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Alkaloids – an overview

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ABSTRACT

Alkaloids are a chemically heterogenous group of natural substances and comprises more than 6000 basic nitrogen containing organic compounds which occur in about 15 percent of all vascular terrestrial plants and in more than 150 different plants families. The alkaloids exhibit diversity of structures and also show an extraordinary spectrum of pharmacological activities. Because of these characters, they are important for chemical, physiological, taxonomic and biogenetic studies.

Keywords: Alkaloids, organic, spectrum, taxonomic

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Introduction :

In view of their chemical and physiological diversity, there is no comprehensive definition of alkaloids .

The term is derived from the word alkali- like and hence , they resemble some of the characters occurring complex amines.

The term alkaloid also covers pseudo proto alkaloids and peudoalkaloids.

In view of all such variations , the only definition that brings all such compounds under one title is as follows.

These are the organic products of natural or synthetic origin which are basic in natures and contain one or more nitrogen atoms ,normally of heterocyclic nature, and posses specific physiological actions on human or animal body, when used in small quantities .

The true alkaloids are toxic in nature, contain heterocyclic nitrogen which is derived from amino acids and always basic in nature.

True alkaloids are normally present in plants as salts of organic acids .

The proto alkaloids or amino alkaloids are simple amines in which the nitrogen is not in a hetrocyclic ring.

Some times, they are considered as biological amines .

They are basic in nature and prepared in plants from amino acids.

Some of the examples of these alkaloids are mescaline, N, N – dimethyl tryptamine ,colchicne, ephedrine.

The term pseudoalkaloids includes mainly steroidal and terpenoid alkaloids and purines.

They are not derived from aminoacids .

They do not show many of the typical characters of alkaloids, but give the standard qualitative tests for alkaloids.

PROPERTIES:

Physical Properties:

With few exceptions, all the alkaloids are colourless, crystalline solids with a sharp melting point or decomposition range.

Some alkaloids are amorphous gums ,

While others like coniine, sparteine, etc..,are liquid and volatile in nature.

Some alkaloids are coloured in nature

Eg .,betanidin is red, berberine is yellow and salts of sanguinarine are copper red in colour.

In general, the free bases of alkaloids are soluble in organic non-polar, immiseible solvents.

The salts of alkaloids are soluble in water.

In contrast, free bases are insoluble in water and their salts are very sparingly soluble organic solvents.

The alkaloids containing quaternary bases are only water soluble.

Some of the pseudoalkaloids and protoalkaloids show higher solubility in water.

For example, colchicine is soluble in alkaline water, acid or water and caffeine(free bases) is freely soluble in water.

Quinine hydrochloride is highly soluble in water i.e 1 part of quinine hydro chloride is soluble in less than 1 part of water,while only 1 part of quinine sulphate is soluble in 1000 parts of water.

The solubility of alkaloids and their salts is useful in pharmaceutical industry for the extraction and formulation of final pharmaceutical preparations

CHEMICAL PROPERTIES :

Most of the alkaloids are basic in reaction, due to the avaliability of lone pair of electrons on nitrogen.

The basic character of the alkaloidalcompound is enhanced if the adjacent functional groups are electron withdrawing like amide group which reduces the availability of the lone pair of electrons.

But, alkaloids exhibiting basic character are very much sensitive to decomposition and cause a problem during their storage.

Their salt formation with an inorganic acid prevents many a time decomposition.

The alkaloids may contain one or more number of nitrogen and it may exist in the form as primary (R – NH 2) , e.g . mescaline ; secondary amine (R2 - NH) ,e.g. ephedrine ;tertiary amine (R3N) e.g. atropine ;and quaternary ammonium compounds (R4N+X) e.g. tubocurarinc chloride.

In the last type,their properties vary from alkaloids , owing to quaternary nature of nitrogen.

In the natural form, the alkaloids exist either in free state, as amine or as salt with acid or alkaloid N-oxides.

CHEMICAL TESTFOR ALKALOIDS:

-The qualitative chemical tests used for detection of alkaloids are dependent on the charecters of alkaloids to give precipitates as salts of organic acids or with compounds of heavy metals ,like mercury ,gold, platinum,etc.

-The different reagents used are MAYERS REAGENT(potassium mercuric iodide solutions) givingcream coloured precipitate ;DRAGENDORFFS REAGENTS (potassium bismuth iodide solution) giving reddish brown precipitate ; and WAGNERS REAGENT (iodine –potassium iodide solution) yielding reddish brown precipitate .some alkaloids also yellow coloured precipitate with picric acid called as HAGERS REAGENT and picrolonic acid .Individual alkaloid gives colour or precipitate with certain specific reagent .

-The chemical tests with heavy metals or not solely limited to alkaloids .Proteins ,coumarins and alpha –pyrones also gives precipitates with these reagants.It may be also noted that some alkaloids do not give such tests ,like caffeine which is highly water soluble .

-Hence ,the tests with heavy metals or in some cases false positive reactionsor false negative reactions .For this purpose ,the specific testsfor individual alkaloids are more important for qualitative evaluation of crude drugs.These tests are covered under individual drugs.

CLASSIFICATION OF ALKALOIDS:

The various methods proposed for classification of alkaloids are as follows

1).Pharmacological classification :

Depending on the physiological response ,the alkaloids are classified under various pharmacological categories,like central nervous system stimulants are depressants ,sympathomimetics ,analgesics,purgatives ,etc.This method doesn’t take in to account chemical nature of crude drugs .With in the same drug ,the individual alkaloid may exhibit different action e.g.morphine is narcotic analagesic , while codeine is mainly antitussive .In cinchona,quinine is anti malarial ,while quindine is cardiac depressant.

2).Taxonomy classification:

This method claassifes the vast number of alkaloids based on their distribution in various plant families ,likesolanaceous or papillionaceous alkaloids . Preferably , They are grouped as per the name of the genus in which they occur e.g. ephedra, cinchona,etc. From this classification, the chemotaxonomic classification has been further derived .

3).Biosynthetic classification :

This is the most accepted way of classification of alkaloids . The main criterion for chemical classification is a type of fundamental (normally hetero cyclic) ring structure is present in alkaloid .

The alkaloid drugs are broadly charecterised in to two divisions .

(a) Hetero cyclic alkaloid (true alkaloids) are divided in to tweleve groups according to nature of their hetero cyclic ring .

(b) Non hetero cyclic alkaloids or proto alkaloids or biological amines or pseudo alkaloids.

ERGOT:

Synonyms:

Ergot of Rye,Ergota.

Biological Source:

Ergot is the dries sclerotium of a fungus, ClavicepspurpureaTulasne (Clavicipitaceae or Hypocreaceae)developed in ovaryof rye plant,Secale cereal Linne(Graminae).It contains not less than 0.19 per cent of the total alkaloids

S.No.	Name of drug and synonym		Active Constituents	Uses
1.	Ergot (Ergot of Rye)	A fungal sclerotium of Clavicepspurpurea in ovary of rye plant Secale cereal. Family of fungus-Clavicipitaceae;	Ergometrine, ergotamine	Oxytocic, prevents postpartum haemorrhage used in treatment of migraine
2.	Nuxvomica (Crow Fig)	Family of rye Graminae Seeds of Strychnousnux vomica, Loganiaceae	strychnine, brucine	CNS stimulant, bitter ,stomachic, tonic
3.	Vinca (Catharanthus)	Entrie plant of Catharanthusroseus, Apocynaceae	vincristine, vinblastine	anticancer (treatment of Hodgkin`s disease and leukemia)

S.No.	Name of drug and Synonym	Biological Source	Active Constituents	Uses
4.	Rauwolfia (Sarpagandha)	Roots and rhizomes of Rauwolfia serpentina, Apocyanaceae	reserpine, rescinnamine	Hypotensive tranquilliser
5.	Opium (Raw opium)	Dried latex from the capsules of Papaversomniferum, Papaveraceae	narcotine, papaverine	narcotic analgesic, in diarrhoea
6.	Belladonna (Deadly night shade leaf)	Dried leaves and flowering tops of Atropa belladonna, Solanaceae	I-hyoscyamine, atropine	anti-spasmodic, anti-cholinergic
7.	Datura herb (Angel`s trumpet)	Dried leaves and flowering tops of daturametel var. fastuosa, Solanaceae	scopolamine, hyoscyamine, atropine	anti-cholinergic, in deodenal ulcers
8.	Cinchona (Peruvian bark)	Dried root or stem bark of cinchona calisaya,C.offi-cinalis,C.ledgeriana,C.succirubra,Rubiaceae	quinine, quinidine, cinchonine, cinchonidine	antimalarial, bittertonic.
9.	Vasaka (Adulsa)	Leaves of Adhatoda vasica, Acanthaceae	vasicine and vasicinone	antitussive, expectorant
10.	Coffee	Dried ripe seeds of Coffeaarabica, Rubiaceae	caffeine trigonelline	stimulant,to counter effect over dosage of CNS depressant.
11.	Ashwagandha (Asgandh)	Dried roots of Withaniasomnifera, Solanaceae	withanine, somniferine, withanolide(steroid)	Sedative and also as anti-rheumatic
12.	Tea(Thea)	Leaves and leaf buds of Theasinensis, Theaceae	Caffeine, Theoromine, Theophylline	C.N.S. stimulant

of ergot, calculated as ergotoxine,of which not less than 15 percent consists of water soluble alkaloids of ergot,calculated as ergometrine.

Geographical Source:

Switzerland,Yugoslavia,Hungary and Czechoslovakia

Collection and Preparation of Ergot:

-Presently,ergot is produced by natural way i.e. cultivation of rye plants and subsequently infecting with this fungus,as well as,by artificial way i.e. saprophytic production.

-For the natural way of production, rye plant is host and ergot is a parasite.It is known that more than 600 plants from different families of wild and cultivated grasses act as hosts for ergot fungus as a parasitic or pathogen. The various other known species of this fungus are C.microcephala,C.nigricans and C.paspali,which can produce ergot.Among all the hosts,rye is the better host for the large scale production of ergot by way of quality and quantity.

-Among the various stages of development of this fungus,sclerotial stage or a dormant stage contains the maximum amount of drug.For a systematic study, it is necessary to know the other development stages of fungus or more precisely the life history of ergot.

Life Cycle of Ergot:

The ovary of the rye plant at its base,gets infected by ascospores of the fungus in spring or summer season.The spread of ascospores to ovaries is influenced by wind and insects.Afterinfecting,theascospores germinate in the favourable conditions, like moisture and damp climate.The germination of ascospores leads to formation of hyphal strands which go on invading the wall of ovary with the help of an enzyme.By this way,the hyphae form a soft, white mass of tissue over the surface of the ovary which is called as mycelium.The mycelium secrets a viscous and sugary fluid called honey-dew.At the same time, the hyphalstrands produce asexualspores called conidiospores,which remain in a suspended form in honey-dew.

Due to the sugary fluid i.e. honey-dew, the insects and ants are attracted which further help in the spread of the fungus to other host plants.This developmental stage is the sexual stage and called as spread of the fungus to other host plants.This developmental stage is the sexual stage and called as SPHACELIAL STAGE.

The hyphae further invade into the deeper parts of ovary and slowly replace the entire tissue of ovary by a compact tissue called pseudoparenchyma which is hard and dark purple. It is called as Sclerotium stage and is considered as resting or dormant stage of the fungus and contain maximum amount of ergot alkaloids.If this sclerotium is left uncollected, it eventually falls on the ground and in the favourable season, i.e. spring gives out `stomata'which are in the elongated form.Eachstromatumhasa globular head and a stalk.The head portion contains a large number of perithecia and every perithecium is like a flask shaped structure which contains a number of sacs,each sac containing the ascospores which are thread like in appearance.Ascospores are the sexual spores capable of inducing fresh life cycle of fungus by infecting the ovary of rye plant.

Selection of a correct strain of fungus(Clavicepspurpurea),appropriate containers for preparing large scale ergot inoculum and an ideal nutrient medium are important requirements for commercial production of ergot. The various chemical races of fungus can produce only specific ergot alkaloids like ergotamine,ergometrineandergotoxin in appreciable quantities from their sclerotia.Theascospores of this species with the specific chemical race are germinated on nutritive medium and by this way large bulk of conidiospores are formed.The suspension of this strain of fungus is sprayed on rye plants in large in large cultivated areas.

Apart from field cultivation,other method which is much practised is saprophytic production of ergot.This process was initiated in japan by Prof.Abe.Saprophytic production is convenient in many ways as it eliminates the variation in yield due to weather conditions and production can be achieved throughout the year.For this method,various strains of ergot are used depending on the type of ergot alkaloid to be obtained,Clavicepspaspali gives clavines and simple lysergic acid derivatives.

It is much easier to manufacture clavines and simple lysergic acid derivatives and then convert them to different peptide alkaloids,i.e. ergot alkaloids.For nutrition of cultureof fungus,specific nutrients are used and fermentation is carried out in temperature range of 20-30 degree C and in a pH of 4.6-6.3.The fermentation process for these submerged cultures in shaking flasks or fermenters or synthesized alkaloidals is done by usual ways applied for other alkaloids.The lysergic acid derivatives are converted to lysergic acid further partly synthesized into ergometrine and other peptide alkaloids.

The saprophytic production is much practised now-a-days,becausemycelial dry weight gives even more than 20 percent of alkaloids,while natural sclerotia contain less than 1 percent of alkaloids.The process of fermentation is properly regulated or controlled for optimum bioproduction of useful metabolites.

Macroscopic Characters:

Colour-Externally, it is dark violet toblack.Internally,it is whitish or pinkish white.

Odour- Disagreeable and faint.

Taste- Unpleasant

Size- The sclerotia are 1 to 3 cm in length and 1to 5 mm in width.

Shape- Sclerotia are fusiform,triangular and usually tapering on both the ends.

Fracture- It is brittle with short fracture.

EXTRA FEATURES:

Longitudinal furrows and transverse cracks are present on each surface.

Microscopic Characters:

The outermost layer of the sclerotium is made up of few thin,flattened,polygonal cells of purple to brown colour,while inner part is made up of dense pseudo parenchymatous cells composedofchitin.Themycelialcells(central region) are round or oval,thick and with high refractive walls.They also contain cells with fixed oil. Sclerotium does not contain starch,calcium oxalate or any of the lignified tissue.

Chemical Constituents:

Ergot contains large number of potentindolealkaloids(0.1 to 0.25%),which are derivatives of lysergic acid.Lysergic acid is present in its peptide derivative form and hence the alkaloids are also called as peptide alkaloids. The six pairs of alkaloids are broadly grouped into water soluble and water insoluble categories. Each pair contains laevo-form which is medicinally active,whiledextro forms is inert in action.The water soluble pair contains (-) ergometrine and its dextro part as ergometrinine.The water insoluble group is further divided into Ergotamine and ergotoxine group.

Besides the alkaloids,ergot also contain pigments,ergosterol and fungisterol,histamine,trymine,amino acids, acetyl choline,chitin,upto 30%fixed oil and 8% moisture.

Chemical Tests:

1)Ergot powder gives a blue colour with p-dimethylaminobenzaldehyde(Van-Urk`s reagent).

2) Ergot is treated with solvent ether and sulphuric acid the filtrate obtained shows red violet colour in its aqueous layer, when treated with Saturated solution of sodium bicarbonate.

3) Ergometrine gives a blue fluorescence in water.

Uses:

-Ergotamine tartarate is used as a specific analgesic in treatment of migraine.

-Lysergic acid diethylamide is a semisynthetic derivative,and possesses psychotomimetic action and used in psychiatry.

Storage:

-It should be stored in well closed containers.

-Ergot alkaloids are sensitive to light and temperature.

-The drug is stored at low temperature in cool place away from light.

NUXVOMICA

Synonyms:

Crow-fig, Semen strychni,Nux vomica seed.

Biological Source:

Nux vomica consists of dried ripe seeds of Strychnosnux vomica Linn., Family Loganiaceae.

It should contain not less than 1.2 percent of total alkaloids calculated as strychnine.

Geographical Source:

It is indigenous to East India and is largely collected from forests in Sri Lanka,Northern Australia and India.

It is found abundantly in South India i.e. in Tamil Nadu, Kerala and on Malabar coast.

It also available in the forests of Bihar, Orissa,Konkan, Mysore and Gorakhpur.

Collection:

-In India, the entire drug is collected from wild grown plants by the local tribal community.

-The nux vomica tree is found throughtout the tropical area,1300 m above the sea level.

-The plants are about 10 to 12 metres in height with a crooked trunk and several branches.

-The leaves are orange,oppositelyarranged,with oval shape,entire margin and acute apex.

-The flowers are greenish-white and the bark is greyish to yellow.

-Fruits of the plants are orangreyellow,berries of normal size.

-Each fruit contains about 4 to 5 seeds and heavy bitter pulp.The ripened fruits are collected and seeds are freed of the pulp.

-They are washed with water thoroughly.

-Unripened seeds are separated by the floating test in water.The seeds are dried on mat and packed in gunny bags for marketing.

-The collection of the fruit and seeds is carried out from November to February.

-In India,about 15,000 tonnes of seeds are collected annually. Seeds, pure and crude alkaloids of Nux-vomica are reguarly exported from India.

-Exports of the alkaloids for 1988 – 89 and 1989 – 90 are Rs. 407.7 lakhs and Rs. 429.5 lakhs respectively.

Macroscopic Character :

Colour: Greenish – brown

Odour: None

Taste: Intensely bitter

Size: Seeds are 10 to 30 mm in diameter and 4 to 6 mm in thickness.

Shape: The seeds are disc shaped, somewhat flat or irregularly bent and concavo-convex. Margin of the seeds is rounded.

EXTRA FEACTURES-

Surface of the seeds is silky due to the radially arranged, densely covered, closely appressed unicellular lignified covering trichomes.The presence of endosperm, embryo and cotyledons can be confirmed in the L.S of the seed.

Microscopic Charecters:

-The epidermis consists of strongly thickened, pitted and lignified trichomes. Epidermis is followed by a layer of collapsed cells.

-Endosperm is characterised by thick walled polyhedral unlignified cells with plasmodesma, aleuronegrains and oil globules.

-Calcium oxalate crystals and starch grains are absent in drug.

Chemical Constituents:

-Nux vomica seeds contain 1.5 to 5% of bitter indolealkaloids.Chief constituents of nux vomica are strychnine and brucine,whilevomicine, alpha-colubrine,pseddostrychnine and strychnicine are also present.

-Apart from seeds,other parts of the plant contain alkaloids.Seeds also contain 3.0% of fat.

-Bark contains brucine and traces of strychnine.

-Wood and root of the plant also contain strychininne.

-The other minor, but,chemically related alkaloids are isostrychninne,N-oxystrychnine,protostrychnine,novacine.

-The nuxvomica also contains a glycoside viz. loganin,chlorogenic acid and fixed oil.

Chemical Tests:

The thin sections of nux vomica seed are defatted and the following tests are performed.

1) Stain the transverse section of nux vomica with ammonium vanadate and sulphuric acid Manddin`sreagent.The endospermic cells because purple due to the presence of strychnine.
2) Stain the transverse section of nux vomica with concentrated nitric acid.Endospermic cells take yellow colour due to the presence of brucine.
3) Srychnine with sulphuric acid and potassium dichromate gives violet colour which turns to red and finally yellow.

Uses:

-Due to its bitter taste, nux vomica is used as bitter stomachic and tonic.

-It is astimulant to central nervous system.

-It increases the blood pressure and is recommended in certain forms of cardiac failure.

VINCA

Synonyms:

Catharanthus, periwinkle.

Biological Source:

It is the dried whole plant of Catharanthusroseus, belonging to family Apocynaceae. It is aslo known as Vincarosea.

Geographical Source:

It is probably indigenous to Madagascar.It is cultivated in south Africa,India,U.S.A.,Europe,Australia and Caribbean islands as an ornamental plant,as well as,for its medicinal properties.

Macroscopic Characters:

The leaves are green,roots are pale grey,flowers are violet pink-white or carmine-red in colour.The odour is characteristic and taste is bitter.Vivca is an erect,pubescentherb,with branched tap-root.Leaves are simple,petiolate,ovate,oroblong,unicostate,reticulate,entire,brittle with acute apex and glossy appearance.Flowers are bractate,pedicellate,complete,hermaphrodite,normally 2 to 3 cm in cymoseasillaryclusters.Fruits are follicles with several black seeds.

Macroscopic Characters:

Upper surface shows presence of single layer of rectangular celled epidermis with unicellular covering trichomes.Palisade is made up of single layer beneath upper epidermis and contains compact elongated cells.Spongy parenchyma is 5 to 8 layered with intercellular spaces.Midrib shows presence of collenchyma below the upper epidermis and above the lower epidermis.Xylem and phloem are present in the centre.Cruciferous stomata are present more frequently on lower epidermis.Calcium oxalate crystals are absent.

Chemical Constituents:

A large number of indole alkaloids are present in vinca.Out of them,about 20 dimericindole-dihydroindole alkaloids possesoncolyticactivity,andamomgthem,vincristine and vinblastine are most significant.Vinblastine contains indole alkaloid part called catharanthine and dihydroindole alkaloid part called vindoline.The other

alkaloids present in vinca are ajmalicine,lochnerine,serpentine and tetrahydroalstonine.It requires about 500 kg crude drug to extract out 1 g of vincristine, because of its extreme low content,viz.0.0002 per cent. This makes these alkaloids very costlier and hence,the efforts for their synthesis are under attempts.From their structure, the five-ring dihydroindole system is present in few other natural drugs. Therefore, the attempts towards the synthesis of four-ring indole system are going on presently. Such two systems can be further coupled.

Uses:

-Vinca is used to extract vincristine,vinblastine and ajmalicine.

-Vincristine sulphate is an antineoplastic agent which may act by arresting mitosis at the metaphase. It is given intravenously in the treatment of acute-leukemia of children; some childhood leukemias are also responded.

-Vinca also exhibits hypotensive and anti-diabetic actions.

Dose:

1)Vincristine sulphate:10 to 30 ug/kg of body weight intravenously,but maximum upto 2 mg

2)Vinblastine sulphate : 100 ug/kg body weight intravenously.

SERPGANDHA

Synonyms:

Rauwolfia root, Serpentina root, Chhotachand

Biological Source:

Rauwolfia consists of dried roots of the known as RauwolfiaserpentiaBenth, belonging to family Apocynaceae.Serpgandha contains not less than 0.15 % of reserpine and ajmalcine, calculated on dried basis.

Geographical Source:

Several species of Rauwolfia are found distributed in the tropical regions of Asia, America and Africa.Commercially, it is produced in India, srilanka,Myanmar,Thailand and America. In India, it is cultivated in Uttar Pradesh, Bihar, Orissa, Tamil Nadu, West Bengal, Karnataka, Maharashtra, and Gujarat.

Cultivation and Collection:

Under wide range of climate conditions, rauwolfia grows luxuriantly. However, it flourishes in hot humid condition and grows satisfactorily in shade.In wild state, it grows in variety of solis. But for cultivation, clay loamy soil with large amount of humus and good drainage are supposed to be ideal. The pH of the soil should be acidic and around 4. The temperature range for cultivation is 10 degree to 38 degree Centigrade.Rainfall should be in the range of 250- 500 cm. Soils containing large amount of sand make the plants more susceptible to diseases.

In can be propagated by various methods, such as by seeds, roots, cutting,root stumps, etc. The propagation from seeds is usually the method of choice. The healthy seeds are sown into the nursery beds. The rate of germination of seeds is very low, hence sufficient quantity of the seeds are sown. Sowing is done in the month of May or at the break of monsoon. The seedlings are then transplanted in the month of August at a distance of 16 to 30 cm. The plants are provided with various chemical fertilizers and manures. The chemical fertilizers include ammonium sulphate, urea; while the manures include, generally, the bone-meal. The plants are kept free from weeds. When the plants are about 3 to 4 years old, they are uprooted. The roots are cut properly, washed so as to remove the earthy matter and dried in air.

It needs abot 5 kg of seeds to produce the seedlings sufficient to cover the area of one hectare after transplantation.The average yield of roots per hectare is 1200 kg. It may vary, depending upon the soil, climatic conditions and age of the plant.

Macroscopic Characters:

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

Odour – Odourless

Taste – Bitter

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

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

Fracture is short and irregular. The transversely cut surface is white, dense with finely radiating xylem.

Extra Features:

Roots are rough with longitudinal marking and slightly wrinkled surface. Rootlets are usually absent, but few small circular root scars with tetrastichous arrangements are seen.

Microscopic Characters:

The cork is made up of stratified cells followed by phelloderm of few rows of parenchyma. Phloem is narrow, parenchymatous with small scattered sieve tissue. Parenchyma contains starch grains and few latex cells, with brown resinous matter.Secondary phloem contains calcium oxalate crystals. Xylem is about 4/5 th of the diameter of the root and consists of vessels, tracheids, wood parenchyma and wood fibres. Xylem vessels are elongated upto 350 u in length and 50 u in width and contain simple or bordered pits. Stone cells and phloem fibres are absent.

Chemical Constitutents:

About 30 indole alkaloids have been reported in drug and total alkaloidal content of rauwolfia roots ranges from 0.7 to 3%, depending upon the source. Alkaloids are concentrated mostly in the bark of the roots. The alkaloids of rauwolfia are broadly classified into the following types,

(1) Indole alkaloids,
(2) Indoline alkaloids,
(3) Indolenine alkaloids,
(4) Oxyindole alkaloids and
(5) Pseudo indoxyl alkaloids

The important alkaloid of rauwolfia is resperine. Apart from the alkaloids, it also contains oleo-resin, phytosterol, fatty acids, alcohol and sugars. The other alkaloids present in the drug are ajmaline, ajmaline, rauwolfinine, rescinnamine, reserpine, yohimbine, serpentine and reserpate and trimethoxybenzoic acid in reserpine and trimethoxycinnamic acid in case of rescinnamine. Syrosingopine is methyl carbethoxysyringoylreserpate.

Reserpine like alkaloids arecolorimetrically determined by reaction between acidic solution of alkaloids and sodium nitrite.

Chemical Tests:

(1) A red coloration along the medullary rays is observed when the freshly fractured surface is treated with concentrated nitric acid.
(2) Reserpine shows violet red colour when treated with solution of vanillin in acetic acid.
(3) Powdered ranwolfia when treated with sulphuric acid and p-dimeeghyl amines benzaldehyde, develops violet to red colour.(Test is for modle alkaloids).

Uses:

Rauwolfia is antihypertensive in activity.

Among the various alkaloids of rauwolfia, reserpine, rescinnamine and ajmalicine are clinically important.

Rescinnamine is used as antihypertensive, but it causes mental depression in higher doses.

Deserpidine is used as antihypertensive and tranquilliser. It shows very less side effects.

Ajmalicine, though less in quantity, has the uses in treatment of circulatory diseases,inrelief of obstruction of normal cerebral blood flow.

Syrosingopine shows peripheral effects similar to reserpine. It has less sedative actions and it is used for the treatment of mild or moderate hypertension.

Dose:

Rauwolfia : 100 to 150 mg (oral twice daily)

Reserpine : Initial dose 250 ug once a day (oral)

Rescinnamine : 500 ug oral twice a day (initial dose); 250 ug oral daily maintenance dose.

OPIUM

Synonym:

Raw opium

Biological Source:

It is the dried latex obtained by incision from the unripe capsules of Papaversomniferum Linn., dried or partly dried by heat or spontaneous evaporation, and worked into somewhat irregulary shaped masses (natural opium) or moulded into masses of more uniform size and shape (manipulated opium).Poppy plant belongs to family Papaveraceae. It contains not less than 10 percent of morphine, and not less than 2.0% of codeine, both calculated as anhydrous morphine.

Geographical Source:

India, Pakistan, Afghanistan, Turkey, Russia, China, and Iran.

History:

Opium has been known to mankind since centuries due to its narcotic properities. It was first cultivated in Mediterranean regions and probably brought by Alexander in 327 B.C. to India. It is known that Dioscorides and Theophrastus were aware of the medicinal properties of opium.

The earliest written record about opium is revealed from Historiaplantarum(some where in 300 B.C.) and De MateriaMedica (78 A.D.). Narcotine was the first alkaloid reported both from opium and among alkaloidal series, to be isolated in 1803 by Derosne.

Segnin isolated morphine in 1804.Magendi and Bally first introduced it in medical practise in 1818.Gulland and Robinson elucidated the structure of morphine in 1923.In 1833, Robiquet isolated codeine from opium, and in 1881, Grimaux reported that codeine is o-methyl derivative of morphine.Merck company isolated papaverine in 1848.

Cultivation, Collection and Preparation:

Being a potent narcotic drug, the cultivation and other aspects of opium are governed by respective in different countries, including India. In India, all the activities about opium and its derivatives are controlled under narcotic drugs and psychotropic substances act, 1985.

The genus Papaver has 50 different species, of which six species are found in India, viz. P.somniferum(Opium poppy), P. nudicaule (Iceland poppy), P.rhoeas(corn poppy), P.orientale, P.argemone, and P.dubium.

Poppy is an erect plant attaining 60-120 cm height. It is rarely branched. The leaves are linear, oblong or ovate oblong and have a dentate or serrate margin. It bears bluish white, purple or violet coloured large flowers. Accordingly, the varieties P.somniferumvar.glabrum, P.somniferum var. album, P.somniferumvar.nigrum are described.The second variety is cultivated in india. Indian opium is considered as the only legal source of opium to many countries including united states of America and Britain.

In India, about 54 thousand hectares of land is under opium poppy cultivation.It is under government control, and cultivation of poppy is restricted to Madhya Pradesh, Rajasthan and Uttar Pradesh.

The weather conditions affect,upto a large extent, the yield of opium. Although, temperate climate is the natural requirement of opium poppy, it can be grown with success under subtropical climate in winter season, as there is a favourable effect on yield by cold weather. But, extreme cold conditions, including frost, adversely affect the plant and ultimately yield of opium. In short, the best climatic conditions for opium poppy are cool weather freezing temperature and cloudiness, and sufficient sunshine.

Opium poppy is grown from November to March. Propagation is done by sowing the seeds, for which 3-4 kg of seeds per hectare are necessary. The seeds admixed with about 3-4 parts of sand are sown. Opium poppy

requires, highly fertile, well drained loamy soil with fine sand.The soil should contain organic matter, nitrogen and should have a PH around 7.

The distance between two plants maintained is usually 25 cm and the plant reaches maximum height of one metre.

Periodically, the thinning of plants is done to get uniform growth and better development. The plants are kept totally free from weeds with the use of suitable weedicides. The plant should be protected from various insect pests like cut worms, leaf minor and poppy borer. The use of manures and fertilizers markedly improve the quality and yield of opium poppy. Especially, nitrogen and phosphorus have remarkable effects on growth of plant.

After sowing, within 3-4 months, the plant bears flowers, which are converted to capsules within few days and attain maturity after 15-20 days.

During the maturity period, the capsule exudes maximum latex which shows a colour change from dark green to light green. Such capsules are incised vertically in the afternoon with the help of specific needle like apparatus called ‘nushtur’.

It penetrates maximum upto 2 mm into the capsule.Because of incisions, latex exudes out and thickens due to cold weather in night which is eventually scrapped and collected next morning by an iron scoop called Charpala. The incising process is repeated for about 4 times on the same capsule with 2 days interval. The latex is collected in plastic containers.Then, capsules are collected and dried in open areas and further the seeds are separated by beating. The average yield of opium is about 25-26 kg per hectare and for seeds, it is from 4-5 quintals per hectare.Opium is exported traditionally from India.The exports for 95- 96 and 96-97 were Rs.2365.5 lakhs and 4102 lakhs respectively.

The opium collected by this way is either exported or some of the part is further processed at government opium factory at Ghazipur. A generalised process is outlined to cover the industrial method for extraction of alkaloids of opium.

Macroscopic Characters:

Colour : strong characteristic

Taste:bitter

1. Indian opium – Dark brown in colour. It is found in the form of cubical pieces weighing about 900 g for marketing purposes. I t is enclosed in tissue paper and is brittle and plastic in nature. Internally, it is homogenous upon the requirement, the powdered form is available in the pack of 5 to 10 kg.
2. Persian opium – Dark brown in colour, found in the form of brick shaped masses, weighing 450 g. It is hygroscopic in nature, granular or nearly smooth with brittle fracture.
3. Natural Turkish or European opium – Brown or dark brown in colour. It is found in conical or rounded and somewhat flattend masses, weighing 250 to 1000 g. On keeping, it becomes hard and brittle.
   It is covered with poppy leaves.
4. Manipulated Turkish opium – It is 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 weighing about 2000 g. It is somewhat plastic or even brittle.
5. Manipulated European opium – It is dark brown in colour internally and covered with broken leaves. It is firm, plastic and with brittle fracture.

Chemical Constituents –

The latex contains mainly the alkaloids derived from amino acids phenylalanine and tyrosine. Chemically, they are placed under benzylisoquinoline and phenanthrene types.

Narcotine(also called noscapine), narceine and papaverine belong to the former, while morphine, codeine and thebaine represent latter category.

Fruits of poppy contain numerous off white coloured and minute seeds. These contain 30-35 % drying fixed oil. Which is used commercially in oil plant industry, which is colourless, tasteless and transparent.

OPIUM ALKALOIDS

- Morphine is monoacidic, laevorotatory phenolic alkaloid and also contains an alcoholic hydroxyl group at C(6) position. Due to presence of phenolic hydroxyl group, it is soluble in alkali hydroxides, expect ammonium hydroxide. Morphine is very less soluble in different solvents like ether(1 in 600), chloroform(1 in 1200), alcohol(1 in 200) and water(1-3000). Diacetylderivatie of morphine is heroin.
- Codeine(methyl morphine) is a strong monoacidic base and laevorotatory. It is soluble in water and organic solvents.
- Papaverine is a weak monoacidic base and inactive optically.It is slightly soluble in organic solvents, but insoluble in water.
- The other important benzylisoquinoline alkaloid narcotine is aslo a weak monoacidic base and is laevorotatory, while its salts are dextrorotatory. Narcotine is soluble in acetone, benzene, chloroform, but insoluble in water, alcohol and ether.
- The opium alkaloids are present as salts of meconic acid.
- Protopine and hydrocotarnine are the minor alkaloids of opium. Opium also contains sugar, wax, mucilage and salts of calcium, potassium and magnesium. Opium does not contain tannis, starch and calcium oxalate.

Chemical Tests:

(1) The general test to detect opium is by testing presence of meconic acid. The alkaloids are present as the salts of meconic acid. Opium is dissolved in water and to the filtrate, ferric chloride is added by dissolved which deep reddish purple colour is obtained, which persists even on addition of hydrochloric acid.

(2) Morphine when sprinkled on nitric acid gives orange red colour. Codeine does not respond to this test.

(3) The treatment of morphine solution with potassium ferricyanide and ferric chloride solutions gives bluish green colour. Codeine does not respond to this test.

(4) Papaverine solution in hydrochloric acid gives a lemon yellow colour with potassium ferricyanide solution.

Uses:

Opium belongs to the category of hypnotic sedative and analgesic in which the action is mainly due to morphine.

Morphine is a potent analgesic. Due to its central narcotic effects, it causes addiction.

Hence, it is given only in severe pains and in those cases, when patient does not show response to other analgesics.

Morphine has a biphasic action on central nervous system.

It sedates the cerebrum and has a mixture of stimulation and sedation on the medulla.

In the medulla, it sedates the respiratory centre, emetic centre and the cough reflex. It also stimulates chemoreceptor trigger zone in the medulla, which leads to nausea and vomiting and is considered as a side effect.

Morphine also produces respiratory depression and constipation.

Codeine relieves local irritation in the bronchial tract and as an antitussive used in various cough medicines.

It has mild analgesic effects,which are potent than asprin, but only one tenth activity of that of morphine. Papaverine has relaxant effects on smooth muscles of the intestinal and bronchial tract and the blood vessels.

Narcotine has a specific depressant action on cough reflex and used in the preparation of cough lintus.

Opium alkaloids are semisynthesized like other medicinal agents.Diacetylmorphine(herion) has more narcotic, analgesic property than morphine.

By losing one molecule of water, morphine gives apomorphine which is emetic and used subcutaneously to treat poisoning cases. Hydromorphone is formed by replacing one of the hydroxyl groups and also removal of adjancent double bond. It is aslo a potent narcotic analgesic, but habit forming tendencies are less.

Dose:

(1) Morphine sulphate: 10 mg, 6 times a day parenterally.
(2) Codenine sulphate/phosphate:10 – 20 mg every 4-6 hours, orally.
(3) Narcotine(noscapine):15 mg, 4 times a day, orally.
(4) Papeverine hydrochloride: 150 mg orally and 30 mg parenterally.

Commercial Varieties of opium:

(1) Indian opium- It is dark brown in colour and found in the form of cubical pieces weighing 900g. It is brittle and plastic in nature. The powdered form is available as 5 to 10 kg packs. It contains 10 % anhydrous morphine.
(2) Persian opium- It is dark brown in colour and brick shaped masses of 450 g. It is hygroscopic, granular or smooth.
(3) Turkish opium- It is commonly called as druggists opium or soft opium. It is brown or dark brown in colour and available as conical rounded or flattened masses.
(4) Chinese opium- It comes in market in the form of flat globular cakes and contains 4-11% morphine.

Different Forms of opium:

(1) Powdered opium – It contains 10 per cent anhydrous morphine with lactose, caramel and powderes cocoa husks.
(2) Opium concentration – It contains different alkaloid hydrochlorides of opium in following proportions:
Anhydrous morphine – 47.5 to 52.5%
Codeine – 2.5 to 5 %
Narcotine – 16 to 22 %
Papaverine – 2.5 to 7 %
(3) Camphorated opium tincture – It contains alcoholic solution of opium, benzoic acid, camphor, anise oil and the formulation is prepared in alcohol. It is used in treatment of diarrhoea as antiperistaltic.

Storage:

Opium is preserved in a well closed container to prevent loss of morphine.

BELLADONNA HERB

Synonyms:

Belladonna leaf; Belladonnae Folium; Deadly night shade leaf(European belladonna).

Biological Source:

Belladonna herb consists of dried leaves or the leaves and other aerial parts of Atropa belladonna Linn.(European belladonna) or Atropa acuminate Royle ex-Lindley(Indian belladonna) or mixture of both the species collected when the planrs are in flowering condition. It belongs to family Solanaceae. It contains not less than 0.3% of the alkaloids of belladonna herb, calculated as I- hyoscyamine.

Geographical Source:

It is indigenous to and cultivated in England and other European countries. In India. It is found in the western Himalayas from simla to Kashmir and adjoining areas of Himachal Pradesh.Its chief habitat is jammu and in forests of Sindh, and chinab valley.

History:

Because of the hallucinogenic effect of this plant, it was used as craft in the middle ages.

In ancient times, the juice of this plant was used as a cosmetic, because of its dilatory effect on the pupil of the eye. This drug was first introduced in the London Pharmacopoeia in 1809.

Cultivation and Collection:

Cultivation of belladonna at an altitude of 1400 m from sea level is found to be satisfactory, if proper irrigation facilities are provided. It is observed that the yield per hectare can be increased substantially by proper cultivation technology.

The experimental trails of applications of several fungicides and insectides right from the treatment of the seeds upto the foliar sprays were very encouraging. Its cultivation in Jammu and Kashmir is found to be successful.

Belladonna berries are crushed to get the seeds for cultivation.Proper processing like washing and sieving is performed.Only healthy seeds are used are used for cultivation.Seeds are sown by broadcasting method in well prepared beds with the application of fungicide like diathon.Sowing is done in May and July.

Transplanting is done by keeping certain distance between two plants and the seedlings are irrigated carefully.

Fertilizers like urea, potash and superphosphate are given as per the needs.

Insecticidal sprays like sevin are also tried when the plant reaches maturity. The leaves, as well as, the flowering tops are cut and sundried or dried in shade. During drying, care is taken to retain the green colour. While grading and packing for market, woolly stems and foreign organic matter are rejected. The yield per hectare is found to be 200 to 600 kg.

Macroscopic characters:

Colour –Leaves are green to brownish-green

Flowers are purple to yellowish-brown

Fruits are green to brown.

Odour – Slight and characteristic

Taste – Bitter and acrid

Size – Leaves are 5 to 25 cm long and 2.5 to 12 cm wide.

Flowers – Corolla 2.5 cm long and 1.5 cm wide.

Fruits – About 10 cm in diameter.

Shape – Leaves-Ovate, lanceolate to broadly ovate, with acuminate apex, decurrent lamina, entire margin, petiolate, brittle and transversely broken.

Flowers- Campanulate, 5, small reflexed lobes of corolla.

Fruits- Berries, sub-globular in shape with numerous flat seeds.

Extra Features:

In general the entire drug is seen as crumpled and twisted. The dropping flowers are associated with as many pairs of leaves. The flowers are with 5 stamens, superior bilocular ovary and numerous seeds.

Macroscopic Characters:

Epidermal cells with slightly sinuous anticlinal wall and striated cuticle,anisocytictrichomes which are uniseriate and with unicellular heads. The palisade ratio is 5 to 7.

Chemical Constituents:

The total alkaloidal content of drug is 4.4 to 1% and varies in different parts of plant, roots(o.6%), stems(0.05%), leaves(0.4%), unripe berries(0.19- 0.21%) and seeds(0.33%).

The main alkaloids are I- hyoscyamine and its racemic form atropine. The drug also contains belladonine, scopoletin (I-methyl aescuetin), hyoscine, pyridine and N- methyl pyrroline. The later two are the volatile bases.

Standards:

1) Total ash – 14 per cent
2) Acid-insoluble ash - 3 per cent
3) Foreign organic matter – not more than 3 per cent

It gives Vitali-Morin reaction – positive.

Uses:

It is the parasympatholytic drug with anticholinergic properities.It is used to reduce

the secretions such as sweat, saliva and gastric juice and also to reduce spasm in cases of intestinal gripping due to strong purgatives. It I also used as an antidote in opium and chloral hydrate poisoning.

Dose:

0.6 to 1 ml in the form of belladonna tincture – 4 times a day.

DATURA

Synonyms:

Datura herb, Angel`s trumpet.

Biological Source:

Datura consists of the dried leaves and flowering tops of Daturametel and D.metel var. fastuosa Safford. It belongs to family Solanaceae.

It should contain not less than 0.20 per cent of total alkaloids of datura, calculated as l-hyoscyamine.

Geographical Source:

It is found in india, England and other tropical and subtropical regions.

Cultivation and Collection:

The drug is cultivated by sowing the seeds. The germination is normally very slow. If the seeds are soaked in water and kept overnight, the rate of germination increases. About 7-8 kg of seeds per hectare are required for sowing purpose. The seeds require about 15-20 days for germination. Weeding and thinning are necessary and performed when the plants reach 10-15 cm height. The distance kept in between 2 plants is about 75-100 cm. The plants should be supplied with organic fertilizers and proper irrigation. The drug is collected after 4 months of its cultivation. The leaves and branches are removed, drug is dried in the sun and marketed by packing in gunny bags.

Macroscopic Characters:

The drug has a characteristic but unpleasant odour and a bitter taste. The drug contains entire, broken wrinkled, crushed leaves along with stem fragments and floral parts.The entire leaf has length of 9-18 cm and width of 8-13 cm. Normally, the margin os of entire, but in some cases sinuated with rounded or acute 2-4 broad lobes. The leaf is covered with minute hairs, lower surface is slightly pale in colour and the leaf has a thin texture. The leaf is unequal at the base with acute apex and glabrouslamina.Each leaf has 3-4 coarse veins on each side and 4-6 secondary veins on either side of the midrib.

Flowers are reddish-purple on outer side and whitish on inner side.Corolla is thin, acuminate, triangular to circular in shape. Flowers are funnel shaped with pedicel which is never erect.

The stems, as well as, branches of drug are purple coloured. Brown coloured seeds are triangular and are found in the thorny capsule.

Microscopic Characters:

Through the transerve section, it shows its dorsiventral character. The epidermal cells of both sides show anisocytic or cruciferous stomata. The cells are covered with thin cuticle and glandular and non-glandular simple trichomes. About 40% of the lamina is occupied by single layer of palisade cells. About 6-8 layers of spongy parenchymatous cells are present. The midrib shows vascular tissue with protoxylem and metaxylem. Trichomes are more on the midrib region. Stomatal index is 12.7 to 19.5 for upper surface and 21.2 to 24 for lower surface. Palisade ratio is 3.5 to 6.5. The spongy parenchyma contains calcium oxalate crystals.

Chemical Constituents:

Datura herb contains upto 0.5%of total alkaloids, among which hyoscine(scopolamine) is the main alkaloid, while l-hyoscyamine(scopoline) and atropine are present in very less quantities.

Standards:

1. Stems, flowers, fruits- not more than 20%
2. Foreign organic matter- not more than 2%
3. Acid-insoluble ash- not more than 4%

Chemical Test:

1) The tropane alkaloid is treated with fuming nitric acid, followed by evaporation to dryness and addition of methanolic potassium hydroxide solution to an acetone solution of nitrated residue. Violet coloration takes place due to tropan derivative.
2) On addiction of silver nitrate solution to solution of hyoscinehydrobromide, yellowish white precipitate is formed, which is insoluble in nitric acid, but soluble in dilute ammonia.

Uses:

Datura herb and its main alkaloid hyoscine are parasympatholytic with anticholinergic and central nervous system depressant effects.

The drug is used in cerebral excitement. Along with morphine, it is used as preoperative medication.

It is also used in treatment of asthma and cough.

Hyoscinehydrobromide used in motion sickness, gastric or duodenal ulcers.

CINCHONA

Synonyms:

Jesuit`s bark, Peruvian bark

Biological Source:

It is the dried bark of the cultivated trees of Cinchona calisaya Wedd.,C. ledgerianaMoens,

C.officinalis Linn., C.succirubraPav. Ex-klotzsch, or of hybrids of either of the last two species with either of the first two. Cinchona belongs to family Rubiaceae. It contains not less than 6 per cent of total alkaloids of cinchona.

Geographical Source:

India, Bolivia, Columbia, Ecuador, Peru, Tanzania, Guatemala, Indonesia and Sri Lanka are the countries where cinchona is found. In India, it is cultivated in Annamalaihills(Coimbatore district) and Nilgiri hills(Nilgiri district)in Tamil Nadu and in Darjeeling area of West Bengal.

Cultivation, Collection and Preparation:

Most of the cinchona species profusely grow in sub-tropical or tropical climates at a height of about 1000-3000 metres. The trees, growing below this height are found to have less percentage of quinine. The rainfall conditions required are uniform (from 250-380 cm in a year). The favourable growth is achieved between an atmospheric temperature of 60 degree – 75 degreeF. Cinchona requires light, well drained forest soil which is rich in organic matter. The acidic soil having a PH of 4.2 - 5.6 and a small amount of nitrogen are found to be most favourable for growth. Cinchona needs slopping situation, high humidity and protection from wind.

The propagation is done either seeds or budding or layering. In West Bengal, only budding is practised and in Tamil Nadu, the budding and layering methods are applied. The seeds of cinchona are very small and light in weight. About one gramme of cinchona seeds contain 3500 seeds. They are admixed with soil during sowing. The maintenance of genetic purity causes a problem as high cross fertilization occurs in cinchona plants.. The affects the yield, like in high alkaloid content giving species, such as C.ledgeriana, the average alkaloid content is reduced. The seeds should be immediately used for propagation as on storage they lose their lose viability. The germination takes place in 3-6 weeks. The seedlings with 2 pairs of leaves are transplanted and space of 6-10 cm is maintained in between two seedlings and 2 rows. The young seedlings are protected from direct sunlight. In forest soil, they are transplanted after 15 months of growth and preferably before heavy rainfall. A distance of 2 metres is maintainedbetween two plants. As cinchona consists of stem, as well as root bark, the plants from 4 to 20 years old age are selected for harvesting, but the maximum alkaloidal content is found to 6 to 10 years old plants. The bark is collected by coppicing method. For this purpose, vertical incisions are

made on branches, trunk of tree and these incisions are connected by horizontal circles. The bark is then stripped off and dried in sun light and further by artificial heat. The drying is done below 175 degree F. During drying, the bark loses upto 70 per cent of its weight. The care should be taken to avoid molding or fermentation during drying. The quills of drug are packed in gunny bags and marketed. The root bark is collected by uprooting the trees and bark is separated manually.

During the two world wars, Java and Indonesia lost their positions as potential as potential producers of cinchona. After that, India has gained the prime position as producer and supplier of cinchona and quinine. By 1985 – 86, the production had reached upto 10 lakh kg of bark and about 26,000 kg of quinine salts.

India exported quinine and its salts of Rs. 299.0 lakhs during 1995 – 96.

Extraction of Quinine:

For extraction of quinine, the bark is powdered and extracted with benzene or toluene in presence of alkali. Further, the alkaloids are extracted with dil.sulphuric acid. By bringing the acid extract to neutrality, quinine sulphate separates, as it is sparingly soluble.

Macroscopic Characters:

Cinchona bark has a slight and characteristic odour, but somewhat astringent and intensely bitter taste. In general, the bark is available in the form of quills and curved pieces.

STEM BARK-

It is upto 30 cm in length and about 2 to 6 mm in thickness. The outer surface shows dull brown grey or grey colour and many a time, shows presence of mosses and lichens owing to its growth in heavy rainfall areas. The bark is rough and has transverse fissures. These fissures are different in different species. It is furrowed or wrinkled longitudinally. The outer bark in some varieties shows exfoliation. The inner surface is pale yellowish-brown to deep reddish-brown and the colour on the species. The fractures is short in external layers and fibrous in the inner portion.

ROOT BARK –

It occurs in length of 2-7 cm. The bark is curved, twisted or irregulary channelled.

The different commercial varieties have some special characters. C. succirubra is also called red bark, while C.ledgeriana is referred to as yellow bark. C. robusta is the hybrid between C. succirubra and C.officinalis.

The typical characters of 4 main species of cinchona:

Characters	C.calisya	C.ledgeriana	C.officinalis	c.succirubra
Size	Diameter is from 12-25 mm and thickness from 2-5 mm	Diameter 12-25 mm and thickness varies from 2-5 mm	Diameter is upto 12 mm and thickness is upto 1.5 mm	Diameter is from 20-40 mm and thickness from 2-5 mm.
Other feactures	Broad longitudunal with transverse cracks.	Broad longitudunal fissures and cracks more in number, but less deep.Some pieces shoe longitudunal wrinkles and reddish warts.	It shows a number of transerve cracks.	Well marked longitudunal wrinkles, but less number of transverse cracks.Only some pieces shoe reddishwarts.

Microscopic Characters:

Cinchona exhibits the typical histological characters of the bark. The cork cells are thin walled, followed by phelloderm. The cortex consists of several secretory channels and phloem fibres. Medullary rays with radially

arranged cells are present.Idioblast of calcium oxalate is the specific characteristic of cinchona bark. Starch grains are present in the parenchymatous tissues.

Stone cells are rarely present in the structure. A few of the cork cells are lignified. Medullary rays are 2 to 3 cells wide.

Chemical Constituents:

Cinchona bark contains about 25 alkaloids, which belong to quinolone group. The important alkaloids are quinine, quinidine, cinchonine and cinchonidine. The alkaloids of lesser importance are quinicine, cinchonicinehydroquinine, hydrocinchonidine and homocinchonidine. C. succirubra contains 5-7% of total alkaloids, of which 30% is quinine. C. ledgeriana yields from 6-10% and, in some cases, upto 14% of total alkaloids, with upto 75% is quinine. C.salisaya has 6-8% total alkaloids (about 50% quinine).

Quinine and Quinidine are stereoisomers of each other. Quinidine is aslo obtained commercially from cuprea bark i.e. RamijiapendunculataFluckiger belonging to family Rubiaceae, or by isomerization of quinine.

Quinine and Quinindine from many salts, but medicinally their suilphates are more significant. Cinchonine and cinchonidine are also isomers of each other.

Apart from alkaloids, cinchona also contains quinic acid and cinchotannic acid. In the plant, the alkaloids are present as salts of these acids. Cinchotannic acid decomposes into insoluble cinchona red, due to its phlobatannin nature. Cinchona bark aslo contains a glycoside called quinovin, tannis and bitter essential oil.

The alkaloid quinine occurs as bitter white crystals and it darkens and it darkens when exposed to light and has fluorescence properties. It shows a strong blue fluorescence in ultra-violet light. This fluorescence is enchanced in presence of dilute sulphuric acid. Quinine forms salts with different acids.

Quinine sulphate is important from pharmaceutical point of view. It has very less solubility in water(1 in 810), due to which, it is suitable for oral use.

Quinidine is similar to quinine in its physical and chemical properties and has higher water solubilty. The free base is soluble in water, ethyl alcohol, methyl alcohol and chloroform.

Chemical Tests:

(1) Heat the powdered drug in a dried test tube with little glacial acetic acid, purple vapours are produced at the upper part of test tube.
(2) Thalleoquin test: The powdered drug gives emerald green colour with bromine water and dilute ammonia solution.
(3) Quinidine solution gives a white precipitate with sliver nitrate solution, which is soluble in nitric acid.

Standards:

(1) Total ash – not more than 4 per cent
(2) Foreign organic matter – not more than 2 per cent

The UV spectrophotometric method of estimation is carried out for quinine.

Uses:

Quinine and its salts are used in the treatment of malaria.

Quinine is a protoplasmic poison, especially for protozoa like Plasmodium vivax, P. falciparum, P.malarie and P. fatal, and hence, used as powerful antimalarial drug.

Quinine has also been found to be highly active in vitro against Trypanosomacruziepimastigotes.

Quinidine is primarily a cardiac depressant and used to prevent certain arrhythmias and tachycardia. Quinidine is valuable in prevention of atrial fibrillation.

Dose:

1. Chinchona powder- 0.3 to 1 g
2. Quinine sulphate-1 g daily for 2 days and then 600 mg daily for 5 days.

3. Quinidine sulphate- 0.2 to 0.4 g every two to four to a total dose of 3 g daily in atrial fibrillation.

VASAKA

Synonyms:

Adhatoda, Adulsa, Malabar nut.

Biological Source:

It consists of dried, as well as, fresh leaves of the plant AdhatodavasicaNees, belonging to family Acanthaceae, and contains not less than 0.6% of vasicine on dried basis.

Geographical Source:

Vasaka is indigenous to India, where it is found in sub- Himalayan track upto an altitude of 1000 m, and in Maharastra especially, in Konkan region. Besides India, it is found in Myanmar, Sri Lanka and Malaysia.

Cultivation and Collection:

The uses of vasaka have been known since old times and it is included in different formulations of Ayurveda.

The plant is not cultivated on commercial scale. It is obtained from garden plants or wild sources. It can be easily propagated by stem cuttings and by seed germination. The plant is obtained in all seasons of the year. It reaches to an height of 2 to 3 meters. It is also observed that the plant favourably grows in loamy soil.

Macroscopic Characters:

The drug contains stem leaf, fruit and seeds. The leaves have 10 – 30 cm length is crenate with acuminate apex. There are 8-10 pairs of lateral veins. Taste is better and odour is characteristic.

MicroscopicCharacters:

The epidermis shows caryophyllaceous stomata with sinous epidermal cells, and covering and glandular trichomes. I t is a dorsiventral leaf with palisade having 2 layers of cells. 2 – 3 bicollateral vascular bundles are seen in midrib. Mesophyll contains prismatic and acicular crystals of calcium oxalate. Stomatal index is from 10.8 to 18.2 and palisade ratio from 5 to 8.5.

Chemical Constituents:

Vasaka leaves contain quinazolinederivaties such as vasicine, vasicinone and 6- hydroxyl vasicine. Biochemically, vasicine is oxidised to its ketonic derivative vasicinone and the latter exerts main activity as bronchodilator. The drug aslo contains volatile oil, betain and Vasakin. It is also reported that vasaka contains adhatodic acid.

Standards:

Foreign organic matter – not more than 2 per cent.

Uses:

Vasaka is used as expectorant and bronchodilator. The large doses are irritant and cause vomiting and diarrhoea.

The pharmacological investigations have shows oxytocic property similar to oxytocin and methyl ergometrine.

Vasicine also shows abortificient action and both the actions are due to release of prostaglandins.

COFFEE

Synonyms:

Coffee bean,coffee seed.

Biological Source:

It is the dried ripe seed of Coffea Arabica Linne or C. libericaHiern, and deprived of most the seed coast. It belongs to family Rubiaceae.

Geographical Source:

Ethiopia, Brazil, India, Vietnam, Mexico, Guatemala, Indonesia and Sri Lanka.

Coffee beverage is popular in different parts of world. The amount of caffeine present is also more than in tea. In middle east countries, it is known by name ‘qahuah’. It is a strong decoction of coffee seed powder. The word has its origin in Turkish and Arabic languages. The major suppliers of coffee, now-a-days, are Brazil and India. Karnataka, Kerala and Tamil

Nadu grow large plantation of coffee. At present it is cultivated in Maharashtra too !

Habitat:

Coffee plant is an evergreen shrub which bears type of fruit with an ellipsoidal or spheroidal shape. Each fruit has 2 locules, containing one seed in each chamber. Each plant gives about 2 – 3 kg of coffee seeds. The fruits are dried to separate the seeds. The seeds are separated by wetting them and mechinacally separating, followed by drying in heaps, which causes fermentation.

The separated seeds or beans are green in coilour. They are roasted by which the colour and adour is effected. The seeds acquire dark brown colour and possess an agreeable odour and bitter taste.

India produced 1.65 and 2.35 lakh tonnes of coffee during 1998-99 and 99-2000 respectively.

Chemical Constituents:

The main constituents of coffee bean are caffeine, tannin, fixed oil and proteins. It contains 2-3% caffeine, 3-5%tannins,13%proteins, 10-15% fixed oils, chlorogenic or caffeotannicacis and sugars in the form of dextrin, glucose, etc. In the seeds, caffeine is present as a salt of chlorogenic acid. During roasting process, the agreeable smell of coffeeis developed which is due to an oil called caffeol composed of mainly furfural along with minor quantities of phenol, pyridine and valerianic acid.

Extraction of caffeine:

Caffeine is prepared either by synthesis or extracted from from natural sources.

Coffee bean is one of the major sources for it.

For the extraction, coffee roasters are used in which caffeine sublimed during roasting is recovered. It is the commercial method for extraction of caffeine.

Uses:

It is used as a source of caffeine. The main effects of coffee i.e. stimulant and diuretic actions are due to caffeine. It is sometimes, used to combat the toxic effects due to CNS depressant drugs.

Other Preparations-

Decaffeniated coffee – This product has been introduced in developed countries. It has been specially designed, because of addiction effects of coffee.

It has all the agreeable odour of coffee beans, but contains a meagre amount(about 0.08%) of caffeine.

ASHWAGANDHA

Synonyms:

Withania root, Asgandh, Winter cherry.

Biological Source:

It consists of dried roots and stem bases of Withaniasomnifera (Linn.) Dunal, belonging to family Solanaceae and should contain not less than 0.02% of total withanolide A and withaferinA on dried basis.

Geographical Source:

This plant grows wildly in all dry parts and subtropical India. It occurs in Madhya Pradesh, Uttar Pradesh, Punjab plains and North Western parts of India like Gujarat and Rajasthan. It is also found in Congo, South Africa, Egypt, Morocco, Jordan, Pakistan and Afghanistan.

Cultivation, Collection and Preparation:

It is reported that the plants from different sources vary in their morphological and therapeutic properties. Now-a-days, the cultivation is mainly done in Madhya Pradesh(Manasa plantations), where, about 2000 hectares are under cultivation. The propagation is done by seeds, for which about 4-5 kg of seeds are required per hectare. The seeds are sown in the soil which is unsuitable for other crops. The sowing is done towards June – July and during growth, no special arrangements are made forirrigation. Even the nitrogenous fertilizers lead to formation of small roots, but large foliage. Towards December or January, the plants bear flowers and fruits and

during January, harvesting is initiated which lasts upto March. The roots are collected by uprooting the plant and either entire roots or the pieces there of are dried immediately.

Macroscopic Characters:

The roots show buff to grey to grey outer colour with longitudinal wrinkles. They are unbranched straight, conical and some of them bear a crown. The root crown possesses a number of bud scars. Roots are bitter in taste andfresh roots smell similar to urine of horse(hence ashwagandha).The fracture is smooth and powdery.

Microscopic Characters:

The transverse section of root shows exfoliated cork which is nonlignified with 2-4 layers of phellogen and about 15-20 rows of phelloderm. It prominently shows parts of vascular tissue like cambium, constiting of 3-5 layers of tangentially elongated cells, phloem region with parenchyma, sieve tubes and companion cells. Secondary xylem is hard which forms a continuous vasculasr ring interrupted by medullary rays. The transerve section of stem base shows pith, pericyclic fibres, xylem with tracheids, fibres, and starch grains.

Chemical Constituents:

The main constituents of ashwagandha are alkaloids and steroidal lactones. Among the various alkaloids, withanine is the main constituent. The other alkaloids are somniferine, somnine, somniferinine, withananine, isopelletierine, anaferine and anahydrine. Two acyl sterylglucosides viz. sitoindoside VII and sitoindoside VIII have been isolated from roots.

The leaves contain steroidial lactones, which are commonly called as ‘Withanolides’. The withanolides have C28 steroidal nucleus with C9 side chain, having six membered lactone ring. Lavie et.al, have isolated such compounds from plants grown in Israel, India and S.Africa.

The various withanolidesresported are as follows. These compounds have been obtained from W.somniferachemotype 1.

Another series of steroidal lactones viz. withanolide E to M have been obtained from chmotype 111.

The drug also contains two monohydric alcohols called somnitol and somnirol; withanic acid; a phytosterol and ipuranol; and a mixture of fatty acids containing cerotic acid; oleic acid, palmitic acid and stearic acid.

Standards:

1) Foreign organic matter- not more than 2 per cent
2) Total ash- not more than 7 per cent
3) Acid- insoluble ash- not more than 1.2 per cent
4) Alcohol soluble matter- not less than 16 per cent.

Uses:

Ashwagandha has sedative and hyptonic effects.

It has hypotensive, respiratory, stimulant actions along with bradycardia.

It is an immune- modulatory agent.

Sitoindosides have been shown to possess anti-stress activity.

Traditionally, it has been used in treatment of rheumatism, gout, hypertension, nervine and skin diseases.

This drug prevents bony degenerative changes in arthritic conditions.

It has been widely used as sex stimulant and rejuvenator and is considered as strength and vigour promoting drug especially in geriatric cases.

The leaf extract shows activity against Staphylococcus aureus and Ranikhet virus.

TEA

Synonyms:

Camellia thea

Biological Source:

It contains the prepared leaves and leaf buds of Theasinenasis(Linne) O. Kuntze, belonging to family Theaceae (Ternstroemiaceae).

GeographicalSource:

Large areas of land are put under cultivation of tea in India, Sri Lanka, China, Indonesia, and Japan. It is available as black tea from India and Sri Lanka and green tea from China and Japan.

Black tea is obtained by fermenting the heap of fresh tea leaves and further drying with artificial heat. Green tea is obtained by putting tea leaves in copper pans and then drying by artificial heat.

Macroscopic Characters:

It is a small evergreen shrub when cultivated reaches to the height of 1.0 – 1.5 metres, while wild growing plants reach upto 6.0 metres. Plant is much branched and bears grey bark.

Leaves- Dark green, lanceolate or elliptical, blunt at apex, base is tapering margin shortly serrate. Young leaves are hairy while matured leaves are glabrous.

Flowers- are solitary or in groups of 2 to 3 in the leaf axils, and drooping.

Odour- Characteristics

Taste- Bitter

Preparation of Green Tea:

It is prepared by exposing the freshly collected leaves to the air until most of the moisture is removed.

Then they are roasted and stirred continuously until leaves become moist and flaccid.

Then they are passed to rolingtable and rolled into balls and subjected to a pressure which removes the moisture.

Then the leaves are shaken out on the copper pans and roasted again till the leaves assume dull green colour.

Then the leaves are winnowed, screened and graded into various varieties.

Chemical Constituents:

Tea leaves are considered as a rich source of caffeine(1 – 3%).

It is extracted from tea dust and tea leaf waste or sweepings.

It aslo contains theobromine and theophylline in minor quantities.The colour of tea leves is due to gallotannicacid(15%).

The agreeable odour is due to presence of a yellow volatile oil.

Tea leaves also contain an enzymatic mixture called thease.

Use:

CNS stimulant in the form of beverage and also as diuretic.