

5.1.6. Ephedra

Ephedra is a native plant of Mongolia and Central Asia. It is an evergreen shrub having ephedrine as the chief active ingredient. The principal medicinal property of ephedrine is its powerful stimulatory action on heart and nervous system.

Synonym

Ma Huang.

Biological Source

Ephedra is the dried young stems of *Ephedra nebrodensis* Tinco, *Ephedra gerardiana* Wall, *Ephedra sinica* Stapf, *Ephedra equisetina* Bunge, and other species of ephedra.

Family

Ephedraceae

5.1.6.1. Occurrence and Distribution

Ephedra plant is found abundantly in North-western India, Pakistan, and Southern sea coast of China.

5.1.6.2. Organoleptic Evaluation

The organoleptic features of different species of ephedra are:

1) *Ephedra Gerardiana*: It consists of a cylindrical, woody, grey or greenish coloured stem. The stem bears nodes, internodes, scaly leaves, and terminal buds. The internodes are 3-4cm apart and the nodes bear the scaly leaves. They are bitter in taste. The plant has stamens and pistils on separate flowers; staminate flowers in catkins and a membranous perianth, pistillate flowers terminal on axillary stalks, within a two-leaved involucre. The fruit has two carpels with a single seed in each and is a succulent cone. Branches are slender and erect. Small scale-like leaves are articulated and joined at the base into a sheath.

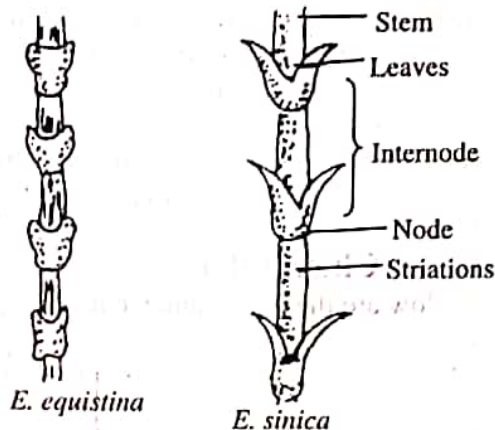


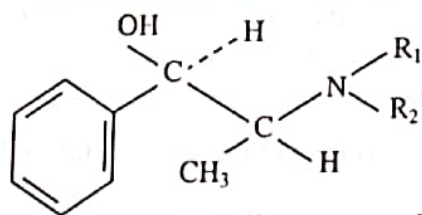
Figure 5.4: Ephedra Stem

- 2) *Ephedra sinica*: The stems are 4-7mm thick and the branches are 1-2mm thick. Their length ranges up to 30cm of branches and 3-6cm of internodes. The main stem is brown in colour. Leaves are 2-4mm long, opposite, decussate, and subulate. Leaf base is reddish-brown, apex acute and recurved, and lamina is white in colour. A pair of sheathing leaves is present at the nodes, encircling the stem and fused at the base.
- 3) *Ephedra equisetina*: Stems are woodier and have more branches of 1.5-2mm thickness. Branches are 25-200cm long and internodes are 1-2.5cm long. The outer surface is grey to pale green coloured and smooth.
- 4) *Ephedra nebrodensis*: The stems are 15-35cm long and 1-2mm thick. They are cylindrical, greenish-yellow in colour; nodes are brownish and distinct and fractured surface is fibrous in the cortex but pith contains brownish powdery mass. The leaves are brownish to whitish-brown in colour, scaly, connate, opposite and decussate, acute, with agreeable and slightly aromatic odour and taste is astringent and bitter.

5.1.6.3. Chemical Constituents

The primary amino alkaloids found in ephedra are ephedrine, n-methyl ephedrine, nor-ephedrine, pseudo-ephedrine, etc.

Ephedra roots also consist of macrocyclic alkaloids, known as ephedradines, along with considerable amount of amino alkaloids. The drug also contains oxazolidone.



- | | | |
|------------------------|------------------------------------|----------------------------------|
| (-) Ephedrine | R ₁ = H, | R ₂ = CH ₃ |
| (-) Nor-ephedrine | R ₁ = H, | R ₂ = H |
| (-) n-methyl ephedrine | R ₁ = CH ₃ , | R ₂ = CH ₃ |

5.1.6.4. Chemical Test

Ephedrine is dissolved in water and dilute hydrochloric acid. The resultant mixture is treated separately with copper sulphate and sodium hydroxide. This solution becomes violet in colour and on shaking with solvent, ether gives a purple colouration to the organic layer and a blue colouration to the aqueous layer.

5.1.6.5. Therapeutic Efficacy

Ephedra possesses the following therapeutic properties:

- 1) Ephedrine is used for providing relief from asthma and hay fever.
- 2) It helps in diminishing hyperaemia and increasing blood pressure for long term.
- 3) It also causes mydriasis in eyes.
- 4) In China, the root has been used clinically for its anti-sudorific (antiperspirant) activity; however, the herb possesses sudorific action.
- 5) Ephedrine salts like ephedrine sulphate and ephedrine hydrochloride possess anti-hypotensive properties.
- 6) It is also used in the treatment of allergic bronchial disorders.
- 7) Ephedrine shows sympathomimetic actions by stimulating the α -, β - and β_2 -adrenergic receptors, thereby exciting the sympathetic nervous system. This in turn causes the stimulation of cardiac system and vasoconstriction of blood vessels.
- 8) Ephedrine helps in the contraction of peripheral arterioles, therefore, can be used for correcting the low blood pressure conditions.

5.1.7. Opium

Opium is the dried latex extracted from the seedpods of the plant opium poppy (*Papaver somniferum*). The un-ripened pods are slit open for the sap to seep out, which is then dried on the outer surface of the pod. The resulting latex is scraped off the pod which is yellow-brown in colour and bitter in taste. Different types of alkaloids, e.g., morphine, codeine, thebaine, and papaverine are present in this latex.

Synonyms

Raw Opium, Gum Opium, and Afeem.

Biological Source

Opium is the dried latex extracted from the unripe capsules of the plant opium poppy or *Papaver somniferum* Linn.

Family

Papaveraceae

5.1.7.1. Occurrence and Distribution

Opium is commercially cultivated in Afghanistan, Yugoslavia, Bulgaria, Pakistan, Turkey, Persia (Iran), and India. In India, it is mostly grown in Madhya Pradesh.

5.1.7.2. Organoleptic Evaluation

The organoleptic features of opium are:

- 1) **Colour and Shape:** Following are the colours and shapes of different opium:
 - i) **Indian Opium:** Dark brown in colour and is found in the form of cubical pieces enclosed in a tissue paper.
 - ii) **Persian Opium:** Dark brown in colour and is found in the form of brick-shaped masses.
 - iii) **Natural Turkish or European Opium:** Brown or dark brown in colour and is found in conical or rounded and somewhat flattened masses.

- iv) **Manipulated Turkish Opium:** Chocolate brown or dark brown internally and covered with broken poppy leaves externally. The masses of this type are oval and flattened on upper and lower surface.
- v) **Manipulated European Opium:** Dark brown in colour internally and covered with broken leaves. It is present in the form of elongated masses with rounded ends.
- 2) **Odour:** Strong characteristic.
- 3) **Taste:** Bitter.

5.1.7.3. Chemical Constituents

The alkaloids present in the latex are derived from amino acids, phenylalanine, and tyrosine. Different alkaloids derived from the opium are grouped under two categories:

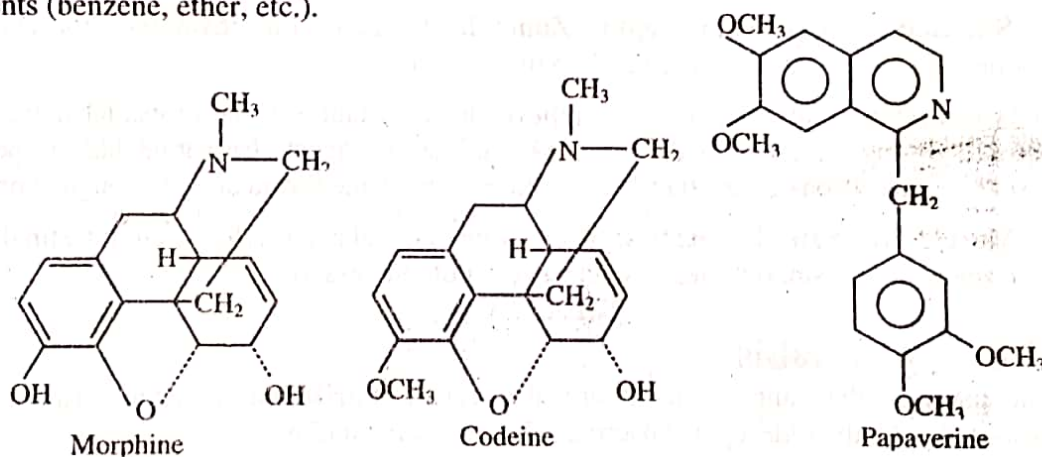
- 1) **Benzylisoquinoline:** Narcotine (noscapine), narceine, and papaverine.
- 2) **Phenanthrene:** Morphine, codeine (methyl morphine), and thebaine.

Narcotine is a weak, monoacidic base and optically laevorotatory, while its salts are dextrorotatory. Narcotine is insoluble in water and in some polar organic solvents (alcohol and ether). It is soluble in acetone, benzene, and chloroform.

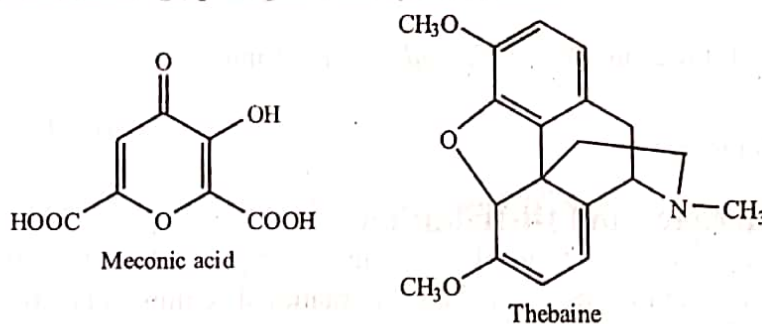
Papaverine is an optically inactive and weak monoacidic base. It is insoluble in water and slightly soluble in organic solvents.

Morphine is a laevorotatory, phenolic and monoacidic alkaloid. At C-6 position, an alcoholic hydroxyl group is present. Morphine is soluble in alkali hydroxides (except ammonium hydroxide) due to the presence of phenolic hydroxyl group. Heroin is a diacetyl derivative of morphine.

Codeine is a laevorotatory, monoacidic base which is soluble in water and organic solvents (benzene, ether, etc.).



The opium alkaloids are present as salts of meconic acid. Few alkaloids are present in minute concentration, e.g., protopine and hydrocotarnine.



Opium also contains sugar, wax, mucilage and salts of calcium, potassium and magnesium. Opium does not contain tannins, starch, and calcium oxalate.

Minute, off-white coloured seeds are present in large number within the poppy fruits. These seeds have 30-35% fixed oil.

5.1.7.4. Chemical Tests

For identification of alkaloids of opium different chemical tests are performed:

- 1) In the general test, opium is identified by testing the presence of meconic acid because opium alkaloids are present as a salt of meconic acid. The test is performed by dissolving opium in water and adding ferric chloride solution to the filtrate. This results in a deep reddish purple colour which remains even on addition of hydrochloric acid.
- 2) Orange-red colour is obtained on sprinkling morphine on nitric acid. It is noted that codeine does not respond to this test.
- 3) On treating morphine solution with potassium ferricyanide and ferric chloride solutions, bluish-green colour is obtained. Codeine is negative for this test also.
- 4) On reacting hydrochloric acid solution of papaverine with ferricyanide solution, lemon yellow colour is obtained.

5.1.7.5. Therapeutic Efficacy

The therapeutic uses of opium poppy are:

- 1) **Hypnotic, Sedative, and Analgesic Properties:** These properties of opium are due to morphine. Due to biphasic action on CNS, it shows sedative effects on cerebrum and medulla. It sedates emetic centre, respiratory centre, and cough reflex. Morphine has central narcotic effects and causes addiction. Therefore, it is used only in case of severe pain, or when other analgesics are ineffective.
- 2) **Stimulation of Chemoreceptor Zone:** It stimulates the chemoreceptor zone in medulla which causes nausea and vomiting (a side effect).
- 3) **Antitussive Properties:** Codeine relieves local irritation in the bronchial tract, thus, used in many cough medicines as an antitussive agent. Narcotine has a specific depressant action on cough reflex, therefore, used in the formulation of cough syrups.
- 4) **Muscle Relaxant Properties:** Papaverine has relaxant effects on intestinal and bronchial tract smooth muscles, and also on blood vessels.

5.1.8. Cannabis

Some parts of the cannabis plant are also called **marijuana** in slang term, and is considered to be the oldest psychoactive substance known to man.

Synonyms

Indian hemp, Ganja, and Marijuana.

Biological Source

Cannabis is the dried flowering tops of *Cannabis sativa* Linn.

Family

Cannabinaceae (Moraceae)

5.1.8.1. Occurrence and Distribution

In India, cannabis is considered as a local plant, but states like Maharashtra, West Bengal, and Madhya Pradesh cultivates cannabis. International commercial production of cannabis is done in Mexico and Africa.

On commercial grounds, cultivation of cannabis is done for variety of purposes, such as fibres, oil, and narcotic and psychotropic substances (charas, bhang, ganja, etc.). Cultivation of cannabis is also done in Almora, Garhwal, Nainital, Kashmir, Nepal, and Kerala for producing fibres.

5.1.8.2. Organoleptic Evaluation

Cannabis shows the following organoleptic characteristics (figure 5.5):

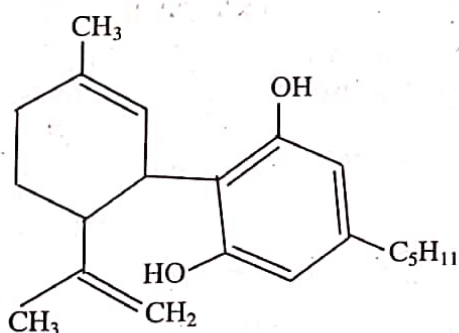
- 1) **Colour:** Dull green.
- 2) **Odour:** Strong, characteristic, and narcotic.
- 3) **Taste:** Somewhat acrid and pungent.
- 4) **Shape:** Branches are flattened and cylindrical in shape; upper part of the stems contains bracts and bracteoles; flowers, fruits, and seeds are pistillate.
- 5) **Stems:** Diameter of stem is not more than 3mm; stems are generally thin, straight, and cylindrical with furrows longitudinally.
- 6) **Bracts:** 1.5-2cm long, simple or lobed with subulate stipules; bracteoles are present in pairs in the axil of bract.
- 7) **Flowers:** Formed in axil of each bracteole with 2 long brownish-red hairy stigmas.
- 8) **Fruits:** 5-6mm in length and 4mm in width; ovate in shape; glossy green or yellowish-green in colour with a single seed.



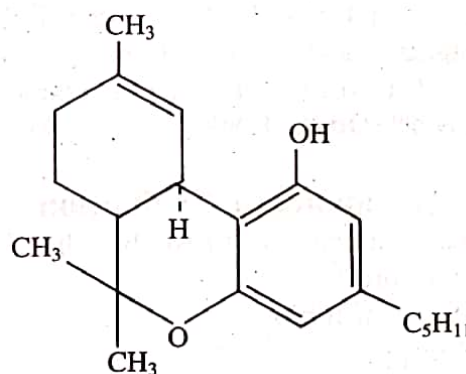
Figure 5.5: *Cannabis sativa*

5.1.8.3. Chemical Constituents

The resin content of cannabis is approximately 15-20%. 1-3-4 *trans*-tetrahydrocannabinol which is commonly known as Δ^1 THC is responsible for the euphoric action. The other contents of resin include cannabiniol, cannabidiol, cannabidiolic acid, cannabichromene, and cannabigerol. Apart from this, it also contains volatile oil, choline, and trigonelline. Seeds of the plant contain fixed oil (20%).



Cannabidiol



Tetrahydrocannabinol

5.1.8.4. Chemical Tests

Cannabis gives the following tests:

- 1) 0.5gm of drug is agitated with light petroleum at 60-80°C. The resultant solution is filtered, and 2ml 15% solution of hydrogen chloride in ethanol is added to 1ml of filtrate. Red colour appears at the junction of the two liquids which on shaking disappears leaving the upper layer colourless and the lower layer pink. This pink colour also disappears on addition of water.

- 2) 1gm of resin is extracted using methanol. The resultant is filtered and evaporated to dryness. The residue obtained is again extracted using petroleum ether at 60-80°C. The resultant is filtered directly in a separating funnel. The ethereal layer is extracted with 5% w/v Na₂CO₃ and 5% w/w H₂SO₄. The ethereal layer is washed with distilled water, decolourised with powdered activated carbon, and evaporated. The residue obtained is added with a few drops of N/10 alcoholic KOH solution. A purple colour appears.

5.1.8.5. Therapeutic Efficacy

Cannabis can be used therapeutically for the following purposes:

- 1) Being a narcotic, it shows sedative (calm down excitement) and analgesic action.
- 2) It is used to induce sleep, i.e., as a hypnotic.
- 3) The phytochemical, tetra-hydrocannabinol shows psychotropic action.
- 4) It is sometimes used as an anti-bacterial agent.
- 5) At the present scenario, it is rarely used as a drug.

5.1.9. Nux-Vomica

Strychnine tree which is a deciduous tree, is also known **nux vomica**, **poison nut**, **semen strychnos**, and **Quaker buttons**. It is native to South East Asia and India. Nux vomica is the major source of very bitter and poisonous alkaloids, **brucine** and **strychnine**. These alkaloids are derived from the seeds present within the green to orange coloured rounded fruit.

Synonyms

Crow-fig, Semen strychni, Nux vomica seed, and Vomit nut.

Biological Source

Nux vomica is the dried ripe seeds of *Strychnos nuxvomica* Linn. It should contain 1.2% or more of total alkaloids as strychnine.

Family

Loganiaceae

5.1.9.1. Occurrence and Distribution

Nux vomica is native to East India and is collected from the forests of Sri Lanka, Northern Australia and India. In India, it is found in southern areas like Tamil Nadu, Kerala and on Malabar Coast. Other than these areas, it is also cultivated in the forests of Gorakhpur, Bihar, Orissa, Konkan, and Mysore.

5.1.9.2. Organoleptic Evaluation

Nux vomica can be identified by the following organoleptic features:

- 1) **Colour:** Greenish-brown.
- 2) **Odour:** None.
- 3) **Taste:** Intensely bitter.
- 4) **Size:** Seeds are 10-30mm in diameter and 4-6mm in thickness.
- 5) **Shape:** Seeds are disc-shaped, flat or bent irregularly and concavo-convex, margin is rounded.
- 6) **Surface:** Due to the radially arranged, densely covered, closely appressed unicellular lignified covering trichomes, surface of seeds is silky.



Figure 5.6: Nux Vomica Plant

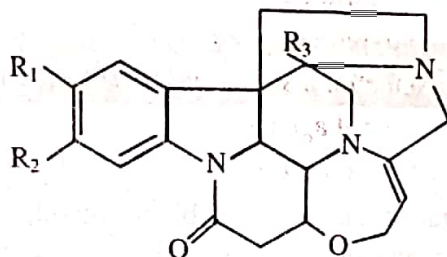
5.1.9.3. Chemical Constituents

Seeds of nux vomica have 1.5-5% of **bitter indole alkaloids**, in which the major constituents are **strychnine** and **brucine**.

Other chemicals present in low concentration are vomicine, α -colubrine, pseudostrychnine, and strychnicine. Along with these chemicals, nux vomica seeds also contain 3.0% of fat.

Apart from seeds, other parts of plant also contain some alkaloids; **for example**,

- 1) Brucine and traces of strychnine are present in bark.
- 2) Strychnine is also present in wood and root.



Strychnine	$R_1 = R_2 = R_3 = H$
Brucine	$R_1 = R_2 = ROCH_3, R_3 = H$
α - colubrine	$R_1 = H, R_2 = OCH_3, R_3 = H$
β - colubrine	$R_1 = OCH_3, R_2 = R_3 = H$

Isostrychnine, N-oxystrychnine, protostrychnine, β -colubrine, and novacine are some chemically related alkaloids present in low concentration.

Nux vomica also contains a glycoside (loganin), chlorogenic acid, and fixed oil.

5.1.9.4. Chemical Tests

Following tests are performed after removing fat from the thin sections of nux vomica seeds:

- 1) The transverse section of nux vomica is stained with **Mandelin reagent** (mixture of ammonium meta-vanadate and concentrated sulphuric acid). This results in purple colouration of endospermic cells due to the presence of strychnine.
- 2) The transverse section of nux vomica is stained with concentrated nitric acid. This results in yellow colouration of endospermic cells due to the presence of brucine.
- 3) Presence of strychnine can also be confirmed by treating the seeds with sulphuric acid and potassium dichromate. Violet colour appears which initially turns red and then yellow.

5.1.9.5. Therapeutic Efficacy

The therapeutic uses of nux vomica are:

- 1) It is used as a bitter stomachic and tonic because of its bitter taste.
- 2) It stimulates CNS, respiratory system, and cardiovascular system.
- 3) It is recommended in certain specific forms of cardiac failure and is also used to increase blood pressure.
- 4) Brucine obtained from nux vomica seeds is used for denaturation of alcohols and inedible fats.
- 5) Tincture of nux vomica seeds has a stimulant action on GIT. It stimulates peristalsis, increases appetite, and in combination with cascara and other laxatives, it is used in the treatment of chronic constipation resulting due to atonic condition of bowel.

- 6) Powdered seeds are used in atonic dyspepsia.
- 7) Strychnine absorbed from GIT reaches the CNS through blood, where vagal centre gets excited. Excitation of vagal centre lowers the heart rate, deepens and quickens respiration. This results in improved pulse and raised blood pressure.
- 8) It stimulates motor or sensory ganglia of spinal cord due to which violent convulsions are observed which increases BP. Therefore, it is used in certain chronic lead poisoning.
- 9) Large doses of it are used in case of cardiac failure and surgical shock.
- 10) In case of chloral and chloroform poisoning, it is used as an antidote.
- 11) It is used in pruritis and as a local anodyne in inflammations of the external ear.

(11)