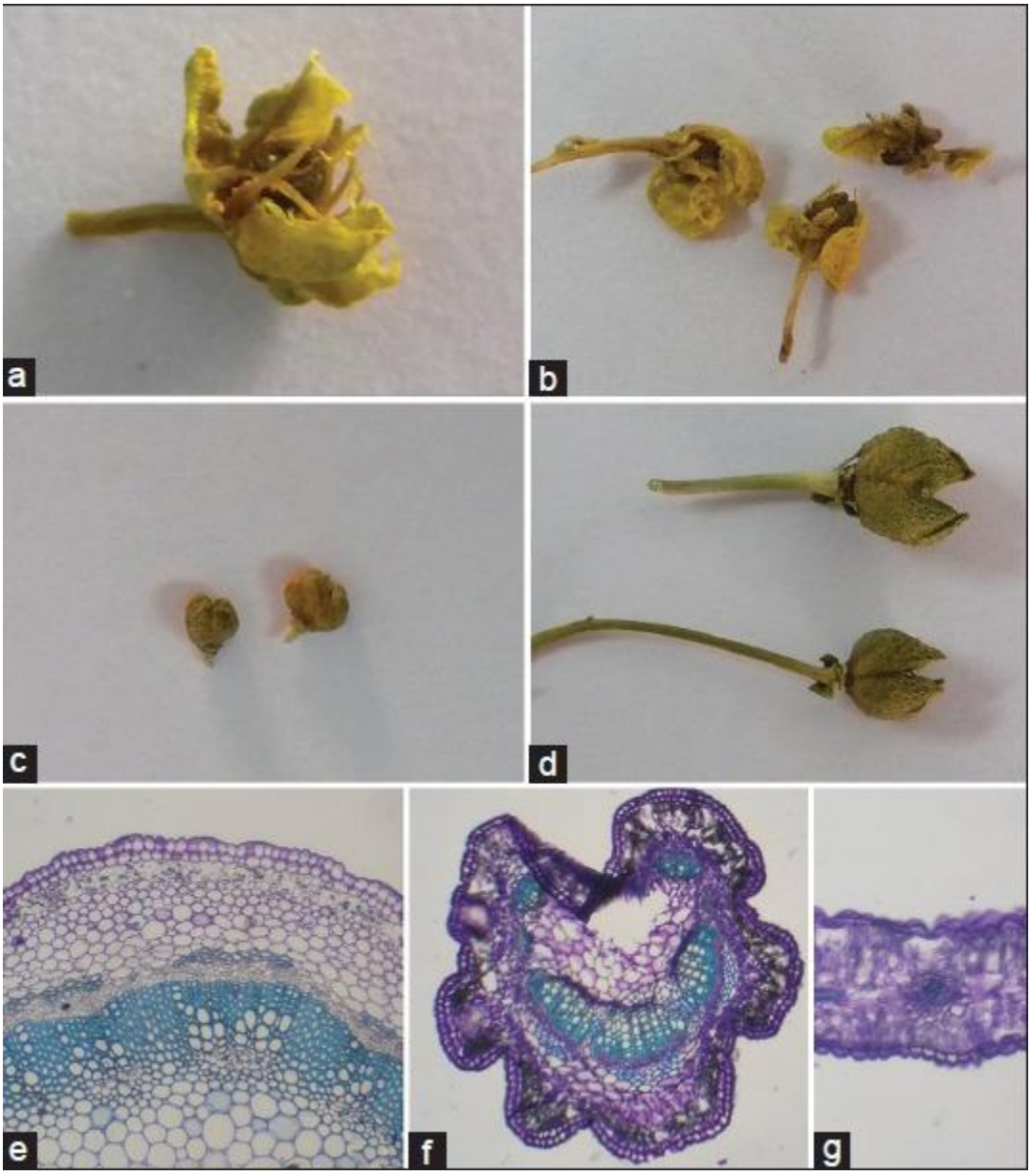
Ruta graveolens L., is a perennial, scented and glabrous herb or a sub-shrub. Stem is slender, smooth, pale glaucous green and reaches up to a meter in height.

Leaves are alternate, gland-dotted, glaucous, compound, 2-3 pinnate. Leaf-lets are linear-oval or oblong. Inflorescence is terminal corymbose, irregularly dichotomous cymes.

Flowers are regular bisexual, terminal ones are pentamerous and others are tetramerous.

Petals are distinct, widely spreading, greenish yellow, wide and hooded at top, abruptly connected to narrow claw below, margin wavy and sometimes toothed .Fruits are dry, hard, roundish, 4-5 blunted lobed at top .

Ruta chalepensis L. is observed more or less similar in its morphological characters. The strong fetid smell, ciliate or fringed petals and sharp fruit lobe tops differentiate this plant from *Ruta Graveolens* L



(a) Flower of *Ruta graveolens* (b) Fruit of *Ruta graveolens* (c) Flower of *Ruta chalepensis* (d) Fruit of *Ruta chalepensis* (e) TS of stem (a portion enlarged) *Ruta graveolens* (f) TS of petiole of *Ruta graveolens* (g) TS of leaf of *Ruta graveolens*

Macroscopic characters of the crude drugs

Ruta graveolens

Market sample consists of chopped pieces or the coarsely powdered aerial parts. They are aromatic and pleasant. The bulk sample is mild to grayish green in color. Usually stem

pieces and leaves are the major portion of the bulk sample. It also consists of flowers and fruits in notable quantity but not in all batches. Stem pieces are up to 15 cm long and 5 mm in thickness. They are mild green outer and white inside, longitudinally shrunken or flattened, hollow or with white translucent pith, smooth surface, sharp in cut ends, woody and fracture is fibrous. Leaves are slightly fragile and most of them are nearly powdery in the bulk sample. They are green to mild green to grayish green in color, thin, papery, with minute dots of dark green colored glands everywhere. Leaflets detach or get fragmented while handling. Flowers are dull and dark yellow. Petals are clearly undulate. Fruits are 4 or 5 lobed and have blunted tips.

Ruta chalepensis

Market sample consists of chopped pieces or the coarsely powdered aerial parts. They are strongly aromatic and fetid. The bulk sample is green to dark green in color. Along with stem and leaves, inflorescence, flowers and fruits are also present, almost in all the supplies. Stem pieces are up to 1 cm in thickness. Pith is mostly hollow in thicker pieces. Leaves are green to dark green and not highly fragile. Petals are fringed or ciliated. Top of the fruits are sharply pointed.

Microscopic characters

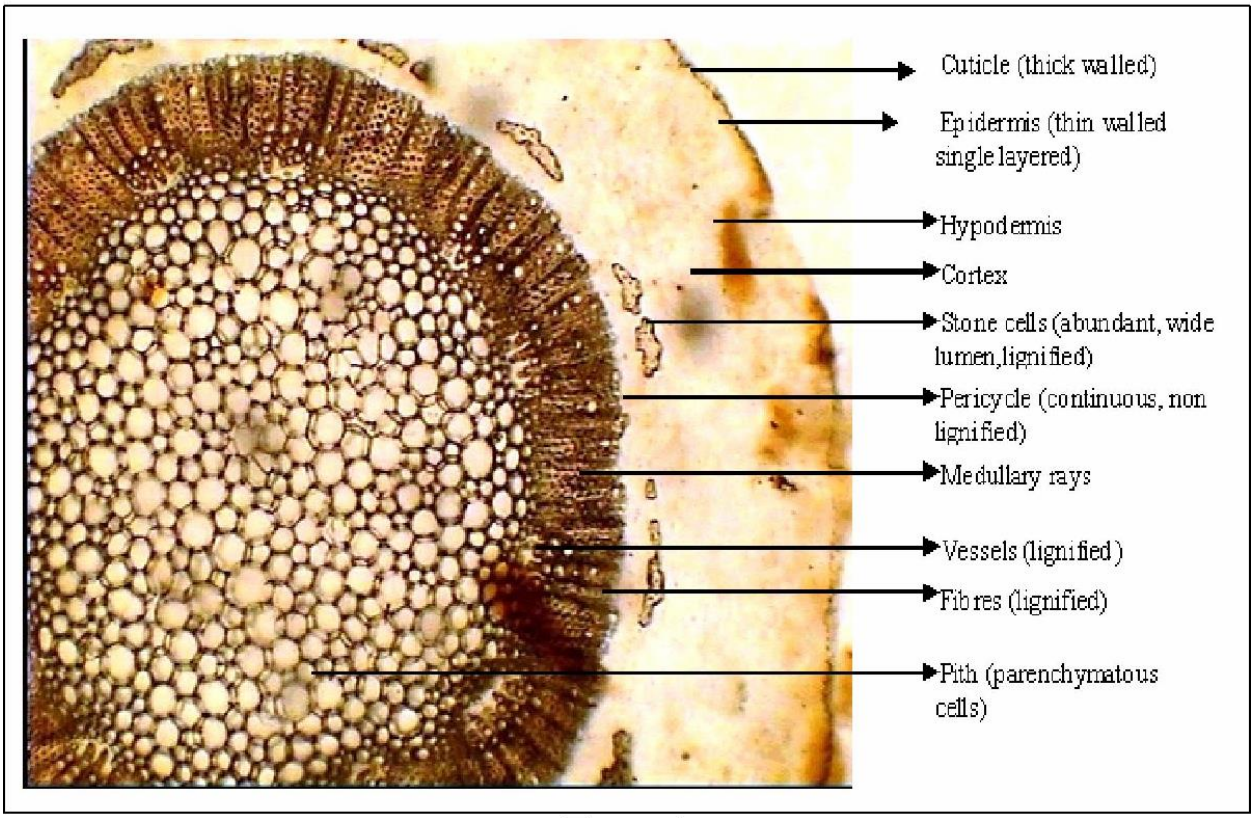


Figure 3

Ruta graveolens stem T.S. at 10X

Leaf

Petiole shows 3-5 vascular bundles in an arc. Above the arc numerous smaller sized bundles are present which may be the leaf traces. Midrib and lamina showed a typical dicot structure with single layered epidermis, double layered palisade cells and loosely arranged spongy cells. Rosette type of calcium oxalates are abundant, especially located in-between the palisade and spongy layers in *R. graveolens* whereas it is scare or nil in *R. chalepensis*.

Chemical constituents:

It is a rich source of secondary metabolites mainly: coumarins, alkaloids, volatile oils, flavonoids, and phenolic acids. It has been used abundantly worldwide due to its diverse medicinal properties.

A Series of furanoacridones and two acridone alkaloids (arborinine and evoxanthine) have been isolated from *R. graveolens*. It also contains coumarins and limonoids

Use:

- antidote to poisonous snake bite
- Extract and essential oil obtained from this plant species have been shown to possess various pharmacological activities including contraceptive, anti-inflammatory, antimicrobial, antipyretic, antioxidant, analgesic, antihyperglycemic, free radical scavenging, hypotensive, antiviral, and antiplasmodial effects

LIQUORICE

Synonyms Glycyrrhiza; Liquorice root; Glycyrrhizae radix.

Biological Sources Liquorice is the dried, peeled or unpeeled, roots, rhizome or stolon of *Glycyrrhiza glabra* Linn., invariably known in commerce as Spanish liquorice, or of *Glycyrrhiza glabra* Linne. var Glandulifera Waldstein et Kitaibel, mostly known in commerce as Russian liquorice, or of other varieties of *Glycyrrhiza glabra* Linne., which produce a sweet and yellow wood, belonging to family Leguminosae.

The word Glycyrrhiza has been derived from the Greek origin that means sweet root; and glabra means smooth and usually refers to the smooth, pod-like fruit of this particular species. Nevertheless, the fruits of the glandulifera variety has a distinct gland like swellings.

Geographical Sources Liquorice is grown in the sub-Himalayan tracts and Baluchistan. It is cultivated on a large scale in Spain, Sicily and Yorkshire (England) *G. glabra* var violaceae is found in Iran; whereas *G. glabra var glandulifera* exclusively grows in Russia (the 'Russian Liquorice').

The following are the three commonly grown varieties of *Glycyrrhiza glabra*, namely:

(a) *G. glabra var. violaceae* (or Persian Liquorice): This specific species bears violet flowers,

(b) *G. glabra var gladulifera* (or Russian Liquorice): It has a distinct big stock together with a number of elongated roots, but it has not got any stolon, and

(c) *G. glabra var. typica* (or Spanish Liquorice): This specific plant bears only purplish-blue coloured papilionaceous flowers. It possesses a large number of stolons.

Cultivation and Collection:

The roots are usually harvested after 3 to 4 years from its plantation when they mostly display enough growth.

The rhizomes and roots are normally harvested in the month of October, particularly from all such plants that have not yet borne the fruits. thereby ascertaining maximum sweetness of the sap.

The rootlets and buds are removed manually and the drug is washed with running water.

The drug is first dried under the sun and subsequently under the shade till it loses almost 50% of its initial weight.

The large thick roots of the Russian Liquorice are usually peeled before drying.

It is an usual practice in Turkey, Spain and Israel to extract a substantial quantity of the drug with water, the resulting liquid is filtered and evaporated under vacuo and the concentrated extract is molded either into sticks or other suitable forms.

Description

Colour : Unpeeled Liquorice-Externally, yellowish brown or dark brown; and internally, yellowish colour

Odour : Faint and characteristic

Taste : Sweet

Size : Length = 20 to 50 cm; Diameter = 2 cm

Shape : Unpeeled drug—Straight and nearly cylindrical

Peeled drug—Mostly angular

Fracture : Fibrous in bark; and splintery in the wood.

Chemical Constituents Glycyrrhiza (liquorice) comprises of a saponin like glycoside known as glycyrrhizin (or glycyrrhizic acid).

Glycyrrhizin is found to be 50 times as sweet as sugar. Glycyrrhizin upon hydrolysis loses its sweet taste and gives rise to the aglycone glycyrrhetinic acid (glycyrrhetic acid) together with two moles of glucuronic acid.

The former is a pentacyclic triterpene derivative of the b amyrin type. A host of other chemical constituents essentially include are namely: coumarin derivatives e.g., umbelliferone and herniarin; flavonoid glycoside e.g., liquiritoside; isoliquiritoside, liquiritin; isoliquiritin, rhanoliquiritin, and rhamnoisoliquiritin; asparagine; 22-33-dihyrostigmasterol;glucose; mannitol and about 20% of starch.Interestingly, carbenoxolone, which is an oleandane derivative is prepared from glycyrrhiza and possesses considerable mineralocorticoid activity.

It is used as an anti-ulcer drug.

Chemical Tests

1. When sulphuric acid (80%) is added to a thick section of the drug or powder, it instantly produced a deep yellow colour.

Substituents/Adulterants

Glycyrrhiza uralansis, also known as Manchurian Liquorice, which is pale chocholate brown in appearance having wavy medullary rays and exfoliated cork is mostly used as an adulterant for *G. glabra.*

This particulr species is from sugar, but contains glycyrrhizin. Sometimes, the Russian Liquorice is also used as an adulterant, because the drug is purplish in appreance, has long roots but having no stolons.

Uses

1. Glycyrrhiza has demulscent and expectorant properties

2. It is used as a masking agent for bitter drugs in pharmaceutical formulations, such as: quinine, aloe, ammonium chloride etc.

3. Ammoniated glycyrrhiza is employed as a flavouring agent in beverages, pharmaceuticals and confectionary.

4. The inherent surfectant activity due to the presence of saponins helps to facilitate the absorption of poorly absorbed drugs, for instance: anthraquinone glycosides.

5. It is invariably added to beer to form stable and enhanced foaminess.

6. It imparts a distinct and characteristic bitter tastte to a number of beverages, such as: stout, root beer and porter.

7. The presence of glycyrrhetinic acid exert mineralocorticoid activity and hence it is used in the treatment of inflamations, rhematoid arthritis and Addison's disease.

8. Liquorice is an important ingredient in 'Liquorice compound powder' wherein it augments the action of senna.

9. Liquorice liquid extract is employed as a foam stabilizer in the foam type-fire-extinguisher.

10. Liquorice liquid extract is used in the treatment of peptic ulcer.

11. In Europe the glycyrrhetic acid is employed exclusively in dermatological formulations for its remarkable antiinflammatory properties.

Caution As glycyrrhzin appreciably enhances sodium and fluid retention and promotes potassium depletion. Therefore, patients with history of either cardiac problems or hypertension must avoid consumption of signficant amount of liquorice.

DIOSCOREA

Synonyms: Yam , Rheumatism root

Biological Source: It consists of dried tubers of the plants, *Dioscorea deltoidea, D. composita,* and other spec Dioscorea,

Family Dioscoreaceae.

Geographical Source: *D. dehadea* is found growing in North Western Himalayas from Kashmir and Punjab to Nepal and China up to an altitude of 1000 to 3000 m. It is cultivated in Jammu and Kashmir and in pan Himachal Pradesh. *D. deltoidea* is also found in U.S.A. and Mexico.

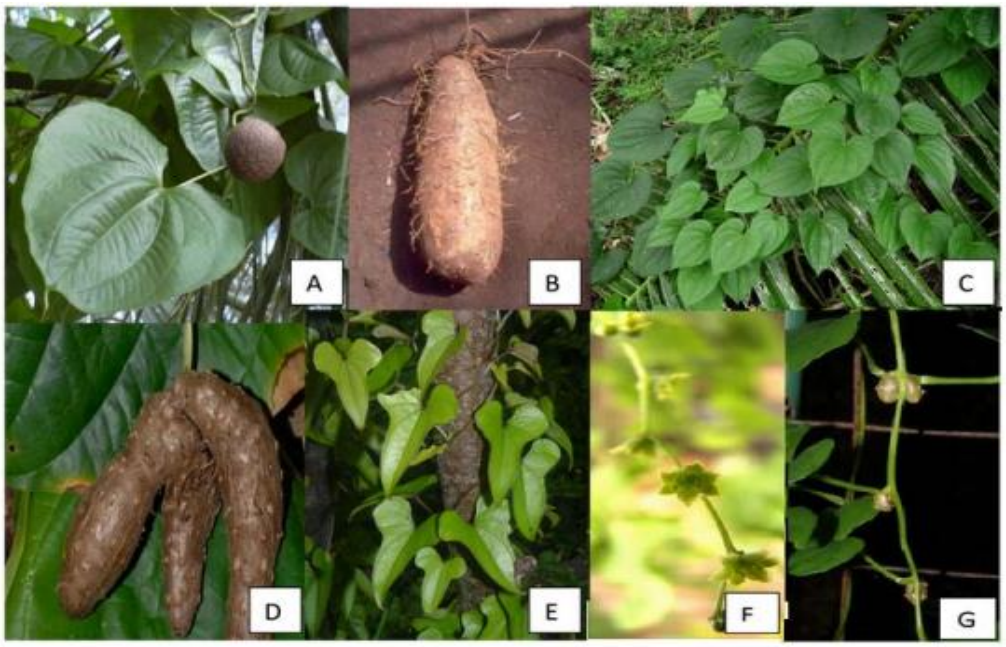
Cultivation and Collection

- In view of the pharmaceutical significance of the drug, it is tried and successfully grown in various parts of India.
- Commercially, it is grown in Tamil Nadu, West Bengal,Maharashtra, Kamataka, and Jammu and Kashmir.
- The crop can be raised from seeds, but variability in progeny and comparatively longer time for harvesting are the disadvantages with this method.
- Therefore, healthy tubers of about 70 -80 g in weight with crown are selected for cultivation.
- For checking the tuber-rot, they are treated fungicide and sown in nursery bed.
- It takes about 30 to 40 days for their sprouting,
- After 2-3 months of growth, tubers are transplanted in the field, which is treated with the insecticide While planting, the tubers are placed at a distance of 30 x 60 cm. Initially, the veins are weak and tender and they need support for their optimum growth. Trellis of 2.5 m in height are provided for this purpose. Since the tubers are

very exhaustive, a high dose of farmyard manure to the extent for 5-10 tonnes per hectare is applied in the beginning.

- Organic fertilizers should be applied subsequently in equal doses at an interval of one month. Irrigation should be done every 10 years.
- No major pests are reported in case of Dioscorea,
- However, preventive measures should taken against white-bugs and mites.
- Intercropping with legumes can be done. Fresh tub high as, 18 tonnes per hectare, can be expected from two year crop.
- Harvesting is done ploughing in the dormant season, as during this period, the diosgenin content is found to be compared to other seasons. Rhizomes lose about 50% of their weight on drying.

Macroscopic Characters



- *Dioscorea bulbifera* with bulbil. B, D- Tuber of Dioscorea alata. C- The habit of *Dioscorea alata*. E- *Dioscorea trinervia*. F- Flowering twig of *Dioscorea deltoidea*. G- Bulbils of *Dioscorea oppositifolia*.

Colour - Slightly brown

Odour- Odourless

Taste- Bitter

Size: Varies depending upon age of rhizomes

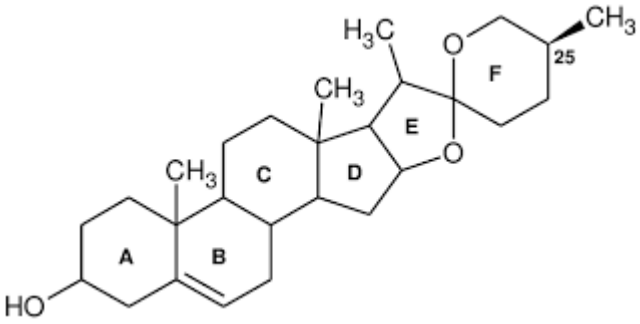
Extra Features

It is a climber with alternate leaves Rhizome are sotf, horizontally arranged and are very close to the soil.Drug is covered with scattered roots. They weigh about 20-50 g

Microscopic Characters

Epidermis is normally absent in the transverse section of the drug. The cork consists of only few layers , followed by thin walled cortical parenchymatous tissue. Stele forms the major part of the drug and consists of several close collateral fibro-Vascular bundles Endodermis and pericycle are indistinguishable.

Chemical Constituents



Diosgenin

Dioscorea rhizomes contain 75% of starch. They are non-edible, since they are very bitter in taste. The chief active constituent of dioscorea is diosgenin, a steroidal sapogenin (4 to 6%), and its glycoside, Smilagenin and epismilagenin and β-isomer yammogenin. Rhizomes are also found to contain an enzyme sapogenase. Tubers are also rich in glycosides, and phenolic compounds. Diosgenin is the hydrolytic product di saponin-dioscin.

Uses

Pharmaceutically, the rhizomes are used as rich source of diosgenin. Diosgenin being steroidal in nature as precursor for synthesis of several corticosteroids, sex-hormones, and oral- contraceptive. Dioscorea is used in the treatment of rheumatoid arthritis

Allied Species

Dioscorea floribunda is cultivated in Central America and India (Karnataka State). It contains 3 to 5% of diosgenin. *D. villosa* Linne mainly from Virginia and Carolina in U.S.A. is also very rich in diosgenin content. *D. villosa* is a twining perennial with beautiful yellow flowers and triangular capsules. Sikkimensis Prain and Burkill (syn. D. deltoidea wall var. sikkimensis Prain) occurs in Eastern Himalayas, Nepal, Sikkim, Bhutan, Assam, Bihar and Bengal upto an altitude d 1600-2000 m. It contains 2 to 2.8 per cent of diosgenin.

Costus speciosus is an alternative potential source for diosgenin (1.5 %) and can be used as a substitute for the genuine drug.

DIGITALIS

Synonyms

Digitalis leaves, Foxglove leaves.

Biological Source

Digitalis consists of dried leaves of *Digitalis purpurea*,

Family Scrophulariaceae

temperature. below 60°C, immediately after collecting the leaves. The leaves more than 5% moisture.

Geographical Source

It is cultivated and collected in England, other parts of Europe, United States and India

Cultivation and Collection

- It is a biennial or perennial herb of about 1 to 2 meters. In India, it is cultivated in Kashmir and and also in Mungapoo and Nilgiri hills.
- It is propagated by seeds of the selected strain, containing high glycosides content.
- It needs calcareous, acidic sandy, light soil with trace of manganese.
- Soil is sterilized by steam before sowing It grows suitably in shady station at an altitude of 1600 to 3000 m. Favourable temperature range 20 - 30°C and rainfall 30-40 cm per annum.
- The seeds of digitalis are very small in size i.e. 100 seeds weigh 40 to 70 mg .
- They are mixed with fine sand and sown in the nursery beds in March/ April.

- About 2.5 kg seeds are needed per hectare.
- The young seedlings are transplanted in September and November. The crop manured properly and kept free of weeds.
- The plantation is done twice a year.
- In the first year, plant bears rosette leaves and in the second year sessile leaves.
- The plant flowers in the month April and is followed by the fruiting.
- If the plants are to be allowed to grow the flowering tops remove.
- Crop is protected from plant diseases, which otherwise lead to loss of potency of drug.
- The leaves are picked up in the afternoon during August and September in the first and the second year, when 2/3 rd of the flowers are fully developed.
- The basal leaves and the leaves at top are collected at the end. The discoloured leaves are rejected.
- While collecting the leaves, dry weather is specifically selected. After plucking, the leaves are immediately brought to the drying centre and dried in vacuum drier. It curtails exposure of fresh leaves to the atmospheric condition.
- The dried leaves (containing not more than 54 of moisture) are packed into the airtight containers with suitable dehydrating agent.
- The activity of the leaves is due to the glycoside. The presence of moisture and the enzymes digipurpuridase and oxidase) cause deterioration of glycosides. If the leaves are dried above 60·C. potency is lost due to chemical degradation.

Macroscopic Characters

 *Digitalis Purpurea*	 *Digitalis Lanata*

Colour -Dark greyish-green

Odour -Slight

Taste-Bitter

Size-10 to 40 cm long and 4 to 20 cm wide

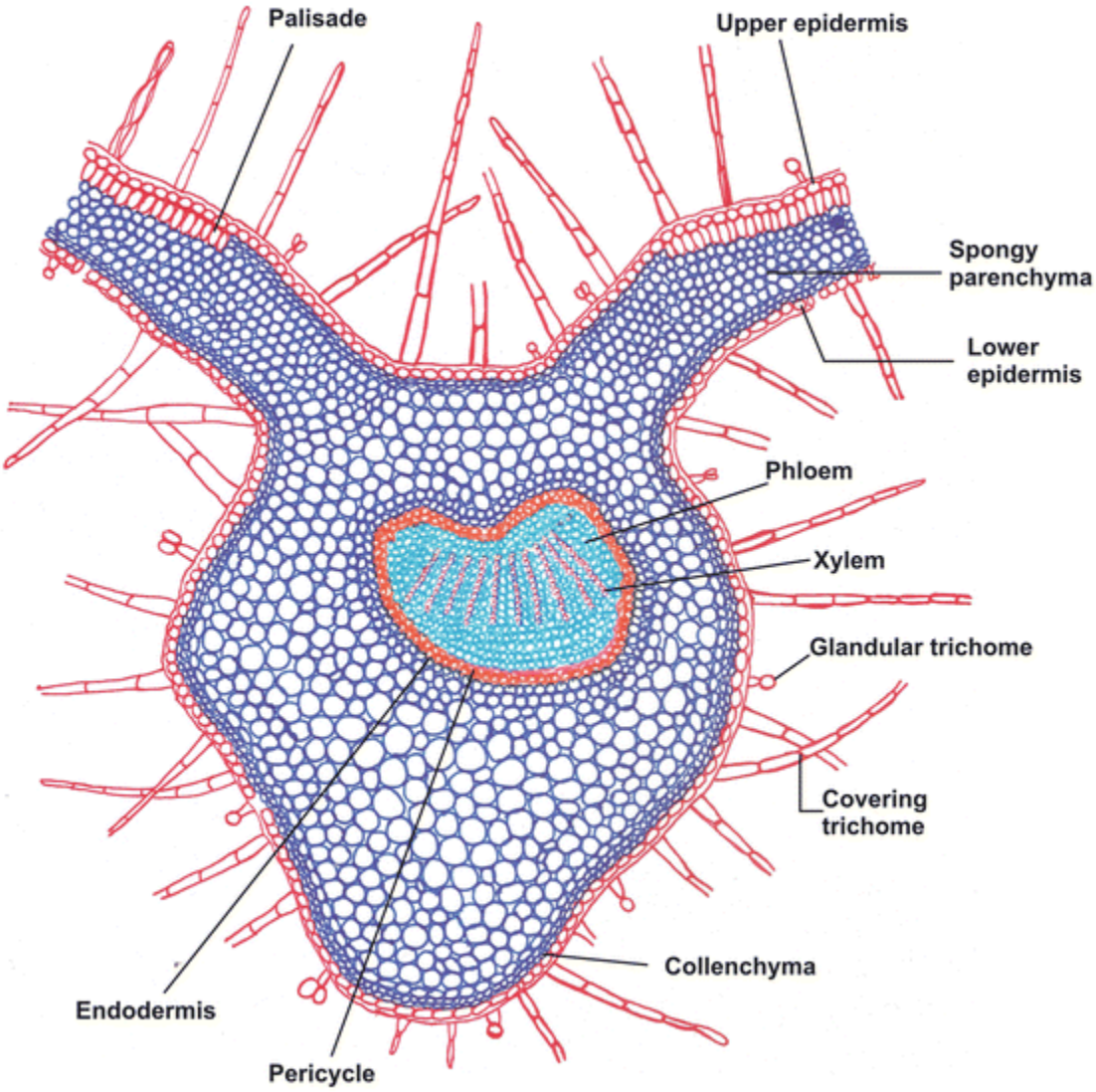
Shape-Ovate-lanceolate to broadly ovate with irregularly crenate or serrate or occasionally dentate margin Extra features.

Extra feather

The leaves are slightly pubescent on both the surfaces with pinnate venation and prominent veinlets on the under surface.

Generally, the leaves are broken and crumpled.

Microscopic Characters



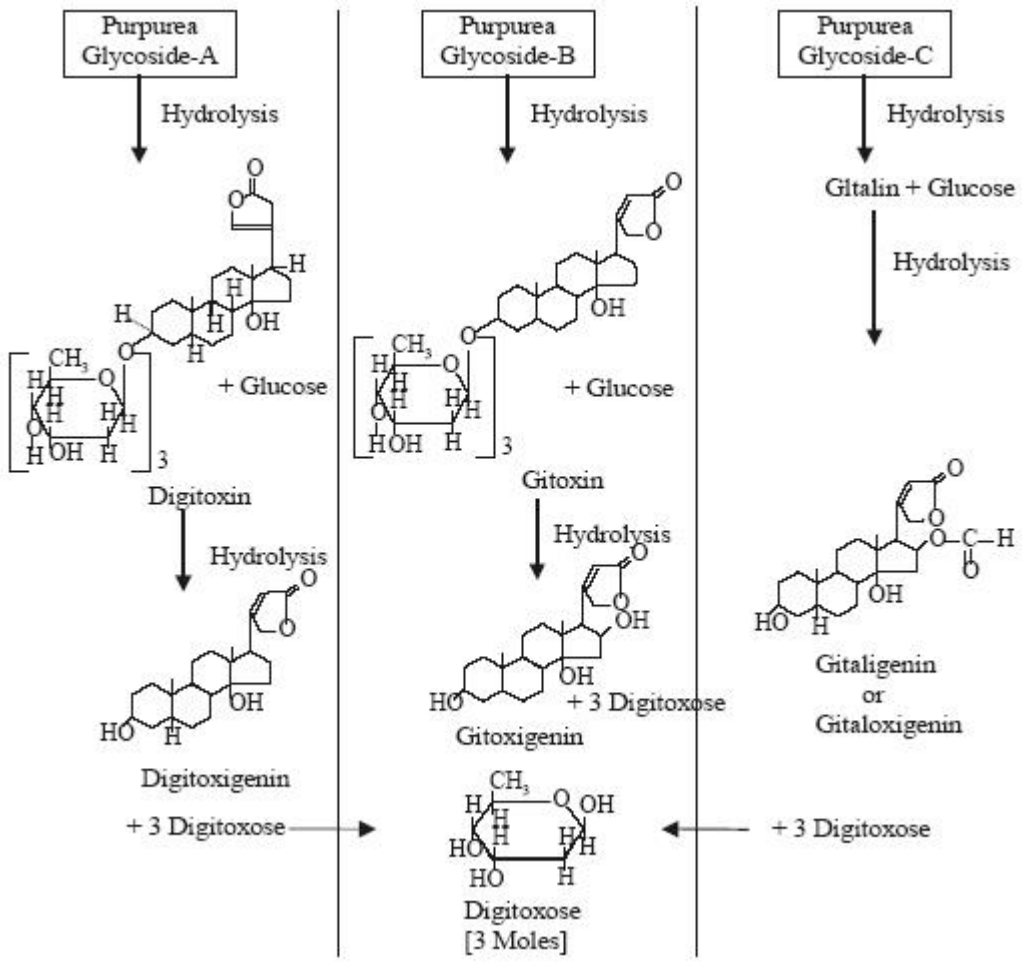
T. S. of *Digitalis purpurea* leaf

- Digitalis is a dorsiventral leaf, It has anomocytic stomata on both surfaces and water pores at the apex of most of the marginal teeth.
- The trichomes are uniseriate, multicellular (3 to 5 cells) and bluntly pointed.
- There are also glandular trichomes with unicellular stalk and unicellular or bicellular head.
- The glandular trichomes are generally located over the veins.
- Collapsed celled covering trichome is an important characteristics of digitalis.
- Digitalis is free of calcium oxalate and sclerenchyma.
- Starch grains are present in the endodermis.

- There is collenchyma at 3 different places ie. at the upper epidermis, lower epidermis, and pericyclic part, which is also characteristic to digitalis.

Chemical Constituents

- Digitalis contains 0.2 to 0.45% mixture of both primary and secondary cardiac glycoside (cardenolides). Purpurea glycoside A and B and glucogitaloxin are primary glycosides possessing of the C-3 of the aglycone, a linear chain of 3 digitoxose moieties terminated by glucose.
- Digitalis contains several other glycosides such as odoroside H, gitaloxin, verodoxin, and glucoverod .
- The primary glycosides are less absorbed and less stable than secondary glycosides such digitoxin, gitoxin and gitaloxin. The products of hydrolysis of purpurea glycoside A and purpurea glycoside B, the chief active constituents of the drug, are as under.



additionally, it contains 2 saponin glycosides, viz digitoxin and gitonin. The total number of glycoside reported in the drug is about 30. Apart from the glycosides, leaves also contain hydrolytic enzyme (Details under D. lanata).

Chemical Tests

Keller-Kiliani test for digitoxose :

- The test consists of boiling about 1 g finely powdered digitalis with 10 ml 70% alcohol for 2 to 3 minutes.
- The extract is fixed to the filtrate is added. 5 ml water and 0.5 ml strong solution of lead acetate. Shake well and separate the filtrate.

- The clear filtrate is beaten with equal volume of chloroform and evaporated to yield the extractive.
- The extractive is dissolved in glacial acetic acid and after cooling. 2 drops ferric chloride solution are added to it
- These contents are transferred to a test tube containing 2 ml concentrated sulphuric acid A reddish brown layer acquiring bluish-green colour after standing is observed due to the presence of digitoxose.

Legal test: The extract is dissolved in pyridine, sodium nitroprusside solution is added to it and made alkaline-pink or red colour is produced

Baljet test: To a section of digitalis, sodium picrate solution is added It shows yellow to orange color.

Others:

1) Foreign organic matter.

2) Loss on drying :Not more than 5 per cent ww, by drying to constant weight

3) Acid-insoluble ash :Not more than 2 per cent

Use

Digitalis is used to treat **congestive heart failure** (**CHF**) and **heart rhythm** problems (atrial **arrhythmias**).

Digitalis can increase blood flow throughout your body and reduce swelling in your hands and ankles.

Mentha

Synonym

Brandy Mint.

Botanical Source

It is the oil obtained by the distillation of *Mentha piperita*, belonging to family Labiatae.

Geographical Source

It is mainly found in Europe, United States, and also in damp places of England.

Cultivation and Collection

Mentha leaves

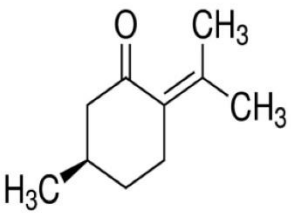
- Peppermint thrives best in a fairly warm, preferably moist climate, with well-drained, deep soils rich in humus.
- Peppermint will grow successfully, if once started into growth and carefully cultivated.
- The usual method of cultivation is to dig runners in the early spring and lay them in shallow
- trenches, 3 feet apart in well-prepared soil.
- The growing crop is kept well-cultivated and absolutely free from weeds and in the summer when the plant is in full bloom, the mint is cut by hand and distilled in straw. A part of the exhausted herb is dried and used for cattle food.

Characteristics

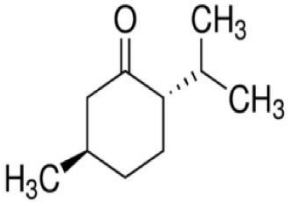
- The leaves are shortly and distinctly stalked, 2 inches long and 3/4 to 1.5 inches broad.
- The margins are finely toothed, with smooth upper and lower surfaces
- The stems are 2 to 4 feet high, frequently purplish in colour.
- The flowers are reddish-violet in colour, present in the axils of the upper leaves, forming loose, interrupted spikes.

- The plant has a characteristic odour and if applied to the tongue has a hot, aromatic taste at first and afterwards produces a sensation of cold in the mouth caused by menthol present in it.
- Oil is colourless, yellowish or greenish liquid, with penetrating odour and a burning, camphorescent taste.
- On storage it becomes thick and reddish but increases the mellowness even if it is stored for 14 years.

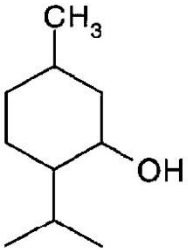
Chemical Constituents



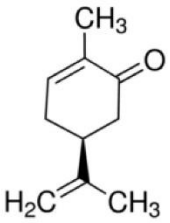
Pulegone



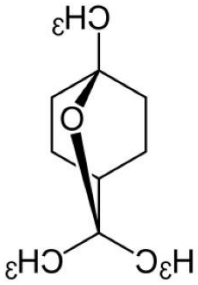
Menthon



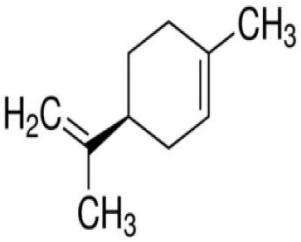
Menthol



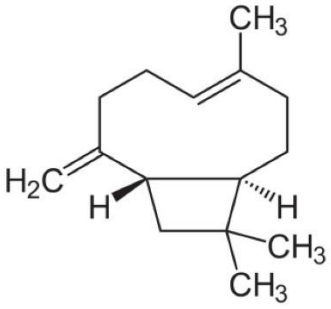
Carvone



1, 8-cineole



Limonene



β-Caryophyllene

The chief constituent of Peppermint oil is Menthol, along with other constituents like menthyl acetate, isovalerate, menthone, cineol, inactive pinene, limonene, and other less important bodies. Menthol separates on cooling it to a low temperature (–22°C).

The flavouring properties of the oil are due to both the ester and alcoholic constituents, whereas the medicinal value is attributed only due to the alcoholic components. The English oil contains 60 to 70% of Menthol, the Japanese oil containing 85%, and the American has only about 50%.

Uses

It is stimulant, stomachic, carminative, inflatulence, and colic; in some dyspepsia, sudden pains, for cramp in the abdomen and also in cholera and diarrhoea. Oil of peppermint allays sickness and nausea, as infants cordial. Peppermint is good to aid in raising internal heat and inducing perspiration. It is also used in cases of hysteria and nervous disorders.

Adulterants

Camphor oil, Cedarwood oil, and oil of African Copaiba are occasionally used as an adulterant of Peppermint oil, the oil is also adulterated with one-third part of rectified spirit. If adulterated with rectified spirit it can be identified by agitating it with water which produces milkiness.

Rosemary oil and Turpentine oil are also sometimes used as adulterants.

Marketed Products

It is one of the ingredients of the preparation known as Dabur lal tooth powder (Dabur).

CLOVE

Synonyms

Clove buds, Clove flowers.

Biological Source

Clove consists of the dried flower buds of *Eugenia caryophyllus*

Thumb., belonging to family Myrtaceae

Geographical Source

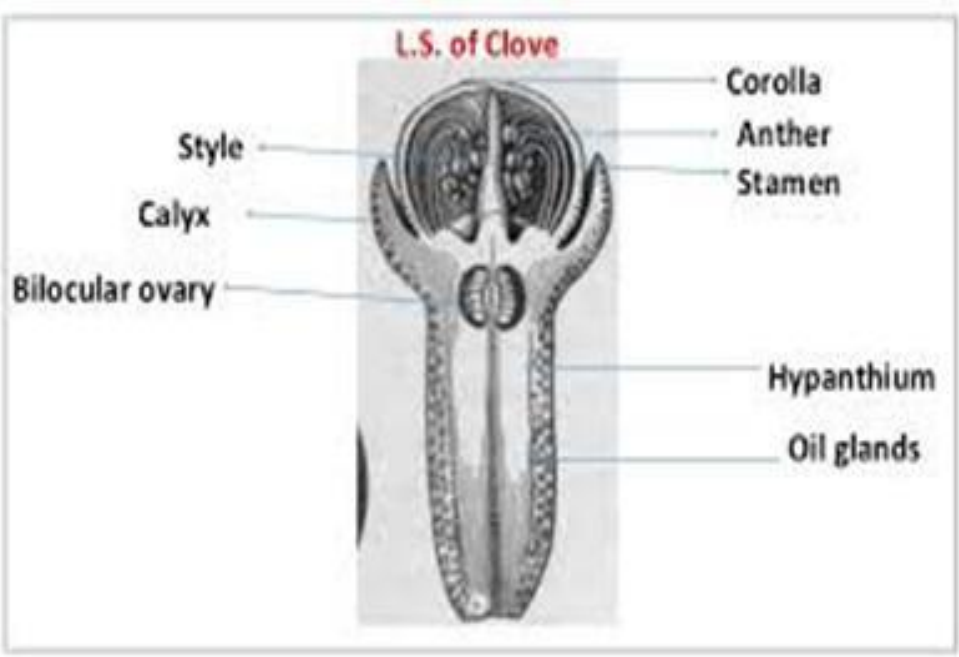
Clove tree is a native of Indonesia. It is cultivated mainly in Islands of Zanzibar, Pemba, Brazil, Amboiana, and Sumatra. It is also found in Madagascar, Penang, Mauritius, West Indies, India, and Ceylon.

Cultivation and Collection

- Clove tree is evergreen and 10 to 20 m in height.
- The plant requires moist, warm and equable climate with well distributed rainfall.
- It is propagated by means of seeds.
- The seeds are sown in well-drained suitable soil at a distance of about 25 cm.
- The plants should be protected against pests and plant diseases.
- Initially it has to be protected from sunlight by growing inside a green house or by constructing
- frames about 1 m high and covering them with banana leaves. As the banana leaves decay gradually more and more sunlight falls on the young seedlings and the seeds are able to bear full sunlight when they are about 9 months old.
- The seedlings when become 1 m high, they are transplanted into open spaces at a distance of 6 m just before the rainy season.
- The young clove trees are protected from sun even for a longer period by planting banana trees in between.
- The drug can be collected every year starting from 6 years old till they are 70 years old.
- Clove buds change the colour as they mature. At the start of the rainy season long greenish buds appear which change to a lovely rosy peach colour and as the corolla fades the calyx turns yellow and then red. The buds are collected during dry weather in the month of August to December.
- The collection is done either by climbing on the tree or by using some ladders or with the help of mobile platforms.

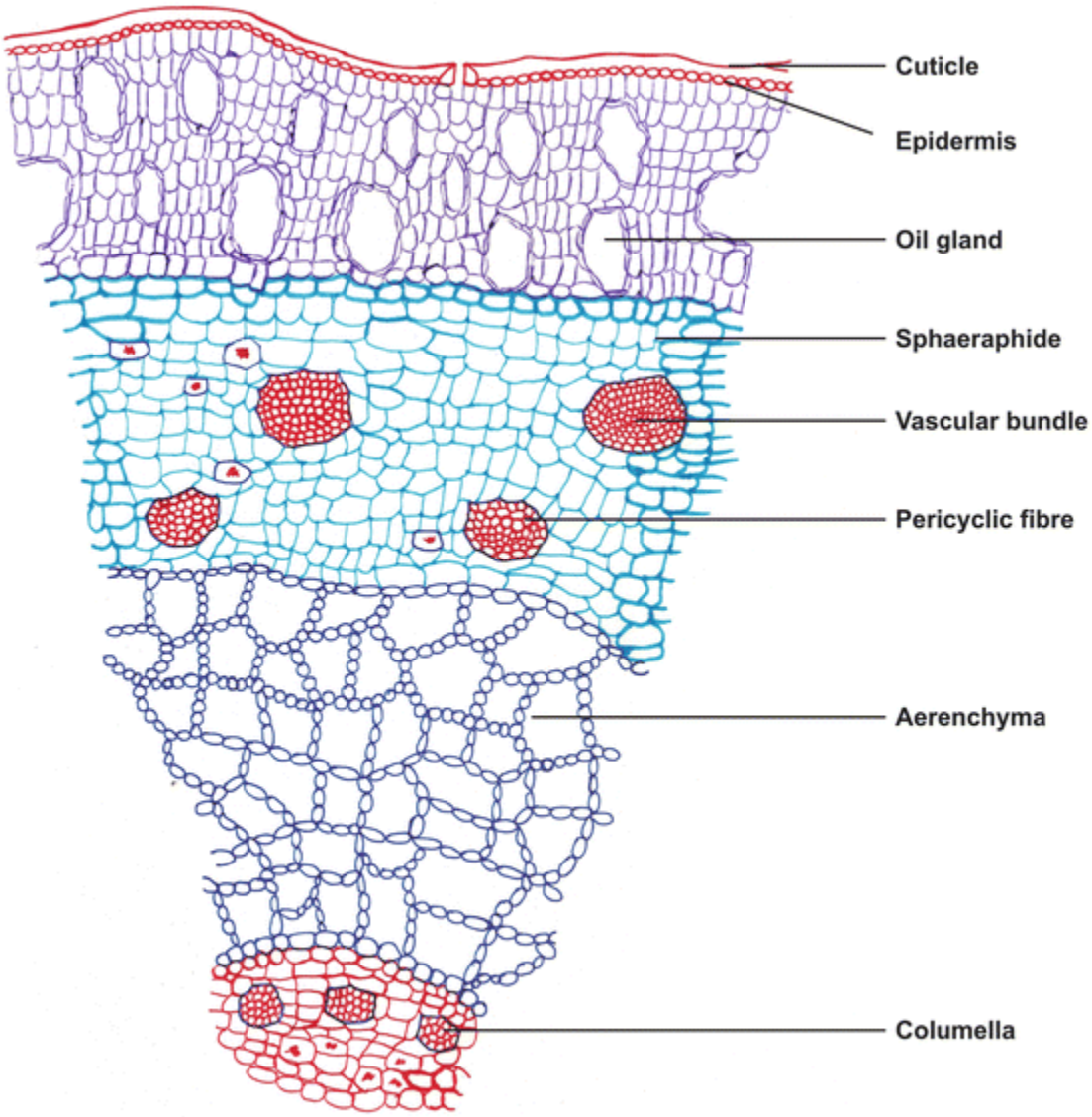
- In some places the trees are even beaten using bamboo sticks for the collection of the bud.
- The drugs which are collected are then separated from the stalks and then placed on coconut mats for drying under sun.
- The buds loose about 70% of its weight, whereas drying and change their colour to dark reddish-brown. The dried clove is graded and packed.

Characterisitics



- Clove is reddish-brown in colour, with an upper crown and a hypanthium. The hypanthium is sub-cylindrical and tapering at the end.
- The hypanthium is 10 to 13 mm long, 4 mm wide, and 2 mm thick and has schizolysigenous oil glands and an ovary which is bilocular.
- The Crown region consists of the calyx, corolla, style and stamens.
- Calyx has four thick sepals. Corolla is also known as head, crown or cap; it is doine shaped and has four pale yellow coloured petals which are imbricate, immature, and membranous.
- The ovary consists of abundant ovules. Clove has strong spicy, aromatic odour, and pungent and aromatic taste

Microscopy

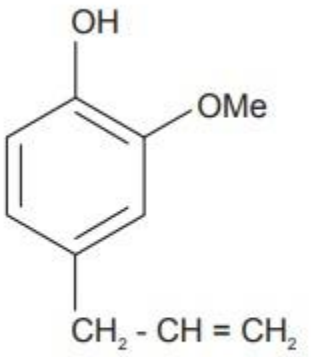


T. S. of Clove flower bud

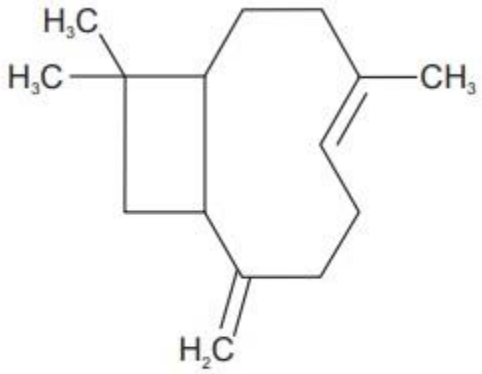
- The transverse section should be taken through the short upper portion which has the bilocular ovary and also through the hypanthium region.
- The transverse section through the hypanthium shows the following characters. It has a single layer of epidermis covered with thick cuticle.
- The epidermis has ranunculaceous stomata.
- The cortex has three distinct region: the peripheral region with two to three layers of schizolysigenous oil glands, embedded in parenchymatous cells.
- The middle layer has few layers of bicollateral vascular bundle.
- In the inner portion it has loosely arranged aerenchyma cells.

- The central cylinder contains thick-walled parenchyma with a ring of bicollateral vascular bundles and abundant sphaeraphides. The T.S. through ovary region shows the presence of an ovary with numerous ovules in it.

Chemical Constituents



Eugenol



Caryophyllene

- Clove contains 14–21% of volatile oil.
- The other constituents present are the eugenol, acetyl eugenol, gallotannic acid, and two crystalline principles; α- and β- caryophyllenes, methyl furfural, gum, resin, and fibre. Caryophyllin is odourless component and appears to be a phytosterol, whereas eugenol is a colourless liquid.
- Clove oil has 60–90% eugenol, which is the cause of its anesthetic and antiseptic properties.

Chemical Tests

1. To a thick section through hypanthium of clove add 50% potassium hydroxide solution; it produces needle shaped crystals of potassium eugenate.

2. A drop of clove oil is dissolved in 5 ml alcohol and a drop of ferric chloride solution is added; due to the phenolic OH group of eugenol, a blue colour is seen.

3. To a drop of chloroform extract of clove add a drop of 30% aqueous solution of sodium hydroxide saturated with sodium bromide; Needle and pear shaped crystals of sodium eugenate arranged in rosette are produced immediately.

Uses

- Clove is used as an antiseptic, stimulant, carminative, aromatic, and as a flavouring agent. It is also used as anodyne, antiemetic.
- Dentists use clove oil as an oral anesthetic and to disinfect the root canals.
- Clove kills intestinal parasites and exhibits broad antimicrobial properties against fungi and bacteria and so it is used in the treatment of diarrhea, intestinal worms, and other digestive ailments.
- Clove oil can stop toothache.
- A few drops of the oil in water will stop vomiting, eating cloves is said to be aphrodisiac. Eugenol is also used as local anaesthetic in small doses.
- The oil stimulates peristalsis; it is a strong germicide, also a stimulating expectorant in bronchial problems.
- The infusion and Clove water are good vehicles for alkalies and aromatics.

Adulterants

The clove is generally adulterated by **exhausted clove, clove fruits, blown cloves and clove stalks.**

The **exhausted cloves** are those from which volatile oil is either partially or completely removed by distillation. Exhausted cloves are darker in colour and can be identified as they float on freshly boiled and cooled water.

Clove fruits are dark brown in colour and have less volatile oil content.

These can be identified by the presence of starch present in the seed of the fruit.

Blown Cloves are entirely developed clove flowers from which corolla and stamens get separated. While separation,sometimes the stalks are incompletely removed and the percentage of volatile oil in clove stalk is only 5%.

clove stalks contain prism type of calcium oxalate crystals and thick-walled stone cells which are absent in clove the clove stalk can also be detected.

Marketed Products

It is one of the ingredients of the preparation known as Himsagar tail (Dabur).

Cinnamon

Synonyms

Cortex cinnamoni, Ceylon cinnamon, Saigon cinnamon,Chinese cassia, Cinnamomum aromaticum, Cinnamomum laurus.

Biological Source

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

Geographical Sources

Cinnamomum zeylanicum is widely cultivated in Ceylon, Java, Sumatra, West Indies, Brazil, Mauritius, Jamaica, and India.

Cultivation and Collection

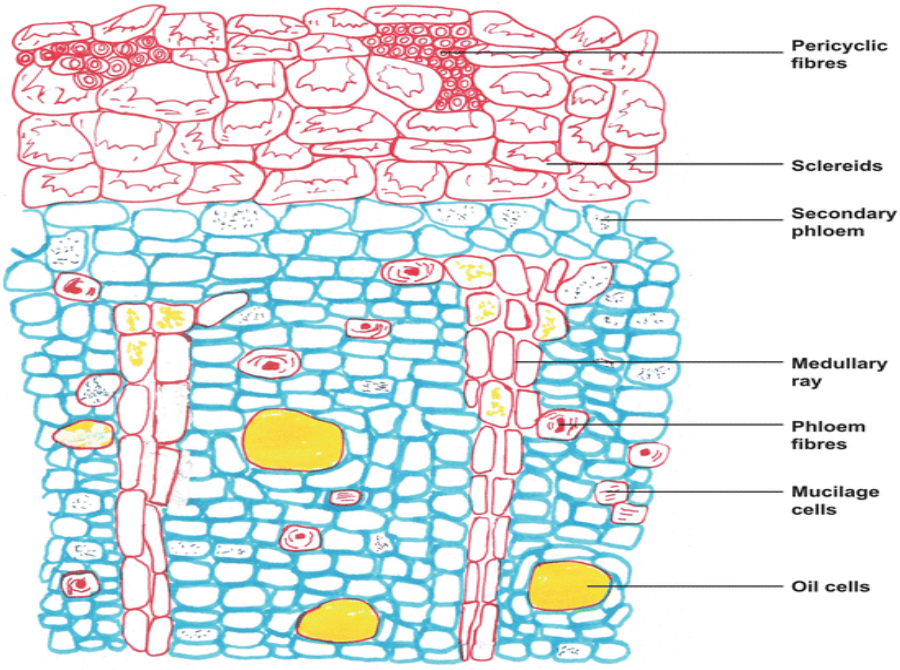
- Cinnamon is cultivated by seed propagation method, about four to five seeds are placed in each hole at 2 m distance between the plants.
- The tree grows best in almost pure requiring only 1% of vegetable substance. It prefers shelter and constant rain of 75" to rainfall.
- Cinnamon is an evergreen tree grows from 20 to 30 feet high, has thick scabrous bark, strong branches.
- The field is kept away from weeds and the plant is coppiced few inches above the ground, leaving five to six straight shoots on them.

- The bark is loosened and the longitudinal incisions are made using copper or brass knife.
- The barks arc stripped off and made into bundles and wrapped in Coir.
- The bundles are kept aside for about 2 hours to facilitate fermentation due to enzymatic action.
- The fermentation helps in the loosening of the outer layer up to pericycle.
- Each strip is taken and then they are scraped using a knife to separate the cork.
- The pieces are dried and they are categorized and packed one inside the other.
- Then compound quills are made by packing the small, quills into larger ones.
- They are cut into pieces of 1 m length and dried first under shade and later under sun.
- During drying, the original pale colour changes to brown due to the presence of some pholobatannins in the bark.

Characteristics

- Cinnamon are either in single- or double-compound quills,with a size of 1 m length, 0.5 mm thickness, and 6 to 10 mm diameter. The outer surface has yellowish brown colour having longitudinal lines of pericyclic fibre and scars and holes representing the position of leaves or the lateral shoots.
- The inner surface is darker than the outer.
- Cinnamon has a fragrant perfume; taste aromatic and sweet.

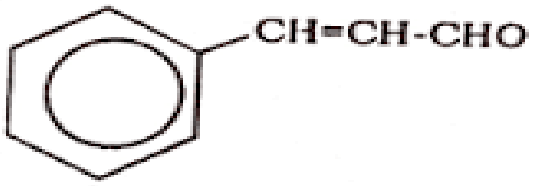
Microscopy



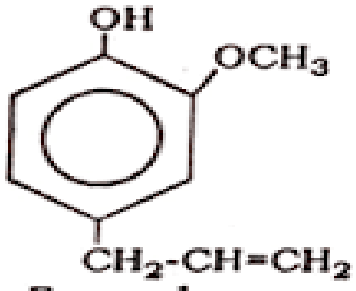
T. S. of Cinnamon bark

- The transverse section shows the presence of three to four layers of sclereids which are horse shoe shaped consisting of starch grains.
- The pericyclic fibres (6 to 15) are present on the outer margin.
- It consists of sieve tubes which are completely collapsed and are arranged tangentially; lignified phloem fibres, arranged as tangential rows of four to five cells; biseriate medullary rays with needle-shaped calcium oxalate crystals; longitudinally elongated idioblast consisting of volatile oil; sub-rectangular parenchyma cells with starch grains and calcium oxalate crystals.

Chemical Constituents



Cinnamic aldehyde



Eugenol

- 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.

Chemical Tests

1. A drop of volatile oil is dissolved in 5 ml of alcohol and to it a drop of ferric chloride is added, A pale green colour is produced. Cinnamic aldehyde gives brown colour with ferric chloride, whereas eugenol gives blue colour.

2. The alcoholic extract is treated with phenylhydrazine hydrochloride, it produces red colour due to the formation of phenylhydrazone of cinnamic aldehyde.

Uses

It is used as an alterative, aromatic, carminative, flavouring agent, analgesic, antiseptic, antirheumatic, antispasmodic, demulcent, digestive, expectorant, stomachic, diaphoretic antibacterial, antifungal, etc. It stops vomiting, relieves flatulence and is given with chalk and as astringents for diarrhoea and haemorrhage of the womb. It is also used in the treatment of bronchitis, colds, palpitations, nausea, congestion, and liver problems.

Other Species

Cinnamon cassia is often used as a substituent. C. culiawan is native of Amboyna and the bark has the flavour of clove, C. iners, Cassia burmarin, Saigon cinnamon, and C. nitidum are also used.

Marketed Products

It is one of the ingredients of the preparations known as Rumalaya gel, Koflet lozenges, Chyavanprash (Himalaya Drug Company), Garbhapal ras, Sutsekhar

FENNEL

Fen
nel

Synonyms:

Sanskrit- Misreya;

Hindi- Sauf; Beng- Panmaury

Eng- Fennel.

Biological source:

The drug consists of the dried ripe fruit of *Foeniculum vulgare* Mill.

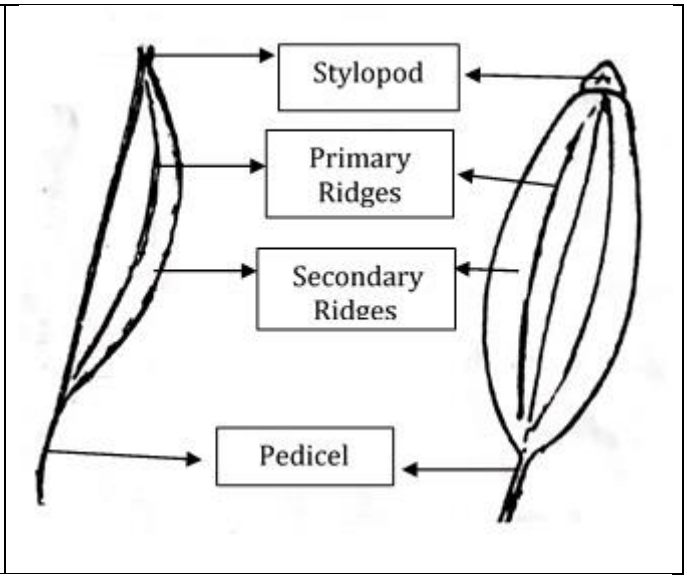
Family:

Umbelliferae.

Geological source:

The plant widely cultivated in many parts of Europe, china, Russia, Egypt and India. In India, it is commonly cultivated throughout the country and often grows wild.

Cultivation and Collection:



- Fennel is cultivated by dibbling method. Quality fruits of good germination rate are sown just before the spring.
- Free branching of herb and special arrangement of leaves (in hair like segments) on the stem require plenty of space between two plants and row, as well.
- Four to five seeds are put, at a time. A hole at distance of 25 cm in between them. Well-drained and calcareous soil in sunny situation is found to be favourable for cultivation of funnel in India; nearly 90% of the fennel production comes from Gujarat alone.
- The crop is kept free of weeds and provided with suitable fertilizers. When the fruits are ripe, crop is harvested and dried in the sun. Fruits are separated by thrashing.

Macroscopical Characters:

(i) Colour: Green to yellowish brown

(ii) Odour: Sweet aromatic.

(iii) Taste: Strongly aromatic

(iv) Size: 5 to 1 0x2 to 4 mm

(v) Shape: Straight or slightly curved.

It is five-sided fruit in the form of cremocarps with pedicels and rarely found in the form of mericarps. Fruits are glabrous with straight, prominent, yellow coloured five primary ridges and a bifid stylopod at the top. It is an orthospermous fruit. Transversely cut surface shows 2 commissural vittae and 4 dorsal vittae. The embryo is small embedded in upper end with abundant oily endosperm.Commissural surface of the endosperm are not grooved.

Microscopical characters of Fennel fruit:

1. Pericarp:

(a) Epicarp: a layer of quadrangular to polygonal cells, with smooth cuticle.

(b) Mesocarp: Reticulate, lignified parenchyma surrounding the vascular bundles.

(c) Vascular bundles:Five in number, bicollateral present below eh ridge (Primary ridge).

(d) Vittae: Schizogenous oil cells, 4 on dorsal side, 2 on commissural surface/ ventral surface. About 250 microns in maximum width, the walls are brown.

(e) Endocarp: Consist of narrow elongated cells having a parquetry arrangement (group of parallel cells arranged in different directions).

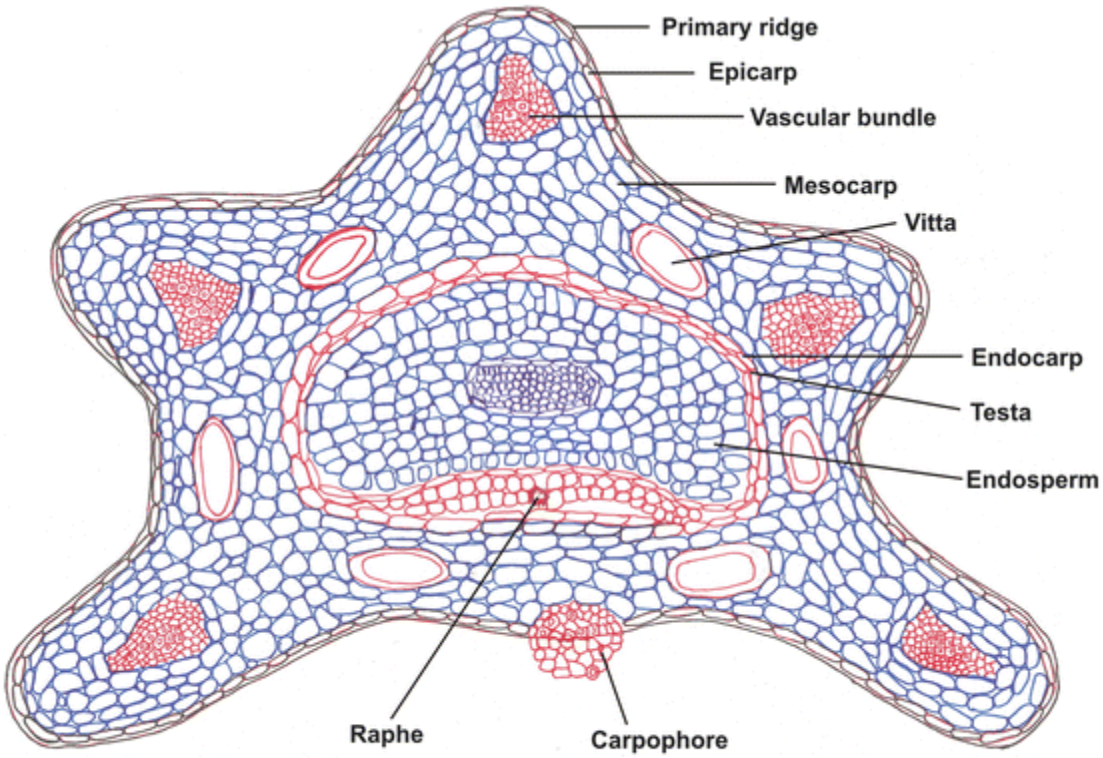
2. Seed:

(a) Testa: Single layered yellowish brown in colour.

(b) Endosperm: Thick walled, polygonal, Cellulosic parenchyma containing oil globules (fixed oil), aleurone, grains and rosette crystals of calcium oxalate.

(c) Raphe: A single ridge of vascular strands appears in the middle of commissural surface.

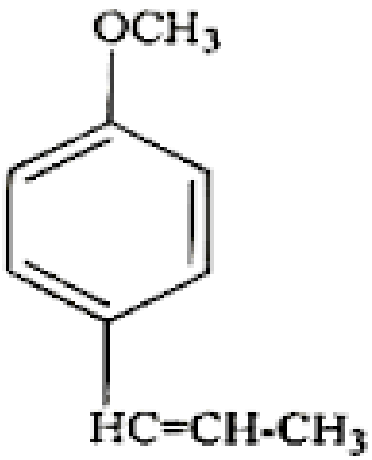
(d) Carpophores: With very thick walled sclerenchyma in 2 strands.



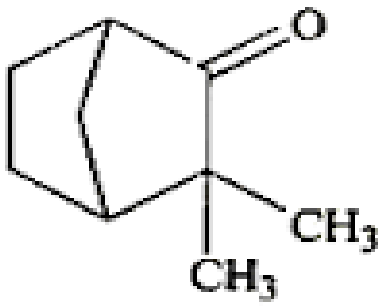
T. S. of Fennel fruit

Chemical Constituents:

Fennel contains volatile oil (1-4%), fixed oil (9-12%) and proteins (20%). The chief constituents of volatile oil are a phenolic ether anethole (50-60%) and ketone fenchone (18-20%). Anethole has an aromatic odour and sweet taste whereas fenchone has a camphoraceous odour and taste. Volatile oil also contains methyl chavicol, anisic aldehydes, α and β- pinene, ascorbic acid, niacin, riboflavin, etc.



Anethole



Fenchone

Uses:

1. Flavouring oil agent
2. Carminative
3. Expectorant
4. Stimulant
5. Stomachic
6. Anthelmintic.
7. It is also useful in dental and mouth wash preparation due to pleasant taste of anethole.
8. Fennel water is useful in colic and flatulence in children

Adulterants:

The drug is adulterated with exhausted fennel from which volatile oil has been extracted out by steam distillation or volatile oil has been removed by treating with alcohol.

Powder analysis of fennel:

1. Mesocarp: Lignified and reticulate nature of the parenchyma
2. Endocarp: Cells showing parquetry arrangement.
3. Endosperm: Polyhedral, thick walled cells containing aleurone grains, minute calcium oxalate crystals and oil globules.
4. Vittae: Many in the form of yellowish brown fragments.
5. Organoleptic characters:

(i) Colour: Yellowish- brown to greenish- brown powder.

(ii) Odour: Pleasant and aromatic odour.

(iii) Taste: Pleasant and aromatic

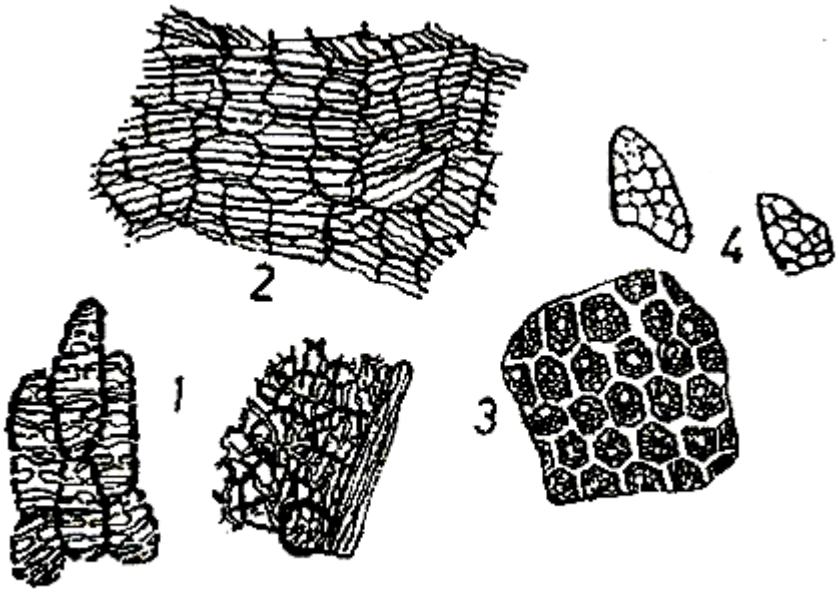


Fig. 16: Identifying characters of fennel fruit powder

Coriander

Synonyms:

Hindi- Dhania;

Biological source:

It consists of the dried ripe fruits of *Coriandrum sativum*

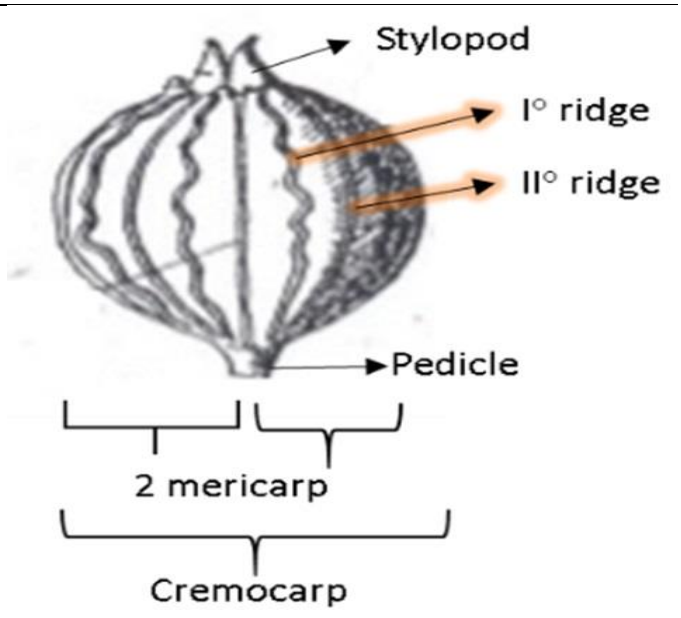
Family: Umbelliferae

Geographical source:

The plant coriander is indigenous to Italy. The plant is widely cultivated in India, Egypt, and Morocco, Holland, Argentina, Eastern Europe, China, Russia and Bangladesh. In India, the plant is cultivated throughout the country. Collection and Preparation the plant is an annual herb, about 0.7 to 1 metre height containing small white and pinkish flowers.

The green plant and unripe fruits gine unpleasant odour like bug but odour disappears during ripping and change to an aromatic odour. Plants are cut and collected when fruits are ripening. After drying, fruits are separated.

Macroscopic characters:



(i) Colour : Yellowish- brown to brown.

(ii) Odour : Aromatic

(iii) Taste : Spicy and characteristic.

(iv) Shape: Sub-globular cremocarpous fruit

(v) Size: Fruits are 2-4 mm in diameter and 4- 30 mm in length

(vi) About 10 primary ridges and 8 secondary ridges are present. Primary ridge are wavy and inconspicuous, while secondary ridge are straight. It is further described as an endospermic and a coelospermic fruit. The weight of 100 fruits is approximately 1 g.

Microscopical characters of coriander:

1. Epicarp: Polygonal cells with occasional stomata and calcium oxalate crystal.

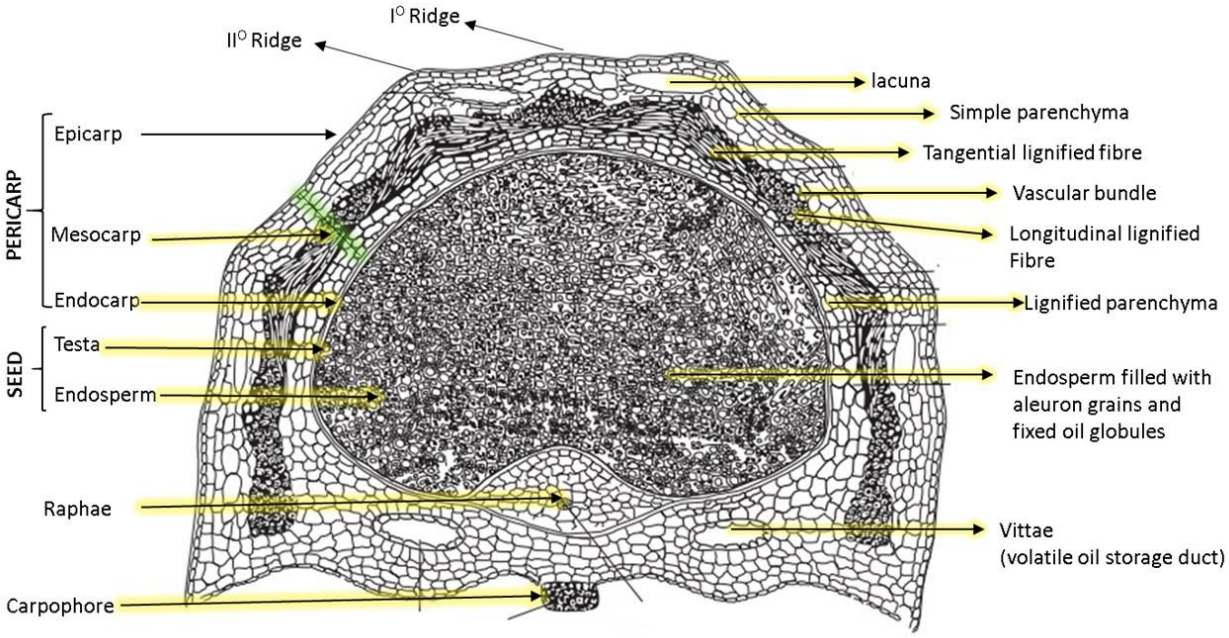
2. Mesocarp: Inner and outer layer of parenchyma with sclerenchyma in between.

3. Sclerenchyma in tangential and longitudinal bands.

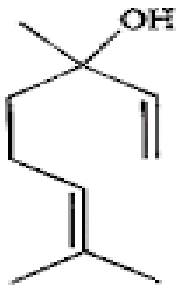
4. Two vittae on the commissural surface and four lacunae on the dorsal surface.

5. Endocarp: Elongated cells forming parquetry layer.

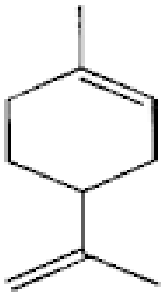
6. Endosperm: Cellulosic parenchyma containing oil globules and aleurone grains.



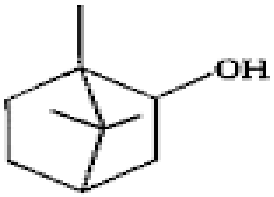
Chemical Constituents:



Linalool



Limonene



Borneol

1. Volatile oil:

(i) Main (+) linalool (coriandrol) and α-pinene

(ii) Limonene

(iii) α and γ-telpinene

(iv) P-cymene

(v) Camphor

(vi) Geraniol

(vii) Borneol

2. Fixed oil

3. Malic acid

4. Tannin

5. Vitamin A.

Uses:

1. Carminative

2. Flavouring agent

3. Anthelmintic

4. Aromatic

5. Diuretic

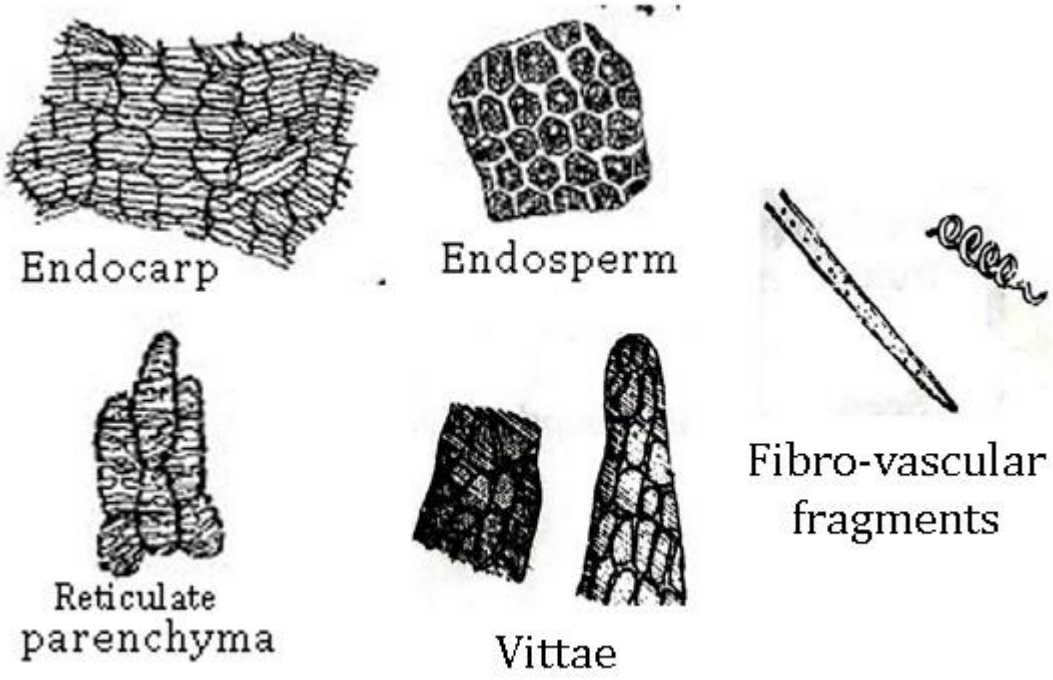
6. Stimulant

7. Stomachic

8. Aphrodisiac.

9. Oil is used along with purgatives to prevent gripping

Powder analysis of coriander fruits:



1. Sclerenchymatous layer: Groups of fusiform fibres of sclerenchyma running way and at times crossing with each other or with thin walled lignified cells of the mesocarp.

2. Endocarp: Fragments of parquetry arrangement of thin walled lignified cells with the polygonal cells of mesocarp.

3. Vittae: Few brown fragments of vittae.

4. Endosperm: Fragments of endosperm with aleurone grains and oil globules.

Organoleptic characters:

a. Colour: Brown powder

b. Odour: Characteristic, aromatic

c. Taste: Spicy

PALE CATECHU

Synonyms

Gambier, pale catechu, catechu.

Biological Source

Gambier or pale catechu is a dried aqueous extract produced from the leaves and young twigs of *Uncaria gambier* Roxburgh., belonging to family Rubiaceae.

Geographical Source

U. gambier is a native of erstwhile Malaya. It is cultivated in Indonesia, Malaysia, Sumatra, Bornea, and Singapore at elevation up to 150 m. The plant is used mostly for the production of the drug, which is marketed through Singapore.

Cultivation, Collection, and Preparation

- Propagation of *U. gambier* is done by seeds.
- Seeds are sown in the nursery to raise the seedlings, which after about 9 months are planted out in the clearing about 3 meters apart.
- Leaves and young shoots are collected as a first crop during second year's growth.
- Later the crop is taken every year. The plant continues to give sufficient leaves and twigs up to 20 years, but the maximum yield is obtained during eighth year of growth.
- The collected leaves and twigs are transported to the factory as loose material.
- The material is put into large drums with about three quarters of boiling water.
- It is boiled for about three hours with intermittent stirring.
- The marc is subsequently removed by large wooden forks and lodged on surface to drain the liquor back to the vessels. It is pressed and washed.
- The washing is added to the extract. The combined total aqueous extract is then concentrated for one and half-hour till it becomes thick, yellowish-green paste.
- It is transferred from the vessels to wooden tubs, stirred while it is hot, and cooling in a stream of water to crystallize tannins.
- Semicrystallized paste is again transferred to wooden trays in which it sets. They are cut into cubes by wooden knife and dried in sum. The drug is also made into large blocks in kerosene tins.

Morphology

Colour : Dull reddish brown colour externally and pale brown buff colour internally.

Odour : Odourless

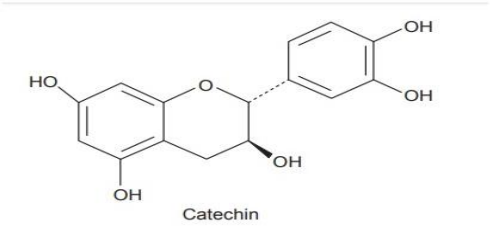
Taste: At first it is bitter and astringent but later it is sweet.

Shape: Strips, flakes or coarse powder Size Pale catechu comes in the form of cubes or rectangular blocks of 2 to 4 cm length Shape Regular cubes or as rectangular blocks.

Microscopy

- The powdered drug, if mounted in the solution of lactophenol or water, shows the small circular crystals of catechu under microscope.
- The water insoluble part of the pale catechu under the microscope exhibits epidermal pieces, unicellular hairs, cork tissues, lignified fibres, etc.
- Alcohol insoluble part shows the absence of starch.
- The pale catechu from Indonesia is reported to have minute starch grains.

Chemical Constituents



Catechin

- Pale catechu contain from about 7 to 30% of pseudotannin ,catechin and 22 to 55% of a phlobatannin, catechutannic acid.
- Both of the about component constitute over 60% of the drug.
- It also contains catechu red, gambier fluorescin and quercetin.
- It contains indole alkaloid up to 0.05%, which includes gambirtannin and its derivatives. Gambirtannin gives a strong fluorescence under UV light.
- Catechin forms white, needle like crystals, which dissolves in alcohol and hot water. Catechutannic acid gives green colour with ferric chloride.

Chemical Tests

1. ***Gambier fluorescin test*:** Gambier fluorescin present in pale catechu gives the fluorescence. If to its alcohol extract, a little sodium hydroxide is added and shaken with petroleum ether. The petroleum ether layer shows green fluorescence. Black catechu gives negative test.

2. ***Vanillin-hydrochloric acid test****:* Drug shows pink or red colour with a mixture of vanillin: alcohol: dilute HCl in the ratio 1:10:10. The reaction produces phloroglucinol which along with vanillin gives pink or red colour.

3. A matchstick dipped in decoction of Pale catechu is air dried and again dipped into concentrated HCl and warmed near the burner. Pink or purple colour is produced.

4. Small quantity of powder is heated on water bath with 5 ml chloroform and filtered. The filtrate is evaporated in white porcelain dish on a water bath. A greenish yellow residue is produced due to the presence of chlorophyll in the drug. Black catechu gives this test negative due to the absence of chlorophyll.

Uses

- Pale catechu is medicinally used as local astringent.
- In diarrhoea, it is used as general astringent.
- It is largely used in various countries of east for chewing with betel leaf.
- Large proportion of gambier is used in dyeing and tanning industries.
- It is used for tanning of animal hides to convert it to leather.

BLACK CATECHU

Synonym

Cutch, black catechu, kattha.

Biological Source

Black catechu is the dried aqueous extract prepared from the heartwood of *Acacia catechu* Willdenow, belonging to family, Leguminosae.

Geographical Source

A. catechu is common throughout the tract from Punjab to Assam ascending to an altitude of 300 m. It is also quite common in drier regions of peninsula such as Madhya Pradesh, Maharashtra, Gujarat, Rajasthan, Bihar, and Tamil Nadu.

Collection and Preparation

- *catechu* is a medium-sized tree with thorns.
- For preparation of the drug the tree is cut off from the ground.
- The main trunk and branches are cleared of foliage and thorns.
- The bark is stripped off, and the heartwood is made into chips.
- Heartwood is boiled in water in large earthen pots.
- The decoction is then strained and boiled in an iron pot with continuous stirring till it forms the syrupy mass.
- When the extract is cool enough, it is spread in the shallow wooden trays and kept for over night. When sufficiently dry, it is cut into pieces.
- Since the decoction is concentrated in iron vessels, the colour of the catechu becomes darker due to its reaction with iron salts.
- If the syrupy extract is stirred during cooling, it develops the shining crystals of catechin and produces translucent black catechu.
- Nowadays stainless steel vessels are used for the manufacture of catechu that produces a lighter coloured product.

Morphology

Colour :Black or brownish black mass

Odour: Odourless

Taste :Astringent and subsequently sweet taste

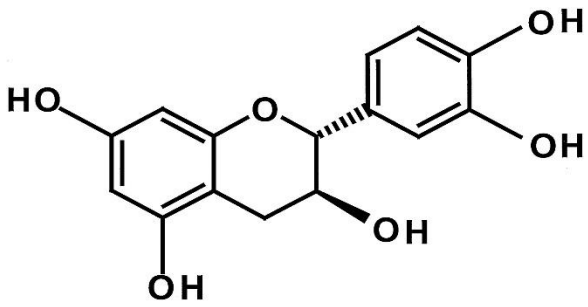
Size :Irregular mass

Extra features : Outer surface is firm and brittle. When broken the fractured surface appears glassy with small cavities

Microscopy

- A transverse section of *A. catechu* heartwood shows numerous uniseriate and biseriate medullary rays, with vessels occurring isolated or in small groups of two or four.
- Xylem fibres with narrow lumen occupy major portion of wood and xylem parenchyma is usually predominantly paratracheal, forming a sheath around vessels.
- Wood consists of crystal fibres having prismatic crystals of calcium oxalate.
- A few tracheids with scalariform thickening and some cells including vessels are also present.

Chemical Constituents



(+)-catechin

- Cutch or black catechu resembles pale catechu or gambier in its composition.
- It contains about 2–12% of catechin and about 25 to 33% of phlobatannin catechutannic acid. The principle fraction of cutch has been identified as a mixture of catechin isomers which includes (-) epicatechin, acatechin, DL-acacatechin, L-acacatechin and D-isoacacatechin.
- It also contains 20–30% gummy matter, catechin red and querecitin. It yields 2–3% of ash.

Chemical Tests

1. Because of the presence of catechin, black catechu gives pink or red colour with vanillin and HCl.

2. Catechin when treated with HCl produces phlorogucinol, which burns along with lignin to give purple or magenta colour. For this purpose, tannin extract is taken on match stick dipped in HCl and heated near the flame.

3. Lime water when added to aqueous extract of black catechu gives brown colour, which turns to red precipitate on standing for some time.

4. Green colour is produced when ferric ammonium sulphate is added to dilute solution of black catechu. By the addition of sodium hydroxide, the green colour turns to purple.

Uses

- Cutch is used in medicine as astringent.
- It cures troubles of mouth, diseases of the throat and diarrhoea.
- It also increases appetite. In India and eastern countries, it is used in betel leaves for chewing.
- In dyeing industries, cutch is used for dyeing fabrics brown or black. It is also used in calico printing.

Marketed Products

It is one of the ingredients of the preparation known as Koflet lozenge (Himalaya Drug Company) as cough expectorant, and Gum tone (Charak Pharma Pvt. Ltd.).

Pterocarpus

Synonyms

Bijasal, Indian kino tree, Malbar kino.

Biological Source

It consists of dried juice obtained by making vertical incisions to the stem bark of the plant *Pterocarpus marsupium* Linn., belonging to family Leguminosae.

Geographical Distribution

It is found in hilly regions of Gujarat, Madhya Pradesh, Uttar Pradesh, Bihar, and Orissa. It is also found in forests of Karnatak, Kerala, West Bengal, and Assam.

Morphology

Colour Ruby-red

Odour Odourless

Taste: Astringent

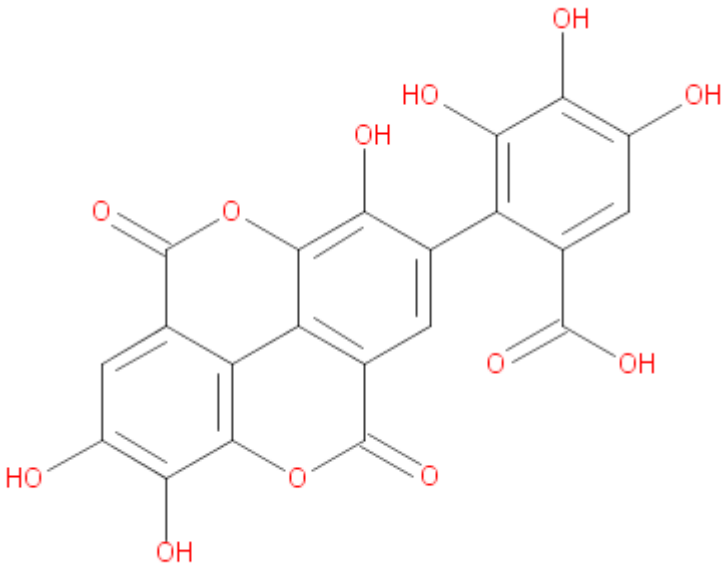
Shape: Angular grains

Size: 3 to 5 to 10 mm granules

Solubility: It is partly soluble in water (about 80—90%),completely soluble in alcohol (90%).

Extra features The pieces of kino are angular, glistening, transparent,breaking with vitreous fracture.

Chemical Constituents



Kinnotannic acid

- Kino contains about 70–80% of kinotannic acid, kino-red, k-pyrocatechin (catechol), resin and gallic acid.
- Kinotannic acid is glucosidal tannin, whereas kino-red is anhydride of kinoin.
- Kinoin is an insoluble phlobaphene and is produced by the action of oxydase enzyme.
- It is darker in colour than kinotannic acid.

Chemical Tests

1. When the solution of drug is treated with ferrous sulphate, green colour is produced.
2. With alkali (like potassium hydroxide) violet colour is produced.
3. With mineral acid, a precipitate is obtained.

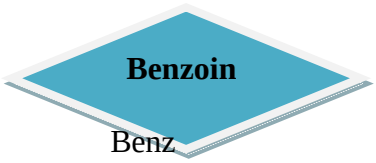
Uses

- Kino is used as powerful astringent and also in the treatment of diarrhoea and dysentery, passive haemorrhage, toothache, and in diabetes.
- It is used in dyeing, tanning, and printing.
- The aqueous infusion of the wood is considered to be of much use in diabetes.
- The alcoholic, as well as, aqueous extracts of heartwood are known to possess hypoglycaemic action.

- The cups made of wood are available with Khadi and Gramodyog commission for treatment of diabetes.

Marketed Products

It is the one of the components of the preparation known as Gludibit (Lupin Herbal Laboratory) and Diabecon (Himalaya Drug Company) for diabetes mellitus



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SIAM BENZOIN

Biological Source

Siam Benzoin is a balsamic resin derived from stem of *Styrax tonkinensis* Craib., belonging to family Styraceae.

Geographical Source

The trees are present in North Laos, North Vietnam, Annam, and Thailand.

Collection

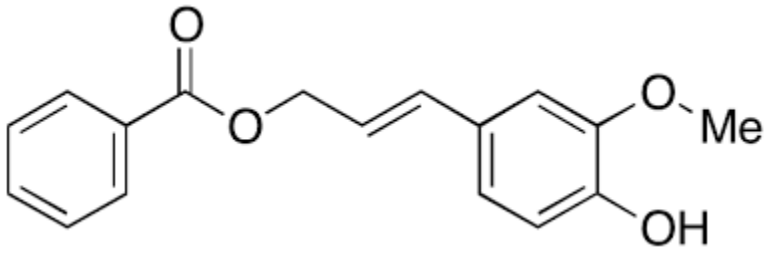
Siam Benzoin is also a pathological resin produced by incising the bark and by fungus attack. The stem of 6–8 years old plant is incised when balsam exudates. The resin is obtained in the form of liquid which is solidified.

Characteristics

Siam Benzoin occurs as tears or in blocks of variable sizes and reddish brown externally, but milky-white or opaque internally. Matrix is glassy, reddish-brown, resinous, brittle but

softening on chewing and become plastic-like on chewing. It has vanilla-like odour and a balsamic taste.

Chemical Constituents



Coniferyl benzoate

The principal constituent of Siam Benzoin is coniferyl benzoate (60–80%) (3-methoxy-4-hydroxycinnamyl alcohol).Other constituents are free benzoic acid (10%), triterpene siaresinolic acid (6%), vanillin, and benzyl cinnamate.

Chemical Tests

1. Heat Sumatra Benzoin (5 g) with 10% aqueous potassium permanganate solution. A bitter almond-like odour is produced due to oxidation of cinnamic acid present in Sumatra Benzoin. This test is negative in case of Siam Benzoin.

2. To a petroleum ether solution of Benzoin (0.2 g),two to three drops of sulphuric acid are added in a China dish. Sumatra Benzoin produces reddish brown colour, whereas Siam Benzoin shows purplered colour on rotating the dish.

3. To alcoholic solution of Benzoin ferric chloride solution is added. A green colour is produced in Siam Benzoin due to the presence of phenolic compound coniferyl benzoate. This test is negative in case of Sumatra Benzoin which does not contain sufficient amount of phenolic constituents.

Uses

- Siam Benzoin acts as antiseptic, culinary and expectorant; it is used to prepare benzoinated lard, cosmetics, fixatives, and in perfumery.
- It is superior to the Sumatra Benzoin with respect to antioxidative effect in lard and other fats.

Marketed Products

It is one of the ingredients of the preparation known as Friar's Balsam.

SUMATRA BENZOIN

Synonyms

Gum Benjamin; Benzoinum; Benzoin; Luban (Hindi).

Biological Source

Sumatra Benzoin is obtained from the incised stem of *Styrax benzoin* Dryander and *Styrax parallelo-neurus* Perkins., belonging to family Styraceae. It contains about 25% of total balsamic acids, calculated as cinnamic acid.

Geographical Source

The trees are found in Sumatra, Malacca, Malaya, Java and Borneo.

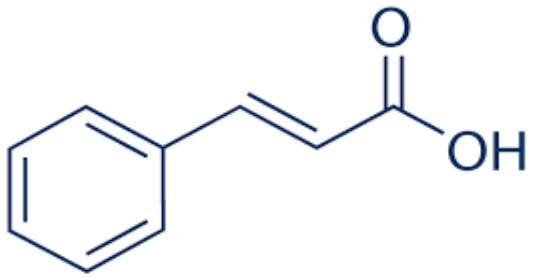
Collection

The plants are medium-sized trees. Sumatra Benzoin is a pathological resin which is formed by making incision and by attack of fungi. In Sumatra the seeds are sown in rice fields. The rice plants provide protection to benzoin plants during first year. After harvesting of the rice crop the trees are allowed to grow. When they are 7 years old, three triangular wounds are made in a vertical row. Tapping consists of making in each trunk three lines of incisions which are
gradually lengthened. The first triangular wounds are made in a vertical row about 40 cm apart, the bark between the wounds being then scraped smooth. The first secretion is very sticky and is rejected. After making further cuts, each about 4 cm above the preceding ones, a harder secretion is obtained. Further incisions are made at three-monthly intervals, and the secretion becomes crystalline. About 6 weeks after each fresh tapping the product is scraped off, the outer layer (finest quality) being kept separate from the next layer (intermediate quality). About 2 weeks later the strip is scraped again, giving a lower quality darker in colour and containing fragments of bark. Fresh incisions are then made, and the above process is repeated. Second exudation is milky white and is used for medicinal purpose.The stem is incised four times during one year. AH types of exudations are sent to industry for further processing. A single tree yields about 10 kg of resin per year and is completely exhausted by the 19th year of its life.

Characteristics

Levent Storax is a viscous, semiliquid, greyish, sticky, opaque mass which deposits as a dark-brown, heavier, oleoresinous product on standing. American Storax is a semisolid,sometimes solid mass softened by warming, becoming hard, opaque, and darker coloured. Storax is transparent in thin layers, has characteristic taste and odour, and is denser than water. It is insoluble in water; almost completely soluble in warm alcohol, ether, acetone, and carbon disulphide. Odour is agreeable and taste is balsamic.

Chemical Constituents



Cinnammic acid

Storax is rich in two resin alcohol (50%) storesin and storesin and balsamic acids (30–47%). The alcohols occur partly free and partly as esters of cinnamic acid (10–20%). Storax also contains cinnamyl cinnamate or styracin (5–10%) phenyl-propyl cinnamate (10%); ethyl cinnamate, benzyl cinnamate, free cinnamic acid (5–15%), styrene, traces of vanillin,and volatile oil (0.5–1%). Steam distillation of Storax yields a pale yellow or dark brown oil (0.5–1.0%) known as oil of Storax. It has a pleasant but peculiar odour.

Uses

Storax is used as a stimulant, expectorant, parasiticide, topical protectant, and an antiseptic. Pharmaceutical preparations like Compound Benzoin Tincture, Friars' Balsam, and Benzoin Inhalation are also prepared from the Storax.

Guggul

Synonyms

Gumgugul, Salai-gogil.

Biological Source

Guggal is a gum resin obtained by incision of the bark of *Commiphora mukul* (H. and S.) Engl.

Family

Burseraceae.

Habitat

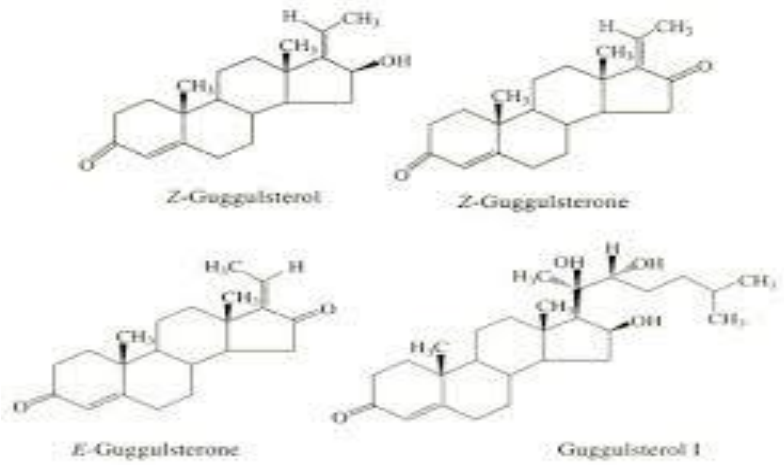
The mukul myrrh (*Commiphora mukul*) tree is a small, thorny plant distributed throughout India.

Collection

Guggal tree is a small thorny tree, 4 to 6 feet tall, branches slightly ascending. It is sometimes planted in hedges. The tree remains without any foliage for most of the year. It

has ash-coloured bark, and comes off in rough flakes, exposing exposing the inner bark, which also peels off. The tree exudes a yellowish resin called gum guggul or guggulu that has a balsamic odour. Each plant yields about 1 kg of the product, which is collected in cold season.

Chemical Constituents



- Guggal contains gum (32%), essential oil (1.45%), sterols (guggulsterols I to VI, sitosterol, cholesterol, Z- and E guggulsterone), sugars (sucrose, fructose), amino acids, camphorene, cembrene, allylcembrol, flavonoids (quercetin and its glycosides), ellagic acid, myricyl alcohol,
- aliphatic tetrols, etc.
- Guggal significantly lowers serum triglycerides and cholesterol as well as LDL and VLDL cholesterols (the bad cholesterols).
- At the same time, it raises levels of HDL cholesterol (the good cholesterol), inhibits platelet aggregation, and may increase thermogenesis through stimulation of the thyroid, potentially resulting in weight loss.
- Also gum is astringent, aritirheumatic, antiseptic, expectorant, aphrodisiac, demulcent,and emmenagogue.
- The resin is used in the form of a lotion for indolent ulcers and as a gargle in teeth disorders, tonsillitis, pharyngitis, and ulcerated throat.

Marketed Formulations

It is one of the ingredients of the preparations known as Arogyavardhini Gutika (Dabur) and Abana, Diabecon, Diakof (Himalaya Drug Company).

GINGER

Synonyms

Rhizoma zingiberis, Zingibere.

Biological Source

Ginger consists of the dried rhizomes of the *Zingiber officinale* Roscoe, belonging to family Zingiberaceae.

Geographical Source

It is mainly cultivated in West Indies, Nigeria, Jamaica, India, Japan, and Africa.

Cultivation

Ginger Plant

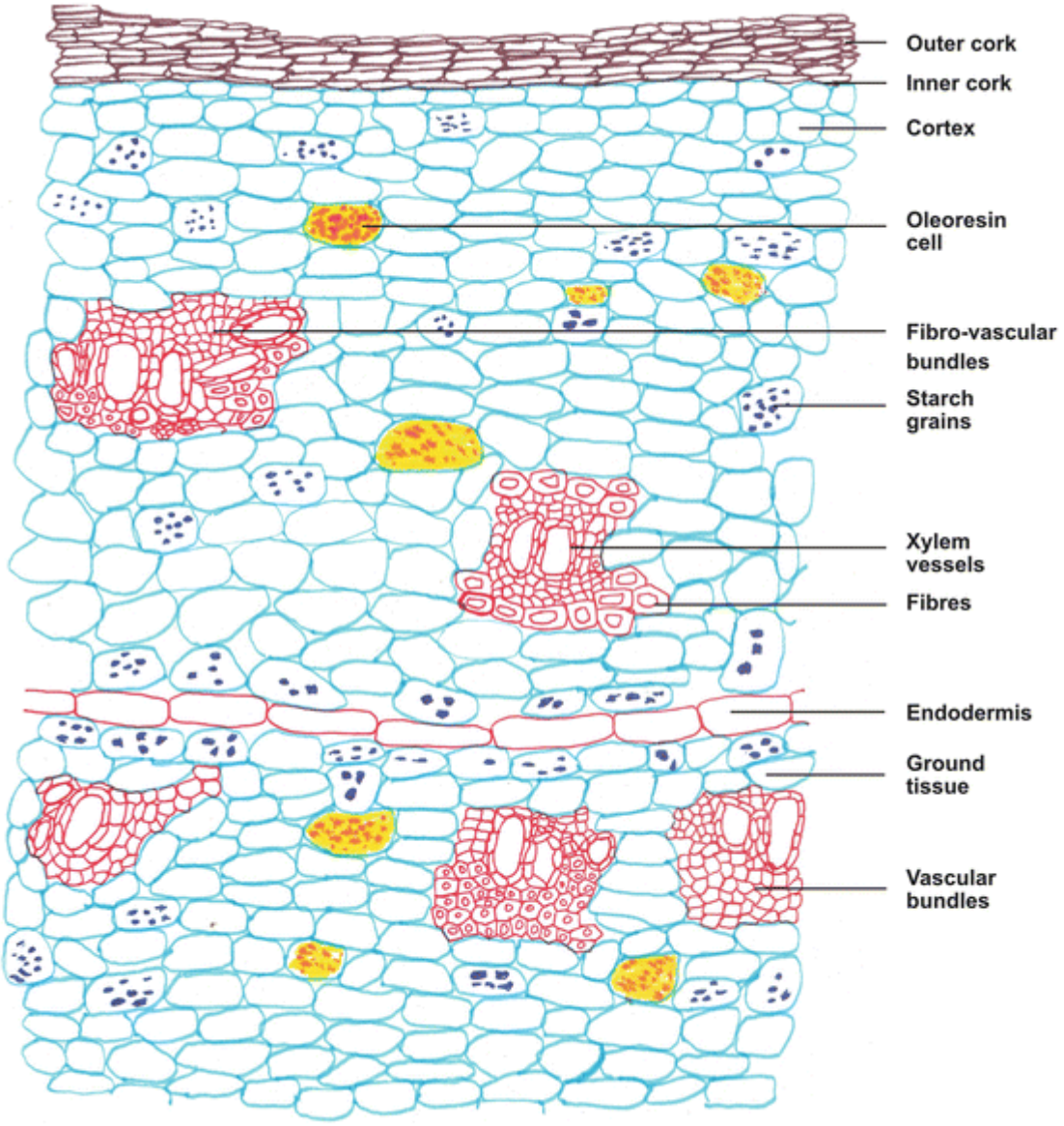
- Ginger plant is a perennial herb that grows to 1 m.
- It is cultivated at an altitude of 600 to 1,500 m above sea level.
- The herb grows well in well-drained rich, loamy soil, and in abundant rain fall.
- The rhizome is cut into pieces called fingers, and each finger consisting of a bud is placed in a hole filled with rotten manure in March or April.
- The rhizomes get matured in December or January. By January the plants wither after flowering and then the flowers are forked up, buds and the roots removed and washed to remove the mould and clay or dirt attached to them.
- The rhizomes are socked in water overnight and the next morning they are scraped with a knife to remove the outer cork and little of parenchyma.
- They are washed again and then dried under sun for a week.
- The rhizomes are turned by the sides at regular intervals to facilitate proper drying.

- This is the 'unbleached Jamaica' or the uncoated ginger.
- The coated or the unpeeled variety is prepared by dropping the rhizome for few minutes in boiling water, and then skin is removed such that the layer on the flat surface is removed but not in the grooves between the branches.
- The 'bleached' or 'limed' is prepared by treating it with sulphuric acid or chlorine or dusting it with calcium sulphate or calcium carbonate.

Characteristics

- The rhizomes are 5 to 15 cm long, 3 to 6 cm wide, and about 1.5 cm thick. The Jamaica ginger occurs as branches.
- It has a sympodial branching and the outer surface has buff yellow colour with longitudinally striated fibres.
- Small circular depressions at the portion of the buds are seen and fractured surface shows narrow bark, a well-developed endodermis, and a wide stele, with scattered small yellowish points of secretion cells and grayish points of fibrovascular bundles.
- The ginger has agreeable and aromatic odour and pungent and agreeable taste.

Microscopy



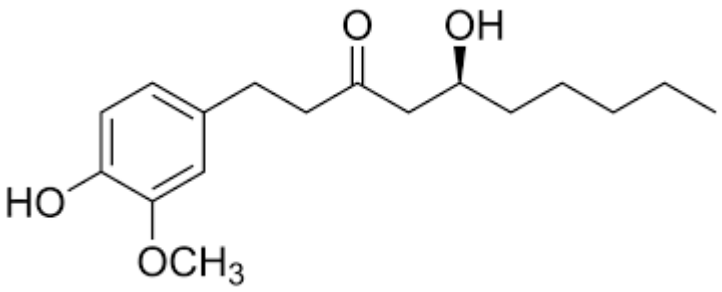
T. S. of Ginger rhizome

The cork is the outermost layer with irregular parenchymatous cells and dark brown colour. The inner cork is few layered, colourless parenchymatous cells arranged in radial rows.

- Cork is absent in Jamaica ginger.
- Phellogen is indistinct and the cortex consists of thin-walled rounded
- parenchyma with intercellular spaces consisting of abundant starch grains. The starch grains are simple, ovate, or sac shaped. Numerous yellowish brown oleoresin are also present along with the collateral fibro vascular bundles.

- The endodermis is distinct without starch and consists of single layer of tangentially elongated cells containing suberin.
- Just below the endodermis it has the ground tissue, a ring of narrow zone of vascular bundle which is not covered with sclerenchymatous fibres.
- The ground tissues contain the large parenchymatous cells rich in starch, oleoresin,
- fibrovascular bundles.
- The phloem has well-developed sieve elements, and the xylem consist of vessels, tracheids either
- annual or spiral, or reticular in nature without lignin.
- The fibres are unlignified, pitted, and separate.

Chemical Constituents



Gingerol

Ginger contains 1 to 2% volatile oil, 5 to 8% pungent resinous mass and starch. The volatile oil is responsible for the aromatic odour and the pungency of the drug is due to the yellowish oily body called gingerol which is odourless. Volatile oil is composed of sesquiterpene hydrocarbon

like zingiberol ,sesquiterpene alcohol bisabolene, farnesene, sesquiphellandrene. Less pungent components like gingerone and shogaol are also present. Shogal is formed by the dehydration of gingerol and is not present in fresh rhizome.

Uses

Ginger is used as an antiemetic, positive inotropic, spasmolytic, aromatic stimulant, carminative, condiment, and flavouring agent. It is prescribed in dyspepsia, flatulent colic, vomiting spasms, as an adjunct to many tonic and stimulating remedies, for painful affections of the stomach, cold, cough, and asthma. Sore throat, hoarseness, and loss of voice are benefited by chewing a piece of ginger.

Adulteration

Ginger may be adulterated by addition of 'wormy' drug or 'spent ginger' which has been exhausted in the extraction of resins and volatile oil. This adulteration may be detected by the official standards, for alcohol-soluble portion, waters soluble portion, total ash and water-soluble ash. Sometimes pungency of exhausted ginger is increased by the addition of capsicum.

Marketed Products

It is one of the ingredients of the preparations known as Pain kill oil, J.P. Liver syrup (Jamuna Pharma), Abana, Gasex (Himalaya Drug Company), Hajmola (Dabur), Strepsils (Boots Piramal Healthcare), and Sage Massaj oil (Sage Herbals).

Asafoetida

Synonyms

Devil's dung; food of the gods; asafoda; asant; hing (Hindi).

Biological Source

Asafoetida is an oleo-gum resin obtained as an exudation by incision of the decapitated rhizome and roots of *Ferula asafoetida* L, *F. foetida,* Royel, *F. rubricaulis* Boiss, and some other species of Ferula, belonging to family Apiaceae.

Geographical Source

The plant grows in Iran, Turkestan and Afghanistan (Karam and Chagai districts).

Collection

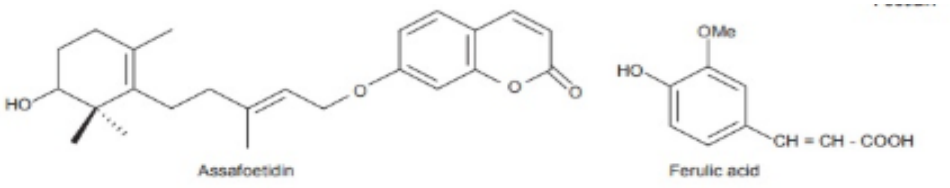
- The plant is a perennial branching, 3 m high herb possessing large schizogeneous ducts and lysigenous cavities containing milky liquid.
- Upon exudation and drying of the liquid, Asafoetida is obtained. For the collection of the drug the upper part of the root is laid bare and the stem cut off close to the crown in March–April.
- The exposed surface is covered by a dome-shaped structure made of twigs and earth. After separating each slice, exudation of oleo-gumresin, present as whitish gummy resinous emulsion in the schizogenous ducts of the cortex of the stem, takes place.
- It hardens on the cut surface which is collected, packed in tin-line cases and exported.
- Removal of the exudation and exposure of fresh surface proceeds until the root is exhausted. The yield is usually soft enough to agglomerate into masses when packed.

Characteristics

- Asafoetida occurs as a soft solid mass or irregular lumps or ‘tears’, sometimes almost semiliquid.
- Tears are rounded or flattened and about 5–30 mm in diameter, grayish-white or dull yellow or reddish brown in colour.
- Asafoetida mass is mixed with fruits, fragments of root, sand and other impurities.
- Asafoetida has a strong garlic-like (alliaceous) odour and a bitter, acrid and alliaceous taste.

- When triturated with water, it makes a milky emulsion.
- It should not have more than 50% of matter insoluble in alcohol (90%) and not more than 15% of ash.

Chemical Constituents



Asafoetida contains volatile oil (4–20%), resin (40–65%), and gum (25%). The garlic-like odour of the oil is due to the presence of sulphur compounds. The main constituent of the oil is isobutyl propanyl disulphide (C6H16S2). The three sulphur compounds, such as, 1-methylpropyl-1 propenyl disulphide, l-(methylthio)-propyl-1-pro-penyl disulphide, and l-methyl-propyl 3-(methylthio)-2-propenyl disulphide have also been isolated from the resin; the latter two have

pesticidal properties. The flavour is largely due to R-2-butyl-l-propenyl disulphide and 2-butyl-3-methylthioallyl disulphide (both as mixtures of diastereoisomers). The drug also contains a complex mixture of sesquiterpene umbelliferyl ethers mostly with a monocyclic or bicyclic terpenoid moiety. Resin consists of ester of asaresinotannol and ferulic acid, pinene, vanillin and free ferulic acid. On treatment of ferulic acid with hydrochloric acid, it is converted into umbelliferone (a coumarin) which gives blue fluorescence with ammonia. Asafoetida also contains phellandrene, sec-butylpropenyl disulphide, geranyl acetate, bornyl acetate, terpineol,

myristic acid, camphene, myrcene, limonene, fenchone, eugenol, linalool, geraniol, isoborneol, borneol, guaiacol, cadinol, farnesol, assafoetidin, foetidin, etc.

Chemical Tests

1. On trituration with water it produces a milky emulsion.
2. The drug (0.5 g) is boiled with hydrochloric acid (5 ml) for sometime. It is filtered and ammonia is added to the filtrate. A blue fluorescence is obtained.
3. To the fractured surface add 50% nitric acid. Green colour is produced.
4. To the fractured surface of the drug, add sulphuric acid (1 drop). A red colour is obtained which changes to violet on washing with water.

Uses

Asafoetida is used as carminative, expectorant, antispasmodic and laxative as well as externally to prevent bandage chewing by dogs; for flavouring curries, sauces, and pickles; as an enema for intestinal flatulence, in hysterical and epileptic affections, in cholera, asthma, whooping cough,
and chronic bronchitis.

Adulteration

Asafoetida is adulterated with gum Arabic, other gum-resins, rosin, gypsum, red clay, chalk, barley or wheat flour, and slices of potatoes.

Allied Drugs

Galbanum and ammonia cum are oleo-gum-resins obtained respectively, from *Ferula galbaniflua* and *Dorema ammoniacum.* Galbanum contains umbelliferone and umbelliferone ethers up to 30% of volatile oil containing numerous mono- and sesquiterpenes, azulenes, and sulphur-containing esters. Ammoniacum contains free salicylic acid but no umbeiliferone.

The major phenolic constituent is ammoresinol. An epimeric mixture of prenylated chromandiones termed ammodoremin is also present. The volatile oil (0.5%) contains various terpenoids with ferulene as the major component.

Marketed Products

It is one of the ingredients of the preparation known as Madhudoshantak (Jamuna Pharma).

MYRRH

Synonyms

Gum-resin Myrrh; Gum Myrrh; Arabian or Somali Myrrh; Myrrha.

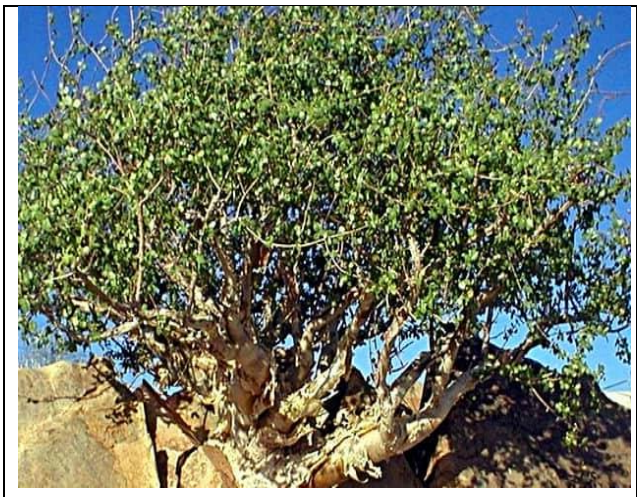
Biological Source

Myrrh is an oleo gum-resin obtained from the stem of *Commiphora molmol* Eng. or *C. abyssinica* or other species of Commiphora, belonging to family Burscraceae.

Geographical Source

It grows in Arabian pennisula, Ethiopia, Nubia, and Somaliland.

Collection



- Myrrh plants are small trees up to 10 meters in height.
- They have the phloem parenchyma and closely associated ducts containing a yellowish granular liquid.
- The tissues between these ducts often collapse, thereby producing large cavities similarly filled, that is, schizogenous ducts become lysigenous cavities.
- The gum-resin exudes spontaneously or by incising the bark.
- The yellowish-white, viscous fluid is solidified readily to produce reddish-brown masses which are collected by the natives.

Characteristics

Myrrh occurs as irregular masses or tears weighing up to 250 g. The outer surface is powdery and reddish-brown in colour. The drug breaks and is powdered readily. Fractured surface is rich brown and oily. Odour is aromatic and taste is aromatic, bitter, and acrid.

Chemical Constituents

- Myrrh contains resin (25–40%), gum (57–61%), and volatile oil (7–17%).
- Large portion of the resin is ether-soluble containing commiphoric acids, resenes, the esters of another resin acid and two phenolic compounds.

- The volatile oil is a mixture of cuminic aldehyde, eugenol, cresol, pinene, limonene, dipentene, and two sesquiterpenes.
- The disagreeable odour of the oil is due to mainly the disulphide.
- The gum contains proteins (18%) and carbohydrate (64%) which is a mixture of galactose, arabinose, glucuronic acid, and an oxidase enzyme.

Chemical Tests

1. A yellow brown emulsion is produced on trituration with water.

2. Ethereal solution of Myrrh turns red on treatment with bromine vapours. The solution becomes purple with nitric acid.

Uses

- Myrrh is used as carminative and in incense and perfumes.
- It has local stimulant and antiseptic properties and is utilized in tooth powder and as mouth wash. Topically it is astringent to mucous membranes.
- It is used in a tincture, paint, gargle and rinse due to its disinfecting, deodourizing, and in inflammatory conditions of the mouth and throat.
- Alcoholic extracts are used as fixatives in the perfumery industry.

Marketed Products

It has been marketed as Guggulipid by CDRI, Lucknow, India. In ayurveda, it is sold as Yograj guggulu (Baidyanath) for antiinflammatory and antihyperlipidemic activity, and it is also a constituent of Madhumehari (Baidyanath).

COLOPHONY

Synonyms

Rosin, yellow resin; Abietic anhydride; colophony resin; amber resin; resin; coloponium.

Biological Source

Colophony is a solid residue left after distilling off the volatile oil from the oleoresin obtained from *Pinus palustris* (long leaf pine) and other species of *Pinus* such as *P. pinaster,P.halepensis, P. massoniana, P. tabuliformis, P. carribacea* var., belonging to family Pinaceae.

Geographical Source

The genus *Pinus* is widely found in United States, France, Italy, Portugal, Spain, Greece, New Zealand, China, India (Himalayan region), and Pakistan. Colophony is chiefly produced in the United States contributing about 80% of world supply. Other countries producing the resin are China, France, Spain, India, Greece, Morocco, Honduras, Poland, and Russia.

Collection

- The collection of the oleoresin is very laborous procedure.
- Although Colophony is a normal (Physiological) resin of *Pinus* species, its amount is increased by injuring the plant.
- For its collection a few-feet long groove or blaze is made in the bark with the help of knife or some other instrument.A metal or earthenware cup is attached below the groove by nails.
- The cup is adjusted accordingly when the size of groove increases.
- The resin is taken out at different intervals and sent for further processing.

Cup and Gutter Method

- This method is used in America, European countries, India, and Pakistan.
- The 60–100 cm long blaze or longitudinal groove is cut with a suitable instrument.
- It is enlarged at intervals and in about four years is about 4 m long.

- The metal or earthenware cups are attached to the trunk by nails and one or two strips of galvanized iron are placed above each to direct the flow of oleoresin.
- As the grooves are lengthened the cups are moved higher up the tree and new grooves are started when the old ones become exhausted or collection is difficult.
- The cups are emptied at intervals and the oleoresin sent to the distillery. Trees can be tapped by this method for about 40 years.

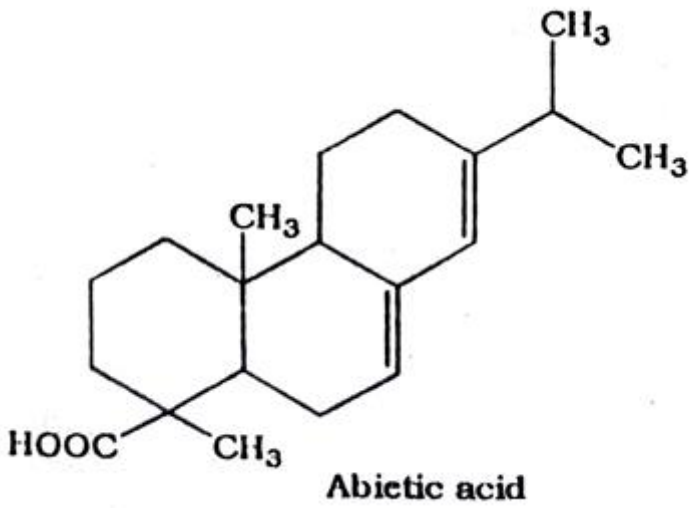
Preparation

- The crude oleoresin arrives at the distillery in barrels. It is mixed with about 20% by weight of turpentine in a heated stainless steel vessel and allowed to stand to separate water and other impurities.
- The diluted oleoresin is then transferred to copper or stainless steel stills and the turpentine is removed by steam distillation.
- When distillation is complete the molten resin is run through wire strainers into barrels, in which it cools and is exported. The resin obtained from trees during their first year of tapping is of a lighter colour than that obtained later on.
- The following grades of American rosin are recognized: B, FF (for wood rosin only), D, E, F, G, H, I, K, L, M,N, WG (window-glass), WW (water-white), and the extrawhite grades and American and Portuguese qualities (XA,XB. XC). A great deal of the American tall oil rosin is now paler than grade X. Grade B is almost black.

Characters

Colophony occurs as translucent, hard, shiny, sharp, pale yellow to amber fragments, fracture brittle at ordinary temperature, burns with smoky flame, slight turpentine-like odour and taste, melts readily on heating, density 1.07–1.09. Acid number is not less than 150. It is insoluble in water but freely soluble in alcohol, benzene, ether, glacial acetic acid, oils, carbon disulphide, and alkali solutions.

Chemical Constituents



Abietic acid

- Colophony contains resin acids (about 90%), resenes, and fatty acid esters. Of the resin acids about 90% are isomeric abietic acids;
- The other 10% is a mixture of dihydroabietic acid and dehydroabietic acid. Before distillation, the resin contains excess amounts of (+) and (-) pimaric acids. During distillation the (-) pimaric acid is converted into abietic acid while (+) pimaric acid is stable. The other constituents of Colophony are sipinic acid and a hydrocarbon.

Chemical Tests

1. To a solution of powdered resin (0.1 g) in acetic acid (10 ml) one drop of conc. Sulphuric acid is added in a dry test tube. A purple colour, readily changing to violet, is formed.

2. To a petroleum ether solution of powdered Colophony twice its volume of dilute solution of copper acetate is shaken. The colour of the petroleum ether layer changes to emerald-green due to formation of copper salt of abietic acid.

3. To alcoholic solution of Colophony sufficient water is added. It becomes milky white due to precipitation of chemical compounds.

4. Alcoholic solution of Colophony turns blue litmus to red due to the presence of diterpenic acids.

Uses

- Colophony is used as stiffening agent in ointments, adhesives, plasters and cerates and as a diuretic in veterinary medicine.

- Commercially it is used to manufacture varnishes, printing inks, cements, soap, sealing wax, wood polishes,floor coverings, paper, plastics, fireworks, tree wax, rosin oil, and for water proofing cardboard.
- The abietic acids show antimicrobial, antiulcer and cardiovascular activity; some have filmogenic, surfactant and antifeedant properties.

SENNA LEAF

Synonyms

Alexandrian senna, Tinnevelly senna, Folia senna.

Biological Source

Senna leaf consists of the dried leaflets of *Cassia acutifolia* Delile (*C. senna* L.) known as Alexandrian senna and of *C. angustifolia* Vahl., which is commercially known as Tinnevelly senna. It belong family Leguminosae.

Geographical Source

Alexandrian senna is indigenous to South Africa. It widely grows and sometimes is cultivated in Egypt and in the middle upper territories of Nile river. It is also cultivated in Kordofan and Sennar regions of Sudan. Indian or Tinnevelly senna is indigenous to southern Arabia and cultivated largely in Tinnevelly and Ramnathpuram districts of Tamilnadu. It also grows in Somaliland, Sindh and Punjab region.

Cultivation and Collection

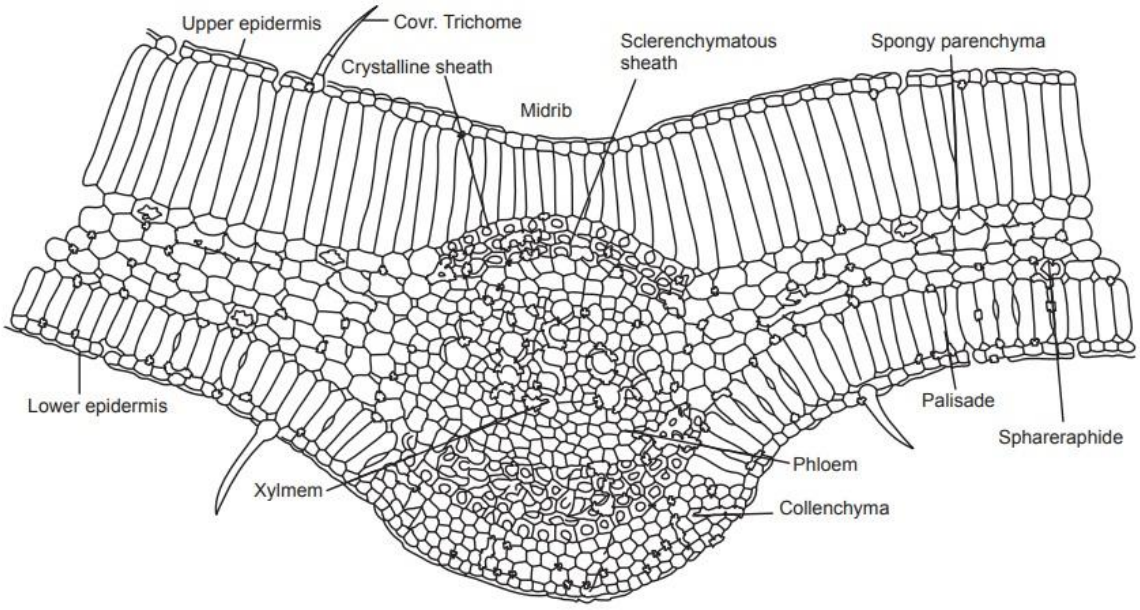
- Senna plant is a small shrub of 1–1.5 m height with paripinnate compound leaves. Tinnevelly senna is mostly cultivated in well-ploughed, levelled, rich clayed semiirrigated land sometimes after paddy crop in South India.
- Propagation is done by seeds which are rubbed with coarse sand and sown thinly by broadcasting or in rows 30 cm apart, first during February–March and second after rain in July.
- Seeds germinate on the third day. The crop becomes ready for harvesting after about 2 months but first plucking of leaflets is done after 3 months of sowing when the leaves appears mature, thick and bluish in colour.
- Second plucking is followed after a month and subsequent pluckings after 4–6 weeks. The plant can survive for two to three years, but it is grown as an annual.
- After third plucking the plants are uprooted. Plant shows great tolerance for salinity. It sometimes shows die-back symptoms in which the branches or shoots die from the tip inward, which is caused by parasites or environmental conditions. Leaflets of Tinnevelly senna are collected by careful plucking from luxuriantly grown plants and compressed into bales.
- Alexandrian senna is obtained almost entirely from the wild and sometimes from the cultivated plants.
- At the stage of fully formed fruits, branches are cut off and rapidly dried in the sun. Pods and large stalks are first separated by using sieves.
- Leaves separated from stalks are graded into whole leaves, whole and half leaves and shiftings.

- Whole leaves and shiftings are generally used for making galenical preparations. The leaves are packed loosely in bales for marketing.

Characteristics

- Senna leaflets are 3–5 cm long, 2 cm wide and about 0.5 mm thick. It shows acute apex, entire margin and asymmetric base.
- Outline is lanceolate to ovate lanceolate. Pubescent lamina is found on both the surfaces. Leaves show greyish green colour for Alexandrian senna and yellowish green for Tinnevelly senna.
- Leaves of Tinnevelly senna are somewhat larger, less broken and firmer in texture than that of Alexandrian senna.
- Odour of leaves is slight but characteristic and the taste is bitter, mucilagenous.
- Both the types of leaflets show impression or transverse markings due to the pressing of midrib.
- Distingushing characters of Alexandrian and Indian senna

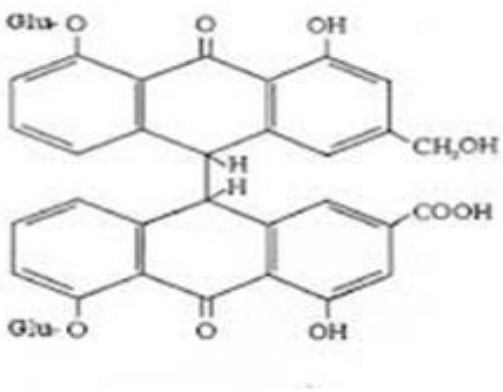
Microscopy



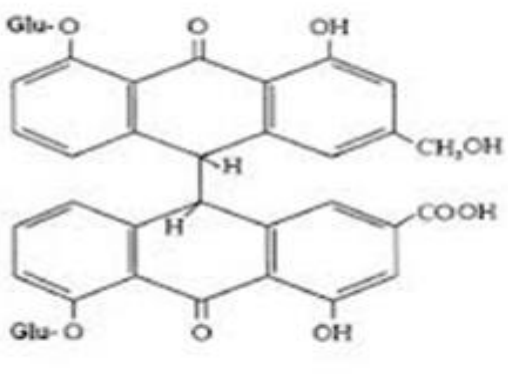
- Being isobilateral leaf, senna shows more or less similar features at both the surfaces of leaf with few differences.
- Transverse section of leaf shows upper and lower epidermis with straight wall cells, few of which contain mucilage.

- Paracytic stomata and nonlignified unicellular trichomes are found on both the surfaces.
- A single layer of palisade parenchyma is observed at both the sides but it is discontinued in the midrib region of lower epidermis due to the zone of collenchymatous tissues.
- Palisade is followed by spongy mesophyll which contains cluster crystals of calcium oxalate and vascular strands.
- Midrib shows the vascular bundle containing xylem and phloem, almost surrounded by lignified pericyclic fibres and a sheath of parenchyma which contains prismatic crystals of calcium oxalate.

Chemical Constituents



Sennoside A



Sennoside B

- Senna contains sennosides A and B (2.5%) based on the aglycones sennidin A and B, sennosides C and D which are glycosides of heterodianthrones of aloe-emodin and rhein are present.
- Others include palmidin A, rhein anthrone and aloe-emodin glycosides. Senna also contains free chryso- phanol, emodin and their glycosides and free aloe-emodin, rhein, their monoanthrones, dianthrones and their glycosides.
- Mucilage is present in the epidermis of the leaf and gives red colour with ruthenium red.

Chemical Test

1. *Borntrager test for anthraquinones:* The leaves are boiled with dilute sulphuric acid and filtered. To the filtrate organic solvent like benzene, ether or chloroform is added and shaken. The organic layer is separated, and to it add ammonia solution. The ammoniacal layer produces pink to red colour indicating the presence of anthraquinone glycoside

Uses

- Senna leaves are used as laxative.
- It causes irritation of large intestine and have some griping effect.
- Thus they are prescribed along with carminatives.
- Senna is stimulant cathartic and exerts its action by increasing the tone of the smooth muscles in large intestine.

Adulterants

***Cassia obovata* (Dog Senna**): They occur as small pieces with Alexandrian senna but can be easily identified by its obovata shape and obtuse and tapering apex. It has only 1% anthraquinone derivatives.

The presence of *Cassia auriculata* **(Palthe senna)** can be identified by treating it with 80% sulphuric acid. It gives red colour.

***Cassia angustifolia* (Bombay or Mecca or Arabian senna)** a mild variety of Indian senna have the morphology similar to that of Tinnevelly senna but the leaflets are narrow, more longated and brownish green in colour.

***C. marilandica* or American Senna,** Wild Senna, *Poinciana pulcherima,* formerly *Maryland Senna,* is a common perennial from New England to Northern Carolina. Its leaves are compressed into oblong cakes like other herbal preparations of the Shakers. It acts like Senna, but is weaker, and should be combined with aromatics. These leaves are also found mixed with or substituted for Alexandrian Senna.

***Coriaria myrtifolia* is** a Mediterranean shrub and highly poisonous, so that it should be recognized when present. The leaves are green, very thin and soft, three veined, ovate-lanceolate, and equal at the base. It is also used to adulterate sweet marjoram.

Cassia montana yields a false Senna from Madras, partly resembling the Tinnevelly Senna, though the colour of the upper surface of the leaves is browner.

Marketed Products

It is one of the ingredients of the preparations known as Constivac, Softovac (Lupin Herbal Laboratory) and Isova powder, Kultab tablet (Vasu Healthcare).

Distinguishing characters of Alexandrian and Indian senna

Character	Indian Senna	Alexandrian senna
Appearance	Generally entire and less broken in good condition	Broken and brittle in nature
Size	2.5–5.0 cm long and 7–9 mm wide	2.4 cm long and 6–12 mm wide.
Shape	Lanceolate	Ovate lanceolate
Apex	Less acute with a sharp spine	Acute with a sharp spine
Margin	Entire, flat	Entire curled
Base	Less asymmetrical	Conspicuously asymmetrical
Veins	Pinnate, distinct towards the under surface and anastomosing towards margin	Pinnate, distinct towards the under surface and anastomosing towards margin
Surface	Transverse and oblique impressions, less pubescent (hairy)	Without transverse and oblique impressions and more pubescent
Texture	Flexible and less brittle	Thin more brittle
Odour	Faint	Faint
Colour	Light green	Light greyish green
Test	Bitter mucilaginous	Bitter mucilaginous
Vein Islet Number	19–22.5	25–29.5
Stomatal index	14–20	10–15
Palisade ratio	4–12	4.5–18

Aloe

Biological Source

- Aloe is the dried juice collected by incision, from the bases of the leaves of various species of Aloe. *Aloe perryi* Baker, *Aloe vera* Linn or *Aloe barbadensis* Mil and *Aloe ferox* Miller., belonging to family Liliaceae.
- *Aloe perryi* Baker is found in Socotra and Zanzibar islands and in their neighbouring areas and so the aloes obtained from this species is known as Socotrine or Zanzibar aloe.
- *Aloe vera* Linn is also known as *Aloe vulgairis* Lamarek, or
- *Aloe barbadensis* Mil. or *Aloe officinalis* Forskal.
- It was formerly produced on the island of Barbados, where it was largely cultivated, having been introduced at the beginning of the sixteenth century.
- It is now almost entirely made on the Dutch islands of Curacoa, Aruba and Bonaire. The aloes obtained from this species is known as Curacao or Barbados aloe.
- *Aloe ferox* Miller and hybrids of this species with *Aloe africana* and *Aloe spicata, A. platylepia* and other species of Aloe grows in Cape Colony and so is known as Cape aloe.

Geographical Source

Aloes are indigenous to East and South Africa, but have been introduced into the West Indies and into tropical countries, and will even flourish in the countries bordering on the Mediterranean.

Cultivation and Collection

- It is an evergreen perennial growing to 0.8 m by 1 m at a slow rate.
- The plant prefers light (sandy) and medium (loamy) soils, requires well-drained soil and can grow in nutritionally poor soil.
- The plant prefers acid, neutral and basic (alkaline) soils.
- It cannot grow in the shade. It requires dry or moist soil and can tolerate drought.
- They are xerophytic plant. It can be propagated by seeds. Seeds are sown in the spring in a warm green house.
- The seed usually germinates in 1–6 months at 16°C. The seedlings are transferred to the pots containing well-drained soil.
- They are allowed to grow in sunny part for at least their first two winters. The offsets will be available, usually in spring.
- The plants produce offsets quite freely and they can be divided at any time of the year as long as it is warm enough to encourage fresh root growth to allow reestablishment of the plants.
- Young offsets are planted in the soil after the rainy season in rows situated at a distance of 60 cm. In the second year leaves are collected by the natives by protecting their hands because of the spiny nature of leaves.
- The leaves are cut near the base, kept inside of kerosene tins and taken them to a central place for the preparation of aloe.
- Juice of aloe is present in parenchymatous cells of pericycle that are mucilage cells. In a single incision mucilage cells exert pressure on pericycle cells and the entire juice from the leaves is drained out.

Preparation of Aloe

Curacao or barbados aloe

- In West Indies the cut leaves are arranged with their cut surface on the inner side, on the sides of V shaped vessel of about 1–2 m long and the flowing juice is collected in a tin vessel that is placed below the V-shaped vessel .
- This juice thus collected is concentrated either by spontaneous evaporation, or more generally by boiling until it becomes of the consistency of thick honey.

- These conditions favours the crystallization of barbaloin and this aloe contains crystals of barbaloin because of the presence of which it becomes opaque and so also known as hepatic or livery aloe.
- On cooling, it is then poured into gourds, boxes, or other convenient receptacles and solidifies.

Socotrine aloe

- When it is prepared, it is commonly poured into goat skins and spontaneous evaporation is allowed for about a month when it becomes viscous pasty mass which are then packed into cases.
- In European countries it is dried in wooden pans with hot air till moisture is about 10%.

Zanzibar aloe

This aloe is prepared similar to Socotrine aloe.

It is packed in skins, of carnivorous animals. This aloe is also known as monkey skin aloe.

Cape aloe

- The leaves of the plants from which Cape aloe is obtained are cut off near the stem and arranged around a hole in the ground, in which a sheep skin is spread, with smooth side upwards.
- When a sufficient quantity of juice has drained from the leaves it is concentrated by heat in iron cauldrons and subsequently poured into boxes or skins in which it solidifies on cooling.
- Large quantities of the drug are exported from Cape Town and Mossel Bay.

Characteristics

Curacao aloe

- It is usually opaque and varies in colour from bright yellowish or rich reddish brown to black.
- Sometimes it is vitreous and small fragments are then of a deep garnet-red colourand transparent.
- It is then known as 'Capey Barbados' and is less valuable, but may become opaque and more valuable by keeping.

- Curacoa Aloes possesses the nauseous and bitter taste that is characteristic of all Aloes and a disagreeable, penetrating odour.
- It is almost entirely soluble in 60% alcohol and contains not more than 30% of substances insoluble in water and 12% of moisture. It should not yield more than 3% of ash. The fracture is waxy.

Socotrine aloes

- It may be distinguished principally from Curacoa Aloes by its different odour.
- Much of the dry drug is characterized by the presence of small cavities in the fractured surface; it is yellow-brown to dark-brown in colour and opaque.Fracture is irregular and porous and taste is bitter.

Zanziber aloes

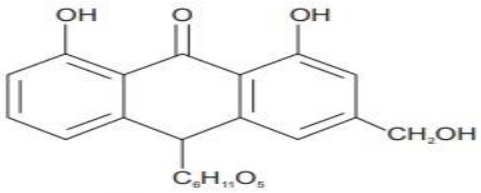
Zanzibar Aloes often very closely resembles Curacoa in appearance and is usually imported in liver-brown masses which break with a dull, waxy fracture, differing from that of Socotrine Aloes in being nearly smooth and even.

It has a pleasant odour and bitter taste.

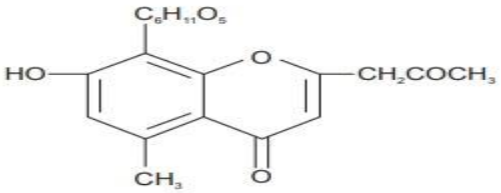
Cape aloes

- It forms dark coloured masses which break with a clean glassy fracture and exhibit in their splinters a yellowish, reddish-brown or greenish tinge.
- Its translucent and glossy appearance are very characteristic and red-currant like odour sufficiently distinguish it from all other varieties of Aloes.

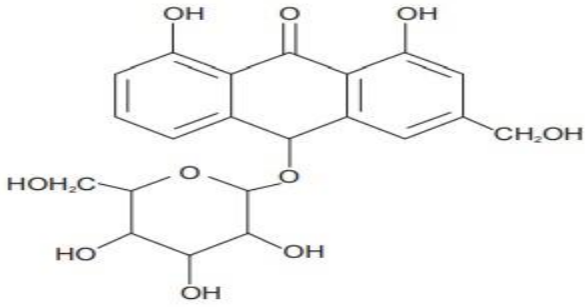
Chemical Constituents



Barbaloin



Aloesin



Aloin

- The most important constituents of Aloes are the three isomers of Aloins, Barbaloin, barboloin and Isobarbaloin, which constitute the so-called 'crystalline' Aloin, present in the drug at from 10 to 30%.
- Other constituents are amorphous Aloin, resin, emodin and Aloe-emodin. Barbaloin is present in all the varieties;
- it is slightly yellow coloured, bitter, water soluble, crystalline glycoside. Isobarbaloin is a crystalline substance, present in Curacao aloe and in trace amount in Cape aloe and absent in Socotrine and Zanzibar aloe.
- The chief constituents of Socotrine and Zanzibar aloe are Barbaloin.

Chemical Tests

Boil 1 gm of drug with 100 ml water, allow it to cool; add 1 gm kieselguhr, stir it well and filter through filter paper.

1. *Borax Test:* Take 10 ml of aloe solution and to it add 0.5 gm of borax and heat; a green coloured fluorescence is produced indicating the presence of aloe-emodin anthranol.

2. *Modified Anthraquinone Test:* To 0.1 gm of drug, 5 ml of 5% solution of ferric chloride is added followed by the addition of 5 ml dilute hydrochloric acid. The mixture is heated on water bath for 5–6 min and cooled. An organic solvent (benzene or chloroform) is added and shaken. Separate the organic solvent layer and add an equal volume of dilute ammonia. The ammoniacal layer produces pinkish red colour.

3. *Bromine Test:* To 5 ml of aloe solution, add equal volume of bromine solution; bulky yellow precipitate is formed due to the presence of tetrabromaloin.

4. *Nitrous Acid Test:* To 5 ml of aloe solution, add little of sodium nitrite and few drops of dilute acetic acid; it produces Pink or purplish colour. Zanzibar and Socotrine aloes give negative test.

5. *Nitric Acid Test:* 2 ml of concentrated nitric acid is added to 5 ml of aloe solution; Curacao aloe gives deep reddish-brown colour, Socotrine aloe gives pale yellowish-brown colour, Zanzibar aloe gives yellowish brown colour and Cape aloe first produces brown colour which on standing changes to green.

6. *Cupraloin Test**:*** 1 ml of the aloe solution is diluted to 5 ml with water and to it 1 drop of copper sulphate solution is added. Bright yellow colour is produced which on addition of 10 drops of saturated solution of sodium chloride changes to purple and the colour persist if 15–20 drops of 90% alcohol is added. This test is positive for Curocao aloe, faint for Cape aloe and negative for Zanzibar and Socotrine aloes.

Uses

- The drug Aloes is one of the safest and stimulating purgatives, in higher doses may act as abortifacient.
- Its action is exerted mainly on the large intestine; also it is useful as a vermifuge.
- The plant is emmenagogue, emollient, stimulant, stomachic, tonic and vulnerary.
- Extracts of the plant have antibacterial activity.
- The clear gel of the leaf makes an excellent treatment for wounds, burns and other skin disorders, placing a protective coat over the affected area, speeding up the rate of healing and reducing the risk of infection.
- To obtain this gel, the leaves can be cut in half along their length and the inner pulp rubbed over the affected area of skin.
- This has an immediate soothing effect on all sorts of burns and other skin problems.

Substituents and Adulterants

A. candelsbmm (Natal aloes) is dull greenish black to dull brown in colour, opaque. When scraped it gives a pale greyish green or a yellow powder. It can be distinguished as it gives negative test to borax test and produces a deep blue colour. Jafferabad aloes and the Mocha aloes are the other two type of aloe which is used as adulterant.

Marketed Products

It is one of the ingredients of the preparations known as Diabecon, Evecare (Himalaya Drug Company),Mensonorm (Chirayu Pharma) and Kumari Asava (Baidyanath).

Bitter almonds

Biological Source

Almond oil is a fixed oil obtained by expression from the seeds of *Prunus amygdalus* (Rosaceae) var. dulcis (sweet almonds), or *P. amygdalus* var. amara (bitter almonds).

Geographical Source

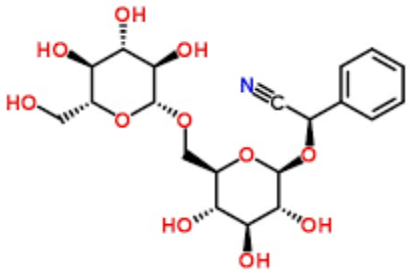
The oil is mainly produced from almonds grown in the countries bordering the Mediterranean (Italy, France, Syria, Spain and North Africa) and Iran.

Characteristics

- Almond trees are about 5 m in height.
- The young fruits have a soft, felt-like pericarp, the inner part of which gradually becomes sclerenchymatous as the fruit ripens to form a pitted endocarp or shell.

- The shells, consisting mainly of sclerenchymatous cells, are sometimes ground and used to adulterate powdered drugs.
- The sweet almond is 2–3 cm in length, rounded at one end and pointed at the other.
- The bitter almond is 1.5–2 cm in length but of similar breadth to the sweet almond.
- Both varieties have a thin, cinnamon-brown testa which is easily removed after soaking in warm water.
- The oily kernel consists of two large, oily planoconvex cotyledons, and a small plumule and radicle, the latter lying at the pointed end of the seed.
- Some almonds have cotyledons of unequal sizes and are irregularly folded.
- Bitter almonds are found in samples of sweet almonds; their presence may be detected by the sodium picrate test for cyanogenetic glycosides.

Chemical Constituents



Amygdalin

- Both varieties of almond contain 40–55% of fixed oil, about 20% of proteins, mucilage and emulsin.
- The bitter almonds contain in addition 2.5–4.0% of the colourless, crystalline, cyanogenelic glycoside **amygdalin**. Almond oil is obtained by grinding the seeds and expressing, them in canvas bags between slightly heated iron plates.
- The oil is clarified by subsidence and filtration. It is a pale yellow liquid with a slight odour and bland nutty taste.
- It contains olein, with smaller quantities of the glycosides of linoleic and other acids.
- Bitter almonds, after maceration on hydrolysis of amygdalin yield a volatile oil that is used as a flavoring agent.

- Sweet almonds are extensively used as a food, but bitter almonds are not suitable for this purpose.
- Essential or volatile oil of almonds is obtained from the cake left after expressing bitter almonds.
- This is macerated with water for some hours to allow hydrolysis of the amygdalin to take place.
- The benzaldehyde and hydrocyanic acid are then separated by stem distillation.
- Almond oil consists of a mixture of glycerides of oleic (62–86%), linoleic (17%), palmitic (5%), myristic (1%),palmitoleic, margaric, stearic, linolenic, arachidic, gadoleic, behenic and erucic acid. Bitter almond oil contains benzaldehyde and 2–4% of hydrocyanic acid. Purified volatile oil of bitter almonds has all its hydrocyanic acid removed and, therefore, consists mainly of benzaldehyde.
- The unsaponifiable matter contains sitosterol, avenasterol, cholesterol, brassicasterol and tocopherols.

Uses

- Expressed almond oil is an emollient and an ingredient in cosmetics.
- Almond oil is used as a laxative, emollient, in the preparation of toilet articles and as a vehicle for oily injections.
- The volatile almond oils are used as flavouring agents.

Marketed Products

It is one of the ingredients of the preparations known as Baidyanath lal tail (Baidyanath Company), Himcolin gel, Mentat, Tentex Royal (Himalaya Drug Company) and Sage badam roghan (Sage Herbals).

Gentian

Synonyms

Gentian Root, Yellow Gentian Root.

Biological Source

Gentian consists of dried unfermented rhizomes and roots of *Gentiana lutea* Linn., belonging to family Gentianaceae.

Geographical Source

Mountanious regions of Central and south Europe, of France and Switzerland, of Spain and Portugal, the Pyrenees, Sardinia and Corsica, the Apennines, the Mountains of Auvergne, the Jura, the lower slopes of the Vosges, the Black Forest and throughout the chain of the Alps as far as Bosnia and the Balkan States.

Cultivation and Collection

- It is a perennial plant growing to 1.2 m to 0.6 m.
- For cultivation,a strong loamy soil is most suitable, the deeper the better, as the stout roots descend a long way down into the soil.
- Plenty of moisture is also desirable and a position where there is shelter from cold winds and exposure to sunshine. Old plants have large crowns, which may be divided for the purpose of propagation, but growing it on a large scale, seeds would be the best method.
- It is advantageous to keep the seed at about 10°C for a few days after sowing, to enable the seed to imbibe moisture.
- Following this with a period of at least 5–6 weeks with temperatures falling between 0 and –5°C will usually produce reasonable germination.

- They could be sown in a frame, or in a nursery bed in a sheltered part of the garden and the young seedlings transplanted. They take about three years to grow to flowering size.
- It is, however, likely that the roots are richest in medicinal properties before the plants have flowered.
- Collection is done from two to five years old plants in spring.
- The rhizome and roots collected and dried. When fresh, they are yellowish-white externally, but gradually become darker by slow drying.
- Slow drying is employed to prevent deterioration in colour and to improve the aroma. Occasionally the roots are longitudinally sliced and quickly dried, the drug being then pale in colour and unusually bitter in taste.

Characteristics

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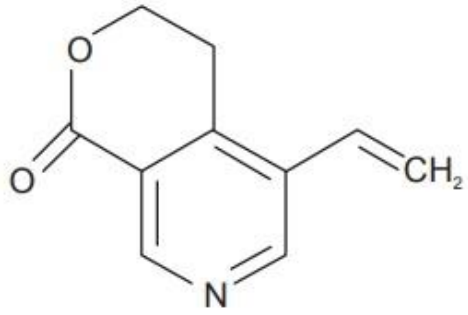
- The dried root as it occurs in commerce is brown and cylindrical, 1 foot or more in length, or broken up into shorter pieces, usually 1/2 inch to 1 inch in diameter, rather soft and spongy, with a thick reddish bark, tough and flexible and of an orange-brown colour internally.
- The upper portion is marked with numerous rings, the lower longitudinally wrinkled.
- The root has a strong, disagreeable odour, and the taste is slightly sweet at first, but afterwards very bitter.

Microscopy

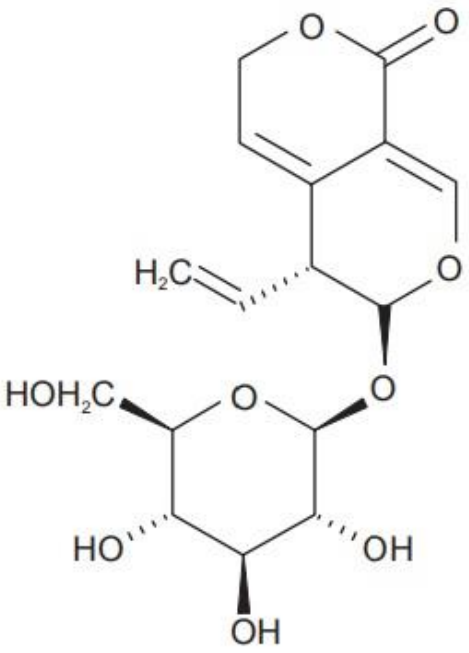
- The transverse section of root shows triarch primary xylem at the centre, where each primary bundle is represented by one to three very small vessels.
- The secondary xylem is very wide with parenchymatous and medullary rays not clearly marked.

- The drug also shows reticulately thickened xylem vessels very few being annular or spiral, scattered throughout the parenchyma of the xylem. Secondary phloem is wide and composed chiefly of parenchyma, with groups of sieve-tissue.
- The phloems are surrounded by a narrow parenchymatous phelloderm and externally are several rows of polygonal tabular, thin walled cork cells.
- Parenchyma cells in all regions of the root contain scattered needles of calcium oxalate crystals, about 3–6 long and 0.5–1.1 wide, also small prismatic crystals.

Chemical Constituents



Gentianine



Gentiopicrin

- Gentian contains bitter glycosides.
- The dried gentian root contains Gentinin and Gentiamarin, bitter glucosides, together with Gentianic acid (gentisin), the latter being physiologically inactive.
- Gentiopicrin, another bitter glucoside, a pale yellow crystalline substance, occurs in the fresh root and may be isolated from it by treatment with boiling alcohol. Gentinin, crystalline glycoside is not a pure chemical substance, but a mixture of gentiopicrin and a colouring substance gentisin (gentianine) or gentlanic acid.

- Gentian contains a bitter trisaccharide, gentianose which on hydrolysis yields two molecules of glucose and one molecule of fructose. The saccharine constituents of gentian are dextrose, laevulose, sucrose and gentianose, a crystallizable, fermentable sugar.
- It is free from starch and yields from 3 to 4% ash.

Uses

- Gentian root has a long history of use as an herbal bitter in the treatment of digestive disorders.
- It contains some of the most bitter compounds known and is used as a scientific basis for measuring bitterness.
- It is useful in states of exhaustion from chronic disease and in all cases of debility, weakness of the digestive system and lack of appetite.
- It is one of the best strengthened of the human system, stimulating the liver, gall bladder and digestive system, and is an excellent tonic to combine with a purgative in order to prevent its debilitating effects.
- It is also used as anthelmintic, antiinflammatory, antiseptic, bitter tonic, cholagogue, emmenagogue, and febrifuge, refrigerant and stomachic.
- It is taken internally in the treatment of liver complaints, indigestion, gastric infections and anorexia.
- It should not be prescribed for patients with gastric or duodenal ulcers.