1. Definition, history and scope of Pharmacognosy including indigenous system of medicine.

PHARMACOGNOSY- History and Scope

It literally means the knowledge or science of drugs. This word is derived from two Greek words, **'PHAMACON'**-meaning **'dry herb'** and, **'GIGNOSCO'**- meaning **'to acquire knowledge of'.** The word **pharmacognosy** was coined by **C.A. Seydler;** a German scientist, in the year **1815,** in his doctoral thesis, titled- ANALECTA PHARMACOGNOSTICA

The simplest definition of pharmacognosy is- "the science which aims at complete and systemic knowledge of Structural, Physical, Chemical and Sensory characters of Crude drugs and their Constituents; obtained from Plants, Animals and Mineral sources." Another definition is- "the science of simultaneous application of various scientific disciplines with the object of acquiring the knowledge of crude drugs from every aspect or point of view."

HISTORY AND DEVELOPMENT OF PHARACOGNOSY

The first requirement of primitive man- was food. It ate available plants, hence arose the categorization of these into EDIBLE and NON-EDIBLE. Non-edible were further categorized into poisonous and 'causing other effects' like emesis (vomiting) or diarrhoea. These and similar effects and healing powers of many plants were certainly discovered accidentally, but; this knowledge, once gained was too important to be forgotten. Each progeny enriched this knowledge, mainly by trial and error method and passed it on to next generation. In beginning, this passage was Orally, then through Baked Clay Tablets, Manuscript Herbals and Materia-medica. Presently even computer is helping in this process of transmission of knowledge.

The available evidences suggest that the Babylonians were aware of healing power(s) of many plants. The **PAPYRUS-EBERS (Ebers papyrus),** a famous document found in tomb of mummy indicates that Egyptians were having the knowledge of medicinal effects of plants.

It is mainly the Greek scientists who enriched the natural sciences. Hippo crates (460-370 BC) dealt with Anatomy and Physiology. Aristotle (384-322 BC) wrote about Animal Kingdom. Theopharastus (Aristotle's pupil; 370-287 BC) described mainly the Plant Kingdom. Dioscorides described various Medicinal Plants in 78 AD. Pliny the Elder (23-78 AD) complied 37 volumes on Natural History. Galen (131-200 AD) complied 20 volumes, describing the methods of preparing formulae from plant and animal drugs.

From this point the Medicine and Pharmacy developed along separate paths. The Physicians started specializing in Diagnosis and Prescribing whereas the Pharmacists (Apothecary) started specializing in identification, collection, preparation and compounding of drugs. The materials possessing medicinal values were arranged alphabetically into following major heads

The Plant materials.

The Animal materials.

The Mineral materials.

and described as separate entities. The books thus prepared came to be known as **Herbals.** A few important herbals are-

ORTUS SANITATIS, 1491- It is written in Latin. English translation of title is- " Garden of Health". Author not known.

DE-HISTORIA STIRPIUM, 1542- It is written in Latin. Author Leonhart Fuchs.

A NEW HERBAL, **1551-** It is in English. Author William Turner.

With increase in knowledge about medicinal substances the description started including their actions, botanical and zoological classification and even the chemical constituents. The physical agents of treatments like heat and electricity were also included. These books were now called **Materia Medica.** One such example of Materia Medica is- Materia Medica by Pereira (1839). The knowledge thus accumulated became beyond the scope of single author hence following four distinct departments of study developed-

Pharmaceutical chemistry- It includes the theory and fundamental principal of chemistry with emphasis on pharmaceutical substances.

Pharmacy/Pharmaceutics- This department is concerned with modes/methods of treatment of crude drugs/chemicals so as to prepare suitable formulations, ready to administer.

Pharmacology/Pharmacodynamic- This department is concerned with study of response of organism when treated with medicinal substance.

Pharmacognosy-It is concerned with study of Structural, Physical, Chemical and Sensory characters of Crude drugs and their Constituents; obtained from Plants, Animals and Mineral sources.

Till the beginning of 20th century, the pharmacognosy developed mainly on the lines of descriptive botany with emphasis on identification (Entire or Powdered drugs), history, cultivation collection, preparation, storage and commerce of drugs.

During the period **1934-1960** the knowledge of pharmacognosy has been greatly enriched by the application of principles of plant chemistry (organic and Bio-chemistry), Pharmacology, and modern methods of analysis. Important events during this period have been-

- Isolation of Penicillin (1928) by A. Fleming and its large-scale production by Florey and Chain in 1941.
- Isolation of Alkaloids from Rauwolfia (Reserpine), Vinca (Vincristine and Vinblastine) and Opium (Morphine). Their structure and use were studied.
- Isolation of various antibiotics like Streptomycin, Chloramphenicol and Tetracyclines.
- SAR (Structure Activity Relationship) of various active constituents studied.
- Semi-synthetic drugs obtained from natural products.
- Certain plant drugs served as models for synthetic drug e.g. Morphine for potent analgesics like Apomorphine, Pethidine. Salicin served as model for Aspirin.
- Biosynthetic pathways for bio-synthesis of primary and secondary metabolites, studied. Examples are- Calvin Cycle (photosynthesis) Shikimic Acid Pathway (for aromatic compounds) Acetate Mevalonate pathway (for biosynthesis of terpenoid compounds)

PROGRESS FROM 1960 ONWARDS

During this period much newer compounds have not been discovered, but newer and better methods for production of Antibiotics, Hormones and Anti-tumour compounds have been devised. From 6- Amino Penicillanic Acid (6-APA), important broad spectrum Antibiotics like Ampicillin, Oxacillin, Methicillin, Cloxacillin and Phenethicillin.

These developments have helped the pharmacognosy to develop to a well-established subject of pharmaceutical science from its descriptive botany stage.

SCOPE OF PHARMACOGNOSY

Pharmacognosy includes the knowledge of History, Distribution, Identification, Cultivation, Collection, Preparation, Evaluation, Preservation and uses of Natural drugs and their constituents; of Plant, Animal and Mineral origin.

The plant drugs may be entire plant, some part of it or its product e.g.

Entire Plant-Irish moss, Ergot, Ephedra and Datura.

Plant Parts-

Roots- Aconite, Ipecac, Senega.

Rhizomes- Ginger, Rhubarb, Turmeric.

Leaves- Buchu, Digitalis, Senna.

Barks- Ashoka, Cinchona, Cinnamon.

Fruits- Amla, Bael, Black pepper, Fennel, Psoralea and Senna pod.

Seeds-Isbagol, Mustard, Nux-vomica.

Plant Products- Acacia (dried gummy exudates), **Aloe** (dried leaf juice), Balsams (pathological resin), **Catechu** (dried aqueous extract of heart wood), **Fixed oils, Opium** (dried latex from capsule and **Volatile oils.**

Similarly the animal drugs include the entire animal, some part of it or its product e.g.

Entire animals- Cantharides, Leech, Mylabris.

Animal's Part- Gall bladder, Pancreas, thyroid gland.

Animal Products- Cochineal, Shellac.

Examples for mineral are- Bentonite, Kaolin and Talc.

Fibres like Cotton, Silk and wool (used in surgery and dressing) are studied.

Substances like Agar, Beeswax, Fixed oils, Lanolin, Lard, Honey, Gelatin, Spermaceti, Starch and Suet can be obtained in fairly pure state. These do not have any medicinal value but are used for various pharmaceutical purposes. These are categorized as Pharmaceutical-aid and studied under this subject.

Filter-aids of natural origin like Asbestos and Fuller's earth also come within scope of this subject.

Other substances falling within its purview are- Allergens, Anti-biotics, Herbicides, Immunizing agents and Insecticides.

Technical products; which find use even in other industries and studied in pharmacognosy are- Beverages, Condiments, flavouring agents, Solvents of biological origin and Tannins.

FORMAT FOR SYSTEMIC STUDY OF DRUGS IN PHARMACOGNOSY

To acquire complete and systemic knowledge of any drug, it is studied under following headings-

Origin- This includes Biological source, Geographical source and History.

Cultivation, Collection and preparation- It means the Cultivation, Collection, Drying, Treatment and Packing of drug so that it maintains its potency during storage.

Characters- It includes Macroscopical (physical), Microscopical (histological) and Sensory characters.

Constituents- Under this heading we study important Active constituents and other constituents present.

Chemical Tests- it includes those chemical tests, which help in Identification or evaluation of drug under study.

Evaluation- It means judging the quality of drug by means of various Physical, Chemical and other parameters so as to know whether the drug is of acceptable quality or not.

Uses- It includes various Therapeutic and other Pharmaceutical Uses.

Substituents- It includes those drug(s), which can be used in place of drug under study.

Adulterant- It includes possible adulterant(s) and their detection by various means.

INDIGENOUS SYSTEMS OF MEDICINE

AYURVEDA

The word 'AYURVEDA' is derived from 'AYURH' meaning life and 'VEDA' meaning knowledge; hence the ayurvedic science is based upon principals of maintaining the health of a healthy person and relieving the patient from diseased state.

Ayurveda is truly a natural and traditional healing system of India as its existence has been proved as far back as 3000 BC. It is considered to be part of Vedic science, which includes **YOGA, MEDITATION and ASTROLOGY**. The ayurveda mainly includes herbal drugs, in addition to dietetics, surgery, psychology and spirituality. In ayurveda the immense power of health maintenance, prevention and treatment of diseases and longevity lies in its HOLISTIC approach.

HOLISTIC APPROACH OF AYURVEDA

Ayurvedic philosophy believes that the ultimate goal of medical treatment is- complete restoration of physical and mental well being with minimum tampering of homeostasis of system. To achieve this goal the ayurveda adopts the holistic approach towards Disease, Patient and Drug i.e. these are viewed in totality instead the component part of a complex system.

DISEASE: According to ayurveda, there are three life forces or biological humours in the body named- **'VATA', 'PITTA' and 'KAPHA'**. The Kapha is organic body and the Vata and Pitta are its functional parts. In each individual one humour, predominates deciding the psychosomatic make up or PRAKRITI of that individual. Perfect balance of these humour means health while imbalance means disease

Patient is also viewed as individual within his/her socio-ecological system including his/her psychosomatic make up.

Holistic approach towards drug us that it is always the entire drug, which benefits the patient. Drugs are prescribed to restore the balance of biological humours. A drug has its action due to following five characteristics-

RASA- Taste

VIPAKA- Taste of digestion product of the drug

GUNA- Certain Physical attributes

VEERYA- Intrinsic property correlated to Sun (Ushanveerya) and Moon (Sheetveerya)

PRABHAVA- Action(s) specific to the drug and independent of other four characteristics

Action(s) of a drug based upon its 1st four characteristics can perfectly be predicted but not the actions based upon its Prabhava characteristic.

The basis of drug action, as explained; clearly shows that drug can benefit the patient only in its totality.

UNANI (YUNANI) SYSTEM OF MEDICINE

Unani is Perso-Arabic system of medicine and is based on the teachings of the Greek physicians Hippocrates and Galen.

It was introduced to India by the 13th century with the establishment of the Delhi Sultanate and it took its own course of development during the Mughal Empire. During this time it was greatly influenced by Indian medical teachings of SHSHUTA and CHARAKA. In 14th century Alauddin Khalji provided royal patronage to this system and this led to its development in India, and also the creation of Unani literature.

BASICS OF UNANI SYSTEM

The origin of Unani medicine is based on four humours: phlegm (*balgham*), blood (*dam*), yellow bile (*ṣafrā*) and black bile (*saudā'*). Unani system is based on theory of the presence of the elements in the human body. According to followers of Unani medicine, these elements are present in fluids and their balance leads to health and their imbalance leads to illness.

Diagnosis and treatment

According to Unani medicine, management of any disease depends upon the diagnosis of disease. Proper diagnosis depends upon observation of the patient's symptoms and temperament.

According to Unani practitioners, the failure of the body's ability to maintain its own health, may lead to derangement of the normal equilibrium of the body's humors. Abnormal humors are believed to lead to pathological changes in the tissues at the affected site, creating the clinical manifestations of illness. The theory postulates the presence of blood, phlegm, yellow bile and black bile in the human body. Each person's unique mixture of these substances determines his *mizaj* (temperament). A predominance of blood gives a sanguine temperament (Optimistic person); a predominance of phlegm makes one phlegmatic (Unemotional and calm disposition); yellow bile, bilious or choleric (Irritable); and black bile, melancholic (Always reflecting sadness).

After diagnosing the disease, treatment follows a pattern -

- Elimination of cause
- Normalization of humors
- Normalization of tissues/organs

These therapies include cupping, Aaromatherapy, bloodletting, bathing, exercise, and massaging the body. It may also involve the prescription of Unani drugs or surgery.

Some medicines traditionally used by Unani practitioners are known to be poisonous. As per the scholars of this system, the methods of preparation of these medicines are such that their poisonous effects get neutralised and even the side effects are taken care of. In the light of modern pharmacological principles this claim is doubtful hence rules have been framed that Unani medicines should pass certain safety parameters before being allowed to enter market.

HOMEOPATHY

Homeopathy or **homoeopathy** is a system of alternative medicine. It was started in 1796 by Samuel Hahnemann. This system believes that a substance that causes symptoms of a disease in healthy people would cure similar symptoms in sick people; this doctrine is called "like cures like".[5] Homeopathic preparations are termed *remedies* and are made using homeopathic dilution. In this process, a chosen substance is repeatedly and thoroughly diluted.

From its inception, however, homeopathy was criticized by mainstream science as therapeutic claims of homeopathy lack scientific justification.

Historical fact which led to idea of Homoepathy

Hahnemann rejected the mainstream medicine of the late 18th century as irrational and inadvisable because it was largely ineffective and often harmful. He advocated the use of single drugs at lower doses. The outcome from no treatment and adequate rest was usually superior to mainstream medicine as practiced at the time of homeopathy's inception.

Hahnemann's concept

Hahnemann conceived of homeopathy; he ingested some bark specifically to investigate what would happen. He experienced fever, shivering and joint pain: symptoms similar to those of malaria itself. From this, Hahnemann came to believe that all effective drugs produce symptoms in healthy individuals similar to those of the diseases that they treat,

"Provings"

The procedure of testing effects of substances in humans, is called "homeopathic proving". These tests require subjects to test the effects by ingesting substances and recording all of their symptoms. Books thus written are called *Materia Medica Pura*.

As per Hahnemann belief large doses of drugs aggravate illness, hence extreme dilutions of the substances should be used. He devised a technique for making dilutions that he believed would preserve a substance's therapeutic properties while removing its harmful effects. Hahnemann believed that this process aroused and enhanced "the spirit-like medicinal powers of the crude substances". The process of dilution and succussion is termed "dynamization" or "potentization" by homeopaths. Hahnemann gathered and published a complete overview of his new medical system in his book, *The Organon of the Healing Art* (1810), whose 6th edition, published in 1921, is still used by homeopaths today.

Homeopathy uses animal, plant, mineral, and synthetic substances in its preparations, generally referring to them using Latin or faux-Latin names. Examples include *arsenicum album* (arsenic oxide), *natrum muriaticum* (sodium chloride or table salt), *Lachesis muta* (the venom of the bushmaster snake), *opium*, and *thyroidinum* (thyroid hormone).

Homopathy has concept of "miasms" as reason for chronic diseases. As per Homopathy some miasm is responsible for specific diseases. Exposure to miasms causes local symptoms, such as skin or venereal diseases. If, however, these symptoms were suppressed by medication, the cause went deeper and began to manifest itself as chronic diseases of the internal organs.

Dilutions: Three main logarithmic dilution scales are in regular use in homeopathy. Hahnemann created the "centesimal" or "C

scale", diluting a substance by a factor of 100 at each stage. There is also a decimal dilution scale (notated as "X" or "D") in which the preparation is diluted by a factor of 10 at each stage.[93] The centesimal scale was favoured by Hahnemann for most of his life.

A 2C dilution requires a substance to be diluted to one part in 100, and then some of that diluted solution diluted by a further factor of 100. This works out to one part of the original substance in 10,000 parts of the solution.[94] A 6C dilution repeats this process six times, ending up with the original substance diluted by a factor of $100^{-6}=10^{-12}$ (one part in one trillion or 1/1,000,000,000,000). Higher dilutions follow the same pattern. In homeopathy, a solution that is more dilute is described as having a higher "potency", and more dilute substances are considered by homeopaths to be stronger and deeper-

Adverse effects

Some homeopathic preparations involve poisons such as Belladonna, arsenic, and poison ivy, which are highly diluted in the homeopathic preparation. In rare cases, the original ingredients are present at detectable levels. This may be due to improper preparation or intentional low dilution. Serious adverse effects such as seizures and death have been reported or associated with some homeopathic preparations.

During the 19th-century cholera epidemic, death rates at the London Homeopathic Hospital were three times lower than at the Middlesex Hospital. Homeopathic sugar pills won't do anything against cholera, of course, but the reason for homeopathy's success in this epidemic is even more interesting than the placebo effect: at the time, nobody could treat cholera. So, while hideous medical treatments such as blood-letting were actively harmful, the homeopaths' treatments at least did nothing either way.

2. **Various systems of classification of drugs of natural origin.**

Classification of drugs

The science of grouping or categorizing the members of natural population and then arranging these groups or categories in some particular sequence, is known as classification. It is humanly impossible to study all members of any natural population; hence to systematize the study of any branch of science, its members/items are grouped and then these groups are arranged in some systemic sequence. The basis for this grouping and sequencing is always-**'similarities amongst members'**. Advancement of knowledge brings to light, new similarities and the system of classification adopts these similarities as basis. This improves and enriches the science of classification; e.g. the Aristotle classified the plants on the basis of structure of stem i.e. Herbs (soft stem), Shrubs (several woody stems) and Trees (Single woody trunk). Linnaeus, in 18^{th} century, classified plants; based upon '**structural similarities'** and arranged these as '**order in nature'** i.e. **Kingdom, Phylum, Class, Order, Family, Genera and Species**. The modern system of classification of plants is based upon similarities in cellular organization, chromosomal and genetic structure.

While dealing with living beings, the manmade systems of classification try to arrange 'systematically' the ever changing (for betterment) nature. Hence no system of classification can ever be perfect. Each system has its own merits, demerits and limitations. We have to choose one, depending upon our needs and convenience. Various systems of classification; followed in pharmacognosy are-

- **Alphabetical**
- **Morphological**
- **Taxonomical or Biological**
- **Chemical**
- **Pharmacological**
- **Chemo taxonomical**

ALPHABETICAL CLASSIFICATION

In this system, the drugs are arranged alphabetically. This system has been used in Materia- Medica. In Materia- Medica the drugs were categorized into three sub headings i.e. Plant, Animal and Mineral drugs and then arranged alphabetically under each division. Advantages of this system are

- It is very simple system.
- Knowledge of name of drug is sufficient to classify it.
- This system can arrange even unconnected drugs.

Disadvantage of this system is that it fails to reveal any character of drug hence no more used in Pharmacognosy; but still finds favour in Encyclopedias, Dictionaries, Pharmacopoeias and indexes.

MORPHOLOGICAL CLASSIFICATION

Dr.T.E.Wallis first adopted this system. Dr. Wallis was of firm belief that the Pharmacognosy is a well-established science; hence the system of classification should arise from pharmacognosy, itself. He started 'Morphological system of classification'. In this system the drugs are grouped according to the parts of plants or animals, these represent. Various examples are-

Roots- Aconite, Ipecac, Senega.

Rhizomes- Ginger, Rhubarb, Turmeric.

Leaves- Buchu, Digitalis, Senna.

Barks- Ashoka, Cinchona, Cinnamon.

Fruits- Amla, Bael, Black pepper, Fennel, Psoralea and Senna pod.

Seeds-Isbagol, Mustard, Nux-vomica.

Organs or Glands- Pituitary, Thyroid, Pancreas and Ox Gall Bladder

This system is very useful to teach Practical Pharmacognosy, but has following limitations-

- ❖ Fails to classify non-cellular drugs i.e. unorganized drugs
- ❖ Fails to give proper order to various morphological parts.
- ❖ Commercial form of drug may not necessarily represent the natural form of drug e. g. the powered drugs, hence it becomes difficult to know; which part this powder represents.

TAXONOMICAL (BIOLOGICAL) CLASSIFICATION

Pharmacognosy has been greatly benefited from advances in biological sciences; knowledge of which is must before starting the systemic study of pharmacognosy, hence the earlier authors, in pharmacognosy; adopted the same system of classification, for drugs, as followed for plants and animals. This system appears quite appealing, but suffers from the drawback that drugs are usually the parts of plants or animals and rarely the entire organism. So, from commercial sample of drug it becomes very difficult to know the name of plant or animal; to which the drug belongs.

CHEMICAL CLASSIFICATION

Medicinal action(s) of drugs depend(s) upon the chemical constituents present in these. Hence even chemical classification of drugs has been attempted. In this system, the drugs are classified according to chemical constituents present in them e.g.

Drugs containing Alkaloids- Opium, Ergot, Ephedra, Rauwolfia and Solanaceous plants.

Drugs containing Glycosides- Senna, Rhubarb, Digitalis, Liquorice and Ginseng.

Drugs containing Volatile oils- Clove, Cardamom, Umbeliferous fruits.

Disadvantages of this system are-

- ❖ Drugs cannot be classified unless their chemical constituents are known.
- ❖ It becomes difficult to decide the position of those drugs, which contain chemical constituents of different chemical nature.

PHARMACOLOGICAL CLASSIFICATION

Each drug has some medicinal effect; hence this can form the basis of classification, known as Pharmacological, Therapeutical or Pharmacodynamical classification.

Cathartic drugs- Aloe, Cascara, Senna, Jalap, Podophyllum and Castor oil.

Cardio active drugs- Digitalis, Strophanthus, Squill and Cinchona.

CNS Depressant- Opium, Cannabis and Cocaine.

Disadvantages are-

- ❖ Pharmaceutical aids natural origin cannot be classified.
- ❖ It becomes difficult to decide the position of those drugs, which have varied actions.

CHEMOTAXONOMICAL CLASSIFICATION

In plants, genes are responsible for production of chemical constituents; hence the latest thinking is that the plant constituents and their relationship with genetic material should form the basis for classification.

The recent advances in Comparative Phytochemistry, Cellular Biology and Genetics have produced sufficient literature, based upon which, a system of classification is possible. This system is named as Chemotaxonomy. This system takes into consideration the Chemical Constituents of plants, the Chromosomal Number, Genes and Enzyme system responsible for production of these plant constituents.

Advantage of this system is, that it takes into account the genetic material and its translation into chemical constituents, as basis, which are less liable to change compared to somatic characters. The main disadvantage is that lot of data is required before attempting this classification.

3. Adulteration and drug evaluation; significance of Pharmacopoeial standards.

ADULTERATION AND EVALUATION OF CRUDE DRUGS

ADULTERATION

Adulteration means the admixture or substitution of genuine drug with spurious, defective or sub-standard material which may be harmless or harmful.

It is also defined as substitution of original drug, partially or wholly, by similar looking substance(s) which is either free from or inferior in chemical constituents and therapeutic properties.

Adulteration is usually practiced for such drugs which are scarce or highly expensive. It is also commonly practiced with contraband drugs. Common terms associated with adulteration are-

Admixture- It means the addition of some other article or material in the drug due to ignorance, carelessness or accidentally.

Sophistication- It means the intentional or deliberate adulteration e.g. addition of Capsicum to ginger for maintaining its pungency.

Substitution- It means the supply of totally different material in place of genuine drug e.g. *Polyalthea longifolia* bark in place of Asoka (*Saraca indica*) bark.

Inferior or substandard drug- It means the drug with lower quality, irrespective of its cause e.g. less than 10 % morphine in Opium means that opium is sub-standard. It can be due to faulty collection like under or over age of the collected plant part.

Deterioration- It means the impairment of quality of drug due to aging, heat, moisture or insect attack e.g. over roasting of coffee reduces its caffeine content, wormy ginger and the rancid oils and fats are also its examples.

Spoilage- It means the impairment of quality due to microbial attack e.g. drugs having fungal growth.

TYPES OF ADUTERATION

- **Unintentional (un-deliberate) adulteration**
- **Intentional (deliberate) adulteration**

I. UNINTENTIONAL (UNDELIBERATE) ADULTERATION

This adulteration is never intended but occurs due to ignorance, negligence and accident. This adulteration may occur under following circumstances.

Faulty Collection- It means the collection of drug without due consideration to its age, stage of development, season and attack by microbes. It may also be due to collection of similar looking plant due to carelessness or ignorance.

Faulty Preparation- It means non-removal of undesirable parts from the genuine drug (Cork from ginger is to be removed). It may even occur due to faulty drying like excessive fermentation in Gentian and long wait in Digitalis before drying. Excessive drying of leaves makes them brittle.

Faulty storage- Volatile oils are always stored at cool and dry place in tightly closed containers. Digitalis and Fixed oils and Fats are always protected from moisture during storage.

Faulty transportation- Faulty transportation means that not protecting the drug from excessive heat, moisture and light leading to deterioration of quality of drug.

Mix up of vernacular names- In different parts of country, the same drug is known by different vernacular names; while different drugs are known by same vernacular names. This causes confusion leading to adulteration.

Examples are-

Trianthema portulacastrum (Ficoidaceae) and *Boerhaavia diffusa* (Nyctaginaceae)- both are known by Common name 'Punarnava'.

Bacopa monniera (=Bacopa monnieri; Scrophulariaceae) and *Centella asiatica* (= *Hydrocotyl asiatica;* Apiaceae)- both are known as 'Brahmi'

Following three plants are named as 'Shankhpushpi'

Evlovulus alsinoides (Convolvulaceae)

Convolvulus microphyllus (C. pluricaulis; Convolvulaceae)

Clitoria ternatea (Leguminosae)

Following plants have 'Rasana' as vernacular name

Alpinia officinarum (Zingiberaceae)

Pluchea lanceolata (Asteraceae)

Vanda roxburghii (Orchidaceae)

Vitex negunda (Verbenaceae)

Following three plants are called 'Bach'

Acorus calamus (Araceae)

Alpinia officinarum (Zingiberaceae)

Anacyclus pyrethrum (Compositae)

From above examples it is clear that *Alpinia officinarum* (Zingiberaceae) is known by two vernacular names i.e. 'Rasna' and 'Bach'

II. INTENTIONAL (DELIBERATE) ADULTERATION

This adulteration is intentional and restored to with the motive of making money. It can be of following types

A) Adulteration with plant material

i) Partial adulteration with other plant material- In this adulteration the genuine drug is mixed with similar looking plant material. Some examples are-

Drug	**Genuine source**	**Adulterant**
Aloe	Dried juice of *Aloe vera*	Black catechu
Belladona leaves	*Atropa belladonna/A. acuminata*	Ailanthus leaves (*A. glandulosa*)
Chirata herb	*Swertia chirata*	*Swertia angustifolia*
Cinnamon bark	*Cinnamomum zeylanicum*	*Cinnamomum cassia*
Digitalis leaves	*Digitalis purpurea*	*Digitalis thapsi*
Stramonium leaves	*Datura stramonium*	Xanthium leaves

ii) Gross substitution with other plant material- In this adulteration, the similar looking material form some different source is supplied in place of the genuine drug.

Drug	**Genuine source**	**Adulterant**
Asoka bark	*Saraca indica*	*Polyalthea longifolia* and *Trema orientalis*
Kurchi bark	*Hollarrhna antidysenterica*	*Wrightia tinctoria*
Rauwolfia root	*Rauwolfia serpentina*	*Rauwolfia canescens*

Senna leaves *Cassia angustifolia and C. acutifolia Cassia auriculata*

iii) Substitution with exhausted drug- Here the drug is mixed with the drug sample from which the active constituents have been removed e.g. the volatile oil containing drugs (Fennel, Dill, Coriander) are adulterated with sample from which the volatile oil has been distilled by use of steam. Powder of Ginger and Liquorice is adulterated in the same way.

B) Adulteration with non-plant material- It means that drug is adulterated with imitations, which are not of plant origin. Sometimes this adulteration is of very serious consequences. Some examples are-

Drug	**Adulterant**
Clove, Ergot and Nutmeg	Imitations of clay and wood
Asafoetida	Mixed with limestone & Artificial imitations from gummy materials.
Tolu balsam	Resinous base with Vanillin & esters of Benzoic acid and Cinnamic acid
Fixed oil	Mineral oil
Cocoa butter	Soft paraffin
Opium	Lead shots
Cardamom	Rodent faecal matter

EVALUATION

Evaluation of drug means the confirmation of its Identity, Purity and Quality.

Identity means the origin or biological source of drug. It can be confirmed by comparing the characters of drug with an authentic sample or with description provided in authentic literature or by collecting the drug from a positively identified plant or animal.

Purity means the freedom from undesirable material. For confirming purity the allowable extraneous material is separated, weighed, its percentage is calculated and compared with official limit.

Quality refers to the amount or quantity of active constituents. It refers to the intrinsic value of the drug. Quality is confirmed by following means-

- Organoleptic evaluation
- Microscopic evaluation
- Physical evaluation
- Chemical evaluation
- Biologic evaluation

ORGANOLEPTIC EVALUATION

It means the evaluation of dug using our sense organs. In Organoleptic evaluation, shape, size, colour, odour, taste and special features like touch, texture and the sound or 'snap' of its fracture, is studied.

For convenience, the organoleptic evaluation is divided into following parts-

- Shape and size
- Colour and external markings
- Fracture and internal surface
- Odour and Taste

Size and Shape

Size- All possible dimensions like Length, Breadth, Thickness and Diameter, are measured. Small structures like seeds are measured by aligning 10 seeds on a sheet of calibrated paper (mm graph paper). Size of drug can be measured in mm or cm or any other convenient unit.

Shape- Each drug has specific shape depending upon the part of plant, it represents.

In case of leaves the shape of lamina is important Fruits are usually Globular, Oblong and Ellipsoidal. Seeds are Globular, Oval, Reniform, Plano-convex and Spherical.

Underground parts are Roots, Rhizomes, Bulbs, Corms and Tubers. These can be Cylindrical (Sarsaparilla), Sub-cylindrical, cylindraceous or nearly cylindrical (Podophyllum), Conical (Aconite), Disc shaped (Calumba).

Barks have the following shapes

- Flat (Arjuna, Quillaia)
- Curved (Wild cherry)
- Recurved (Kurchi)
- Channelled (Asoka)
- Quilled (Cascara)
- Double quilled (Cinnamon)
- Compound Quill (Cinnamon)

COLOUR AND EXTERNAL MARKINGS

Colour- Colour name consists of 'hue' name along with one or two modifiers which indicate the intensity, dullness or shade of the 'hue'.

External markings- External markings refer to the 'marks' present on the surface of the drugs. These are formed due to shrinkage of underlying tissues. These are-

Furrows- Alternating ridges & valleys e.g. Calamus, Jalap, Nutmeg

Wrinkles- Fine or delicate furrows e.g. Black pepper and Liquorice

Annulations- Transverse ring like markings Ipecac and Galanga

Fissures- Splits extending into tissues Cinchona

Nodules- Rounded outgrowth on the surface

Projections- Remains of root bases, stem bases and buds Withania, Senega, Male fern

Scar- Marks left by removal of stem, leaf, roots and buds Turmeric, Podophyllum, Cinnamon

FRACTURE

Fracture- It refers to the way the plant part breaks, upon being subjected to the pressure. The various terms used are-

Weak- Breaking easily

Tough- Breaking with difficulty e.g. Moist Gentian

Complete- Breaking clean across e.g. Bees wax

Incomplete- Breaking only part way across e.g. Liquorice

Short- Clean break with quick 'snap' e.g. Colchicum, Ginger, Black catechu

Fibrous- Fractured surface having projections of the fibres e.g. Ginger, Bark of Liquorice

Splintery- Breaking irregularly in pieces with larger and smaller projecting edges and splinters e.g. Quillaia, Wood region of Glycyrrhiza

Brittle- Easily breaking into many pieces upon dropping on a hard surface e.g. Colophony

ODOUR AND TASTE

Odour is the perception received when volatile molecule present in the inhaled air, binds to olfactory receptors present in the nostrils. It can be 'distinct' or 'indistinct'. It can also be agreeable or non-agreeable, **Agreeable odours are-** Aromatic, Balsamic and Spicy. **Non agreeable odours are-** Alliaceous, Camphoraceous and Terebinthinate.

Taste- This means the perception by taste buds present on the tongue. The taste can be-

- **'True taste'**
- **'Taste due to odour'**
- **'Taste due to distinct sensation on tongue'**

True tastes these are- Sour, Saline, Sweet, Bitter and Alkaline.

Taste due to odour- Agreeable tastes are- Aromatic, Balsamic and Spicy. Non agreeable tastes are- Alliaceous, Camphoraceous and Terebinthinate.

Taste due to distinct sensations on tongue which are named as taste-

Mucilaginous- Soft slimy feeling e.g. Gum acacia, Bael and Agar

Oily- Bland smooth feeling

Astringent- Contraction of tissue; puckering feeling

Pungent- Warm biting sensation

Acrid- Unpleasant irritating tingling sensation e.g. Squill, Honey (after taste)

Nauseous- The taste which excites vomiting

Insipid or **no taste-** All those drugs which are insoluble in saliva

MICROSCOPIC EVALUATION

For microscopic evaluation, sections (T.S., L.S.) and Powdered drug (# not more than 40) is examined under the compound microscope.

Plant parts are made up of tissues. Each tissue performs a definite function hence each one has the specific structure. During microscopic evaluation the structure and arrangement of tissues, is studied.

During microscopic evaluation even the **Ergastic substances** (like Starch grains, Aleuronic grains and the various crystals) are studied. Their presence/absence, shape, size and frequency of occurrence are of diagnostic value. This helps in establishing the identity of genuine drug or that of adulterant, if present. **Lycopodium spore method** of Quantitative microscopy is used to determine the %age of adulterant in the powdered drug.

PHYSICAL EVALUATION

In this method the quality of drug is evaluated by application of various physical constants to the drug. These are-

Specific gravity- It means the wt. per unit volume. Good quality Nutgalls sink in water. Jalap also has sp. gr. higher than that of water. Sp. gr. is important even for Fixed oils and Volatile oils.

Optical rotation- It is more important for Volatile oils.

Refractive index- It is important for Fixed oils and Volatile oils.

Melting point- It is more important for solid lipids and certain alkaloids.

Fluorescence- It is behaviour of drug towards filtered UV light. Rhapontic rhubarb shows marked fluorescence whereas genuine Indian and Chinese rhubarbs do not show the fluorescence. Similarly the acidic solution of Quinine shows marked fluorescence.

Solubility- It is expressed as g/ml of the solvent'.

Congealing point, Ash values and **Spectroscopic analysis** are other important parameters of physical evaluation.

CHEMICAL EVALUATION

Each drug has some active constituents. These constituents react with various reagents to produce specific colours or precipitates. This forms the basis of chemical evaluation. This includes the qualitative tests and quantitative assays for specific constituents. Some common examples are-

- ❖ Chemical tests for Carbohydrates.
- ❖ Chemical tests for proteins.
- ❖ Chemical tests for Alkaloids.
- ❖ Borntrages's test for Anthraquinones
- ❖ Determination of Acid value, Iodine value and Saponification value for fixed oils
- ❖ Determination of Methoxyl value and Volatile acidity for gums
- ❖ Use of Acid-base titration and Non-aqueous titration for assay of many drugs

BIOLOGIC EVALUATION

In biologic evaluation, living animals and the intact or excised organs are used for evaluation and standardization of drugs. This evaluation is preferred when chemical evaluation fails to distinguish the active isomer of a compound from less active or inactive isomer e.g. digitalis. Some common examples are-

- ❖ Use of bacteria for evaluating the Antiseptic potential of products and the assay of Vitamins and Antibiotics
- ❖ Use of frogs to standardize Digitalis. Now pigeons are used for this purpose
- ❖ Use of guinea pigs for testing toxicity and anti-genicity of biological products
- ❖ Standardization of Posterior Pituitary injection using chicken
- ❖ Use of rabbits for testing pyrogens and muscle relaxants
- ❖ Use of dogs for testing drugs having pressor activity
- ❖ Use of earthworms to evaluate the Anthelmintic drugs.

SIGNIFICANCE OF PHARMACOPOEIAL STANDARDS

It is must that we should be absolutely sure about the identity and purity of crude drugs being used for various formulations. To ensure same IP prescribes test under headings 'IDENTITY' and 'MINIMUM QUALITY STANDARDS'

Identity tests are based on 'classical pharmacognosy assessment methods' like

Organoleptic, Physical, Chemical, Biological and Microscopical methods. The tests prove the identity of the drug sample.

Minimum Quality Standards are

Moisture content

Foreign matter

Ash value (Ash left after ignition of drug)

Extractive values (Alcohol extractive, water extractive)

Other Specifications like %age of Alkaloids, Volatile oil or a specific chemical constituent.

Sometimes classical standards are prescribed like Swelling factor (Isapgol) Bitterness value (Gentian) and certain coloured reactions.

It is must that drug complies with all the tests prescribed. This leaves no doubt about the identity and purity of drug sample being used.

4. Brief outline of occurrence, distribution, outline of isolation, identification tests, therapeutic effects and pharmaceutical applications of alkaloids, terpenoids, glycosides, volatile oils, tannins and resins.

ACTIVE CONSTITUENTS OF PLANT DRUGS

Each plant drug has organic constituents in it. These are known as **phyto-constituents or plant constituents or constituents**. These are produced in plants, due to **activity of many enzymes** by a process called **biogenesis or biosynthesis.** These constituents may be **inert constituents** like cellulose, lignin, suberin and cutin. These inert constituents are mainly the **structural part of** cells of plants. Other constituents which have some **pharmacological or therapeutic activity** are known as **active constituents.** Anthraquinones in Senna, Reserpine in Rauwolfia, Anethol and Fenchone in Fennel, Tannic acid in Catechu and Gingerol in Ginger are examples of **active constituents**. Followings are various classes of such constituents-

Primary metabolites

- Carbohydrates
- Lipids

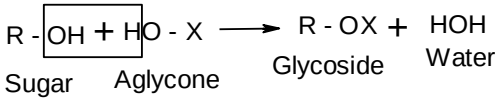
Secondary metabolites

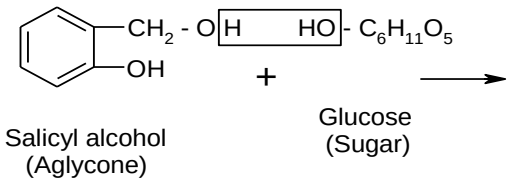
- Glycosides
- Alkaloids
- Volatile oils
- Resins & resin combinations
- Tannins and phenolic substances

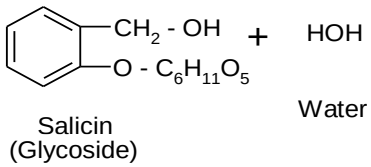
SECONDARY METABOLITES

GLYCOSIDES

Glycosides are **non-reducing** secondary plant metabolites. These upon enzymatic or acid hydrolysis, yield one or more sugar(s) along with a non-sugar part known as **aglycone or genin**. The sugar and aglycone parts are usually attached by O-linkage though S-, N-, and C-linkage are also found.







When numbers of sugar molecules are more than one, then these are usually attached as di-, tri-, and tetra- saccharides though all sugars may be attached as separate linkages.

CLASSIFICATION

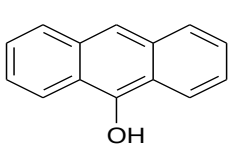
Glycosides are classified depending upon the chemical nature of aglycone coupled with pharmacological activity. Various classes are-

- ❖ Anthracene glycosides
- ❖ Saponin glycosides
- ❖ Cardiac glycosides
- ❖ Cyanogenetic (Cyanophoric) glycosides
- ❖ Iso-thiocyanate (glucoisinolate) glycosides
- ❖ Flavonoid glycosides
- ❖ Coumarin and Furano-coumarin glycosides
- ❖ Aldehyde glycosides
- ❖ Phenol glycosides

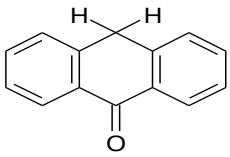
- ❖ Steroidal glyco-alkaloids
- ❖ Bitter glycosides (Glycosidal bitters)
- ❖ Miscellaneous glycosides

ANTHRACENE GLYCOSIDES- These are phenolic in nature. These contain Anthraquinone, Anthrone, Oxanthrone and Anthranol as aglycone-

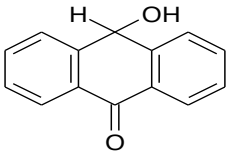
These show Purgative and Cathartic activities, only in combination with sugar e.g. Aloe Cascara sagrada (*Rhamnus purshiana* bark), Frangula (*Rhamnus frangula* bark), Rhubarb and Senna.



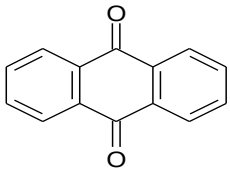
Anthranol



Anthrone

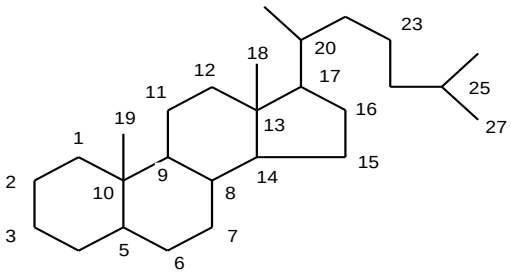


Oxanthrone

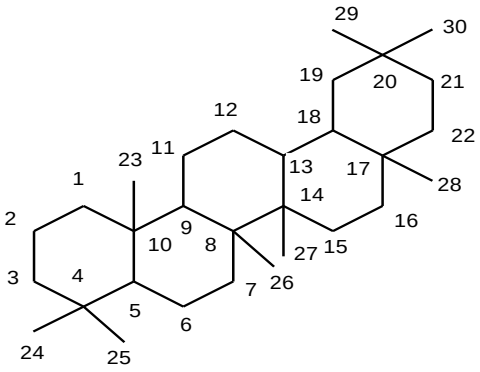


Anthraqunone

SAPONIN GLYCOSIDES- Up on shaking with water, these produce soap like foam and also show Haemolytic activity. These may have steroidal or triterpenoidal aglycone. The aglycone may even be attached to Uronic acid.



Steroidal



Triterpenoidal

The steroidal type saponins have importance due to their relation ship with Sex hormones, Cortisone, Vitamin-D and Cardiac glycosides e.g. Agave, Dioscorea, Sarsaparilla, Strophathus, Thevetia and Yucca sps.

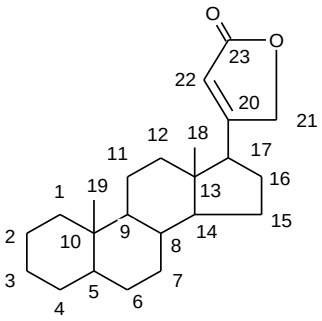
Example of Triterpenoidal types are- Aralia, Calendula, Glycyrrhiza, Primula, Quillaia, Senega and Thymus sps.

Ginseng has both Steroidal and Triterpenoidal saponins.

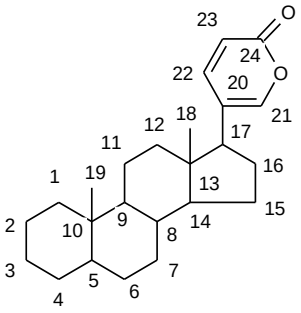
CARDIAC GLYCOSIDES- These glycosides strengthen the weakened heart. In past, these have been used as arrow poisons. The basic structure is Cyclopentano-per-hydro-phenanthrene. These glycosides can be of two types.

Cardenolides- These have five membered lactone ring at C-17 of steroid nucleus e.g. Digitalis, Strophanthus, Thevetia and Nerium.

Bufadienolide- These have six membered lactone ring at C-17 of steroid nucleus e.g. Helleborus and Squill.

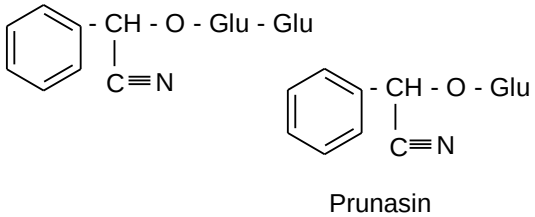


Cardenolide

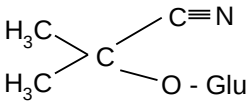


Bufadienolid

CYANOGENETIC (CYANOPHORIC) GLYCOSIDES- Upon hydrolysis these give Hydrocyanic acid (HCN). These are abundantly found in family Rosaceae. Some important examples are- Amygdalin in Bitter almond, Prunasin in *Prunus sps.* and Linamarin in Linseed.

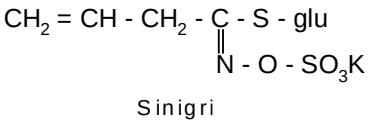


Prunasin

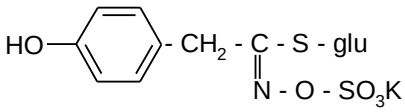


Linamarin

ISO-THIOCYANATE (GLUCOISINOLATE) GLYCOSIDES- These glycosides contain Iso-thiocyanate (-NCS) gp. in their aglycone part. These are mainly present in family Cruciferae. Examples are- Sinigrin from black mustard and Sinalbin from white mustard.

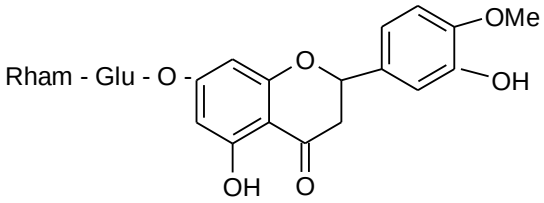


Sinigri



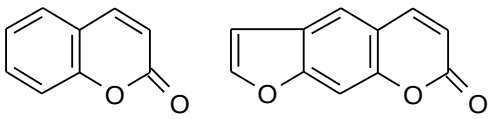
Sinalbin

FLAVONOID GLYCOSIDES- Aglycone of these glycosides has Flavonoid structure. Silybin (Hepato-protective) from *Silybum marianum* and Hesperidin (prevents capillary fragility) from Citrus fruits- are important examples.



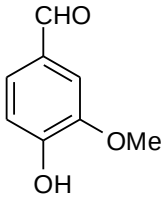
Hesperidin

COUMARINS AND FURANOCOUMARINS- These are derivatives of Benzo-α- pyrone. Important drugs are *Ammi visnaga* (Smooth muscle relaxant and coronary vasodilator) *Ammi majus* (treatment of vitiligo) *Psoralea corylifolia* (Leucoderma) and Cantharides (Rubefacient and Counter-irritant).



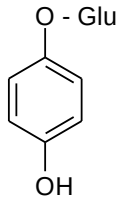
Coumarin Furanocoumarin

ALDEHYDE GLYCOSIDES- These have aldehyde group in aglycone part. Example is Vanilla pod containing Vanillin (Flavouring agent).



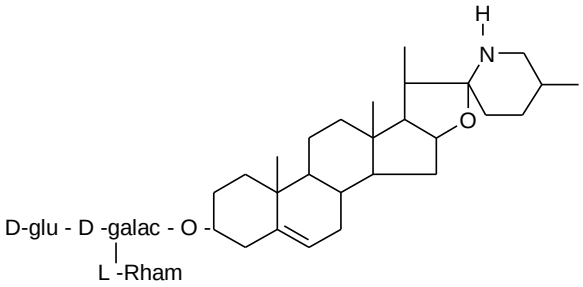
Vanillin

PHENOL GLYCOSIDES- Example is- Arbutin, present in Bearberry (Uvaursi) known as *Aristostaphylos uvaursi*; (Dried leaves; Ericaceae) used as diuretic even in urethritis.



Arbutin

STEROIDAL GLYCOALKALOID- These have steroidal structure and find use in synthesis of steroidal compound. The example is fruits of Solanum (*Solanum khasianum*; Solanaceae).



GLYCOSIDAL BITTERS- These are mainly used to improve appetite and examples are dried roots of Gentian (*Gentiana lutea*; Gentianaceae), whole plant of Chirata (*Swertia chirata*; Gentianaceae), wood of Quassia (*Picrasma excelsa*; Simarubaceae), rhizomes of Picrorrhiza (*Picrorrhiza kurroa*; Scrophulariaceae) and leaves of Kalmegh (*Andrographis paniculata*; Acathaceae).

MISCELLANEOUS GLYCOSIDES- Example in this class are leaves of Gymnema (*Gymnema sylvestre*; Asclepiadaceae) used as Anti-diabetic and leaves of Henna (*Lawsonia inermis;* Lythraceae) used as Anti-bacterial and Anti-fungal.

EXTRACTION OF GLYCOSIDES

The crude drug is dried and powdered. It is now extracted by Soxhlation process using alcohol as solvent. The temperature is kept below 45^0 C if constituents are thermo-labile. The various enzymes present, get inactivated due to heat. The extract is separated and from it the Tannins and Non-glycosidal impurities are removed by adding the solution of Lead acetate. The excess Lead acetate is removed by passing H_2S gas. Precipitates of Lead sulphide (PbS) are removed by filtration and the filtrate is concentrated to get the mixture of crude glycosides.

The glycosides can be obtained in pure state using techniques like Fractional crystallization, Fractional Solubility and Chromatography.

ALKALOIDS

Alkaloids (from alkali like) are widely distributed (nearly 6500 alkaloids known) basic constituents of plants, which have nitrogen atom in their hetero- cyclic ring and have marked physiological action in humans and animals.

Most alkaloids are colourless crystalline solid. Their basic form is soluble in organic solvents while salts are soluble in water. These are usually present in various mature parts of plants.

Families rich in alkaloid bearing plants are-

Apocynaceae,
Legumonosae
Paaveraceae
Ranunculaceae
Rubiaceae
Solanaceae

EXTRACTION

From plants the alkaloids can be separated by any one of following two methods-

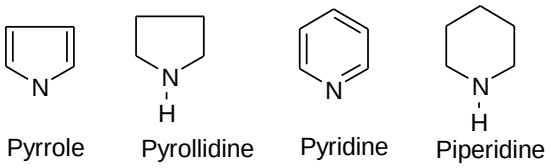
Method A

Powdered drug is moistened with water and mixed with lime. Lime combines with plant acids and the tannins and phenolic substances. The lime also releases or sets free the alkaloids in their base form. Material is now extracted with organic solvent like pet ether. Organic layer is separated and concentrated. It is now shaken with an aqueous acidified layer. Alkaloids convert into salt form and come in the aqueous acidified layer. The impurities remain behind in the organic layer.

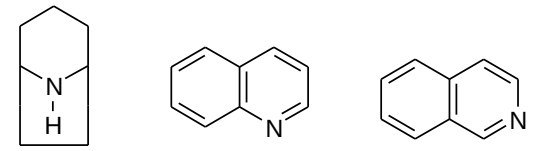
Method B

The powdered drug is extracted with acidified water or the acidified alcohol. From this layer, the pigments and other impurities are removed by shaking this layer with organic solvents like ether and chloroform. Now $NaHCO_3$ solution or NH_3 solution is added to the aqueous layer to precipitate the alkaloids in their basic form. Alkaloids are recovered in some organic solvent.

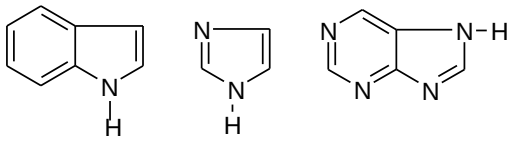
Basic nucleus in alkaloids-



Pyrrole Pyrollidine Pyridine Piperidine



Tropane Quinoline Iso-quinoline

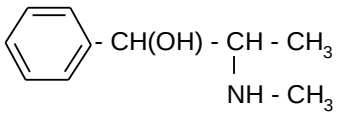


Indole Imidazole Purine

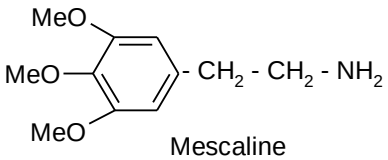
Drugs containing various types of alkaloids-

I) Non-Heterocyclic alkaloids- These alkaloids contain the nitrogen atom in the side chain. Examples are-

Ephedra (Ephedrine), Colchicum (Colchicine) *Lophophora sps.* (Mescaline) *Streptomyces erythrens* (Erythromycin antibiotic)



Ephedrine



Mescaline

II) Heterocyclic alkaloids

Class	Name of alkaloid	***Source***
Pyrrole and Pyrrolidine alkaloids	Hygrine	*Coca sps.*
Pyridine and Piperidine alkaloids	Trigonelline Coniine Arecholine Nicotine Anabasine Piperine	*Fenugreek* *Conium macularum* *Areca catechu* *Nicotiana tabacum* *Nicotiana glauca* *Piper sps.*
Tropane alkaloids	Hyoscyamine, Atropine and Hoscine Cocaine	*Sps. of Atropa, Datura, Hyoscyamus, Duboisia and Scopolia* *Coca sps.*
Quinoline alkaloids	Quinine, Quinidine, Cinchonine, Cinchonidine Cusparine	*Cinchona sps.* *Remijia sps.* *Cusparia bark*
Isoquinoline alkaloids	Morphine, Codeine, Papaverine, Narcotine and Narceine Berberine Emetine and Cephaeline	*Papaver somniferum* *Various genera of Berberis* *Cephaelis sps. (Ipecac)*
Indole alkaloids	Ergotamine & Ergometrine Physostgmine Almaline, Serpentine & Reserpine Vincristine & Vinblastine Strychnine & Brucine	*Claviceps sps.* *Physostima venenosum* *Rauwolfia sps.* *Catharanthus roseus* *Strychnous nux-vomica*
Imidazole alkaloids	Pilocarpine	*Pilocarpus sps.*
Purine	Caffeine	*Thea sinensis (Tea), Coffea arabica*

alkaloids	Theobromine	*(Coffee) & Cola vera (Cola nuts) Theobroma cacao*
Steroidal alkaloids	Solanidine Veratrum Conessine Funtumine	*Shoots of Potato* *Veratrum sps.* *Holarrhena antidysenterica.* *Funtumia elastica*
Terpenoid alkaloids	Aconite, atisine and Lyctonine	*Aconitum and Delphinium sps.*

VOLATILE OILS

Volatile oil, ethereal oil or essential oils are odorous principles of plant which, even at room temperature, evaporate upon exposure to air. These can be present in any part of plant like petals, fruits, fruit rind, bark and leaves. In plants, these are present in special secretory structures. These are obtained by distillation or expression processes.

Fresh and pure volatile oils are usually colourless liquids while few are crystalline or amorphous solids. These become darker upon storage especially in presence of light. Due to this reason these are stored in amber coloured bottles.

These are slightly soluble in water but soluble in organic solvents like ether and alcohol. In plants these are produced from isoprene (C_5H_8) units. Chemically these are Hydrocarbons, Alcohols, Esters, Ketones, Aldehydes, Phenols, Ethers and oxides.

Hydrocarbons

Pinus sps. (Sesquiterpenoids)

Alcohols

Coriander and Sandalwood

Esters and alcohols

Lavandula, Rosemary and Pippermint

Aldehydes

Lemon, Lemon grass, Cinnamon bark and *Eucalyptus citriodora*

Ketones

Spearmint, caraway and Dill

Phenols

Cinnamon leaf, clove, ajowain

Ethers

Anise, Fennel, Euclyptus, Indian dill and Nutmeg

Peroxides

Chenopodium

Uses

Antiseptic
Analgesic
Anthelmintic
Carminative
Flavouring agent.

Extraction process-

Mainly Hydro-distillation.

RESINS AND RESIN COMBINATIONS

Resins are plant exudates of complex chemical mixture, which may be physiological product (Asafoetida, Copaiba) or Abnormal (Pathological) product (Tolu balsam, Peru balsam, Benzoin and Storax).

In plants the resins are present in following threr forms

Oleo-resins- These resins are usually present as homogeneous mixture with volatile oils e.g. Capsicum, Ginger and Male fern.

Oleo-gum-resin- these resins are present in combination with volatile oil and gums e.g. Myrrh and Asafoetida.

Balsams- Resins containing Benzoic/Cinnamic acid and/or their esters, are known as balsams or balsamic resins e.g. Tolu balsam, Peru balsam, Benzoin and Storax.

Glycosidal resins- The resins present in combination with glycosides are known as Glycosidal resins or Glycoresins e.g. Jalap and Scammony, Ipomoea and Podophyllum.

Characters-Physically, resins are amorphous, transparent or translucent solids, semi-solids or liquids. These soften upon heating and finally melt to produce clear adhesive fluids. These are heavier than water, insoluble in water but soluble in organic solvents like alcohol, acetone, carbon disulphide, fixed oils, ether, volatile oils and solution of chloral hydrate.

USES

Antiseptic
Carminative,
Cathartic
Diuretic
Expectorant
Purgative
Stomachic
Anti-tumour.

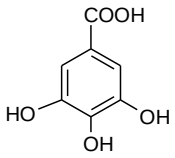
TANNINS AND PHENOLIC COMPOUNDS

These are those plant substances which have molecular weight between 1000-5000 and combine with protein of animal hide to prevent its putrefaction and change it into leather. Tannins derive this property from presence of large number of phenolic groups (1-2 per 100 molecular weight). These phenolic groups are present as O-dihydroxy or O-trihydroxy groups.

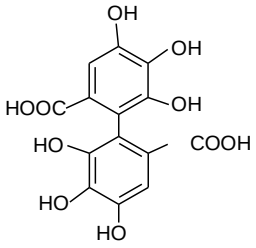
Term tannin was 1st applied by Seguin in 1796. To be effective for tannage, the molecule must not be very large otherwise it will not be able to enter the interstices of collagen fibrils. It should not be very small otherwise it will not be able to cross-link the protein molecules of adjacent fibrils.

Tannins are soluble in water and alcohol. These are classified based upon ease of hydrolysis.

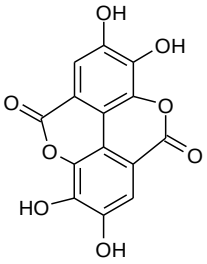
Hydrolysable tannins- These can easily be hydrolyzed using acid or enzyme. These are formed from several molecules of phenolic acids like Gallic and Ellagic acids. These tannins produce blue colour with Ferric chloride e.g. Clove, Chestnut, Pomegranate rind and bark, red rose petals and Rhubarb.



Gallic acid



Hexa hydroxy diphenic acid



Ellagic acid

Condensed tannins- These are true tannins and are resistant to acid or enzymatic hydrolysis. Upon treatment with acid or enzyme, these decompose to red coloured insoluble compounds called Phlobaphenes. These produce green colour with solution of Ferric chloride. Cinnamon bark, Cinchona bark, Wild cherry bark, Acacia bark, Oak bark, Male fern root, Cocoa seeds, Areca seeds, Tea leaves and Catechu.

TESTS FOR TANNINS

- These precipitate the solution of Gelatin.
- These precipitate the solution of Alkaloids
- Salts of Copper, Tin and Lead precipitate the solution of Tannins.
- Solutions of tannins form precipitate with strong solution of Pot. Dichromate.
- These form ppt. with Chromic acid.
- These give bluish black to Brownish green colour with Ferric chloride solution.
- These produce deep red colour with Pot. Ferri-cyanide and Ammonia solution.
- These produce brown to black colour with Gold beater skin. (Ox intestine is treated with HCl and washed with water. It is then placed in tannin solution for 5 minutes. It is washed with water and dipped in Ferrous sulphate solution to get the colour).

5. Occurrence, distribution, organoleptic evaluation, chemical constituents including tests wherever applicable and therapeutic efficacy of following categories of drugs.

LAXATIVES

Laxatives are the drugs which make the stool soft and usually used to treat acute or chronic constipation. These are also useful during piles and also for preparing patients for colonoscopy. Constipation is a common problem of old age and pregnancy. Laxatives have the effects on GIT and help relieving constipation by turning stool soft and improving peristaltic movements due to their irritant effects. Depending upon degree of effects these are classified as Lubricant, Laxatives, Purgative, Cathartics and Violent Cathartics. Violent Cathartics can even lead to presence of blood stains in the stool hence should always be used with utmost care.

ALOES

Botanical Source - Aloes is dried juice, collected by giving incision to the bases of leaves of various species of Aloe like *Aloe vera, A. barbadensis, A. ferox, A. africana, A. spicata* and *A. perryi*

Family- Liliaceae

Geographical Source – Zanzibar, North Africa, South Africa and India

Aloe Plant

Aloe Plant

CHARACTERS

Appearance: Masses of variable size and shape

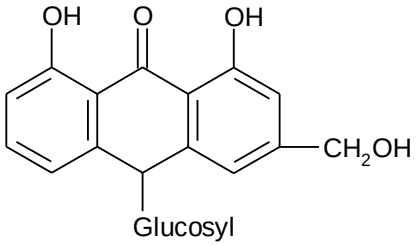
Colour: Yellowish Brown or Chocolate

Odour: Characteristic and sour

Taste: Bitter and Unpleasant

CHEMICAL CONSTITUENTS

Aloe contains 30% Aloin. Aloin consists of Anthraquinone Glycosides. It also contains Aloe resin A and Aloe Resin B.



Aloin (C-Glycoside)

USES

Used as Purgative; it causes griping action hence prescribed with Carminatives or Antispasmodics (Belladona)

Gel from plant is used in Sun burns, Thermal burns, Radiation burns Skin irritation and Abrasions.

RHUBARB

Botanical Source: Rhubarb consists of dried rhizomes and roots of *Rheum palmatum* and *Rheum officinale*. Indian rhubarb comes from *Rheum emodi* and *Rheum webianum*

Family: Polygonaceae

Geographical Source: America, Tibet, China Nepal, India and Siberia

MACROSCOPICAL CHARACTERS

Appearance: Occurs as compact & firm pieces of rhizomes and roots

Shape: Cylindrical, conical or barrel shaped

Size: 2.0 to 20 cm long; 3 to 8 cm in diameter

Colour: Yellowish brown to reddish brown

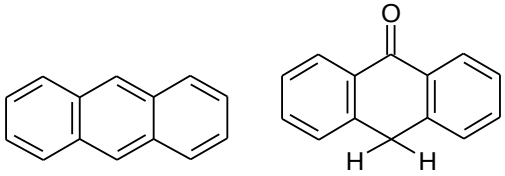
External surface: Usually show longitudinal wrinkles, furrows or ridges. Some pieces may show transverse wrinkles

Fracture: Uneven and granular

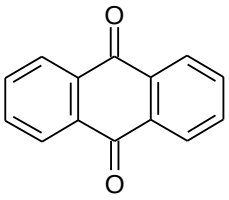
Odour: Faint and characteristic

Taste: Bitter and astringent

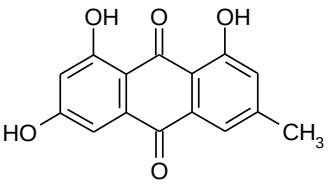
CHEMICAL CONSTITUENT: Rhubarb contains 2.5 to 4.5% of Anthraquinone glycosides and free anthraquinone. Important are- Chrysophnol, Aloe-emodin, Emodin and Rhein. It also has Starch, Tannins and rosette crystals of Calcium oxalate.



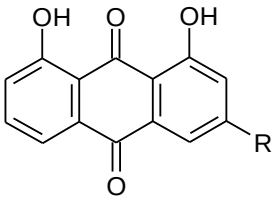
Anthacene Anthrone



Anthraquinone



Emodin



R = CH_3, Chrysophanol

R = CH_2OH, Aloe-emodin

R = COOH, Rhein

USES: Normally laxative, but large doses can act as purgative.

CASTOR OIL

Botanical source: Castor oil is obtained from the ripe seeds of ***Ricinus communis*** (Ricinus- A Latin word meaning 'bug' due to resemblance of shape and markings present on seeds).

Family: Euphorbiaceae

Geographical Source: This tree is native of India. Now it is widely cultivated in India, Africa, Brazil East and West Indies and United States.

(Its seeds have also been found in Egyptian tomb)

Collection and Preparation: Seeds of Castor has large variation in size (Length 8 to 18 mm, Width 4 to 12 mm). Testa of seeds is cracked in grooved rollers and fanned away using current of air. Kernel is pressed to express the oil. Oil is filtered and then steamed between 80 to 100^0 C to coagulate proteins Ricin and Lipase and again filtered.

Remaining oil is extracted by heating the cake, with steam, to 40^0 C and then pressing hard. Residual oil is removed by

using solvent extraction method (Benzene or Carbon-di-sulphide).

Cake is unfit as cattle feed. It is used as source of enzyme Lipase, which is used to split non-edible fixed oils into fatty acids and Glycerol and the Ricin, which has anti-tumour activity.

(Cake contains extremely poisonous toxins called RICINS. These are protein in nature and in human body these induce the formation of antibodies. RICIN-D is sugar-protein having 23 sugar molecules and 493 amino acids. It has anti-tumour activity. Cake also contains enzyme LIPASE and crystalline alkaloid RICININE, which resembles Nicotinamide and is not markedly toxic).

CHARACTERS

Appearance: Colourless to Pale yellow highly viscous transparent liquid.

Odour: Faint.

Taste: Bland, slightly acrid with nauseating after taste.

Specific gravity: 0.961 to 0.963 at 15.5^0 C

Refractive index: 1.473 at 1.477

Other Characters: Castor oil has excellent keeping quality. It becomes rancid only upon excessive heating.

Chemical Constituents: It contains tri-glycerides of –

Ricinoleic acid (87%)

Oleic acid (7%)

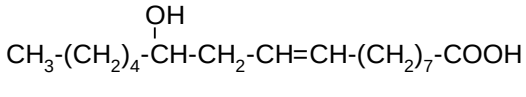
Linoleic acid (3%)

Palmitic acid (2%)

Stearic acid (1%)

Di-hydroxysteraic acid (traces)

About 75% of castor oil is TRI-RICINOLEIN. Remaining oil is DI-RICINOLEO glycerides with third fatty acid being any one of the five mentioned above.



Ricinoleic Acid

USES

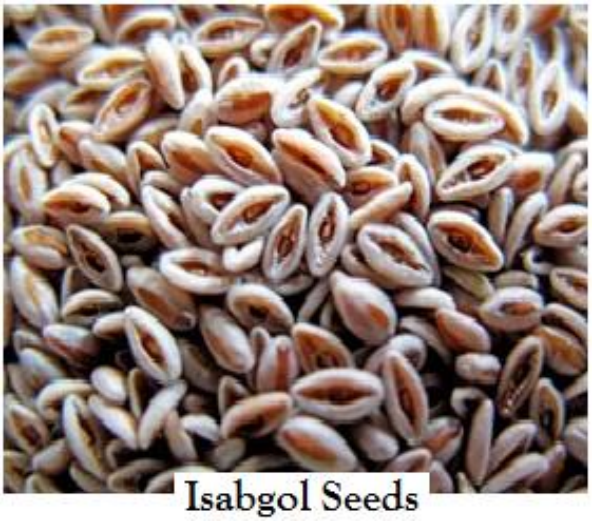
- Purgative & Cathartic (In duodenum, the duodenal lipase hydrolyses it to ricinoleic acid which has purgative and cathartic action).
- From castor oil, UNDECYLENIC ACID (CH_2= CH- $(CH_2)_8$ - COOH) is prepared. This acid and its zinc salt are used as fungi-static.
- Castro oil is reacted with Ethylene oxide to produce a non-ionic surfactant which is used to dissolve the low water soluble drugs for intravenous use
- It is constituent of FLEXIBLE COLLODION (It is solution of Cellulose nitrate (Pyroxylin) with resin and castor oil. It forms a flexible film on skin and used as protective dressing).
- Castor oil is also used to manufacture Soaps. Paints, Varnish, Plasticizers and Lubricants.

ISPHAGHULA (Synonym- Isabgol)

Botanical Source: Isphaghula consists of dried ripe seeds of *Plantago ovata*

Family: Plantaginaceae

Geographical Source: Punjab, Persia and Sind. Seeds are grown extensively around Sidhpur of Gujarat.



Isabgol Seeds

MACROSCOPICAL CHARACTERS

Appearance: Occurs as small seeds

Shape: Boat shaped

Size: 2.0 to 3.5 mm long; 1.5 to 1.75 mm broad

Colour: Pale greyish brown with pinkish tinge. A small, elongated, shinning, reddish brown spot is present in the centre of dorsal or convex surface. A cavity; having Hilum in its centre, is present on the ventral or concave surface. Hilum is covered with a thin, whitish membrane

Odour: Odourless

Taste: Bland and mucilaginous

CHEMICAL CONSTITUENT: Epidermis of seed contains 10% mucilage. Seeds also contain Proteins and Fixed oils. Mucilage is constituted from Pentosans and Aldibionic acid

USES: Mucilage is not acted upon digestive enzymes and intestinal bacteria. It can absorb irritating substances, bacteria & bacterial toxins, hence used in Amoebic & Bacillary dysentery, Diarrhoea, Gonorrhoea, Duodenal ulcer, Piles and habitual constipation. Sticks prepared from mucilage are used in Medical Termination of Pregnancy (MTP)

ISPHAGHULA HUSK

It consists of dry seed coats of seeds of *Plantago ovata*. These are obtained by crushing and winnowing process.

Husk is translucent or white, thin, boat shaped structures, length 2 to 3 mm and width 0.5 to 1.0 mm, odourless with bland and mucilaginous taste.

Husk is used in the same way as seeds it is preferred over seeds as dose is less.

SENNA

Botanical Source: Senna consists of dried leaflets of *Cassia acutifolia (Cassia senna)* known as **Alexandrian senna** and leaflets of *Cassia angustifolia* known as **Tinnevelly senna.**

Family: Leguminosae

Geographical Source: Alexandrian senna in Egypt & Tinnevelly senna in Arabia, Somalia and South India.

Senna Leaves

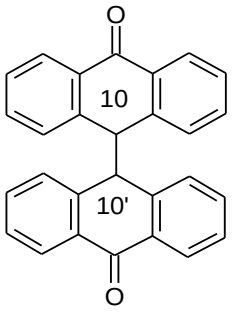
MACROSCOPICAL CHARACTERS

	Alexandrian senna	**Tinnevelly senna**
Appearance:	Less entire & more broken	Entire & less broken
Shape:	Ovate-lanceolate	Lanceolate
Size:	2 to 4 cm. long, 7 to 12 mm wide	2.5 to 6.0 cm. long, 7 to 8 mm wide

Colour:	Pale, Greyish green	Green
Margin:	Entire & curled	Entire
Apex:	Acute with sharp spine at apex	Less acute with sharp spine at apex
Base:	More Asymmetrical	Less Asymmetrical
Surface:	More Pubescent	Less pubescent with pressure marking
Venation:	Pinnate veins anastomosing towards margin	Pinnate veins anastomosing towards margin
Texture:	Thin, brittle	Firm, flexible
Odour:	Faint	Faint
Taste:	Mucilaginous, Slightly bitter & unpleasant	Mucilaginous, Slightly bitter & unpleasant

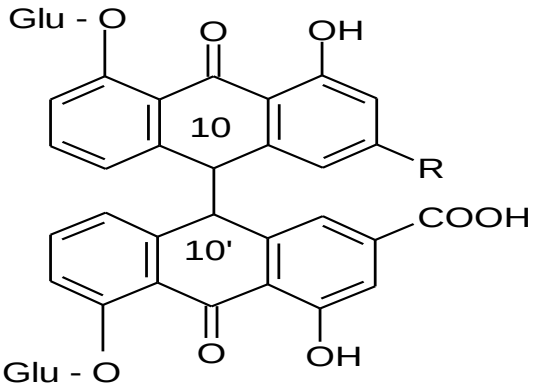
CHEMICAL CONSTITUENT

Senna has 2 to 3 % Sennosides A, B, C & D. Senna also contains free Chrysophanol, Aloe-emodin,Rheinand their glycosides. Mucilage is also present.



Dianthrone

USES: Cathartic and Purgative. Due to its gripping action it is usually prescribed with Carminatives



R = COOH, 10 - 10' trans
Sennoside A

R = COOH, 10 - 10' meso
Sennoside B

R = CH_2OH, 10 - 10' trans
Sennoside C

R = CH_2OH, 10 - 10' meso
Sennoside D

.

CARDIOTONICS

Muscle of heart is termed as Myocardium. In failing heart disease, myocardium is not able to contract properly hence all cells of body fail to get proper supply of blood. Less supply of blood leads to less oxygen availability to all cells. Cardiotonics bring about positive changes in heart muscles and muscles are able to contract slower but forcefully. This improves the blood and oxygen supply to every cell of body.

DIGITALIS (Synonym- Foxglove)

Botanical Source: Digitalis consists of dried leaves of *Digitalis purpurea*, containing Not More than (NMT) 6% moisture; the leaves being dried immediately after collection and stored in moisture proof containers.

Family: Scrophulariaceae

Geographical Source: England, European Countries, France, Germany, North America & Kashmir.

Digitals Plant

MACROSCOPICAL CHARACTERS

Appearance: Usually broken and crumbled leaves

Shape: Ovate lanceolate or broadly ovate

Size: 10 to 30 cm long; 4 to 10 cm wide

Margin: Crenate to dentate

Apex: Sub-acute to rounded

Base: Tapering with de-current lamina

Upper Surface: Dark green, slightly pubescent

Lower surface: Greyish green, very pubescent

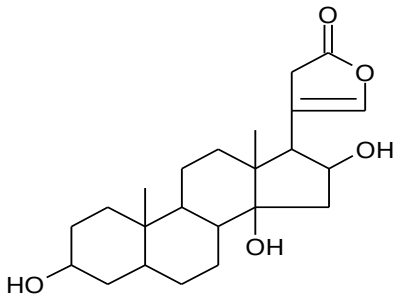
Venation: Pinnate, mid-rib, lateral veins & veinlets are prominent on lower surface of leaf: main veins anastomise repeatedly

Petiole: Winged, 2.5 to 10 cm long

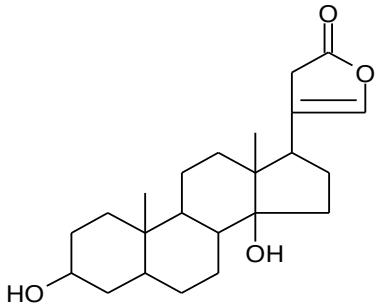
Odour: Faint and Characteristic

Taste: Distinctly bitter

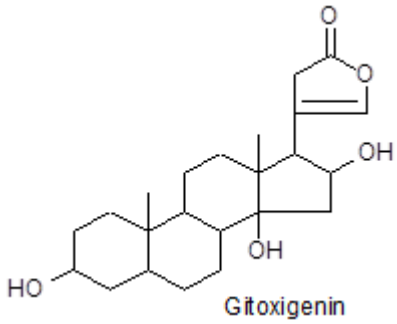
CHEMICAL CONSTITUENT: Fresh leaves contain primary glycosides Purpurea glycoside A and Purpurea glycoside B and Gluco-gitaloxin. During drying, these get converted to secondary glycosides Digitoxin, Gitoxin and Gitaloxin respectively.



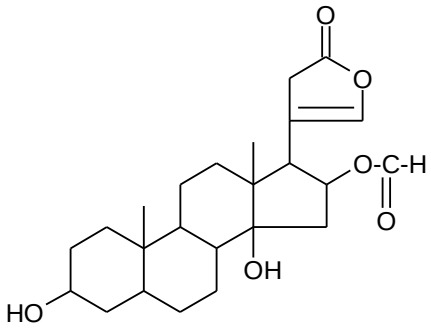
Gitoxigenin



Digitoxogenin



Gitoxigenin



Gitaloxigenin

USES: Cardio-tonic and Diuretic. Used in Congestive heart failure, Atrial flutter and Atrial fibrillation.

ARJUNA

Botanical Source: Arjuna consists of dried stem bark of *Terminalia arjuna*

Family: Combretaceae

Geographical Source: Common throughout India on the sides of streams.

MACROSCOPICAL CHARACTERS

Appearance: Flat and thick pieces of stem bark

Shape: Usually flat but sometimes slightly curved

Size: Usually variable size up to 15 cm long, up to 10 cm wide and up to 1.0 cm thick

Colour: Externally dark greyish brown; internally reddish brown to brown

External Surface: Dark greyish brown; smooth

Internal Surface: Reddish brown to brown with fine longitudinal striations

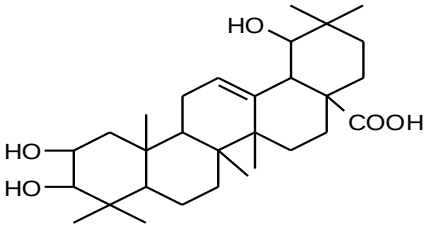
Fracture: Short.

Odour: Odourless

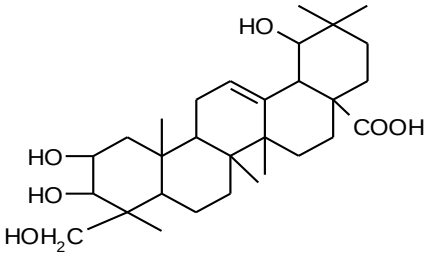
Taste: Astringent

CHEMICAL CONSTITUENT

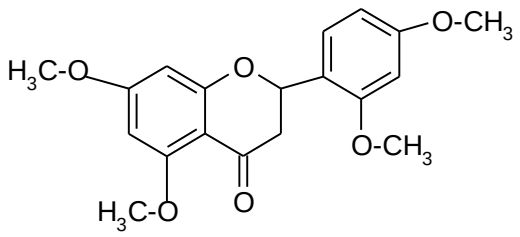
Arjuna bark contains 15 to 20% tannins along with Triterpenoid saponins. It also has arjunic acid arjunolic acid and arjunone. Other constituents' are- Calcium salts, colouring matter and sugars.



Arjunic Acid



Arjunolic acid



Arjunone

USES

Cardio-tonic, diuretic and astringent. It is used to reduce blood pressure and heart rate.

CARMINATIVES and GIT REGULATORS

Carminatives are the drugs which help the digestive system to work properly. These have soothing effect, help preventing gripping (pain due to contraction of muscles) and also prevent formation of gas. These also help in expelling of gas from GIT (Flatulence).

GIT regulators are those drug which help in maintaining the normal functioning of GIT. These mainly act by regulating the motility of intestine and also by their Anti-inflammatory action. Various actions of GIT regulators are- Appetizer (Stimulating hunger), Stomachic (Improving digestion), Anti-emetics (preventing vomiting), Sialagogues (increasing secretion of saliva) and Cholagogue (increasing flow of Bile juice) and Aromatics (Drugs given along with certain purgative to avoid griping).

CORIANDER

Botanical Source: Coriander consists of dried ripe fruits of *Coriandrum sativum.*

Family: Umbelliferae

Geographical Source: Cultivated throughout European countries like Holland, Hungary and Russia. Cultivated also in India

Coriader Fruits

MACROSCOPICAL CHARACTERS

Appearance: Occurs as cremocarp and separated mericarp

Shape: Sub-globular

Size: 3 to 5 mm in diameter

Colour: Yellowish brown to brown

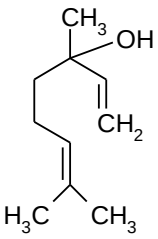
Odour: Aromatic

Taste: Spicy and characteristic

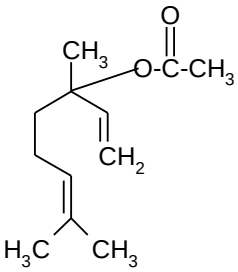
External surface: Each cremocarp has 10 wavy and inconspicuous primary ridges separated by 8 straight secondary ridges,

CHEMICAL CONSTITUENT: Coriander has 0.3 to 1.0% volatile oil, 13% fixed oil and 20% protein. Volatile oil contains Coriandrol, Coriandryl acetate and Pinene.

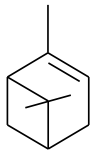
Leaves of coriander are very rich source of Vitamin A



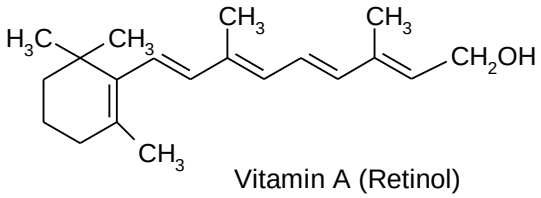
Coriandrol



Coriandrol Acetate



Pinene



Vitamin A (Retinol)

USES: Coriander helps to lowers Blood pressure and Blood glucose level

It is useful in Digestive discomforts and Food poisoning.

It decreases bad cholesterol (LDL) and increases good cholesterol (HDL)

It helps treating Urinary tract infections and Neurological inflammation.

FENNEL

Botanical Source: Fennel consists of dried ripe fruits of *Foeniculum vulgare*

Family: Umbelliferae

Geographical Source: Fennel is mainly grown in France, India, Japan and Russia.

Fennel Fruits

MACROSCOPICAL CHARACTERS

Appearance: Mainly cremocarp, rarely mericarp

Shape: Oval, slightly curved

Size: 0.5 to 1.0 cm long, 2 to 4 mm broad

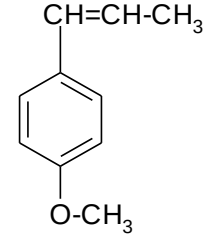
Colour: Greenish brown

Odour: Aromatic

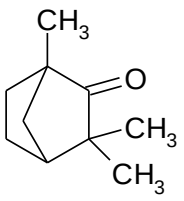
Taste: Sweet and aromatic

External surface: Glabrous with five prominent straw coloured straight primary ridges on each mericarp. Apex has bifid stylopod.

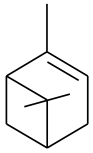
CHEMICAL CONSTITUENT: Fennel contains 2.0 to 6.5% of Volatile oil and nearly 12 to 18% Fixed oil. Volatile oil contains 50 to 60% of phenolic ether called Anethole (Sweet in taste) and 18 to 20% ketone called Fenchone (Pungent in taste). Terpenes are- α-pinene, dipentene and limonene. It also contains aleurone grains.



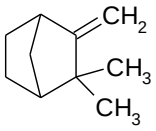
Anethole



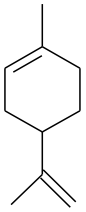
Fenchone



Pinene



Camphene



Limonene

USES: Aromatic, stomachic, carminative and expectorant

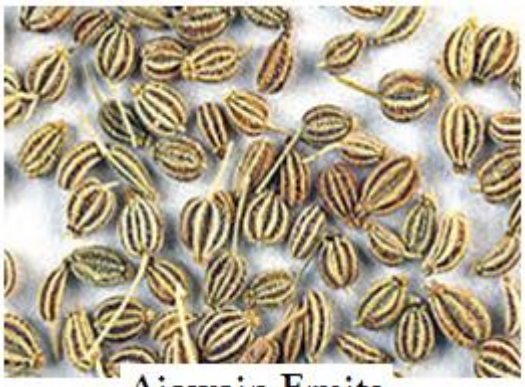
Flavouring agent for mouth and dental preparations

AJOWAIN (BISHOP'S WEED)

Bot. Source – Ajowain consists of dried ripe fruits of *Tachyspermum ammi.*

Family- Umbelliferae

Geographical Source – Native of Egypt. Cultivated in Iraq, Iran, India and Pakistan



Ajowain Fruits

CHARACTERS

Appearance: Cremocarp or separated Mericarps

Colour: Yellowish brown

Odour: Agrreable

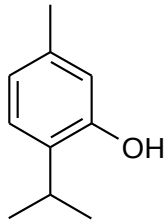
Taste: Aromatic and warm

Size: 1.7 to 3 mm long, 1.5 to 2.4 mm wide and 0.5 to 1.5 mm thick

Surface: Each mericarp has 05 light coloured ridges on its surface.

CHEMICAL CONSTITUENTS

Ajowain contains Volatile oil (2 – 4%), Protein (16 – 17%), Fat (21 – 22%) and Carbohydrate (25%). Volatile oil contains mainly Thymol.



Thymol

USES

Antispasmodic, Stimulant and Carminative

Used in Sore throat and Bronchitis

Oil is Antiseptic, Anti-fungal, Insecticide and Anthelmintic

It is useful in Rheumatic pain.

CARDAMOM (Synonym- Chotti-Elaichi)

Botanical Source: Cardamom consists of dried ripe fruits of *Elettaria cardamomum var. miniscula*

Family: Zingiberaceae

Geographical Source: Native to Sri-Lanka and Malaysia. Extensively grown in various states of south India.

Cardamom Fruits

MACROSCOPICAL CHARACTERS

Appearance: Three sided capsule with fibrous and papery pericarp

Shape: Oblong-ovoid

Size: 8 to 15 mm long; 5 to 10 mm in thickness

Apex: Shortly beaked

Base: Rounded with remain of stalk

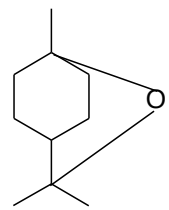
Colour: Green to Pale buff

External Surface: Longitudinally striated

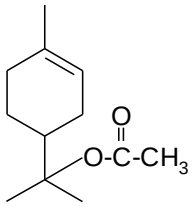
Odour: Aromatic

Taste: Aromatic, pleasant

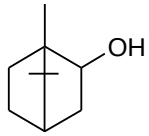
CHEMICAL CONSTITUENT: Seeds of Cardamom contain 3 to 6% Volatile oil. The main constituent of vol. oil is Cineole. Its other constituents are- α-terpinyl acetate, Borneol & Limonene. Seeds also contain fixed oil, starch and protein.



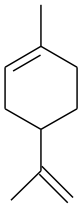
Cineole



Terpinyl Acetate



Borneol



Limonene

USES: Carminative, Stimulant and flavouring agent.

BADI ELAICHI

Botanical Source: Fruits of *Amomum aromaticum* are known as Badi Ealichi.

Family: Zingiberaceae

Its seeds are less aromatic and often used as adulterant for cardamom.

GINGER

Botanical Source: Ginger consists of dried rhizomes of *Zingiber officinale*; the rhizome being dried after scrapping its cork or skin.

Family: Zingiberaceae

Geographical Source: Ginger is native of South East Asia. It is cultivated in Africa, Australia, India and Jamaica. India produces 35% of total world production.

Ginger Rhizome

MACROSCOPICAL CHARACTERS

Appearance: Horizontal rhizomes with sympodial branching. These rhizomes are called 'Hands" or 'Races'

Shape: Lateral sides are flat. From upper side short and oblique branches arise. These branches are called fingers.

Size: 5.0 to 15 cm long; 3 to 6 cm wide and 0.5 to 1.5 cm thick

Colour: Buff coloured

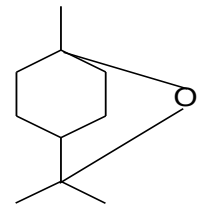
Odour: Aromatic and agreeable

Taste: Pungent and agreeable

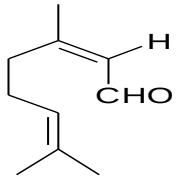
External surface: Surface has longitudinal striations with occasional projecting fibres.

CHEMICAL CONSTITUENT: Ginger contains 1.0 to 2.0% volatile oil, 5 to 8% resin along with starch and mucilage. Important constituents of vol. oil are Cineole, Citral, Borneol and Zingeberene

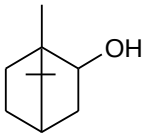
Resinous matter is called Gingerol. It is oily liquid having homologous phenols.



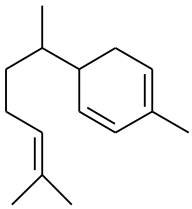
Cineole



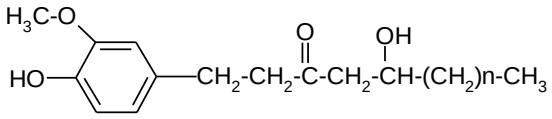
Geranial (Citral)



Borneol



Zingiberene



Gingerols (n = 3,4 or 5)

USES: Stomachic, Stimulant and Carminative

Anti-emetic

Used as an important condiment

BLACK PEPPER

Bot. Source: Black pepper is the dried unripe fruits of a perennial climbing vine called *Piper nigrum.*

Family: Piperaceae

Geographical Source: Indonesia, Brazil, Malaya, Sri-Lanka and India

Black Pepper Fruits

CHARACTERS

Shape; Globular

Size: 03 to 06 mm in diameter.

Colour: Blackish brown to greenish black

Surface: The surface is coarsely reticulately wrinkled and the pericarp is thin.

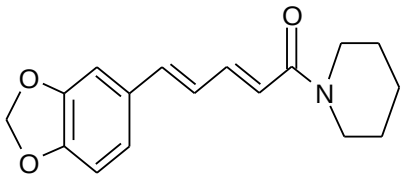
Odour: Aromatic

Taste: Pungent

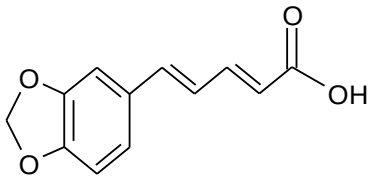
Other Characters: Central part of the fruit is hollow

CHEMICAL CONSTITUENTS

Black pepper contains an alkaloid Piperine (5 – 9%), yellow coloured volatile oil (01 – 2.5%) and a resin. Piperine is Piperidine amide of Piperic acid. Pungency is due to presence of Piperine and Resin.



Piperine



Piperic Acid

USES

Aromatic, Stimulant, Stomachic and Carminative

Used as Spice and Condiments

It increases the formation of gastric juice and bio-availability of many drugs.

It is a safe and very effective insecticide against house flies.

ASAFOETIDA (Synonym- Heeng; Devil's dung)

Botanical Source: Asafoetida is the physiological Oleo-gum-resin, obtained by giving incisions to the living roots & rhizomes of *Ferula foetida, Ferula asafoetida, Ferula rubricaulis* and other sps of Ferula.

Family: Umbelliferae

Geographical Source: Afghanistan, Iran

Asafoetida Resin

MACROSCOPICAL CHARACTERS

Asafoetida occurs mainly in two forms i.e. Tears and Mass or Lump or Block

TEARS: These are rounded or flattened structures, 5 to 30 mm in diameter having Greyish white of dull yellow colour. With aging these may become reddish brown.

MASS or LUMP or BLOCK: These consist of tears agglutinated together. Masses are usually mixed with fruits, fragments of roots, soil, stone and even Ca. carbonate. In market, usually masses are available

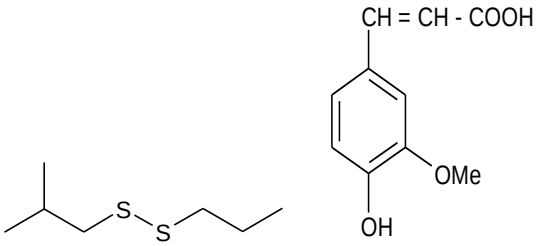
Odour: Intense, Alliaceous, penetrating and persistent

Taste: Bitter, acrid, Alliaceous

CHEMICAL CONSTITUENT

Asafotida contains Volatile oil (4 to 20%) Resin (40 to 60%) and Gum (about 25%) along with impurities

Volatile oil contains mainly Isobutyl-propyl-disulphide. It is responsible for alliaceous odour. Other related organic disulphides are also present. Resin consists of Asa-resinolferulate, free ferulic acid and Asa-resene.



Isobutyl propyl disulphide Ferulic Acid

USES

Carminative (In-flatulence), Anti-spasmodic, Laxative and Expectorant

Asafoetida is Nervine stimulant, hence used in nervous disorders like Hysteria

NUTMEG (Synonym- Jaiphal)

Botanical Source: Nutmeg consists of dried kernels of the seeds of *Myristica fragrans*

Family: Myristicaceae

Geographical Source: Nutmeg is indigenous to Molucca and neighboring islands (in Malaysia). It is cultivated in Indonesia, West Indies and India (Tamil Nadu & Kerala)

Nutmeg Seeds

MACROSCOPICAL CHARACTERS

Appearance:

Shape: Ovoid or broadly elongated

Size: 2 to 3 cm long & 1.5 to 2.0 cm in diameter

Colour: Brown to Greyish brown

External Surface: Rough, with reticulate furrow; one end has radicle of embryo while other end has chalaza; in between two, is present the raphe

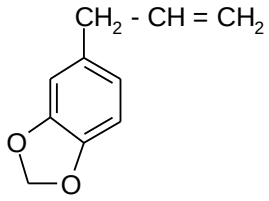
Odour: Strong aromatic

Taste: Pungent & slightly bitter

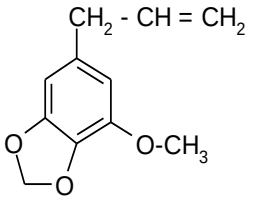
CHEMICAL CONSTITUENT

Nutmeg contains5 to 15% Volatile oil and about 30% fat, known as Nutmeg butter

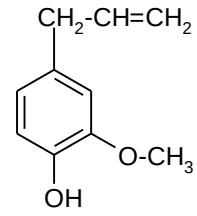
Volatile oil contains Myristicin, Elemicin, Safrole, Geraniol & Eugenol; terpenes in oil are- Pinene ,Dipentene & Camphene. Eugenol is present as free Eugenol, Iso-eugenol, Methyl- eugenol, Methoxy-eugenol& Methoxy-isoeugenol.



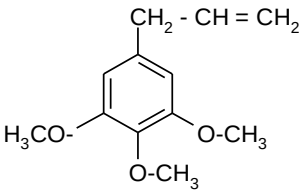
Safrole



Myristin



Eugenol



Elimicin

USES

Carminative, flavouring agent, Anti-inflammatory and Anti-rheumatic & Hair tonic.

CINNAMON

Bot. Source: Cinnamon is dried inner bark of coppiced tree of *Cinnamomum zeylanicum*

Family: Lauraceae

Geographical Source: Sri-Lanka, Brazil India.

CHARACTERS

Shape: Compound quill

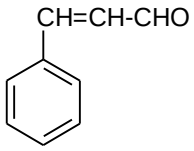
Size: Up to 01 meter in length, 01 cm in diameter and 0.5 mm thick.

Colour: Outer surface is dull yellowish brown and the inner surface is yellowish brown

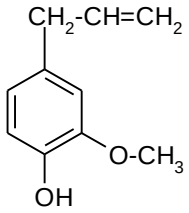
Surface: The outer surface has wavy longitudinal striations and holes and scars of branches while inner surface has longitudinal striations.

CHEMICAL CONSTITUENTS

The bark has Volatile oil and Phloba-tannins, Calcium oxalate crystals, starch and mucilage. The main constituents present in volatile oil are- Cinnamaldehyde and Eugenol.



Cinnamon aldehyde



Eugenol

USES

Carminative, Stomachic, Flavouring agent, Anti-bacterial and Anti-fungal.

Useful in diabetes, weight loss and healing of wounds

CLOVE

Botanical Source: Clove consists of dried flower buds of *Eugenia caryophyllus*

Family: Myrtaceae

Geographical Source: Clove is Native to Moluccaisland. It is cultivated in Zangibar, Madagaskar, Srilanka and India (Tamil Nadu and Kerala)

Clove Buds

MACROSCOPICAL CHARACTERS

Appearance: Occurs as nearly 18 mm long bud with lower 2/3rd stalk like Hypanthium and upper 1/3rd dome shaped Crown.

Shape: Hypathium is tapering downward. Above hypanthium spreading sepals are present. Inside the sepal is present the dome shaped unopened corolla, which enclose numerous stamens and single stiff style.

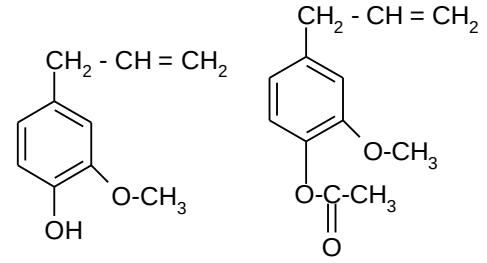
Size: Up to 18 mm long 4 mm wide and 2 mm thick

Colour: Crimson to dark brown

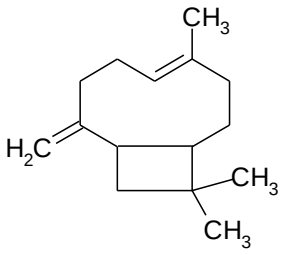
Odour: Aromatic

Taste: Pungent and aromatic followed by numbness

CHEMICAL CONSTITUENT: Clove contains 15 to 20% Volatile oil along with 10 to 13% tannins. Volatile oil contains mainly Eugenol (70 to 90%) along with Eugenol acetate and Caryophyllene.



Eugenol Eugenol Acetate



Caryophyllene

USES: Clove is useful in Aerophagia (Flatulence), difficult digestion, Lack of appetite, Diarrhoea and Intestinal worms.

It is valuable in Cold, Cough and Bronchitis.

Clove oil is used in toothache, mouth and dental preparations

Clove oil is mounting medium in microscopic work

ASTRINGENTS

Astringents are the drugs which react with proteins and cause their precipitation. In this way these lead to contraction of body cells and tissues. These are usually applied to skin to reduce bleeding from minor abrasions. These help in reducing inflammation and also have Anti-bacterial effects. These may be used as Lozenges for their local effect in mouth and throat.

BLACK CATECHU; (KATTHA)

Botanical Source: Black catechu is dried aqueous extract, prepared from the heartwood of *Acacia catechu*.

Family: Leguminosae

Geographical Source:

CHARACTERS

Appearance: cubes, lumps or masses

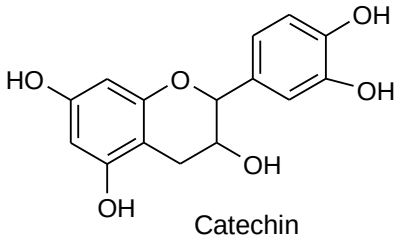
Colour: Dark brown or Black

Odour: slight but not characteristic

Taste: Bitter in beginning but turning astringent afterwards

Surface: Firm, glossy and porous

Chemical Constituents: Contains 4 – 12% Acacia Catechin or Acacatechin, 25 – 30% Catechu tannic acid, 25 – 30% gummy matter along with flavonoids and moisture.



Catechin

USES – Used for cleaning of mouth and gums

Used as Astringent in diarrhoea

Used in dyeing and tanning industry

Used for calco printing

In India it is added to betel leaves.

Kattha is regarded as astringent, cooling and digestive.it is used for relaxed conditions of

throat, mouth and gums. It is used in cough and diarrhoea. Externally it is employed as astringent and cooling application to ulcers, boils and eruptions of skin.

It is also reported to be Anti-leprotic and highly efficient Anti-oxidant; so used in oils and fat where it doubles their shelf life.

DRUGS ACTING ON NERVOUS SYSTEM

Nervous system controls all activities of body. It consists of CNS (Central nervous System- Brain and Spinal Cord) and PNS (Peripheral Nervous System Nerves from CNS). The PNS get further divided into Somatic Nervous System (SNS) and Automatic Nervous System (ANS). Somatic system controls the movement of voluntary or skeletal muscles while ANS controls the movement of Involuntary or smooth muscles. ANS is further divided into Sympathetic and Parasympathetic Nervous systems. Sympathetic nervous system predominates when body is active and keeps it alert by increasing the consumption of body reserves.

Parasympathetic Nervous System is active while body is at rest and helps conserving the body reserves.

Drugs acting on Nervous system are those which have CNS stimulant, Anti-convulsant, Anti-anxiety, Sedative, Muscle relaxant, Narcotic analgesic and Bronchodilator effects.

HYOSCYMUS (Synonym- Henbane)

Botanical Source: Hyoscyamus consists of dried leaves or the leaves, stem and flowering tops of *Hyoscyamus niger*

Family: Solanaceae

Geographical Source: Indigenous to Europe, Western Asia & Northern Africa. Cultivated in Belgium, England, Germany and India

Hyoscyamus is a biennial herb. During 1st year it produces small stem and petiolated leaves. These leaves are collected; hence the 1st year drug has only leaves. During 2nd year the stem gets elongated, branched, produces sessile leaves and flowers. The 2nd year drug hag leaves, stem and flowering tops.

Hyoscyamus Plant

Hyoscyamus Plant

MACROSCOPICAL CHARACTERS

1st year drug (Only leaves)

Appearance: Usually broken and crumbled leaves

Shape: Entire leaves are Ovate to lanceolate

Size: 20 to 30 cm long; 7 to 10 cm wide

Petiole: Up to 5 cm long

Margin: Irregularly dentate

Apex: Tapering

Base: Tapering

Mid-rib: Prominent

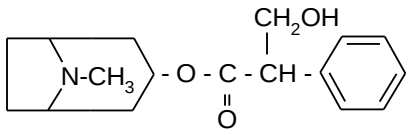
Taste: Bitter

2nd year drug (Leaves, Stem & Flowering Tops)

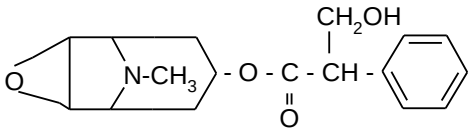
Stem: Hollow, Sub-cylindrical, covered with hair, pale green with alternate leaves

Flowers: 2 to 3 cm long, pedicle 4 mm, Calyx- five lobed, broadly bell shaped, hairy, spiny, pointed & persistent; Corolla- five lobed, funnel shaped, yellowish with purple veins; Stamens- five; Stigma- capitate, two lobed; Fruit- capsule, about 1.3 cm in diameter.

CHEMICAL CONSTITUENT Hyoscyamus contains about 0.045 to 0.15% Alkaloids. Important alkaloids are- Hyoscyamine and Hyoscine. It also contains Volatile oil and Cal. Oxalate crystals.



Hyoscyamine



Scolopamine

USES

Hyoscyamus is used along with purgatives to prevent gripping

It is used to relieve spasms of urinary tract.

It is used to control secretion of Saliva, as Anti-spasmodic, Anti-asthmatic and Sedative

BELLADONA

(Synonym- Deadly night shade)

Botanical Source: Belladona consists of dried leaves, flowering and fruiting tops of *Atropa belladona*

Family: Solanaceae

Geographical Source: Indigenous to Central & Southern Europe. Cultivated in England, Germany, United States and India (J&K)

Belladona Plant

Belladona Plant

MACROSCOPICAL CHARACTERS

1st year drug (Only leaves)

Appearance: Thin and brittle leaves. Leaves are present in pairs, one is large and other small

Shape: Ovate lanceolate to broadly ovate

Size: 5 to 25 cm long; 2.5 to 12 cm wide

Margin: Entire

Apex: Acuminate

Surface: Upper surface is darker than lower surface

Colour: Brownish green

Odour: Characteristic

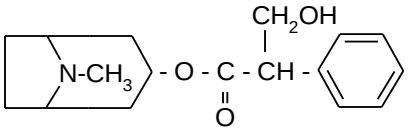
Taste: Bitter & Acrid

Flowers: Solitary, shortly stalked, dropping, about 2.5 cm long; Calyx- broadly bell shaped, deeply five lobed, persistent; Corolla- five lobed, bell shaped, purplish or yellowish brown; Stamens- five, epipetalous; Ovary- superior, bilocular with numerous ovules;

Fruit- globular-berry, green to brown , about 12 mm in diameter with numerous, flattened, sub-reniform brown coloured seeds.

CHEMICAL CONSTITUENT

Belladona contains about 0.3 to 0.6% Alkaloids. Important alkaloid is- Hyoscyamine. Other alkaloids are Hyoscine& Atropine leaves also contain a fluorescent substance called β-methylaesculetin and crystals of Calcium oxalate.



Hyoscyamine

USES: Belladona is Parasympatholytic with Anti-cholinergic actions, hence used to reduce

Salivary, Sweat and Gastric secretions

Belladona is used along with purgatives to prevent gripping

It is used to relieve spasms of urinary tract.

It is also used as Anti-dote for Opium and Chloral hydrate poisoning

ACONITE

(Synonym- Meetha-zahar)

Botanical Source: Aconite consists of dried tuberous roots of *Aconitum napellus*

Family: Ranunculaceae

Geographical Source: Native to Germany, Hungry, Spain, and Switzerland. It is Cultivated in England and India. In India it grows even in wild state.

Aconite Roots

MACROSCOPICAL CHARACTERS

Appearance: Usually occurs as parent and daughter roots; the daughter root being attached as side branch near the crown

Shape: Conical, being wide at crown and tapering downwards

Size: 4 to 10 cm long and 2 to 3cm in diameter near crown

Colour: Dark brown to almost black

External Surface: Slightly twisted with longitudinal wrinkles and numerous thin wiry rootlets or their scar

Fracture: Short, horny & starchy

Odour: Slight

Taste: Burning with tingling sensation followed by numbness

CHEMICAL CONSTITUENT

Aconite contains 0.3 to 1.2% alkaloids. The main alkaloid is Aconitine. It also has other alkaloids like Neopelline, Napelline and Neoline. Aconitic acid and Starch are also present.

USES

Aconitine is a highly poisonous alkaloid. Even small dose can cause heart and respiratory failure; hence aconite is not used on wounded skin. It finds use as external analgesic in Neuralgia toothache, rheumatism and inflammation

ASHWAGANDHA

(Synonym- Withania root, Asgandh)

Botanical Source: Ashwagandha consists of dried roots and stem bases of *Withania somnifera*

Family: Solanaceae

Geographical Source: Afghanistan, Congo, Egypt, India (M.P., U.P., Punjab, Gujarat, Rajasthan), Jordan Pakistan

Ashwagandha

MACROSCOPICAL CHARACTERS

Appearance: Occurs as un-branched pieces. Some root pieces may bear crown

Shape: Cylindrical, usually tapering

Size: 10 to 18 cm long; 6 to 12 mm in diameter

Colour: Externally light brown, internally creamy

External Surface: Smooth and longitudinally wrinkled. Pieces having crown usually possess number of bud scars.

Fracture: Short, smooth and mealy

Odour: Strong and characteristic

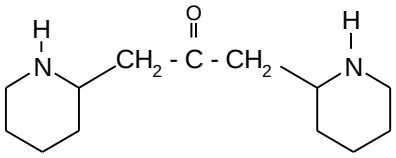
Taste: Mucilaginous, bitter and acrid

Leaves: Leaves are present at nodes in whorls of two as decussate, triangular, scarious sheath. These are much reduced being only 2 to 4 mm long, lamina is whitish but base is

reddish brown. These fall immediately after getting dried.

CHEMICAL CONSTITUENT

Ashwagandha contains alkaloids and Steroidal lactone called Withanolides important alkaloids are- Somniferine, Withanine, Peudo-withanine, Tropine, Pseudo-tropine, Anaferine and Anahygrine. Important withanolide is- Withaferin A.



Anaferine

USES

Tonic and Aphrodisiac.

In insomnia, it is used as sedative.

It is Immuno-modulatory and adaptogenic hence used as geriatric medicine to promote vigour. Also used as anti-bacterial and anti-tumour.

EPHEDRA

(Synonym- Ma-huang)

Botanical Source: Ephedra consists of entire plant or over-ground portion of *Ephedra sinica* and *E. equisetina* (both Chinese species). Indian and Pakistan species are- *E geradiana and E nebrodensis.* Another sps is *E. distachya.*

Family: Gnetaceae (Ephedraceae)

Geographical Source: Sea coast in Southern China. North-western region of India and Pakistan.

MACROSCOPICAL CHARACTERS

Appearance: Occurs as long, slender, branched stem

Shape: Cylindrical

Size: Up to 2 mm in diameter with variable length

Colour: Grayish green

External Surface: Rough, with many fine longitudinal ridges and nodes and 3 to 6 cm inter-nodes

Fracture: Fibrous

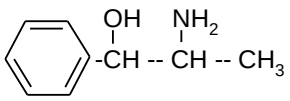
Odour: Aromatic or odourless

Taste: Astringent, bitter

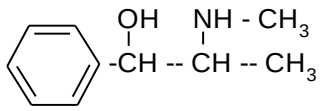
Leaves: Leaves are present at nodes in whorls of two as decussate, triangular, scarious sheath. These are much reduced being only 2 to 4 mm long, lamina is whitish but base is reddish brown. These fall immediately after getting dried.

CHEMICAL CONSTITUENT

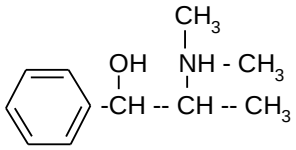
It contains 0.5 to 2.0% alkaloids. The main alkaloid is Ephedrine. Even pseudo-ephedrine, Nor-ephedrine and Methyl ephedrine are also present.



Nor-Ephedrine



Ephedrine



Methyl Ephedrine

USES

Ephedrine is adrenergic (Sympathomimetic) drug having broncho-dilator effect.

It is used in Asthma, Hay-fever, Rhinitis and Whooping cough.

It increases Blood pressure, causes Cardiac stimulation and Mydriasis.

OPIUM

(Syn: Afeem)

Bot. Source: Opium is air dried latex (Milky exudates) obtained by giving incisions to the unripe capsules of *Papaver somniferum*.

Family: Papaveraceae

Geographical Source: Native to Turkey: grown in Yugoslavia, India, Iran, Pakistan and Russia

Opium Capsule

Opium Capsule Exuding Latex

CHARACTERS

Indian opium is available in four categories

Export Opium: Good quality opium available in blocks of 5 kg each, meant for export.

Medicinal Opium: This category is meant for preparation of Tinctures, Pills and Powders

Opium for alkaloid production: Drug for extraction of Morphine, Codeine, Papaverine and Thebaine

Excise opium: This category is meant for issue to registered addicts

Appearance: Indian opium is available in form of cubes, each wrapped in tissue paper.

Colour: Dark brown

Odour: Strong and Characteristic

Taste: Bitter

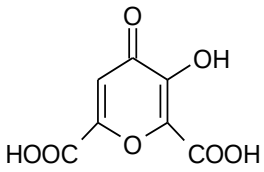
CHEMICAL CONSTITUENTS

Opium contains about 25 alkaloids. These belong to following two categories.

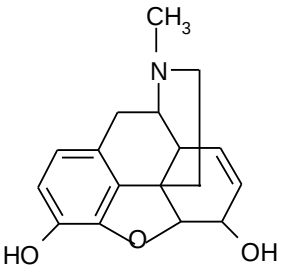
Phenanthrene nucleus alkaloids: These are Morphine (8 – 20%), Codeine (1 – 4%) and Thebaine

Benzyl Iso-quinoline nucleus alkaloids: These are Papaverine (1.0%), Narcotine, also called Noscapine (6.0%) and Narceine

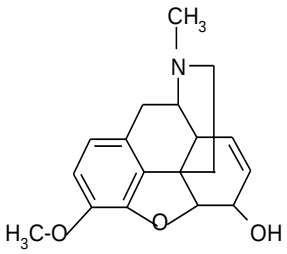
These alkaloids are present in combination with Meconic acid (Dibasic acid). Opium also contains Sugars, Wax, mucilage and salts of Calcium, Magnesium and Potassium.



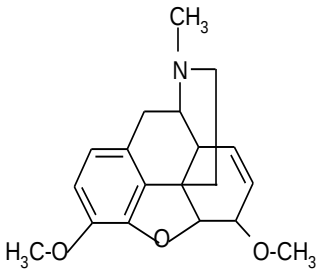
Meconic Acid



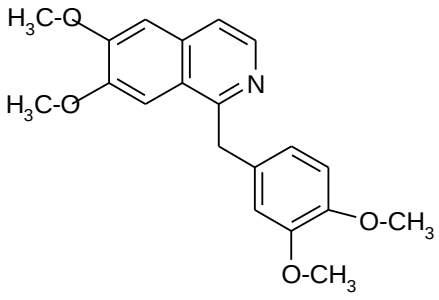
Morphine



Codeine



Thebaine.



Papaverine

USES

Analgesic, Sedative and Hypnotic. Opium is habit forming hence used only in severe burn, injury and pain.

Also used in combination with other analgesics to increase their action

Used in diarrhoea, dysentery and cough

Papaverine is spasmolytic and Narcotine is anti-tussive.

Synthetic compounds have been synthesized, which have structural similarity to Morphine. These have medicinal action of Morphine but are not habit forming. These are called OPIOIDS.

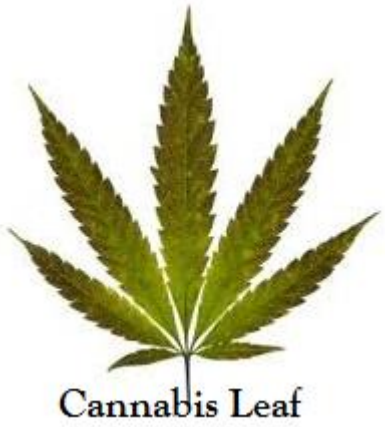
CANNABIS

(Synonym- Hashish, Bhang, Ganja & Charas)

Botanical Source: Cannabis consists of dried flowering and fruiting tops of pistillate plants of *Cannabis sativa*

Family: Cannabinaceae

Geographical Source: Africa, America & India (North India, Maharashtra & Bengal)



Cannabis Leaf

Cannabis Plant

MACROSCOPICAL CHARACTERS

Appearance: Matted or compact masses of much branched flowering & fruiting tops

Shape: Flat or Cylindrical

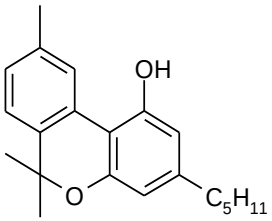
Colour: Dull dusky green

External Surface: Uneven, rough, resinous and harsh to touch

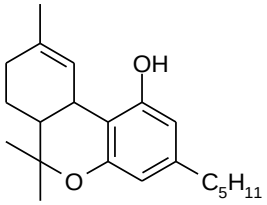
The stem bears bracts, bracteoles, flowers, fruits and few leaves. Bracts are about 1.5 cm long; bracteoles are in pairs, boat shaped with acute apex; flowers have hairy perianth, ovary with brownish red style and the fruit is 5 to 6 mm long, 4 mm wide, ovoid, glossy, single seeded

CHEMICAL CONSTITUENT

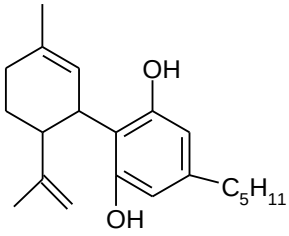
Cannabis contains 2.5 to 20 % resin (Indian cannabis has 15 to 20% resin). It contains over 60 compounds called Cannabinoids. Important Cannabinoids are- Cannabinol, Cannabidiol, Cannabidiol-carboxylic acid and Cannabigerol. Cannabis also has Volatile oil, Alkaloid, flavonoids and Calcium carbonate.



Cannabinol



Tetra hydro cannabinol



Cannabidiol

USES

Cannabis is Sedative, Hypnotic, Analgesic, Anti-convulsant, Anti-anxiety & Anti-tussive.

It has Psychotropic activities similar to LSD & Mescaline. In the beginning it causes euphoria followed by mental disturbance and depression. Due to this reason, it is no more used in medicine.

Recently a Tetra hydro cannabinol has been found to be useful to relieve the nausea and vomiting caused by chemotherapy of cancer.

NUX- VOMICA

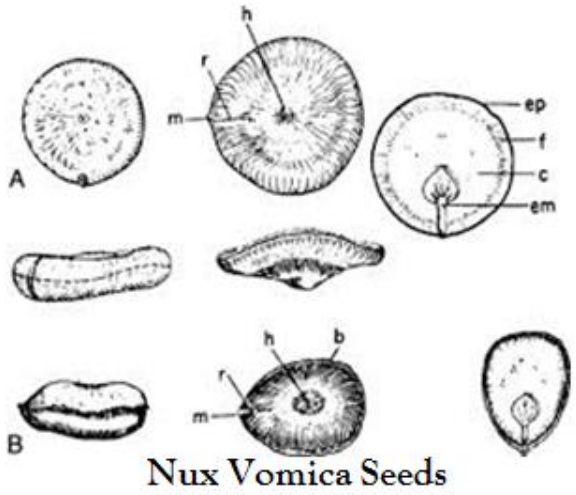
(Syn: kuchla)

Bot. Source: Nux-vomica consists of dried ripe seeds of *Strychnos nux-vomica*

Family: Loganiaceae

Geographical Source: Australia, East Indies, India and Sri-lanka

Nux Vomica Seeds



Nux Vomica Seeds

CHARACTERS

Shape: Disc shaped, flat, concavo-convex or irregularly bent

Size: Dia 1 to 3 cm, thickness 4 to 6 mm

Edges: Rounded or acute

Colour: Greenish grey or grey

Surface: Very hard, the testa is covered with silky, closely oppressed hair, which radiate from centre.

Centre of one flattened side has distinct hilum. On the circumference is present micropyle, as a small projection. The micropyle and hilum are joined by a radial ridge.

Odour: None

Taste: Very bitter

CHEMICAL CONSTITUENTS

Nux-vomica contains mainly Strychnine (1.25%) and Brucine (1.5%). Brucine is actually dimethoxy strychnine.

Minor alkaloids are Vomicine and Pseudo-strychnine. Other constituents' are-Caffeotannic acid (Chlorogenic acid), Loganin (A glycoside), fixed oil and aleurone grains

USES

Bitter stomachic

Stimulant for Respiratory and Cardio-vascular system

Used to improve Reflux action

Nerve and sex tonic

Strychnine is used as rodent killer

Brucine (Four times as bitter as Strychnine) is used as denaturant for Alcohol and non-edible fat and as dog poison.

ANTIHYPERTENSIVES

Hypertension (HTN or HT), also known as high blood pressure (HBP), is a long-term medical condition in which the blood pressure in the arteries is persistently elevated

Normal blood pressure is 120/80 mm Hg.

Usually blood pressure above 140/90 is considered HYPERTENSION and is considered severe if the pressure is above 180/120.

Drugs which can bring down the elevated blood pressure are called ANTI-HYPERTENSIVES. These mainly bring down the elevated blood pressure by relaxing the circular smooth muscles of the blood vessels. Diuretics also bring down the hypertension by excreting the water from body hence reducing the blood volume.

RAUWOLFIA

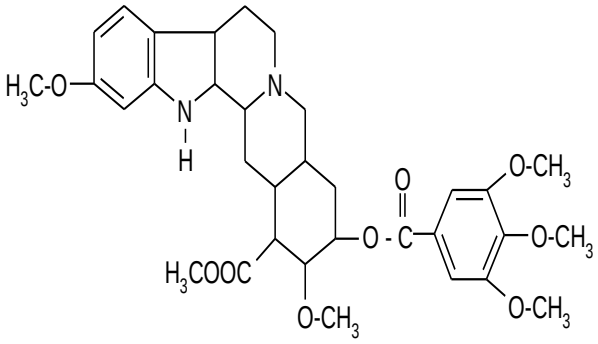
(Synonym- Sarpgandha, Pagal-ki-dawa)

Botanical Source: Rauwolfia consists of dried roots and rhizomes of 3 to 4 yrs old plants *Rauwolfia serpentine*; collected in autumn with bark intact

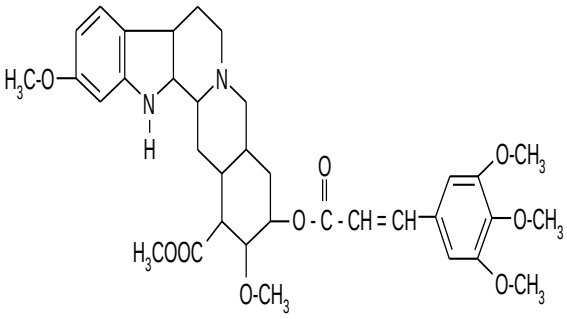
Family: Apocynaceaee

Geographical Source: Burma, India, Java, Pakistan and Thailand.

Rauwolfia Root



Reserpine



Rescinnamine

MACROSCOPICAL CHARACTERS

Appearance: Pieces of root and rhizomes, rarely branched

Shape: Cylindrical or sub-cylindrical or slightly tapering tortuous pieces

Size: Usually 8 to 15 cm in length, 0.5 to 1.0 cm thick; some pieces may be up to 40 cm long and 2.0 cm thick

Colour: Dull with grayish yellow to light brown to brown

External Surface: Young pieces have slight wrinkles while older pieces have longitudinal ridges. Bark exfoliates easily especially in older pieces. Some pieces may show mould on their surface.

Fracture: Easy and short. Fractured surface shows narrow yellowish brown bark and wide, dense pale yellow wood. Both are starchy

Odour: Odourless

Taste: Bitter

CHEMICAL CONSTITUENT: Rauwolfia contains 0.7 to 2.4% of total alkaloids. More than 30 alkaloids have been reported. Important indole alkaloids are- Reserpine Rescinnamine, Ajmaline and Ajmalicine. Rauwolfia also contains Phytosterols, fatty acids, unsaturated alcohols and sugars.

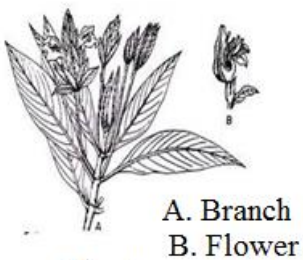
USES: Anti-hypertensive and Tranquilizer. It is used to treat essential hypertension and neuro-psychiatric disorders. Ajmaline is used in cardiac arrhythmia.

ANTITUSSIVE DRUGS

Cough is a protective reflex mechanism which helps in expelling the foreign particles and secretions from the respiratory tract. It is controlled by cough centre present in brain. Unnecessary coughing due to hyper activity of cough centre becomes irritating. Anti tussives are the drugs which act by subduing (depressing) the cough centre so that patient can be spared of the unnecessary coughing.

VASAKA (Adhatoda, Adusa)

Vasaka is a small evergreen shrub growing in dry climate and dry soil. It can grow in plains and foothills of Himalaya. Almost all parts of this herb are used but its leaves have value in providing support to lungs and respiratory system.



Vasaka

Bot. Source: Vasaka consists of fresh and dried leaves of *Adhatoda vesica.*

Family: Acanthaceae

Ge**ographical Source:** Vasaka is native to India. It is also found in Myanmar, Malaya ans Sri-Lanka.

CHARACTERS

Appearance: Entire or crumbled leaves

Shape: Petiolated, exstipulated with lanceolate shape.

Size: 10 to 30 cm long; 04 to 10 cm wide.

Margin: Crenate

Apex: Acuminate

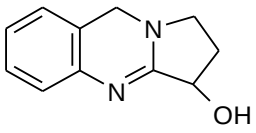
Venation: 08 to 10 pairs of lateral veins

Odour: Characteristics

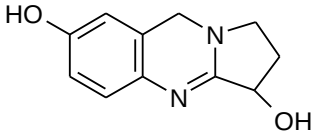
Taste: Bitter and unpleasant

CHEMICAL CONSTITUENTS

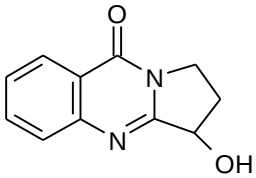
Vasaka contains alkaloids. These are Vasicine, Vasicinone and 6-hydroxy vasicine. It also has Volatile oil and Adhatodic Acid.



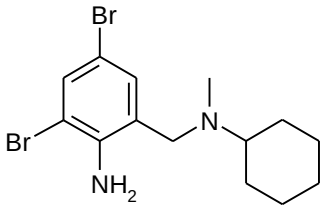
Vasicine



6-Hydroxy Vasicine



Vasicinone



Bromhexine

USES

Expectorant and Bronchodilator

Higher doses cause Vomitting and diarrhoea

It has oxytocic property hence Abortifacient.

From the structure of vasicine; Bromhexine HCl, has been derived which helps in reducing viscosity of Sputum hence its easy removal.

BALSAM OF TOLU

(**Synonym**: Tolu Balsam)

Botanical Source: It is Pathological Balsamic, ester resin obtained by giving incisions to the stem of ***Myroxylon balsamum*** and ***Myroxylon toluifera***

(Tolu is a small place near Cartagena; on the North coast of Columbia where it was once exclusively produced).

Family: Leguminosae

Geographical Source: Columbia, Cuba and West Indies

Collection and Preparation

V shaped incisions are made in the stem of Tree. Resin is collected in special cups and then transferred to tins and exported.

CHARACTERS

Appearance: Freshly imported drug is soft, tenacious yellowish brown resinous mass. Upon keeping it hardens to brownish or yellowish brown brittle thin layers, which soften upon heating.

Taste: Aromatic, slightly pungent.

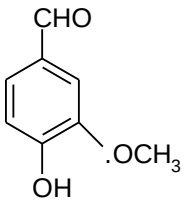
Odour: Faint, agreeable and aromatic

NOTE: Upon chewing it sticks to teeth.

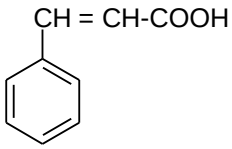
CHEMICAL CONSTITUENTS

It contains mainly resin esters (70 to 80%) like Tolu-resinatannolcinnamate and traces of Toluresinatannol benzoate.

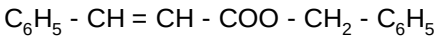
It also contains 12 to 15% free Cinnamic acid and nearly 8% Benzoic acid along with 7.5% Cinnamein which is mixture of Benzyl benzoate and Benzyl cinnamate and small percentage of Styrol and Vanillin.



Vanillin



Cinnamic acid



Benzyl cinnamate

Total balsamic acids present are- 35 to 50% (free and combined).

USES

Externally: Anti-septic and Expectorant

Also used as Flavouring agent in Confectionary items, Chewing gums and perfumes.

TULSI (Holy Basil)

Tulsi is herbaceous, much branched, annual under shrub, grown for its leaves and extensively used as herbal tea.

A branch of Tulsi

Bot. Source: It consists of dried leaves of *Ocimum sanctum.*

Family: Labiatae (Lamiaceae)

Geographical Source: Tulsi is abundantly found in India and neighbouring countries.

CHARACTERS:

Tulsi is erect, profusely branched, perennial under shrub of about 30-60 cms high. It is grown annually mainly for its leaves. Various useful parts of this plant have following characters-

LEAVES:

Colour: Green or purple

Petiole: Petiolated

Shape: Ovate or Elliptical

Size: Up to 05 cms

Margin: Slightly Toothed

Phyllotaxy: Decussate

Odour: Strong and aromatic

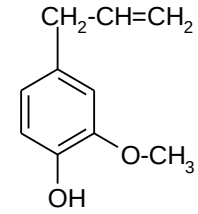
Taste: Characteristic, Aromatic, Agreeable

Stem: Erect, herbaceous, hairy, much branched and quadrangular.

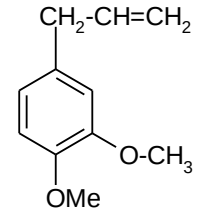
Flowers: Crimson and purple in colour

CHEMICAL CONSTITUENTS

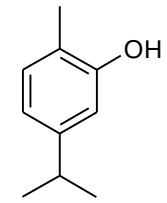
Leaves and flowering tops have 0.1 to 0.9% volatile oil. The volatile oil is bright yellow coloured having aromatic odour. Volatile oil contains Eugenol, Methyl eugenol, Carvacrol and Caryophyllene. Seeds have fixed oil along with Glycosides, Alkaloids, Saponins, Tannins and Vitamin C. Tulsi also has Ursolic Acid.



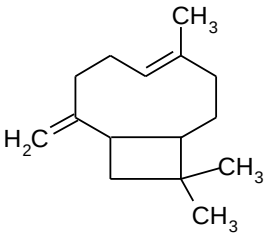
Eugenol



Methyl Eugenol



Carvacrol



Caryophyllene

USES

Stomachic, Carminative, Febrifuge, Antibacterial, Antiprotozoal, Insecticide

Adaptogenic and Immuno-modulator

Expectorant and useful in Respiratory tract infections

Anti-inflammatory and Anti-allergic

ANTI-RHEUMATICS

Anti-rheumatics are the drugs are those drugs which are used to slow down the progress of Rheumatoid arthritis. Rheumatoid arthritis or Rheumatism is damage associated with the inflammatory diseases of the joints. Anti-rheumatics reduce pain, inflammation and stiffness of joints.

COLCHICUM

(**Synonym:** Meadow Saffron, Autumn saffron)

Botanical Source: Colchicum consists of seeds and corm of Colchicum. These are respectively the dried ripe seeds and fresh or dried corm of *Colchicum autumnale*.

Family: Liliaceae

Geographical Source: Central and South Europe and England.

Colchicum Corm

CHARACTERS

SEEDS

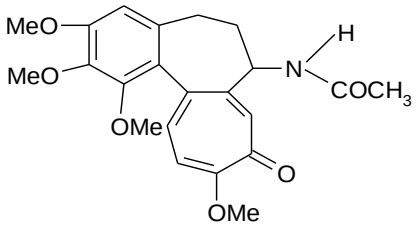
Shape: Globular with Strophiole (Parenchymatous outgrowth of raphae) on its side.
Size: 2 to 3 mm in dia
Outer Surface: Dark reddish brown, minutely pitted, very hard.
Endosperm: Large and very hard.
Embryo: Very small
Odour: None
Taste: Very bitter and Acrid

CORM

Appearance: Dried transverse slices
Size: Length 03 cms thickness 2 to 5 mm
Colour: dark brown
Fracture: Short and Starchy
Fractured Surface: Bears several fibrous vascular bundles as greyish point.
Odour: None
Taste: Bitter and Acrid

CHEMICAL CONSTITUENTS

Seeds contain 0.6 to 1.2% alkaloid colchicines and number of other colchicines type alkaloids.



Colchicine

It also contains Resin, Fixed oil and Reducing sugars.
The corm contains up to 0.6 % colchicines along with related alkaloids

USES

Alkaloidal preparations are used in Gout, but this should be used with utmost precautions due to its toxicity.
Colchicine is used in plant experiment to produce Polyploidy.

GUGGAL

(**Syn:** Guggulu; Guggul
Botanical Source: Guggal consists of Oleo-gum-resin obtained by giving incisions to the stem bark of *Commiphora weightii* (= *Comiphora mukul= Balsamodendron mukul*).
Family: Burseraceae
Geographical Source: India, Pakistan, Baluchistan and Arabia (In India, Rajasthan, Gujrat, Maharashtra and Karnataka)

CHARACTERS

Colour: Brown to pale yellow to dull green
Size: Agglutinated masses of 0.5 to 1.0 to 2.5 cm in diameter.
Shape: Rounded or ir-regular masses of agglomerated tears. Tears are somewhat transparent with waxy surface and brittle nature,
Feel: Gummy to touch
Odour: Agreeable, aromatic and Balsamic
Taste: Bitter and Characteristic
Solubility: Partly soluble in Alcohol but forms a white emulsion when triturated with water.

CHEMICAL CONSTITUENTS

Guggal contains nearly 60% resin, 30 % gum and 0.5 to 1.5% volatile oil. It also contains 3 to 4% moisture along with steroids.

USES

Guggal is used as Anti-inflammatory, Anti-rheumatic, Hypolipidemic and Hypocholesteremic.

ANTI-TUMOUR

Anti-tumor are the drugs, which are used to treat cancer. The cancer is defined as the growth of abnormal cells. Various chemical and natural drugs are used to treat cancer. A few important natural drugs are-

Vinca rosea: Vincristine, Vinblastine

Taxus baccata: Taxol

Podophyllum hexandrum: Podophyllotoxin

VINCA

(Syn: Catharanthus, Baramasi, Sada bahar)

Botanical Source: Vinca or Catharanthus is whole dried plant of *Catharanthus roseus* also called *Vinca rosea.*

Family: Apocynaceae

Geographical Source: Vinca is indigenous to Madagaskar. Presently it is widely grown as ornamental plant in India, Africa, Australia, Eastern Europe, Taiwan and Thailand.

Vinca Plant

Vinca Plant

CHARACTERS

Appearance: Catharanthus is herbaceous sub-shrub; 40 to 80 cm high with woody base.

Leaves: Leaves are simple, petiolated, opposite, obovate, glossy with mucronate or rounded apex and entire margin

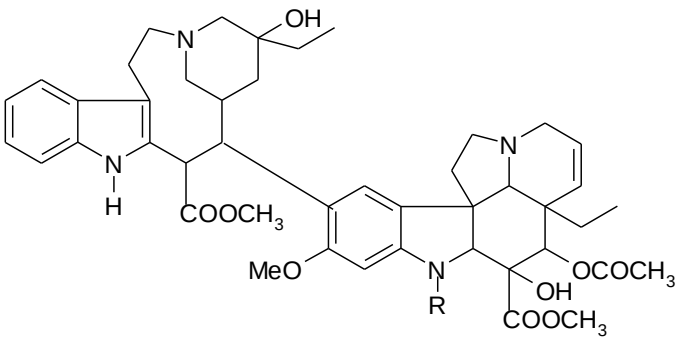
Flowers: Bracteate, complete, violet, pink or white in colour

Fruit: Divergent follicles

Seeds: Black coloured.

CHEMICAL CONSTITUENTS

From vinca about 90 alkaloids have been isolated. These are mainly Indole alkaloids (Catharanthine) or dihydro indole alkaloids (Vindoline). Other alkaloids of this category are- Ajmalicine, Serpentine Lochnerine and Tetrahydro alstonine. Alkaloids of maximum interest are about 20 dimeric alka;oids (Having both Indole and Dihydro-indole nucleus). Examples of this category are- Vincristine and Vinblastine.



R = CH_3 Vinblastine

R = CHO Vincristine

USES

Vinblastine is used in treatment of Hodgkin's disease and Chorion-epithelioma.

Vincristine is used to treat Leukaemia

Vinca leaves are useful in diabetes and high blood pressure

ANTILEPROTICS

Leprosy is an infectious disease caused by a bacillus, *Mycobacterium leprae*. This bacterium multiplies slowly and the symptoms may take as long as 20 years or even more to occur.

The disease mainly affects the skin, the peripheral nerves, mucosa of the upper respiratory tract, and the eyes.

Untreated, leprosy can cause progressive and permanent damage to the skin, nerves, limbs, and eyes.

Anti-leprotics are the drugs which interfere with the proliferation of the bacteria causing leprosy

CHAULMOOGRA OIL

Synonym: Hydnocarpus oil

Botanical Source: It is cold pressed fixed oil obtained from fresh ripe seeds of *Hydnocarpus weightiana, Hydnocarpus anthelmintica, Hydnocarpus heterophylla and Hydnocarpus alpine* (Chaulmoogra is the original Burmese name of the plant)

Family: Flacourtiaceae

Geographical Source: Native to Burma. Found even in India, China and Thailand

CHARACTERS

Colour: Yellow to Brownish liquid at room temperature but whitish mass at lower temperature (Below 25^0C).

Taste: Acrid

Odour: Characteristic

Density: 0.95

Refractive Index: 1.472 to 1.476

Optical Rotation: $+48^0$ to 60^0

CHEMICAL CONSTITUENTS

Chaulmoogra oil consists of mixed triglycerides of

Hydnocarpic acid

Chaulmoogric acid

Gorlic acid

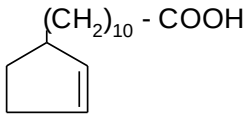
Oleic acid

Palmitic acid

Certain alkaloids of vinca are Sedative and Tranquiliser

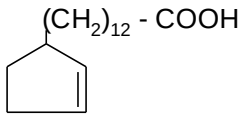
Vinca alkaloids are used to increase blood supply to brain

Vinca alkaloids are useful to prevent dementia.



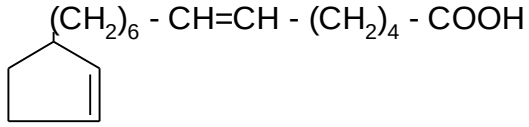
$C_{16}H_{28}O_2$

Hydnocarpic Acid



$C_{18}H_{32}O_2$

Chaulmoogric Acid



$C_{18}H_{30}O_2$

Gorlic Acid

USES

Fatty acids present in the Chaulmoogra oil has specific toxicity against bacteria of TB and Leprosy (Mycobacterium Tuberculosis and Mycobacterium leprae). The oil has quite unstable nature hence Sodium and Ethyl salts of these acids are used.

This oil also finds use in Psoriasis and Rheumatism (External and internal use)

ANTIDIABETICS

Antidiabetics are the drugs which are used to control the sugar (Glucose) level in the blood. Diabetes is endocrine disorder characterized by increased blood glucose level. Glucose level is controlled by proteinaceous hormone called INSULIN. Insulin is secreted by **β-cells of pancreas.** Decreased insulin secretion is either death of β-cells or decreased secretion by β-cells. Hence diabetes is of two types

Type – 1 Diabetes or Insulin Dependent Diabetes Mellitus (IDDM): This type of diabetes develops due to death of β-cells hence patient is dependent on external insulin for the control of blood glucose level.

Type-2 Diabetes or Non-Insulin Dependent Diabetes Mellitus (NIDDM): This type of diabetes develops due to reduction of secretion by β-cells hence patient is given drugs which either increase the efficiency of β-cells or decrease the absorption of sugar from GIT.

PTEROCARPUS

(Syn: Vijayasar; Indian Kino)

Botanical Source: Pterocarpus consists of heart wood of *Pterocarpus marsupium.*

Family: Leguminosae

Geographical source: Hilly regions of Bihar, Gujarat, Madhya Pradesh, Orissa and Uttar Pradesh.

Pterocarpus wood

CHARACTERS

Appearance: hard and brittle root with pieces of variable length and thickness.

Colour: Golden yellow brown with darker streaks

Aqueous extract: Up on extracting even with cold water, the drug yields a brown coloured aqueous extract with blue shade on the surface of water.

CHEMICAL CONSTITUENTS

Pterocarpus contains mainly flavanoids and tannins. Important constituents are-

Pterostilbene

Liquiritigenin

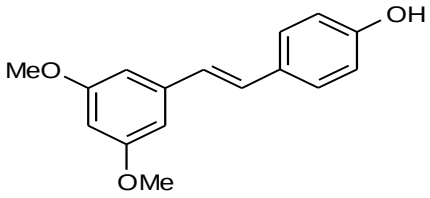
Isoliquiritigenin

Marsupsin

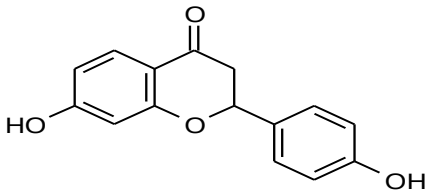
Pterosupin

Pterocarpol

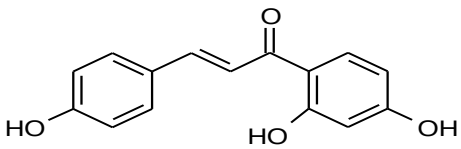
Pterocarposide



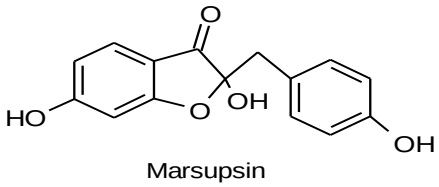
Pterostilbene



Liquiritigenin



Isoliquiritigenin



Marsupsin

USES

Pterocarpus is used as Anti-diabetic and astringent. It increases the blood insulin level and also reduces the resistance to the insulin. It is also useful to reduce cholesterol.

Heart wood is carved in beakers (or glasses). These are filled with water and the extract is consumed after 12 hours. One beaker can serve purpose up to 45 days.

GYMNEMA

(Syn: Gurmar)

Botanical Source: Gymnema consists of whole plant or dried leaves of perennial woody climber called *Gymnema sylvestre.*

Family: Asclepiadaceae

Geographical Source: Gymnema is widely distributed in central and southern India. It is also found in Goa.

Gymnema Plant

CHARACTERS

Appearance: Gymnema is a stout, woody climber with densely appressed hairy branchlets.

Leaves: Leaves are Ovate or elliptical with acute or acuminate apex. Lower surface is more pubescent. Size is 3 to 5 cm long and 1 to 2 cm wide. Colour is green with pleasant and aromatic odour and taste is tasteless. Up on chewing these paralyse the sweet and bitter taste buds hence person is not able to sense these taste for few hours.

Flowers: Small, Bell shaped, yellow coloured. Flowering July to September

Fruit: Slender Follicle with glabrous surface. Fruiting October to December

Seeds: Ovoid, winged and pale brown

CHEMICAL CONSTITUENTS

Gymnema consists of Amino acids, Aromatic acids, Alkaloids and Glycosides. Glycosides are saponin type being mixture of Gymnemic acid I to V. it also contains a polypeptide known as GUMARIN. This polypeptide is responsible for paralysis of sweet and bitter taste buds.

USES

Leaves: Hypoglycemic, useful in cough and fever. Leaves help in regeneration of β-cells hence increasing the secretion of Insulin. These also saturate the glucose absorption sites of GIT hence decreasing the absorption of sugar from GIT.

Whole plant: Whole plant is used as anti-periodic, diuretic and stomachic.

DIURETICS

Diuretics are the drugs which increase the flow of urine. In this way these help in removal of excess water, urea, accumulated poisons and drugs from the body. These mainly act by interfering with re-absorption of water from tubules and are highly useful in edema.

GOKHRU (Synonym- Trikanta)

Botanical Source: Gokhru consists of dried ripe fruits of *Tribulus terrestris*

Family: Zygophyllaceae

Geographical Source: Annual weed (prostrate herb) of pasture lands, road sides and other waste lands, throughout the plains of India (ascending up to 300 meters in Kashmir)

Gokhru Fruits

Gokhru Plant

MACROSCOPICAL CHARACTERS

Appearance: Stalked spiny fruits, divisible in to five densely, hairy woody cocci (Singular Coccus)

Shape: Globose or spherical

Size: 1.0 cm in diameter

Colour: Yellowish light brown to greenish grey

External Surface: Surface is covered with short and long stiff spines

Coccus: Each fruit can be divided into five segments, each known as Coccus. Each coccus is plano-convex in shape, has a pair of stiff spines (about 0.5 cm long), directed towards apex. Tips of these spines almost meet in pairs forming a pentagonal frame work around fruit. Each coccus also has a pair of short spines, directed downwards. Each coccus has 4 to 5 seeds.

Odour: Odourless

Taste: Slightly astringent

CHEMICAL CONSTITUENT: Gokhru has Steroidal saponins which yield Diosgenin, Ruscogenin and Gitogenin, upon hydrolysis. It also has traces of alkaloids Harman and Harmine along with Potassium nitrate and fixed oil.

USES: Diuretic. It is used in Nephritis, kidney stones, painful micturition and gout

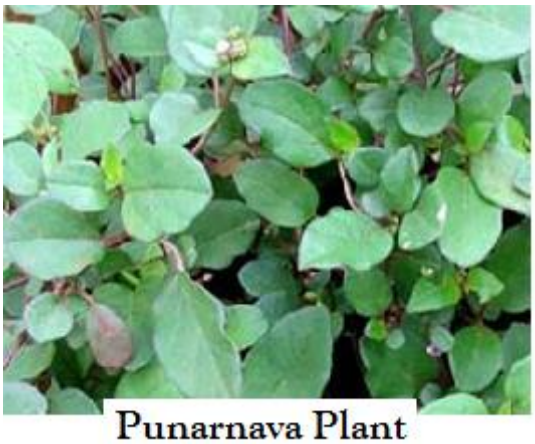
PUNARNAVA

Syn: Kathilla, Lal-punarnava, Hog weed

Botanical Source: Punarnava consists of dried matured whole plant *Boerhaavia diffusa*

Family: Nyctaginaceae

Geographical Source: It grows throughout India as trailing herb and collected after rainy season.



Punarnava Plant

CHARACTERS

Stem: Greenish purple, stiff, slender, being swollen at nodes.

Root: Well developed, fairly long and somewhat tortuous, 0.2 to 1.5 cm in diameter.

Leaves: Opposite in unequal pairs, larger is 25 to 37 mm long smaller one is 12 to 18 mm long.
Flowers: Very small, nearly sessile, pink coloured.
Fruit: Nut; one seeded

CHEMICAL CONSTITUENTS

Punarnava contains alkaloids collectively called Punarnavine.
It also contains Xanthine derivatives and fatty acids like Stearic and arachidic acids.
Also contains Inorganic salts like KNO_3, K_2SO_4 and KCl

USES

Anti-inflammatory, Diuretic and liver tonic

ANTIDYSENTERICS

Dysentery is intestinal infection which results in severe diarrhoea accompanied by presence of blood and/or mucus in the stool. It may be caused by Bacteria (Bacterial or Bacillary dysentery or Amoeba (Amoebic dysentery).

Anti-dysentrics are the drugs which help in controlling dysentery

IPECAC

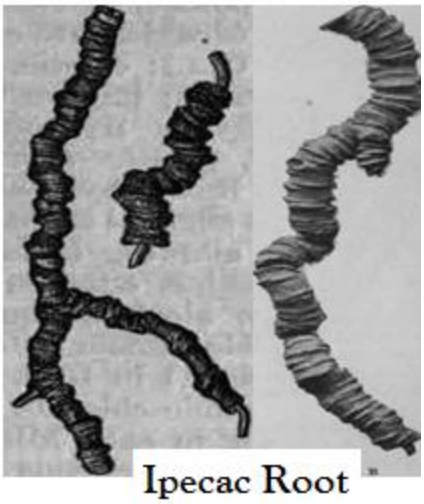
(Syn: Ipecacuanha)

Botanical Source: Ipecac consists of dried roots or dried roots and rhizomes of *Cephaelis ipecacuanha* and *Cephaelis acuminata* containing not less than 2.0% of ether soluble alkaloids.

Family: Rubiaceae

Geographical Source: Brazil, Burma, Malaya, Nicaragua and India.

Ipecac Root



Ipecac Root

CHARACTERS

Shape: Cylindrical, slightly tortuous

Size: Length 05 to 15 cm, thickness 03 to 5 mm

Colour: Dark brick red to dark brown

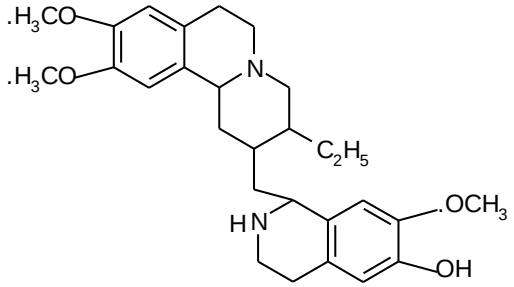
Surface: Annulated, each annulation is in form of ring which encircles root and forms half to 3/4th of the total drug. In some pieces the bark may get removed; here and there thus exposing central wood.

Fracture: Short and starchy in bark region and splintery in wood region.

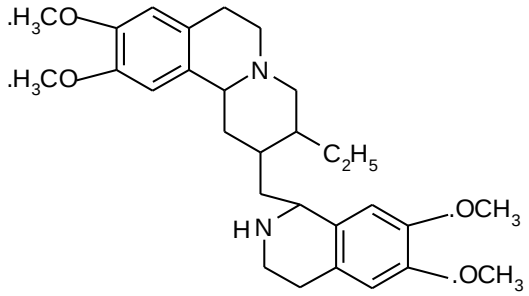
Odour: Slight to none

Taste: Bitter and acrid

CHEMICAL CONSTITUENTS



Cephaeline



Emetine

Ipecac contains 2.0% Isoquinoline type of alkaloids. These alkaloids are grouped into phenolic (Psychotrine and Cepheline) and non-phenolic alkaloids (Emetine, O-methyl psychotrine and emetamine)

Ipecac also contains a resin called Ipecacuanhin and Ipecacuanhic acid. Even starch and Calcium oxalate are also present.

USES

Expectorant, Emetic, Anti-amoebic and Anti-tumour

ANTISEPTIC and DISINFECTANTS

Antiseptics: These are those agents which are used to check the growth of micro-organisms and can safely be applied to the skin.

Disinfectant: These are those anti-microbial agents which cannot be applied to skin, as these are corrosive hence used to check the growth of micro-organisms on inanimate objects. These agents help in checking the spread of infection.

BENZOIN

(**Synonym**: Sumatra benzoin)

Botanical Source: Benzoin is pathological, ester balsamic resin obtained from the stem of ***Styrax benzoin.***

(Stryax is Greek word meaning sweet scented gum; benzoin is from two Arabic words Ben- meaning fragrant and Zoa- meaning exudation.)

Family: Styraceae

Geographical Source: Tree is native to Borneo and Java; but for obtaining commercial quantities, plant is grown in Sumatra.

Collection and Preparation

Benzoin tree is allowed to grow till it is seven years old. On its trunk triangular wounds are made in the specified way. 1st secretion from these wounds is amorphous and yellow coloured and not fit for use in medicine. 2nd secretion is milky white in colour and is of best quality. It is known as Almond benzoin. 3rd and 4th secretions are of darker colour and of inferior quality. 2nd, 3rd and 4th secretions are blended to get benzoin of commerce grade.

Each tree is capable of producing about 10 kg. of drug each year up to the age of nearly twenty years, after which it dies.

CHARACTERS

Appearance: Whitish or reddish opaque tears (called almonds) embedded in translucent reddish brown or greyish brown mass

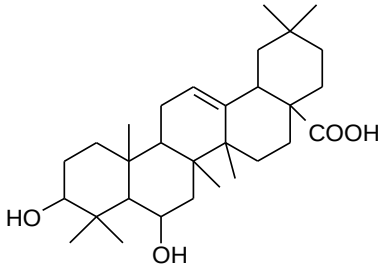
Taste: Balsamic, Acrid

Odour: Balsamic, Aromatic and agreeable

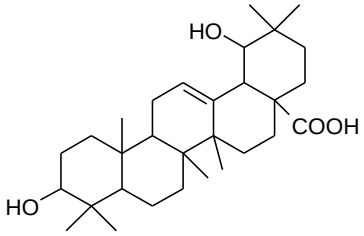
Upon slow heating it gradually evolves the irritating fumes of Benzoic and Cinnamic acid. Vapours of these acids sublime at the cooler parts of the test tube.

CHEMICAL CONSTITUENTS

It contains free balsamic acids like benzoic acid and cinnamic acid. It also contains resin acids Sia-resinolic acid and Suma-resinolic acid and their esters with balsamic acids. It even contains Vanillin, Styrol and Phenyl propyl cinnamate.



Suma resinolic acid
(6-hydroxy Oleanolic acid)



Sia Resinolic acid
(19-hydroxy Oleanolic acid)

USES

Externally: Anti-septic, Protective and Healing agent

Internally: Expectorant and Diuretic

Also used as Flavouring agent in drinks, Confectionary items food- industry.

Finds use even in perfumes and toiletry preparations.

TESTS

1. Heat benzoin in a dry test tube- irritating fumes (of benzoic and cinnamic acid) produced.
2. Heat 5.0 g coarsely powdered benzoin with 10 ml 1% $KMnO_4$ solution- bitter almond (Benzaldehyde) smell produced.
3. Digest 0.2 g coarsely powdered benzoin with 5 ml ether for five minutes. Pour 1.0 ml of this ethereal solution to porcelain

dish containing 2 to 3 drops of H_2SO_4- reddish brown colour produced.

MYRRH

(Synonym: Arabian Myrrh; Somali Myrrh)

Botanical Source: Myrrh is Physiological Oleo-gum-resin obtained from Species of ***Comiphora*** like ***Comiphora molmol, Comiphora myrrha, Comiphora abyssinica and Comiphora schimperi***

Family: Burseraceae

Geographical Source: Ethiopia and Somali-land.

CHARACTERS

Appearance: Myrrh occurs as translucent or transparent rounded or ir-regular tears of about 2.5 cms in dia. It also occurs as agglutinated mass of tears; up to 10 cms in dia. Tears and mass are brittle in nature.

Colour: Externally reddish brown; internally brown

Odour: Aromatic, agreeable

Taste: Aromatic, bitter and acrid

Surface: Outer surface is rough, dull and dusty. Freshly fractured surface is waxy and granular with whitish marks.

CHEMICAL CONSTITUENTS

Volatile oils- 7 to 17%

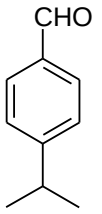
Resin- 25 to 40%

Gum- 57 to 61%

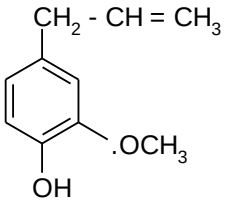
Impurities- 3 to 4%

Myrrh also contains very little of a bitter principle.

The volatile oil is thick yellowish liquid which resinifies upon exposure to air. It contains terpenes, sesquiterpenes esters, cuminic aldehyde and eugenol.



Cuminic Aldehyde
(p-iso propyl benzaldehyde)



Eugenol

Chemistry of resin is complex and not fully understood. It has large ether soluble part consisting of α-, β- and γ-commiphoric acid; esters of another resin acid and two phenolic resins. The ether insoluble portion is small and consists of α- and β-heerabo-myrrholic acid.

The gum is acacia type and it forms mucilage with water. This mucilage does not ferment easily. The gum is associated with enzyme oxidase. The gum upon hydrolysis provides arabinose, galactose and glucuronic acid.

The bitter principle is sparingly soluble in water but soluble in alcohol.

USES

Myrrh is local stimulant, anti-septic, protectant and astringent.

It is chiefly employed in medicated tooth powders, mouth washes and gargles for its action on mouth and pharynx. Its alcoholic tincture is used for inflamed skin.

Myrrh is also used in perfumes and incense sticks.

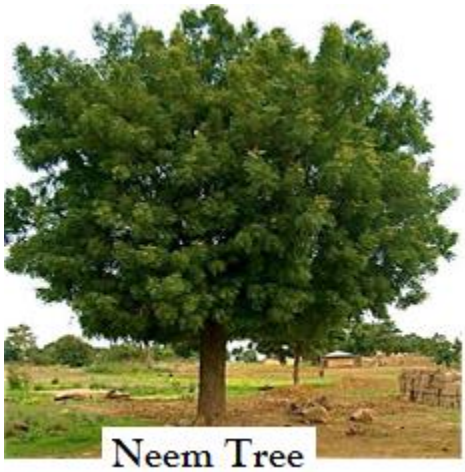
NEEM

(Syn: Nim; Nimba)

Botanical Source: Neem consists of almost all parts of tree called *Azadirachta indica (= Melia azadirachta).*

Family: Meliaceae

Geographical Source: India, Pakistan, Bangladesh, Sri-Lanka, Thailand and Malaysia.



Neem Tree

Neem
Leaves & Fruits

CHARACTERS

Almost all parts of neem are put to one or another use.

Almost all parts of neem are used. Its bark, leaves, dry flowers, berries (fruits) gum and seed oil is put to one or the other use.

Appearance: A large ever green tree 12 to 18 meter in height and 1.8 to 2.4 in girth. The tree has straight bole and long spreading branches which make a broad crown.

Leaves: Alternate, im-paripinnate, 9 – 19 leaflets, glossy surface and bluntly serrate margin, bitter in taste.

Flower: Numerous, white or pale yellow, small, scented.

Fruit: Oblong, smooth, 1.3 to 1.8 cm long; green when unripe but yellow to brown when ripe, pulp is bitter sweet.

Bark: Dark gray outside, rough, reddish brown, inside, Characteristic smell and bitter taste. The bark exudes a clear bright amber coloured gum called East India gum. This gum is available as tears or vermiform pieces and blackens upon aging.

CHEMICAL CONSTITUENTS

Neem contains bitter substance called Nimbidin and a Complex limonoid compound called Azadirachtin

From the seed oil bitter limonoids like Nimbin, Nimbinin and Salanin have been isolated. These have nor-terpenoid structure.

From leaf extract Sterols, Limonoids, Flavonoids & their Glycosides and coumarins have been isolated.

USES

Leaf Extract: Anti-malarial, Anti-Gastric ulcer and Insecticide.

Seed oil: Anti-inflammatory, Anti-bacterial, Anti-pyretic and Hypoglycaemic.

Bark: Very useful in skin diseases. Anti cancer activity has also been reported.

Presently the neem is being viewed as a potential source for developing natural insecticide.

Tender leaves chewed along with black pepper; are effective against intestinal worms.

CURCUMA (TURMERIC)

Botanical Source: Turmeric consists of dried rhizome of Curcuma domestica (=Curcuma longa)

Family: Zingiberaceae

Geographical source: China, India, Malaya and Pakistan

Collection and Preparation

Turmeric is perennial herb. Its rhizome is collected upon withering of aerial parts. Rhizomes are then boiled in their own juice or water for 12 to 24 hours. Boiling kills the viability of rhizomes, gelatinizes the starch present in the rhizomes and the yellow colour spreads to all cells after coming out of its secretary cells. These are then dried in Sun or in the oven. After drying these are sorted into bulbs and fingers.

Turmeric

MACROSCOPY

Rhizomes of turmeric occur as **Primary and Secondary rhizomes**

The primary rhizomes are short, ovate or pear shaped. These are also known as Bulbs or Round turmeric.

Secondary rhizomes are 4 to 7 cms. long, 1 to 1.5 cms wide, curved or almost straight, cylindrical pieces, bluntly tapering at both the ends. These are known as Fingers or Long turmeric.

Surface: Longitudinally wrinkled wit transverse ring (Leaf scars). These may bear short branches or circular scars of these broken branches.

Fracture: Short and tough. The freshly fractured surface is uniform dull brownish yellow with waxy and tough appearance,

Colour: Deep yellowish brown

Odour: Characteristic, aromatic

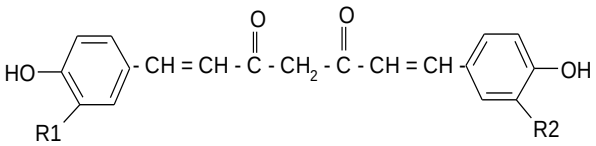
Taste: Characteristic and aromatic. Upon chewing, it colours the saliva yellow.

CHEMICAL CONSTITUENTS

Turmeric contains Volatile oil, Colouring matter Curcumin and resin. It also contains sugars like Arabinose, Glucose and Fructose along with abundant gelatinized zingiberaceous starch grains

Volatile oil contains mainly the Zingiberene (Sesquiterpene hydrocarbon) along with ketone turmerone and ar-Turmerone.

Colourin matter Curcumin is present in three forms Cucumin-I (60%) Curcumin-II (24%) and Curcumin-III (14%)



Compound	R1	R2
Curcumin-I (Diferuloyl methane)	-OCH3	-OCH3
Curcumin-II Feruloyl (4-hydroxy-cinnamoyl) methane	-OCH3	-H
Curcumin-III Bis (4-hydroxy cinnamoyl) methane	-H	-H

USES

Turmeric is used as Aromatic, Stomachic, Diuretic and in treatment of Jaundice and Hepatitis. (Curcumin-I and Curcumin-II have choleretic and Cholagogue actions while Curcumin-III is Anti-choleretic)

It also has Anti-inflammatory activity and is also useful in cough and Bronchitis. Ayurveda includes it even as Anti-diabetic.

It is also used for identification of boric acid and Borates (Turmeric paper gives red colour with Boric acid).

It is also used as colouring material for food stuffs like Cheese and Sweets and dye for fabrics like wool and silk.

ANTIMALARIALS

Malaria is characterised by high fever and chills and shivering. Drugs used ti treat this disease are called ANTIMALARIAL. Most common and still widely used natural drug is – CINCHONA BARK. Artemisin is another natural drug being extensively used.

CINCHONA

Cinchona Bark; Peruvian Bark

Bot. Source: Cinchona is dried stem and root bark of Cinchona calisaya, Cinchona ledgeriana, Cinchona succirubra and Cinchona officinalis or hybrids of first two species with last two species.

Family: Rubiaceae

Geographical Source: India, Indonesia, South America and Guatemala.

Cinchona Bark

Cinchona Bark

CHARACTERS

Colour: Yellowish brown to deep reddish brown

Size: Up to 30 cm long and 2 to 6 mm thick.

Shape: Curved, Quill or Double quill

Outer Surface: Rough having longitudinal and transverse cracks, fissures, ridges and protuberances. Outer surface usually has moss and lichens adhering to it.

Inner Surface: Inner surface has longitudinal striations.

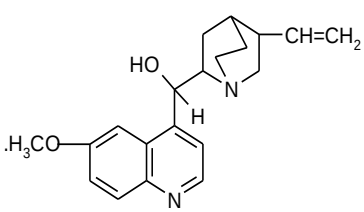
Odour: Slight

Taste: Bitter and Astrigent

CHEMICAL CONSTITUENTS

Cinchona bark has about 6.5% alkaloids. These are 25 in number. Important alkaloids are- Quinine, Quinidine, Cinchonine and Cinchonidine. These are mainly used as Sulphate

It also contains Quinic acid and Cinchotannic acid.Cinchotannic acid decomposes to Cinchona red.



Quinine Cinchonine

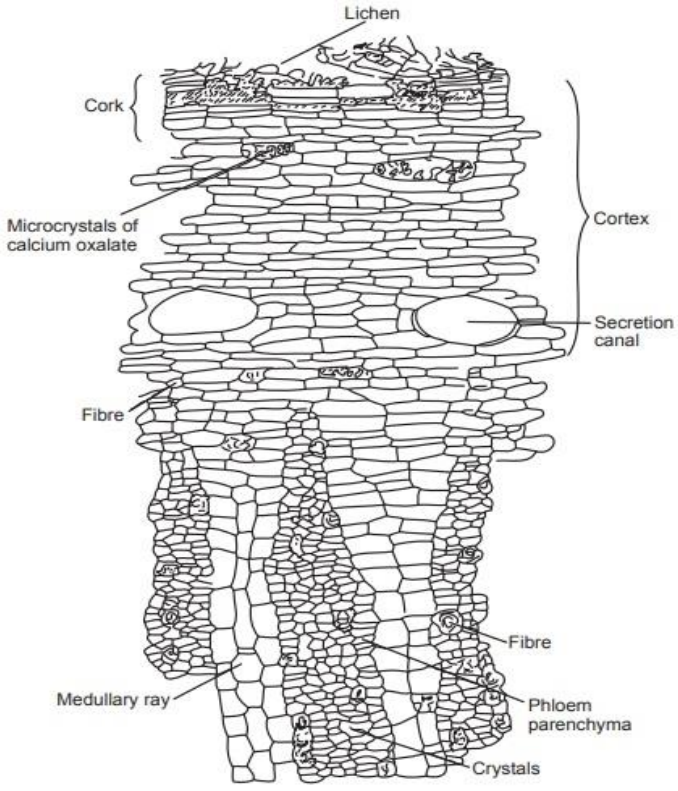
USES

Antipyretic, Analgesic and Anti-malarial.

Also used as Bitter tonic and appetite stimulant.

Quinidine is used in Cardiac arrhythmia and Atrial fibrillation.

MICROSCOPY



CORK: It is composed of several layers of thin walled cells, arranged in radial rows and appears polygonal in surface view. These have reddish brown cell content and are coated with Suberin.

PHELLODERM: Cork is followed by Phelloderm consisting of several layers of regular cells with dark cell walls.

CORTEX: Cortex consists of thin walled tangentially elongated parenchymatous cells containing amorphous reddish brown matter. These also contain small starch grains. In cortex are scattered the Idioblast cells; which contain the micro crystal of Calcium oxalate.

PHLOEM: Phloem is wide and consists of sieve tubes, parenchyma and Phloem fibres. These fibres are spindle shaped, lignified and have conspicuously striated walls. These occur isolated or in ir-regular radial rows. Medullary rays are two to three cells wide and somewhat radially elongated.

OXYTOCICS

Oxytocin is a hormone secreted by posterior lobe of Pitutary gland. During child birth, this hormone causes contraction of uterine muscles and during lactation it causes contraction of smooth muscles of mammary glands. In this way it helps in safe delivery and also breast feeding.

Drugs having similar effects are called OXYTICICS

ERGOT

Botanical Source: Ergot is dried SCLEROTIUM of fungus *Claviceps purpurea* developing on the ovary of food grain plant *Secale cereal* (Fam. Gramineae)

Family: Clavicipitaceae

Geographical source: India, Portugal, Russia and Spain.

LIFE CYCLE OF *CLAVICEPS PURPUREA*

Life cycle of this fungus has three stages

- Sphacelia or Honey dew stage
- Sclerotium or resting stage
- Ascospore stage

Sphacelia or Honey dew stage

Rye plant bears flowers by the end of spring season. During this time the ASCOSPORES ofthis fungus are carried to the spikes of plant by wind or insects. These spores settle to the base of ovary and start growing. By enzymatic action these enter the wall of ovary and form a soft white mass of filamentous hyphae callec SHACELIA. This mass secretes a sweet, viscous yellowish liquid called HONEY DEW. Several conidiospores come out of hyphae and enter this sweet liquid. Insects gets attracted to this fluid and help spreading the infection to nearby plants.

Sclerotium or resting stage

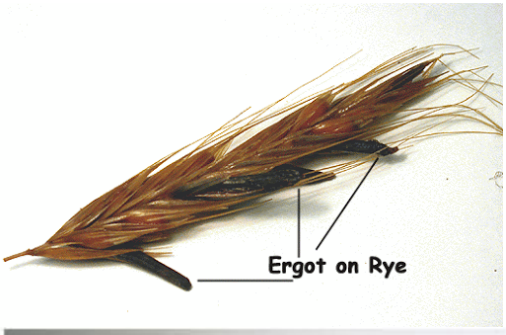
The hypae spread further and penetrate deeper in the ovarian tissue. These consume the ovarian tissue and attach to the vascular tissue for the nutrition. The ovary gets replaced by a dark purple, compact Pseudo-parenchymatous tissue called SCLEROTIUM. In summer, the sclerotium increases in size and protrudes out of the spike. The sclerotium has remains of Sphacelia on its apex. It may get collected along with grains or may fall on the ground. The sclerotium has alkaloids of medicinal importance.

Ascospore stage

The sclerotium which falls on the ground stays dormant till next spring season. Now it develops to produce upright stalks having globular head called STROMATA. Each stromata has many flask like structures called PERITHECIA. Each perithecia has many sacs each having 08, thread like ASCOSPORES. These ascospores are carried to the spikes of rye plant to start the life cycle again.

To produce ergot commercially, the ascospores are grown on nutritive medium. These produce conidiospores. From these conidispores will prepare the suspension and use it to infect the spikes of rye plants, manually or mechanically.

The sclerotium develops in due time and collected from fields in June/July. It is then dried to remove extra moisture and packed in air-tight containers.



Ergot Sclerotium

CHARACTERS (of Sclerotium)

SIZE: 01 to 04 cm long; 02 to 07 mm wide

Shape: Slightly curved, Sub-cylindrical, fusiform or tapering at both ends.

Colour: Purplish brown to almost black

Outer Surface: Longitudinally furrowed with occasional transverse cracks

Odour: Characteristic

Taste: Unpleasant

CHEMICAL CONSTITUENTS

Ergot has six pairs of alkaloids. All are indole alkaloids. One pair is water soluble while other five pairs are water insoluble.

Each pair has one active alkaloid (Laevorotatory) and other inactive alkaloid (Dextrorotatory)

This are-

Active (LAEVOROTATORY)	Inactive (DEXTROROTATORY)

WATER SOLUBLE	
Ergometrine Group	
Ergometrine	Ergometrinine
WATER SOLUBLE	
Ergotamine Group	
Ergotamine	Ergotaminine
Ergosine	Ergosinine
Ergotoxine Group	
Ergocristine	Ergocristinine
Ergocriptine	Ergocriptinine
Ergocornine	Ergocorninine

Sclerotium also contains 30-40% fixed oil. It contains about 01% Ergosterol and other sterols. It also has many Amino acids. Cell wall of sclerotium is made up of CHITIN.

USES

Ergometrine has Oxytocic activity. It causes strong contraction of uterine muscles so used to help in delivery and to reduce post-partum hemorrhage. Other alkaloids are used in migraine and certain nervous disorders.

VITAMINS

Vitamins are essential nutrients for humans and are found in many plants and animals. These are required in small quantity and help the person to stay healthy and ward off many diseases. Vitamins can be fat soluble (Vitamin A, D E and K) or Water Soluble (Members of Vitamin B-complex and Vitamin C). If consumed in excess amount, the fat soluble vitamins get stored in body but excess amount of water soluble vitamins get excreted; hence water soluble vitamins should be present in diet on daily basis.

SHARK LIVER OIL

(**Synonyms:** Oleum Selachoidae)

Biological Source: It is the fixed oil obtained from fresh or carefully preserved livers of shark **Hypoprion brevirostris** and other varieties of shark. (As per IP one gram oil should contain not less than 6000 IU activity of Vitamin A)

Family: Carcharhinidae

Geographical source: Many European countries and India. In India it is in Kerala, Maharashtra and Tamil Nadu.

Preparation: Livers are removed from fish and cleared from fatty and other tissues. Livers are minced and heated at a temperature not exceeding 80^0 C. the oil gets separated. Water from the oil is removed by using de-hydrating agent. Oil is freezed to remove stearin. Suspended impurities are removed by filtration. Clarity may be improved by centrifugation. The Vitamin A strength is adjusted. It may even be fortified with Vitamin D.

CHARACTERS

Appearance: Pale yellow to brownish yellow slightly viscous liquid.

Odour: Fishy but not rancid

Taste: Bland & fishy

Other Characters: Insoluble in water. Slightly soluble in alcohol but miscible with Petroleum Ether ($50\text{-}60^0$ C fraction), Solvent ether and Chloroform

CHEMICAL CONSTITUENTS

Shark liver oil Contains Vitamin A (15,000 to 30,000 IU/g). It also contains glycerides of saturated and un-saturated fatty acids.

USES

Source of Vitamin A in Xerophthalmia

Nutritive and Tonic

STORAGE: Store in an amber coloured bottle under the atmosphere of Nitrogen.

AMLA

(Syn: Amritphala)

Botanical Source: Amla consists of fresh or dried fruits of *Emblica officinalis (=Phyllanthus emblica)*

Family: Euphobiaceae

Geographical Source: India (ascending up to the height of 1300 mtrs. in hills). It grows well in many tropical and sub-tropical countries of the world.

Amla Fruit

Amla Fruit

CHARACTERS

Appearance: Smooth, fleshy drupe fruit having stony endocarp.

Shape: Globose

Size: 2.5 to 3.5 cm in diameter

Colour: Green when tender but changing to light pinkish, yellowish or golden yellow; upon maturity. Few dark specks are present on the surface of mature fruits.

External Surface: Shiny hard and smooth, with six prominent lines on the surface. At one end is present the depression of its peduncle.

Odour: Odourless

Taste: Sour and astringent taste followed by delicately sweet taste.

CHEMICAL CONSTITUENTS

Amla is the richest source of Vitamin C (650 to 900 mg per 100g pulp). It also contains 5% tannins (Gallic acid, Ellagic acid and Phyllembelin) and minerals like Calcium, Iron and Phosphorus.

USES

Amla is useful in Scurvy, liver diseases and Diabetes

Amla is a general tonic hence is considered useful in Anaemia, Cough, Bronchitis and Tuberculosis

Amla is ingredient of TRIPHALA and CHAYVANPRASH.

Amla is also used in preparation of Hair oils, Shampoos and Inks.

ENZYMES

Enzymes are bio catalysts, high molecular weight molecules of proteinaceous nature and are capable of catalyzing various biological reactions at body temperature. These can be obtained from plants and animals

Plant Enzymes: Papain, Diastase, Maltase and Emulsin

Animal Enzymes: Pepsin, Renin and Trypsin

PAPAYA OR PAPAIN

(Syn: Vegetable pepsin)

Papaya is the fruit. The ripe fruit is eaten raw without skin and seeds while unripe fruit is eaten cooked in curries and salads. From the latex of it an enzyme, called PAPAIN is prepared. Papain is a powerful proteolytic digestive enzyme capable of digesting even tough proteins.

Botanical Source: Papain is purified dried latex of unripe or green fruit of *Carica papaya*. Papain can also be obtained from the Stem, Leaves and Petioles of this plant. Even this product is having comparable activity.

Family: Caricaceae

Geographical Source: This tree is native to Southern Mexico. Presently grown in Brazil, Hawaii, India, Sri Lanka, South Africa Tanzania and many more countries.

CHARACTERS

Appearance: Amorphous powder

Colour: White, Grayish white or brownish white.

Nature: Slightly hygroscopic

Odour: Characteristic

Taste: Characteristic

Optimum pH: 5 to 6

Optimum Temperature: 60 to 90^0C

Solubility: Soluble in water, partially soluble in glycerin but insoluble in organic solvents

CHEMICAL CONSTITUENTS

Papain contains many proteolytic enzymes. The main are Papain, Papaya proteinase and Chymopapain.

USES

Papain is able to convert protein (Polypeptide) to dipeptide. It can easily digest 35 times it its weight of meat. It is used for meat tederisation, beverage clarification, degumming of silk and de-hairing of skin in the preparation of leather.

DIASTASE

(Syn: Amylase)

Diastase is an amylolytic enzyme present in plant (Germinated barley) and animals (In saliva). This enzyme is capable of converting starch to maltose.

Botanical Source: Diastase is obtained from germinate barley seeds called *Hordeum vulgare.*

Family*:* Graminae

Geographical Source: Almost throughout world including USA, Russia, India and China.

CHARACTERS

Appearance: Amorphous powder

Colour: Yellowish white

Odour: Characteristic

Taste: Characteristic

Solubility: Soluble in water, but insoluble in alcohol

CHEMICAL CONSTITUENTS

Diastase contains amylolytic enzyme amylase. It also contains Dextrin, Maltose and traces of glucose.

USES

Diastase is used as digestant. It can easily digest 50 times of its weight of potato.

YEAST

(Syn: Khameer)

Botanical Source: Yeast consists of the cells of suitable strain of *Saccharomyces cerevisiae.* It is dried to preserve its vitamin content.

Family: Saccharomycetaceae.

CHARACTERS

Appearance: Whitish, pale buff or brownish powder.

Odour: Characteristic, resembling that of beer.

Microscopic Characters: Under microscope the cells appear Spherical, Elliptical or ovate. These can be up to 08µ. Some cells show budding.

CHEMICAL CONSTITUENTS

Yeast consists of members of Vitamin B-complex group-

B1 – Thiamine

B2 – Riboflavin

B6 – Nicotinic acid

B12 – Cynocobalamin

and folic acid.

Yeast also contains 46% protein and 36% carbohydrates (Mainly Glycogen). Other constituents' are- fat, sterols and enzymes.

USES

Dried yeast is rich source of Vitamin B-complex. It is also rich source of biologically complete protein and also used to synthesize nucleic acids. Dried yeast is also used in the treatment of Furunculosis (painful boils)

NOTE: Yeast is unicellular organism, which are greatly reduced sac fungi. These feed upon sugar and split it into alcohol and carbon-di-oxide. These are also termed as baker's yeast and used extensively for manufacture of alcohol and bread.

PERFUMES AND FLAVORING AGENTS

These are odorous volatile constituents of plant and animal origin. These are also known as ethereal oils as, like ether, these evaporate upon exposure to air. These are also named as essential oils as these represent the essence, perfumed or flavoured active constituents of the plant.

OCCURRENCE

Families' rich in volatile oil bearing plants are-

FAMILY	EXAMPLES
Labiatae	Pippermint, Tulsi, Rosemary.
Lauraceae	Camphor, Cinnamon.
Myrtaceae	Clove, Eucalyptus.
Piperaceae	Black Pepper, Long Pepper. Betel.
Rutaceae	Orange, Lemon, Buchu leaf.
Umbelliferae	Coriander, Fennel, Dill
Zingiberaceae	Cardamom, Ginger, Turmeric.

Unlike fixed oils, which are mainly confined to seeds, the volatile oils occur in almost all parts of plants. The various examples are-

Bark	Cassia, Cinnamon.
Bulb	Garlic.
Flower bud	Clove.
Flower head	Artemisia, Rosemary.
Fruits	Anise, Caraway, Black pepper.
Herb (Entire)	Benafsha (Viola odorata, Violaceae), Chenopodium, Lemon Grass.
Leaves	Eucalyptus, Mentha, Tulsi.
Rhizome	Ginger, Jatamnsi, Rasna, Turmeric, Valerian.
Rind	Lemon peel, Orange peel.
Root	Sausurrea (S. lappa).
Seeds	Cardamom, Nutmeg.
Stigma	Saffron.
Wood	Camphor, Sandalwood.
Oleoresin	Turpentine oil.

Animals containing volatile oils are-

Beaver (Castor fiber, an amphibious contains Castoreum.)

Cantharides (An Insect).

Civet (Cat).

Musk (Deer).

Whale Stomach (Contains Ambergris)

PHYSICAL CHARACTERS

Volatile oils are liquids with pleasant smell and having specific gravity less than one (1) i.e. these are lighter than water, notable exception being clove oil, which is heavier than water. These are nearly insoluble in water (1;200) but soluble in Alcohol, Chloroform and Petroleum ether. These have high refractive index and show optical activity (Camphor is dextro-rotatory while Menthol is leavo-rotatory).

CHEMICAL NATURE

Volatile oils contain several constituents, which are hydrocarbons and their oxygenated derivatives collectively known as TERPENOIDS. These can have acyclic, monocyclic and bicyclic structure. Hydrocarbons are represented by Monoterpenes ($C_{10}H_{16}$), Sesquiterpenes ($C_{15}H_{24}$)and Diterpenes ($C_{20}H_{32}$). The oxygenated derivatives are- Alcohol, Aldehydes. Esters, Ethers, Ketones, Phenols and Oxides.

The volatile oils obtained from Bitter almond, Mustard and Wintergreen are glycosidic in nature.

USES

Therapeutic uses of volatile oils are-

Anthelmintic, Antiseptic, Bactericidal, Carminative, Digestant, Disinfectant, Diuretic, Expectorant, Spasmolytic and Stimulant. In pharmacy these also find use as Flavouring agent and also for masking the objectionable smell of the drugs.

These are used in confectionary and food items as flavours and preservative. These also find use in Perfumery and Cosmetics.

PIPPERMINT OIL

SOURCE- This volatile oil is obtained by steam distillation of fresh flowering tops of the plant named- *Mentha pipperita variety forma pallescens (white var.)* and *variety forma rubescens (Black var.).*

FAMILY- Labiatae.

GEOGRAPHICAL SOURCE-Native to Europe, cultivated in Japan, England, France, Italy, USA, Bulgaria, USSR & India (Jammu and Tarai region of UP)

Pippermint Plant

CULTIVATION AND COLLECTION-

For cultivation of *Mentha pipperita,* a well-drained fertile neutral sandy loam soil is required. Cultivation is started by vegetative propagation using suckers. The suckers are placed in soil in the month of Jan./Feb. Foliar spray of fertilizer is preferred. De-weeding is done frequently and the pest control achieved by using suitable pesticides. Harvesting is done when the crop reaches the flowering stage.

PREPARATION OF OIL- The bulk of crop is reduced by drying it in shade, to about ¼th of its original weight. Drying in direct sun or fermentation is avoided as it affects the quality and quantity of volatile oil.

The still with false perforated bottom is used to distill the oil from the harvested crop. The steam under pressure is passed through still and the coiled condensers are used for the condensation of oil. Normally 0.5-1.0 % oil is obtained.

CHARACTERS

Appearance & colour- Colourless to yellow, thin liquid.

Odour- Characteristic and pleasant.

Taste- Pungent followed by cooling sensation.

Solubility- Insoluble in water, soluble in 70 % alcohol, ether and chloroform.

pH- Neutral towards litmus paper.

Specific gravity- 0.9 to 0.912.

Optical rotation- -16^0 to -30^0.

Refractive index- 1.459 to 1.465.

CHEMICAL CONSTITUENTS

70 % Menthol (in Free State and as esters)

Menthone, Menthofuran, Jasmone, Menthyl Acetate, Menthyl isovalerate, Cineole, Pulegone, Isopulegone and terpenes like l-limonene, pinene and camphene.

Jasmone and esters are responsible for pleasant flovour. Upon long storage, the Menthofuran is responsible for unpleasant smell due to resinification.

USES

Carminative, Aromatic, Flavouring agent, counter-irritant and Antiseptic. Used in dental preparations (tooth powder, tooth paste) shaving creams, tobacco, betel nuts, chewing gums, jellies, perfumes and essence.

STORAGE

Store in a well filled, well closed container at cool place protected from light.

OTHER SPECIES

Mentha arvensis, M. roundifolia, M. longifolia.

The oil distilled from ***Mentha arvensis var. piperascens*** is known as Japanese pippermint oil or Mentha oil. This oil has considerable amount of Menthol (up to 80 %) but is inferior in flavour. This oil is mainly used as source of Menthol.

Volatile oil obtained from flowering top and leaves of ***Mentha spicata (Mentha viridis)*** is known as Spearmint oil. This oil contains a least 50 % carvone.

LEMON OIL

Botanical Source: Lemon oil is essential or ethereal oil obtained from the oil cells present in outer skin of fruits of *Citrus limon (C. limonum)*

Family: Rutaceae

Geographical Source: Lemon is native of India (Assam). It is grown in Burma, China, Italy, Egypt and Australia.

Lemon Fruits

Lemon Fruit

Preparation of oil: Lemon Oil is present in special cells. These cells are present in outer peri-carp of the lemon fruit. A machine breaks up the cells (by use of fine needles) and uses spray of water to flush off the oil. Oil is then separated using centrifugal machines.

CHARACTERS

Colour: Pale yellow to greenish yellow liquid.

Odour: Characteristic; resembling lemon

Taste: Characteristic: resembling lemon

Specific Gravity: 0.849 to 0.855

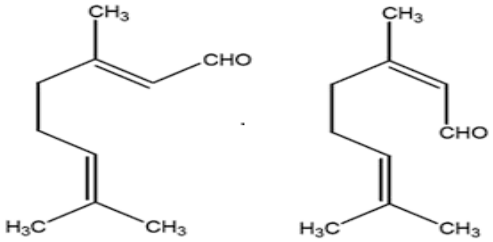
Optical rotation: +59 to + 65

Refractive Index: 1.474 to 1.475

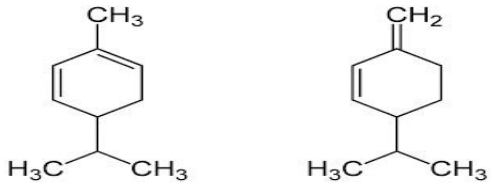
Solubility: Soluble in 03 volumes of alcohol, CS2 and GAA, Miscible with absolute alcohol.

CHEMICAL CONSTITUENTS

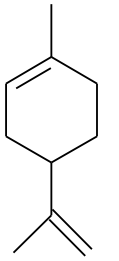
Contains 04 to 06% Citral, Terpenes (Limonene, phellendrene and pinene) are present up to 90%.



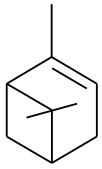
Citral



Phellendrene



Limonene



Pinene

USES

Mainly used for flavouring and perfumery purpose

Used for teeth whitening, laundry freshener, house hold cleaner, mood elevator and nausea reliever.

ORANGE OIL

Orange oil is a volatile oil obtained from the rind (peel) of Orange fruit. This oil is present in the special oil producing cells of rind.

Botanical Source: Orange oil is obtained from the outer part of pericarp of Citrus aurantium, Citrus sinensis.

Family: Rutaceae

Geographical Source: Orange is indigenous to India. Now grown in Spain and USA.

Orange Fruit

Preparation of oil: Orange oil is obtained as a by-product in Orange juice industry. From fresh peels it can be obtained by crushing the peels followed by centrifugation. From dried peels it can be obtained by solvent extraction method using alcohol as solvent. This oil can also be obtained by infusion with suitable fixed oil.

Characters

Appearance: Thin liquid

Colour: Yellow to deep orange

Odour: orange like

Taste: orange like

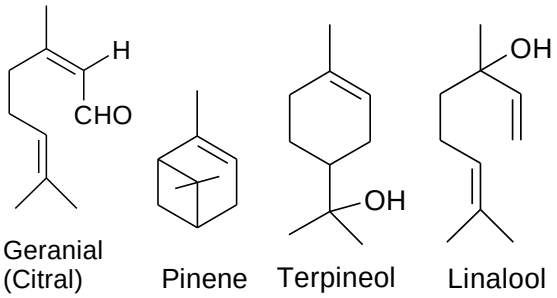
Specific Gravity: 0.842 to 0.846

Refractive Index: 1.4723 to 14737

Optical Rotation: +94 to +99.

Chemical Constituents

Orange oil contains mainly Limonene along with Citral, α-pinene, Terpineol and Linalool.



Geranial (Citral) Pinene Terpineol Linalool

Uses

Orange oil is mainly used for Flavouring and Perfumery purpose.

It is used to relax muscles, lessen anxiety and anger and also as mood elevator.

Used as Anti-inflammatory and Anti-fungal

Used to cure Acne and dermatitis

LEMON GRASS OIL

Lemon grass is tall grassy plant growing as a dense shrub and has leaves with very sharp edges.

Botanical Source: Lemon grass consists of over-ground portion of the plant named Cymbopogan citratus and Cymbopogan flexuosus.

Family: Graminae (Grass family).

Geographical Source: India, Indonesia< China, Sri-Lanka. In India, Kerala, TN, Gujarat and Punjab.

Lemon Grass

Preparation of oil: From lemon grass the volatile oil is obtained by steam distillation process.

CHARACTERS

Appearance: Comparatively thick liquid.

Colour: Yellowish brown

Odour: Lemon like

Taste: lemon like

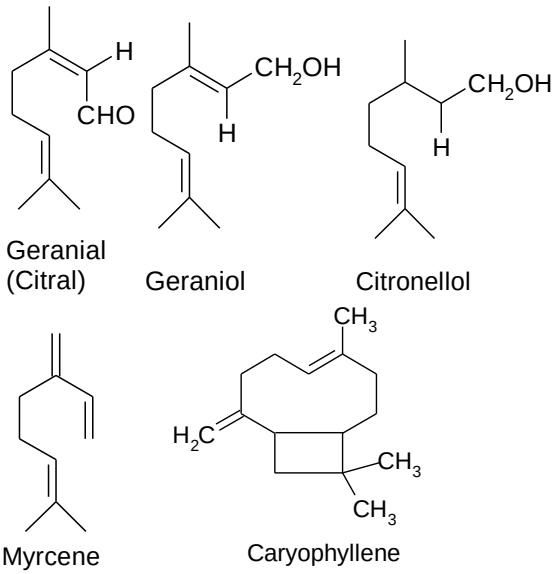
Specific Gravity: 0.892 to 0.909

Refractive Index: 1.4808 to 1.4868

Optical Rotation: - 03 to + 01

Chemical Constituents

Lemon grass contains 0.2 to 0.5% volatile oil. The oil contains mainly Citral, Citronellol, Geraniol with Limonene, β-caryophyllene and Myrcene.



Uses

Perfuming agent for Cosmetics, Disinfectant and Soaps

Flavouring agent.

Used as source of Citral which is then used for synthesis of Vitamin A

Anti-bacterial and Anti-fungal

SANDAL WOOD OIL

Botanical Source: Sandal wood oil is the volatile oil obtained by distilling the heart wood of Santalum album.

Family: Santalaceae

Geographical Source: India and Malaysia. (In India; Karnataka and Tamil Nadu)

Preparation of Oil: Sandal wood oil is obtained at least from 25 years old tree. The tree is uprooted and bark removed. The heart wood is divided into small chips and oil obtained by steam distillation of these small chips.

Sandal Wood

CHARACTERS

Appearance: Viscous or sticky liquid.

Colour: Pale yellow to colourless.

Odour: Characteristic and Persistent

Taste: Unpleasant

Solubility: Very less soluble in water. Soluble in Alcohol and Chloroform

Specific Gravity:

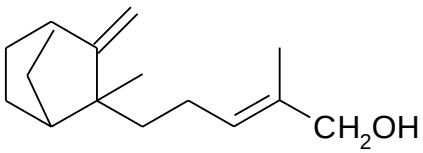
Refractive Index:

Optical Rotation:

CHEMICAL CONSTITUENTS

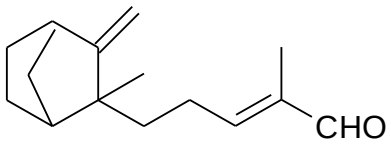
Sandal wood oil contains two isomeric alcohol called α-Santanol and β-Santanol.

An aldehyde Santanal is also present.



$C_{15}H_{24}O$

Santanol



$C_{15}H_{24}O$

Santanal

USES

Sandal wood oil is urinary Anti-septic. It is used to treat Dysurea and also to diminish the frequency of micturition in the tuberculosis of urinary bladder.

Extensively used in Perfumes, Cosmetics and Incense sticks.

PHARMACEUTICAL AIDS

Pharmaceutical aids are the substances which have little or no therapeutic value but are used in manufacture or compounding of pharmaceutical preparations to achieve varied objective(s).

One of the main objectives of pharmacy is to prepare potent and stable preparations which are acceptable to patients. To achieve the same, various techniques like absorption, clarification, emulsification, filtration, solubilisation and suspension are employed. Similarly we make use of substances like colouring, flavouring, sweetening and perfuming agents. These substances may have little or no therapeutic value but are must for preparing the pharmaceutical products. These are termed are Pharmaceutical aids. These can be of plant, animal, mineral or synthetic origin. Following table enlists some important Pharmaceutical aids-

Carbohydrates	
Starch	Disintegrating agent
Glucose, Sucrose honey	Sweetening agent
Gums	Binding, Suspending & Emulsifying agent
Sodium alginate	Deflocculating Emulsifying, Gelling, Stabilising & Thickening agent
Agar	Emulsifying & Solidifying agent
Lipids	
Fixed oils	Emollient & vehicle
Fat & Waxes	Ointment base
Volatile oils	Flavouring agent
Chlorophyll, Cochineals, Saffron	Natural colouring agents
Animal protein Gelatin	Suspending agent & making of capsule shell
Kaolin	absorbent

HONEY

(Synonyms: Clarified Honey, Strained Honey, Mel)

Biological Source- Honey is sweet fluid prepared from the nectar of flowers and deposited in the cells of honeycomb by honeybee ***Apis mellifica (Apis mellifera)*** and other species of Apis like ***A. dorsata, A. indica and A. florea* .**

Family Apidae

Geographical Source- West Indies, California, Chile, Africa, Australia, New-zeland and India.

CHARACTERS

Appearance- Honey is viscid (thick) syrupy fluid having light yellowish to reddish brown colour. Freshly prepared honey is clear and translucent but upon keeping it becomes opaque and granular due to crystallization of dextrose.

Odour- Agreeable and Characteristics

Taste- Sweet and faintly acrid

The odour and taste may vary depending upon the floral source of the honey

Optical rotation- (+) 3^0 to (-) 15^0

Specific gravity- 1.36 at 15.5^0 C

CHEMICAL CONSTITUENTS

Honey contains about **80% equimolar mixture of dextrose and fructose** (known as invert sugar). Water content is about 20%.

It contains small quantities of **sucrose, dextrin, formic acid, volatile oil, wax and pollen grains**.

Microscopical examination of honey exhibits the pollen grains, which can indicate the floral source of honey.

USES

- Sweetening agent and Pharmaceutical aid.
- Used as nutritive agent
- Finds use as demulcent and mild laxative
- Used as vehicle for linctuses and cough mixtures
- It is ingredient for pills and oxymel.

Adulteration- Honey is adulterated with artificial invert sugar, sucrose and liquid glucose.

Test for artificial invert sugar- Artificial invert sugar is prepared by hydrolysis of sucrose using HCl or H_2SO_4. It contains furfural that can be detected by following test **(Fiehe's test)**

FIEHE'S TEST- Shake 10 ml honey with 5 ml ether. Separate the upper ethereal layer in a porcelain dish and evaporate to dryness. To the residue add 1 drop of 1% resorcinol in HCl.

No persist cherry colour is produced (a transient pink colour, fading in half a minute may get produced).

Now days, invert sugar is produced by using enzyme invertase. The honey containing this sugar is devoid of taste and flavour of natural honey.

STARCH (AMYLUM)

Starch is the most common reserve carbohydrate or polysaccharide granules **(Glucosan)** of plants, which upon complete hydrolysis yield glucose.

Starch is the 1st or primary product of photosynthesis

Commercial quantity of starch is prepared from Maize, Rice, Wheat and Potato

Biological and Geological Source

WHEAT- *Triticum sativum (Gramineae)* Many temperate countries

MAIZE- *Zea mays (Gramineae)* USA, Argentina, India, Tropical & Subtropical countries.

RICE- *Oryza sativum (Gramineae)* India, China, Japan, Tropical & Subtropical countries

POTATO- Tubers of *Solanum tuberosum (Solanaceae)* Many countries of the world

CHARACTERS

Appearance- Starch occurs as irregular angular masses or fine powder.

Colour - White

Odour - Odourless

Taste - Taste less

Sp. gr. - 1.60 to 1.65

Nature - Maize starch- Neutral
Rice starch- Alkaline
Wheat & Potato starch- Acidic

Solubility- Starch is insoluble in cold water but swells up and forms colloidal solution with 15 times of its own weight of boiling water. This colloidal solution, upon cooling sets to a translucent jelly. This colloidal solution is also called **starch mucilage**. This gives deep blue colour with solution of Iodine; which disappears upon heating above 93^0C but reappears upon cooling.

When starch is heated with water, the grains of starch swell up and then undergo gelatinization. Gelatinization also occurs with caustic potash, concentrated solution of Cal or Zinc chloride and concentrated solution of Chloral hydrate.

MICROSCOPIC EXAMINATION

Under microscope, the starch grains appear as colourless, highly refractive (R.I. = 1.5) granules or grains having Hilum and Striations. The Hilum is the starting point of formation of grain. It can be Central or Eccentric. The grains with eccentric Hilum are usually longer than their breadth. Striations are the fine lines, which surround the Hilum and are formed by successive deposition of starch material.

During drying the fissures (cracks) may appear in grains. These fissures may appear to originate from the Hilum. Due to this reason the Hilum may appear rounded dot, curved or multiple cleft.

CHEMICAL CONSTITUENTS

Starch consists of two polysaccharides-

Amylopectin (α-amylose)……..80%

Amylose (β-amylose)……..20%

The molecule of amylopectin consists of 20 to 26 α1-4 linked glucose molecules. Several hundred of these chains are linked by α1-6 linked glycosidic bonds to the neighboring chains.

The amylopectin is present in the outer part of grains. It is insoluble in water and swells up in hot water, hence is responsible for gelatinizing property of starch. It has low Iodine binding and gives purple colour with iodine solution. It

gets completely hydrolyzed by mineral acids and enzymes (other than β-amylase).

β-amylase can attack only the outer linear chain and is not able to attack α1-6 bond, hence it can hydrolyse the amylopetin only up to the extent of 50-60%.

AMYLOSE or - β-AMYLOSE: It consists of α1-4 linked glucose molecules. Several thousand molecules form a chain

It is present in inner part of grain. It is soluble in water and has strong binding with Iodine and gives deep blue colour with Iodine solution. It can be completely hydrolyzed by β-amylase into maltose.

USES

- Starch is used as Nutritive, Demulcent, Protective, Absorbent and Pharmaceutical-aids. Its various uses are-
- Dusting powder (as it can allay the skin irritation in swelling and/or inflammation)
- Starch mucilage is used as emollient for skin
- Anti-dote for Iodine poisoning
- Used as base for some enemas
- Used as Disintegrating agent for pills and tablets
- Used as Diluent for dry extracts and medicinal powders.
- Sterilized maize starch is used as lubricant for surgeon's gloves (Unlike Talc, it gets completely absorbed by the body)
- Used as Suspending agent for Barium meal.

GUM ACACIA

Source- Gum Acacia is dried gummy exudates, obtained from stems and branches of ***Acacia senegal*** and other species of ***Acacia***

Acacia is from Greek word Akakia meaning pointed and refers to the thorny nature of plant. Senegal refers to habitat of plant

Family- Leguminosae

Geographical source- Central and West Africa, Senegal and Sudan

CHARACTERS

Appearance - Spheroidal tears, angular fragments or flakes of variable size, translucent with numerous minute fissures.

Colour- Whitish or yellow white

Fracture- Very brittle (Breaks up easily) with transparent and glassy fractured surface

Odour- Odourless

Taste- Mucilaginous

Solubility- Soluble in twice its weight of water, insoluble in alcohol

CHEMICAL CONSTITUENTS

Gum Acacia contains mainly Arabin. Arabin is mainly the Calcium salt of Arabic acid with traces of Potassium and Magnesium salt. .Arabic acid has complex polysaccharide structure which upon complete hydrolysis produces following molecules-

Arabinose,

Galactose

Rhamnose,

Gluco-uronic acid

Acacia also contains about 15% moisture and an enzyme Oxidase.

USES

- Acacia is demulcent hence used in Cough, Throat and Diarrhoea preparations.
- Used as Emulsifying agent.
- Used as Binding agent in Tablets and Lozenges
- It finds use in Food, Drug and other industries.

TRAGACANTH (Gum Tragacanth)

Source- Gum Tragacanth is the air hardened gummy exudates, obtained from stems and branches of *Astragalus gummifer* and other species of Astragalus.

Family- Leguminosae

Geographical source- Asia, Greece, Iran, Soviet Union and Syria

CHARACTERS

Appearance- Translucent, flattened ribbons up to 25 mm long, 12 mm wide and 0.5 to 2.5 mm thick. These ribbons are almost curved.

Colour- Colourless or slightly yellow

Odour- Odourless

Taste- very slight

Surface- Number of ridges are present on the surface which indicate the successive temporary stoppage of exudation.

Fracture- Short, tough and horny

Solubility- Only small portion of it dissolves in water but it swells up to form a gelatinized mass. It is insoluble in alcohol.

CHEMICAL CONSTITUENTS

Tragacanth contains mainly two portions-

Water-soluble portion- Tragacanthin (30%)

Water insoluble portion- Bassorin (70%)

(Less the Tragacanthin, better is the quality)

Tragacanthin consists of Tragacanthic acid and a Polysaccharide. (The tragacanthic acid gives Fructose, Galactose, Xylose and Galacto-uronic acid upon hydrolysis. The Polysaccharide yields Arabinose and Galactose). The bassorin is Poly-methoxylated acids. Tragacanth also contains a neutral Polysaccharide, traces of water, Starch, Cellulose and a Nitrogenous substance. Enzyme Oxidase is absent.

USES

- Suspending agent for mixtures containing insoluble powders.
- Emulsifying agent for Oils and Resins
- Adhesive for pills
- Demulcent and emollient for hand lotions
- Used for textile sizing, Cloth printing and Confectionary items

GUAR GUM (Guar flour)

Source- Guar gum is the powdered endosperm of the seeds of ***Cyamopsis tetragonolobus.***

Family- Leguminosae

Geographical source- India, Pakistan and USA

CHARACTERS

Appearance- Pale yellowish white powder

Odour- Characteristic

Taste- Mucilaginous

Taste- Gummy

Solubility- Swells up rapidly, in water, to form a thick colloidal solution.

CHEMICAL CONSTITUENTS

Guar gum has two portions

Water soluble portion……. 85%

Water insoluble portion…...15%

The water soluble portion is high molecular Hydro-colloidal polysaccharide known as GURAN. Chemically it is Galacto-manan containing 30 to 35% Galactose and 60 to 65% Mannose.

Galacto-manan consists of linear chain of 1: 4, β- glycosidal Mannose with 1: 6, α-glycosidal Galactose in the side chain.

Fatty acids in free and ester form have also been reported along with 5 to 7% protein.

USES

- Used as Thickening agent, Binding agent and Disintegrating agent.
- Used in treatment of Peptic ulcer and as Bulk laxative and Appetite suppressant.
- Recent studies show that the guar gum produces changes in gastric emptying time and Gastro-intestinal transition time hence can delay the absorption of sugars and Oligosaccharides. This makes it Hypoglycaemic agent; but this has not been conclusively proved.
- Guar gum also lowers the Cholesterol level. This action is possibly due to its binding action on bile salts.

AGAR (Agar-agar, Japan isinglass)

Source- agar is dried gelatinous hydrophilic colloidal substance. It is obtained by concentrating the decoction of various red algae, particularly of various species of ***Gelidium, Gracilaria and Pterocladi.***

Class- Rhodophyceae

Geographical source- Australia, India, Japan, New Zealand and USA

CHARACTERS

Agar occurs in two forms-

Bundles of somewhat agglutinated translucent yellowish white thin strips 60 cms long and 4 mm wide

Coarse powder or flakes

Agar swells in cold water but very little of it dissolves in cold water. It can only be dissolved by boiling. 1% of its solution sets to stiff jelly up on cooling.

CHEMICAL CONSTITUENTS

Agar is heterogeneous Polysaccharide of two components known as AGAROSE and AGAROPECTIN.

Agarose is polymer of disaccharide called AGAROBIOSE. (Alternate units of 3,6 anhydro L-galactose and D-galactose). It is also known as neutral gel forming agent and is responsible for gel strength of the agar.

USES

- Agar is used to treat chronic constipation.
- It is used as Emusifying agent.
- It is used as Solidifying agent in bacteriological culture medium.
- Agar and Agarose are used in Electrophoresis, gel filtration and Chromatography.

PECTIN

Source- Pectin is purified carbohydrate product. Its riches source is rind of Lemon and Orange; hence it is obtained as by product of citrus canning industry. It is also present in pulp of Papaya, Mango, Guava and Apple

Family- Rutaceae (Lemon and Orange)

CHARACTERS

Appearance- Coarse to fine powder

Colour- Yellowish white

Odour- Odourless

Taste- Mucilaginous

Solubility- Soluble in 20 times of its weight of water. The solution is viscous, opalescent, colloidal and acidic to litmus paper. It is insoluble in alcohol and organic solvents.

One part of pectin upon heating with 9 times of water forms a stiff jelly upon cooling.

CHEMICAL CONSTITUENTS

Pectin consists of partially methoxylated Polygalacto-uronic acid. In side chain are present sugars like D-galactose, L-arabinose, D-xylose and D-fucose. It contains 6 to 7% Methoxyl group and Not Less Than 74% Galacto-uronic acid.

The gelling power of pectin depends upon number of Galacto-uronic acid units or on its Molecular weight; which varies from 1,00,000 to 2,50,000.

USES

- Thickening agent
- Emulsifying agent
- Preparation of Jelly
- Plasma substitute
- Used in Diarrhoea Gastro-enteritis and Ulcer due to its Colloidal and protective nature.

SODIUM ALGINATE

Source - Sodium alginate is sodium salt of Alginic acid, obtained from the walls of brown algae like *Laminaria Sps.* (Kelp), *Macrocystis sps (M. pyrifera) Ascophyllum sps. (A. nodosum).*

Class - Phaeophyceae

G. S. - Atlantic and Pacific Ocean (US, Japan, Canada, Australia, India)

CHARACTERS -

Appearance: Coarse or fine powder

Colour: White or buff coloured

Odour: Odourless

Taste: Tasteless

Solubility: Soluble even in cold water. Upon dissolution in cold water, it forms viscous colloidal solution. Insoluble in Alcohol and organic solvents

Chemical Constituents: Sodium alginate is co-polymer of homo-polymeric blocks.

It contains two uronic acids called D-Mannuronic acid (M) and Guluronic acid (G). Mannuronic acid can form M- block (MMM…) and Guluronic acid can form G-block (GGG…). Combination of two gives MG –block. Molecule of Alginic acid has M & G blocks in it, along with some MG blocks. This gives samples of varying characters. Quality is directly proportional to the proportion of G component.

USES

- Thickening Agent, Suspending agent, Stabilizing agent, Emulsifying agent
- Film forming agent, Gel formation
- Used in skin and dental preparation

OLIVE OIL

(**Synonyms:** Jaitoon-ka-tael, Salad oil, Sweet oil)

Botanical source: Olive oil is obtained from the pulp of ripe fruits of ***Olea europaea*** (An ever green tree with white flowers). Two varieties are extensively cultivated-Variety ***latifolia*** and variety ***longifolia***. Variety longifolia produces best quality oil.

Family: Oleaceae

Geographical source: This tree is native of Palestine. Now it is widely cultivated in Australia, Italy, Spain and United States.

CHARACTERS

Appearance: Pale yellow liquid with greenish tint and having natural fluorescence.

Odour: Slight but characteristics.

Taste: Bland

Specific gravity: 0.915 at 25^0 C

Refractive index: 1.46 at 40^0 C

Other Characters: Upon chilling it tends to be cloudy and becomes whitish granular mass at 0^0 C. It becomes rancid upon exposure to air.

Chemical Constituents: It contains mixed triglycerides of –

Oleic acid (83.5%)
Palmitic acid (9.5%)
Linoleic acid (4%)
Stearic acid (2%)
Arachidic acid (1%)

It also contains Squalene (0.7%) and the Phytosterol and Tocopherol (0.2%) as minor constituents.

USES

- Internally- Used as nutritive (salad oil and cooking medium) and vehicle for parenteral preparations.
- Externally: It is emollient and soothing hence used in Liniments and Plasters
- Used in preparing soap and textile lubricant.

ARACHIS OIL

(**Synonyms:** Ground nut oil, Pea nut oil, Earth nut oil)

Botanical source: Arachis oil is obtained from the ripe seeds of ***Arachis hypogaea.***

Family: Leguminosae

Geographical source: Ground nut is indigenous to Brazil. Now it is extensively cultivated in Africa, China, India and United States.

(**NOTE:** Ground nut oil is third largest source of fixed oil and India produces about 45% of world's production)

CHARACTERS

Appearance: Pale yellow to greenish yellow to colourless.

Odour: Ground nut like.

Taste: Bland and nut like,

Specific gravity: 0.910 to 0.915

Chemical Constituents: It contains mixed triglycerides of –

Oleic acid (50 to 65%)
Linoleic acid (18 to 30%)
Palmitic acid (8 to 10%)

It also contains Small percentage of triglycerides of following acids

Arachidic acid
Stearic acid
Behenic acid
Lignoceric acid

USES

- Arachis oil is used in the same way as Olive oil
- Solvent for I/M injections.
- As an article of food
- For the preparation of hydrogenated oil (Vegetable ghee)
- Emulsion containing 10% oil and 40% glucose is used as intra-gastric drip for nitrogen free diet.
- Used for preparation of Ointments, Liniments and Plasters.

- Used for preparation of soap (Arachis oil gets saponified slowly but gives a firm white soap).

WOOL FAT

(**Synonyms:** Anhydrous Lanolin)

Biological Source: Lanolin is purified wax obtained from the wool of sheep **Ovis aries**

Family: Bovidae

Preparation: Wool fat is secreted by Sebaceous glands present in the skin. This secretion is wax in nature and passes to the wool fibres of the sheep. The raw wool has nearly 25% crude lanolin or Wool grease. From wool, the wool grease is separated by washing with water or organic solvent. The washings are acidified or the organic solvent is evaporated to separate the crude lanolin. The lanolin is now purified by bleaching and centrifugation

CHARACTERS

Appearance: Pale yellow tenacious (Sticky) and unctuous (greasy) almost solid material.

Odour: Slight but characteristics.

Melting point: 34 to 40^0 C

Other Characters: Insoluble in water; Soluble in organic solvents like Acetone, Alcohol and Benzene.

Chemical Constituents: Lanolin contains the mixture of Esters and Polyesters of 33 high molecular weight alcohols and 36 fatty acids.

Alcohols are of three types- Aliphatic, Steroid and Triterpenoid alcohols. Acids are hydroxyl and non-hydroxyl types. Main acids are- Lanoceric, Lanopalmitic, Carnaubic, Oleic, Myristic and Palmitic acids. These acids also occur in Free State also. Lanolin also contains appreciable amount of Cholesterol (30%) and Iso-cholesterol.

Consistency of lanolin is directly related to the molecular weight of acids and alcohols. Liquid Lanolin is rich in low molecular weight branched chain aliphatic acids while waxy Lanolin is rich in high molecular weight straight chain acids and alcohols.

USES

- Lanolin is used as emollient base for ointments and creams as it promotes the absorption of drugs in skin.
- It is also used as base for water absorbable ointment as it can absorb up to 30% water.
- Lanolin is used to prepare Wool alcohols and Hydrous lanolin (Hydrous Wool Fat)

NOTE: During storage Butylated hydroxy Toluene is used as anti-oxidant (up to 200 ppm).

BEESWAX

(**Synonyms:** Yellow Beeswax)

Biological Source: It is purified wax obtained from honey-comb of honey bee ***Apis mellifica (=Apis mellifera)*** and other species of ***Apis.***

Family: Apidae

Geographical source: Africa, France, India, Italy and Jamaica

CHARACTERS

Appearance: Yellowish or Brownish yellow solid

Odour: Honey like

Taste: Characteristic, some -what honey like

Specific gravity: 0.938 to 0.970

Refractive index: 1.4380 at 1.4420

Melting Point: 62 to 64^0 C

Fracture: Granular fracture

Other Characters: Upon chilling it becomes brittle. It is insoluble in water, soluble in hot Alcohol and in ether, Chloroform, Carbon tetrachloride, fixed oils and volatile oils.

Chemical Constituents: It contains mainly the esters of straight chain Fatty acids with straight chain Monohydric alcohols.

Alcohols are even numbered monohydric alcohols having carbons 24 to 36. Main alcohol is Myricyl alcohol $C_{30}H_{61}OH$. The fatty acids are also having even number of carbon atoms (up to 36 carbons). Main acids are Palmitic acid $C_{15}H_{31}COOH$ and Cerotic acid $C_{25}H_{51}COOH$.

Main constituent is Myricin. It is in about 80% proportion, Chemically it is Myricyl-palmitate. ($C_{15}H_{31}COOC_{30}H_{61}$)

It also contains free wax acid called Cerotic acid ($C_{25}H_{51}COOH$) and its homologues. It also has small percentage of moisture, an aromatic substance Cerolein, pollen grains and bee glue called Propolis.

Pollen grains and the bee glue are responsible for the colour of the beeswax

USES

- Beeswax is used to prepare Ointments, Plasters and Polishes
- It is also used for hardening of soft ointments.
- It also finds use for preparation of White beeswax by bleaching in Sunlight or by chemicals.

KAOLIN

(**Synonyms**: China Clay, Kaolinite

Kaolin is purified Aluminium silicate obtained from native Kaolin by elutriating process. The native Kaolin is produced by the weathering of Felspar granite (Pot. Alumino-silicate).

Geographical source: Mainly in South Eastern United State, England, France and India.

In medicine following two types of Kaolins are extensively used-

Natural light Kaolin- In this Kaolin particle size does not exceeding 3 µ. (75 to 90% particles)

Heavy Kaolin- Particle size is up to 20 µ. These particles do not show Brownian movement.

Light Kaolin- It is Natural Light Kaolin containing suitable dispersing agent.

CHARACTERS

Appearance: Very fine soft clay, crumbling to fine powder upon pressing between fingers

Colour- White or very faintly grey brown or yellow tinged.

Feel: Slightly soapy to touch

Odour: Odourless (develops clay like odour when moistened)

Taste: Very slightly earthy taste.

Size: 10 to 60 µ.

Density: 2.3

Solubility: Insoluble in water, dil. acids and dil. alkalis. Conc. HCl decomposes it partially while prolonged boiling with Conc. H_2SO_4 decomposes it into insoluble silica and Aluminium sulphate.

MICROSCOPY

Medicinal Kaolin has particle size from 2 to 20 µ. The fine particles have various shapes while the bigger particles are usually flat and irregularly angular.

CHEMICAL NATURE

Kaolin is almost pure Aluminium silicate represented by formula $Al_2O_3.2SiO_2.2H_2O$.

USES

- Used as adsorbent to treat Gastro-enteritis, dysentery, alkaloidal and food poisoning.
- Used externally as dusting powder and as filtering aid.
- Heavy Kaolin (up to 60 µ) is used in Kaolin Poultice.

GELATIN

Gelatin is protein derivative (Sclero-protein or Albuminoid); which is obtained by evaporating the purified extract of skin, bones, tendons and ligaments derived from Sheep ***(Ovis aries)***, Pig (***Sus sacrofa***) and Ox (***Bos taurus***).

Family: Bovidae (Sheep and Ox); Suidae (Pig)

CHARACTERS

Appearance: Thin translucent sheets, shreds or granular powder

Colour: Colourless or very slight pale yellow or amber coloured

Odour: Odourless or slight Characteristic odour

Taste: Tasteless or slight characteristic taste

Fracture: Short, hard and brittle

Solubility: Gelatin swells up in cold water but it dissolves in hot water. Gelling property is

lowered/destroyed upon excessive boiling. 2% solution, upon cooling; sets to a jelly. Soluble in Acetic acid and Glycerin. Insoluble in Ether and Alcohol.

CHEMICAL CONSTITUENTS

Gelatin consists of protein GLUTIN.

USES

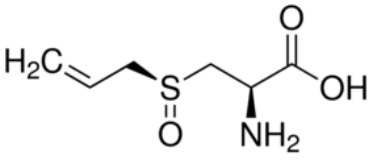
- Gelatin is a **Pharmaceutical-aid**. It is used in preparation of Absorbable gelatin sponge, Capsule shell, Pastes, Pessaries and Suppositories.
- It is also used in Bacteriological culture medium and in pill coating.

TESTS

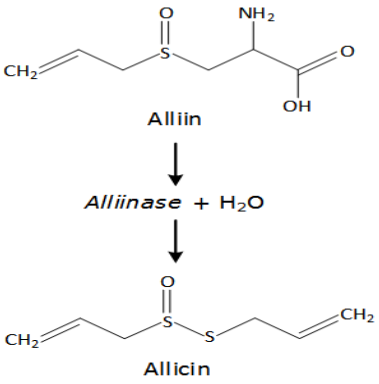
- Heat Gelatin, in a dry test tube; with soda lime- NH_3 evolves (due to presence of Nitrogen, which is about 18%)
- Prepare solution of gelatin by boiling 0.5 g gelatin in 100 ml water. Perform following tests with this solution-
- To few ml solution add few drops of Tannic acid solution- White buff colour gets produced which does not dissolve upon heating.
- To few ml solution add few drops of Millon's reagent- White precipitate is produced which turns red upon heating.
- To few ml solution, add few drops of Picric acid solution; drop wise- Yellow coloured precipitate gets formed.

5c. Miscellaneous
GARLIC (Lashun)

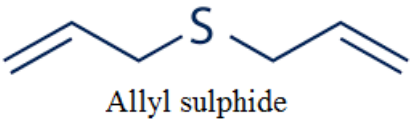

Botanical Source: Garlic consists of ripe bulbs of *Allium sativum.*
Family: Liliaceae
Geographical Source: Garlic is cultivated in India, Italy, Russia and US.
CHARACTERS
Appearance: The bulb consists of a central main bulb which is ovate in shape and is surrounded by 6-15 secondary bulbs. Both main and secondary bulbs are surrounded by white membranes
Odour; Aromatic, Alliaceous and Characteristic
Taste: Alliaceous and Pungent
CHEMICAL CONSTITUENTS
Garlic contains 'Alliin' which is water soluble sulphur containing compound.
Upon crushing or distillation, it changes to 'Allicin' by the action of an enzyme called Alliinase. In presence of water and oxygen, the allicin changes to Polysulphides; which are responsible for unpleasant smell.
In humans, this degradation is responsible for smell in the exhaled air.



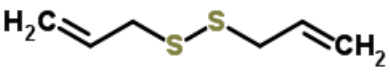
Alliin



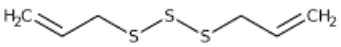
USES
Garlic lowers blood cholesterol level hence used in B. P and Atherosclerosis.
Used in indigestion and intestinal infections.
Bacteriostatic
Used as spice for seasoning of soups, sauces and pickles.
Garlic is Stimulant, Diaphoretic, Expectorant, Diuretic and Tonic.
It is Anthelmintic, Emmenagogue and also had Anti-fertility effect (due to Oxytocic effect0
It is used in Rheumatic and Catarrhal conditions and also found to be useful in Diabetes and Leprosy.
It is effective mosquitocide and pesticide and externally found to be Rubefacient.
Incorporation of Garlic, in diet; in moderate amount, is likely to shift the balance of g.i.t. micro-flora in favour of Lactobacillus hence favouring absorption of dietary minerals.



Allyl sulphide



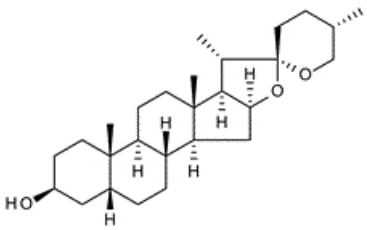
Diallyl disulphide



Allyl trisulphide

SHATAVARI
Botanical Source: Dried tuberous roots of *Asparagus racemosus.*
Family: Liliaceae
Geographical Source: India, Himalayan and Sub-Himalayan region up to the height of 1300-1400 mtrs.
CHARACTERS
Appearance: Plant of Shatavari is perennial shrub. The stem is covered with recurved spines and linear green, needle like leaves

The root has following characteristics
Shape: Cylindrical, swollen in the middle, tapering towards base
Size: 5 to 15 cm long and 1 to 2 cm in diameter.
Colour: White to buff
Taste: Bitter
Other Characters: When soaked in water, the root becomes soft and swells considerably.
CHEMICAL CONSTITUENTS
Satavari contains 0.1 to 0.2% steroidal saponin I to IV. These saponins have Sarsapogenin as aglycone but differ in sugar part.
USES
Anti-oxytocic activity, hence used as cure for threatened abortion and safe delivery. Also has Galactogogue activity.



Sarsasapogenin

SHANKHPUSHPI (Vishnukranti)

Botanical Source: Shankhpushpi consists of whole dried herb called *Convolvulus pluricaulis.*
Family: Convolvulaceae
Geographical Source: It is found growing wildly in plains of North India and Bihar
CHARACTERS
Stem and Leaves: The herb is procumbent (Prostrate) and has woody stem at its base. The leaves are Linear, Elliptical and Sub-sessile which have trichomes on their both surfaces.
Flowers: Flowers are Short, Axillary, Solitary or 2-3 together. These have white, rose or purple colour.

CHEMICAL CONSTITUENTS
Shankhpuspi contains alkaloid Shankhpushpine. It also hag Flavonoids, Starch and Inorganic salt KCl.
USES
Nervine Tonic, hence used in Epilepsy, Insanity and Nervous debility.
NOTE: Evolvulus alsinoides of family Convolvulaceae is also considered Shankhpushpi.

Liquorice (Glycyrrhiza)

Botanical Source: Liquorice consists of dried peeled or unpeeled underground Roots and Stolons of *Glycyrrhiza glabra*
Family: Leguminosae
Geographical Source: Baluchisatan, England, India, Russia and Spain

Liquorice Root

CHARACTERS

Shape: Unpeeled pieces are cylindrical while peeled pieces are angular

Size: Up to 20 cms or more in length and 0.5 to 2.0 cm in dia (Liquorice root can grow up to 04 meters depth, in soil.)

Colour: Unpeeled pieces are reddish brown while peeled pieces are pale yellow

The stolon pieces have buds, scale leaves and scar of lateral roots.

Outer surface: Unpeeled have longitudinal wrinkles while peeled have fibrous surface.

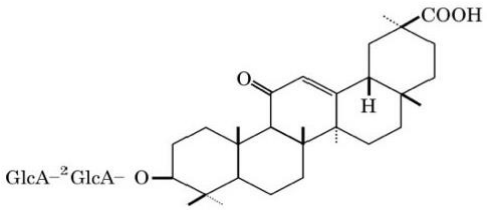
Taste: Sweet, very faintly acrid

Odour: Faint and Characteristics

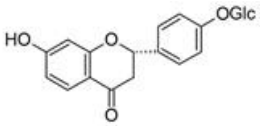
CHEMICAL CONSTITUENTS

Liquorice contains 5 to 8% sweet saponin glycoside called GLYCYRRHIZIN. It is 50 times sweeter than sucrose. It is mixture of Pot. And Cal. Salts of GLYCYRRHIZINIC ACID. The glycyrrhizic acid is a glycoside which upon hydrolysis yields two molecules of Glucuronic acid & one molecule of GLYCYRRHETINIC acid (Glycyrrhetic acid). Liquorice also contains glycosides Liquiritin and Isoliquiritin. These have Liquiritigenin as aglycone.

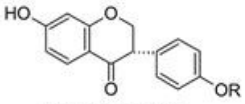
Liquorice also contains Sucrose and Starch.



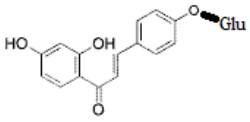
Glycyrrhizinic acid



Liquiritin



Isoliquiritin R=Glc
Isoliquiritigenin R=H



Isoliquiritin

USES

Demulcent, Expectorant, Anti-spasmodic, Anti-ulcer, Anti-inflammatory diuretic and Sweetening agent.

Liquorice potentiates the laxative action of senna and is also used in fire-extinguishers due to its frothing property.

PYRETHRUM

Botanical Source: Pyrethrum consists of dried flower heads of Chrysanthemum cinerarifolium

Family: Compositae

Geographical Source: Mainly Kenya, Rwanda, Tanzania Ecuador Brazil and India.

Chrysanthemum cinerarifolium

CHARACTERS

Appearance: Flower head is 06 to 12 mm in dia.

Peduncle: Short and longitudinally striated.

Involucre: It is present as 02 to 03 rows of yellowish or greenish yellow lanceolate hairy bracts with membranous margin.

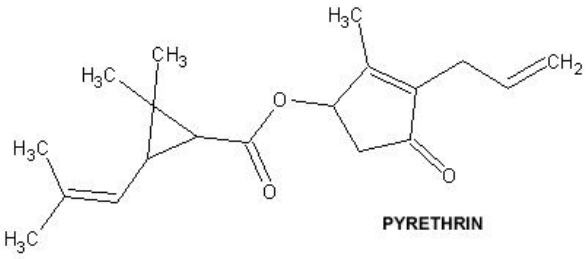
Receptacle: Flat, bearing numerous yellow tubular florets and a single row of cream or straw coloured ligulate florets
Ovary: Inferior and 05 ribbed
Taste: Bitter and Acrid

CHEMICAL CONSTITUENTS

Pyrethrum consists of 01 to 02% esters known as PYRETHRINES. Pyrethrines are mixture of esters of Chrysanthemic acid and Pyrethric acid.
It also has keto alcohols called PYRETHROLONE and JASMOLONE
All esters are yellowish oily liquid and are unstable in air (Due to presence of unsaturation)

USES

Contact poison for flying insects like Flies and Mosquitoes. It is also an effective poison for Cockroaches, Lice and Bugs.
It is used in form of Dusting powder, Sprays, Aerosols and Spiral fuming coils.
Internally it is Anthelmitic for Ascaris worm.



PYRETHRIN

LINSEED

(Syn: Alsi kae beej, Flax seeds)
Botanical Source: Linseed consists of dried ripe seeds of Linum Usitatissimum.
Family: Linaceae
Geographical Source: Linseed is indigenous to India. It is grown for its fiber and oil yielding seeds. Now it is grown world over especially in Russia, Greece, Spain, Italy and Afghanistan.

CHARACTERS

Appearance: Linseed is annual erect plant attaining height up to 04 feet. It has bluish green coloured slender, lanceolate leaves, pale blue or red coloured flowers and dry capsular fruit. The seeds yield a viscous fixed oil and have following characters
Shape: Seeds are oval, flatted and elongated. These have one end as rounded while other end is obliquely pointed.
Size: 04 to 06 mm long; 02 to 03 mm wide
Colour: Reddish brown
Extern ()al Surface: Smooth, hard, glossy and minutely pitted
Odour: Odourless
Taste: Oily and mucilagenous
Other Characters: Hilum is present at pointed end; micropyle is present in the depression of this end. Raphe is present along one edge while endosperm is narrow and encloses embryo.

CHEMICAL CONSTITUENTS

Linseed Contains fixed oil (30 to 40%) Protein (25%) mucilage (06%) along with enzyme Lipase and

USES

Linseed is source of Omega-3-fatty acids for vegetarians
Oil obtained from seeds is Emollient, Demulcent, Expectorant, Diuretic and Laxative
Oil is used as base for lotions and liniments
Mucilage is also used as demulcent in Cough, Cold and Bronchitis
Mucilage is an effective Anti-inflammatory in Urinary tract Infections, Gonorrhoea and Diarrhoea

5d. Collection and preparation of crude drug for the market as exemplified by Ergot, opium, Rauwolfia, Digitalis, Senna.

CULTIVATION, COLLECTION AND PREPARATION OF DRUGS

Most of the drugs are still collected from wild sources. Collection from wild source poses following problems-

- Difficulty in collecting (Difficult terrain and sparsely spread)
- Quality and quantity not as desired
- Skilled labor can not be employed for collection (Cost consideration)
- Immediate drying is not possible

Cultivation of drug avoids these problems and also improves quality and quantity due to following reasons-

- Cultivation of desired Sps. Variety or hybrid
- Optimum preparation of field
- Timely use of Fertilizers/manure and pesticides/insecticide
- Immediate processing by skilled works

Collection helps in improving quality in following way

- Timely collection (When active constituents are maximum)
- Consideration of season, stage of development, condition of plant part (affected by fungus/insects) and environment conditions (Rain/dew drops, moisture in air, strong wind)
- Collection and processing by skilled workers

Preparation for market

Collected drugs have active constituents. Therapeutic activity is due to these constituents; hence these should remain intact till drug is used. This help in exerting desired degree of action. So drug is processed or prepared for market in a way so as to maintain these constituents and also to provide pharmaceutical elegance to the drug. Common processing steps are-

- **Washing:** to remove adhering soil (Usually the underground parts)
- **Removal of undesirable parts:** It reduces foreign organic matter and also reduces bulk and weight of drug
- **Peeling and Slicing:** These help in drying
- **Drying:** Reduces weight and bulk. Helps avoiding hydrolysis of active constituents and attack by fungus and insects. Temperature of drying, duration of drying and mode of drying- all are important.
- **Preservation**: Suitable preservative is added so as to prevent attack by fungus/insects

SENNA

Leaflets of *Cassia acutifolia* (Alexandrian/Egyptian senna) *C. angustifolia* (Tinnevelly senna)

Family: Leguminosae

Leaflets: Pinnate compound leaf (Uni-pinnate, Bi, Tri, Tetrapinnate: Peripinnate, Imperipinnate)

Palmate compound leaf (Unifoliate, bi, tri, quadrifoliate, Multifoliate)

Senna requires red loamy soil (Red-Siliceous and aluminous with high Potassium: Loamy Sand: Silt: Clay:: 40:40:20). Seeds are sown in Feb.-March by Broadcasting method and thin sowing.

(Seeds are abraded using sand so early germination occurs)

Second sowing is possible in October-November

Light irrigation is preferred as water logging and low temp harm the crop. (Temp less than 10- plant dies)

Nitrogen fertilizer is required as senna is not having root nodules.

In about 2-3 months, the leaves are ready for collection. Leaves which are fully grown and bluish green are hand plucked.

Second plucking is done after one month.

Third plucking is done after 30 to 45 days when even pods (Fruits) are collected. Plant is now uprooted.

Active constituents decrease as the plant matures.

Leaves are dried in shade, as thin layer for 7-10 days. Shade drying helps in preserving green color and also maintains flexibility.

Pods are separated using sieves

Packed in bales using pressure. This leads to pressure markings (transverse and oblique lines) on the surface of leaves.

DIGITALIS

Digitalis is a biennial/perennial herb. It grows wild but good quality of drug can be obtained from cultivated plants; hence it is grown as biennial herb.

Plant grows in well drained loose soil. Plants growing in sunny condition produce more active constituents compared to plants growing under shade.

Seeds of digitalis are very small and light. These are mixed with sand and can be sown by broadcasting method. Germination of its seeds is not certain hence seedlings are prepared in nursery beds. Seeds selected for seedlings are special seeds and produce disease free plants. The seedlings are transplanted in fields at 6-9 inches distance, in the month of May.

The plants are inspected periodically for absence of attack by diseases and insects. Irrigation is must during dry season.

In first year, the plants grow a long stalk bearing rosette of leaves. These leaves are collected from September to November. The leaves are hand plucked. This helps in avoiding foreign organic matter and discoloured leaves. Leaves are immediately dried at temperature NMT 60^0 C till residual moisture is NMT 5%.

Drying chambers, in which leaves are dried, have automatic temperature and humidity control. Rate of collection is so kept that it matches the drying capacity. This also helps in maintaining the continuous supply of the leaves.

In 2^{nd} year, plant bears flowers and seeds. In second year leaves are collected only from those plants from which seeds are not to be collected. These leaves are comparatively inferior. Seeds are collected and immediately used for sowing as fresh seeds give better percentage of germination.

OPIUM

Air dried milky exudate from the capsules of *Papaver somniferum* (Papaveraceae)

India, Bulgaria, Persia, Turkey and Yugoslavia

CULTIVATION

For cultivation of opium permission of Govt. is required. Plant prefers rich, porous alluvial soil. Bright sunshine and use of fertilizers helps in increasing the qty. of Opium

In India seeds are sown in November by broadcasting method. Seeds are very small hence mixed with 3-4 times sand before sowing. After germination the plants are thinned so that each plant gets space for branching and grow to a height of about 1.5 meter.

Flowering starts by end of May. Each plant bears 5-8 capsules. These capsules are ready for incision after about 02 weeks of fall of petals and it turns yellowish from bluish green. Incisions are given in June/July. The time selected for incision is sunny afternoon when rain/dew drops are not present and day is not windy. Capsule is held in the left hand and incision made using NUSHTUR. Nushtur has 3-4 blades held at distance of 03mm and has projecting teeth of about 02mm. Incision is made longitudinally from below upwards. Incision is repeated at interval of 2-3 days till exudation stops (Usually 3-4 times). Now plant is not shaken and path is not retraced so as not to shake off the drops of latex from the capsule.

Next morning the hardened latex is collected in a small copper instrument shaped like a tray. This opium is now transferred to a tilted vessel where a thick deleterious liquid separates.

The thick liquid is decanted off and opium mixed well to get homogeneous mass. It is dried by exposing to the air till it gets desired consistency and moisture content. It is now turned into cubes and stored for further use.

In Yugoslavia and Bulgaria, horizontal incision is given which is equatorially around the capsule. Next morning latex is collected in tins lined with opium leaves, each holding about 750g opium.

ERGOT

Ergot is dried SCLEROTIUM of fungus *Claviceps purpurea* developing on the ovary

of food grain plant *Secale cereal* (Fam. Gramineae)

Family: Clavicipitaceae

Geographical source: India, Portugal, Russia and Spain.

LIFE CYCLE OF *CLAVICEPS PURPUREA*

Life cycle of this fungus has three stages

- Sphacelia or Honey dew stage
- Sclerotium or resting stage
- Ascospore stage

Sphacelia or Honey dew stage

Rye plant bears flowers by the end of spring season. During this time the ASCOSPORES ofthis fungus are carried to the spikes of plant by wind or insects. These spores settle to the base of ovary and start growing. By enzymatic action these enter the wall of ovary and form a soft white mass of filamentous hyphae callec SHACELIA. This mass secretes a sweet, viscous yellowish liquid called HONEY DEW. Several conidiospores come out of hyphae and enter this sweet liquid. Insects gets attracted to this fluid and help spreading the infection to nearby plants.

Sclerotium or resting stage

The hypae spread further and penetrate deeper in the ovarian tissue. These consume the ovarian tissue and attach to the vascular tissue for the nutrition. The ovary gets replaced by a dark purple, compact Pseudo-parenchymatous tissue called SCLEROTIUM. In summer, the sclerotium increases in size and protrudes out of the spike. The sclerotium has remains of Sphacelia on its apex. It may get collected along with grains or may fall on the ground. The sclerotium has alkaloids of medicinal importance.

Ascospore stage

The sclerotium which falls on the ground stays dormant till next spring season. Now it develops to produce upright stalks having globular head called STROMATA. Each stromata has many flask like structures called PERITHECIA. Each perithecia has many sacs each having 08, thread like ASCOSPORES. These ascospores are carried to the spikes of rye plant to start the life cycle again.

To produce ergot commercially, the ascospores are grown on nutritive medium. These produce conidiospores. From these conidispores will prepare the suspension and use it to infect the spikes of rye plants, manually or mechanically.

The sclerotium develops in due time and collected from fields in June/July. It is then dried to remove extra moisture and packed in air-tight containers.

CHARACTERS (of Sclerotium)

SIZE: 01 to 04 cm long; 02 to 07 mm wide

Shape: Slightly curved, Sub-cylindrical, fusiform or tapering at both ends.

Colour: Purplish brown to almost black

Outer Surface: Longitudinally furrowed with occasional transverse cracks

Odour: Characteristic

Taste: Unpleasant

CHEMICAL CONSTITUENTS

Ergot has six pairs of alkaloids. All are indole alkaloids. One pair is water soluble while other five pairs are water insoluble.

Each pair has one active alkaloid (Laevorotatory) and other inactive alkaloid (Dextrorotatory)

This are-

Active (LAEVOROTATORY)	Inactive (DEXTROROTATORY)
WATER SOLUBLE	
Ergometrine Group	
Ergometrine	Ergometrinine
WATER SOLUBLE	
Ergotamine Group	
Ergotamine	Ergotaminine
Ergosine	Ergosinine
Ergotoxine Group	
Ergocristine	Ergocristinine
Ergocriptine	Ergocriptinine
Ergocornine	Ergocorninine

Sclerotium also contains 30-40% fixed oil. It contains about 01% Ergosterol and other sterols. It also has many Amino acids. Cell wall of sclerotium is made up of CHITIN.

USES

Ergometrine has Oxytocic activity. It causes strong contraction of uterine muscles so used to help in delivery and to reduce post-partum hemorrhage. Other alkaloids are used in migraine and certain nervous disorders.

SARPGANDHA

Rauwolfia commonly called Sarpagandha is an important medicinal plant distributed in the foot-hills of Himalayan range, up to the elevation of 1300-1400 m. and almost throughout all over the country. It is an erect evergreen, perennial under-shrub, 75 cm to 1 m. in height. Root is prominent, tuberous, usually branched, 0.5 to 2.5 cm in diameter, Up to 40 to 60 cm deep into soil. The root possesses high alkaloid concentration.

CULTIVATION:

SOIL AND CLIMATE

The plant requires slightly acidic to neutral soils for good growth with medium to deep well drained fertile soils. Clay-loam to silt-loam soils, rich in organic content are suitable for its commercial cultivation. It grows well in frost-free tropical to subtropical situations under irrigation. The crop can be propagated by seed, stem cutting and root cuttings. Seed propagation is the best method for raising commercial plantation.

SEED GERMINATION

Seed germination in Rauwolfia is highly variable. It is reported to vary from 5 to 30 percent even when only heavy seeds are chosen for sowing purpose. Light and heavy seeds can easily be separated by simple water flotation. Germination of heavy seeds during May-June after soaking them in water for 24 hours was 20-40 percent and 62.77 percent germination was recorded in freshly collected heavy seed lot. In all, 6 kg of seeds are sufficient to raise one-hectare plantation.

MANURES, FERTILISERS AND PESTICIDES

The medicinal plants have to be grown without chemical fertilizers and use of pesticides. Organic manures like, Farm Yard Manure (FYM), Vermi-Compost, Green Manure etc. may be used as per requirement of the species. To prevent diseases, bio-pesticides could be prepared (either single or mixture) from Neem (kernel, seeds & leaves), Chitrakmool, Dhatura, Cow's urine etc.

IRRIGATION

Rauwolfia, if grown in areas which receive rainfall of 150 cm or above well distributed throughout the growing season such as in Assam and Kerala, can be raised and rain fed crop under subtropical conditions. It needs regular irrigation where temperature rise high combined with low rain fall during rainy season. It is suggested that 15 to 16 irrigations, amounts to irrigation at 20 days interval in summer and at 30 days interval in winter.

WEEDING

The Rauwolfia field should be kept relatively weed-free in the initial period of growth. This means giving two to three weedings and two hoeings in the first year where sole Rauwolfia crop is taken or 5-6 weeding where intercrops in Rauwolfia are practiced.

HARVESTING/POST-HARVESTING

Root yields at different age and season have showed that 18 months duration crop produce maximum root yield. Transplanting is done in July; the harvesting period coincides with the shedding of leaves during early autumn season next year. At this stage, the roots contain maximum concretion of total alkaloids. At harvest the root may be found to go up to 40 cm deep in the soil. Harvesting is done by digging up the roots and thin roots are also collected.

After digging the roots are cleaned, washed and cut into 12 to 15 cm pieces for convenience in drying and storage. The dry roots possess up to 8-10 per cent of moisture. The dried roots are stored in polythene lined gunny bags in cool dry place to protect it from mould.

5e. Study of source, preparation and identification of fibres used in sutures and surgical dressing's cotton, silk, wool and regenerated fibre.

FIBRES

Botanically the fibres are very long cells having length many more times than their breadth. Usually these have thick walls with narrow lumen. Thickening on walls may be to the extent that cavity is almost oblitered. Fibres usually occur as bundles and provide mechanical strength to the plant.

Plant fibres are mainly composed of cellulose. Cell walls contain lignin, hemi-cellulose, pectic substance, resin, mineral material fat and waxes.

Animal fibres contain mainly protein while synthetic fibres are derived from cellulose, animal protein and petrochemical products.

Fibres are mainly used as Surgical dressings, Filter medium and for heat and fire proofing.

Surgical dressings mean all those MATERIALS, which are **USED TO COVER THE**

Classification of FIBRES

Fibres can be natural, regenerated or manmade. Examples are-

Natural:

Vegetable or plant fibres:

Cotton (Gossypium herbaceum; Malvaceae)
Jute (Corchorus capsularis; Tiliaceae)
Hemp (Cannabis sativa; Cannabinaceae)
Flax (Linum usitatissimum; Linaceae)

Animal fibres

Silk (Bombyx mori; Bombycidae)
Wool (Ovis aries; Bovidae)

Mineral fibres

Glass wool

Asbestos

Regenerated fibres:

Regenerated from carbohydrate material

Viscose rayon or acetate rayon (Artificial Silk)
Cellulose wadding
Alginate yarn

Regenerated from protein material

Fibrolin (From milk casein)
Aridil (From Ground nut protein)

Synthetic fibres

Nylon
Terylene
Orlon
Polyester

PLANT FIBRES

COTTON, Raw Cotton

Botanical Source: Cotton consists of Epidermal trichomes or hairs of the seeds of *Gossypium herbaceum and other cultivated species of Gossypium like G. hirsutum, G. barbadense.*

Family: Malvaceae

Geographical Source: USA, Egypt and India

PREPARATION

Cotton plant is a shrub. It produces 3 to 5 celled capsules. Each capsule contains several seeds. Seeds covered with its hairs, is known as BOLLS. When ripe, the bolls are collected and subjected to a process known as GINNING. This process removes long hairs from seeds and the short hairs remain attached to them. These short hairs are removed by second GIN known as LINTERS.

Seeds thus remaining are used to produce cotton seed oil and the oil cake (Cattle feed) while short hairs are used to produce low quality cotton wool and the rayon. Long hairs are used to spin yarn.

Length of cotton hair is known as STAPLE. Length less than 25 mm is known as short staple. 25 to 30 mm is medium staple, while length longer than 30 mm is long staple. Very fine yarn can be spun by using only the long staple (Sea island cotton yarn has staple length up to 54.5 mm). the yarn thus produced is referred as COMBED YARN and the machine used for this purpose is known as cotton combing machine. This machine separates all short fibres and spins the yarn using only long, uniform, well paralleled fibres. (The short fibres separated by combing machine, are used to produce, the best quality cotton wool).

The machine using short and less uniform fibres is known as CARDING MACHINE. The yarn thus spun, is known as CARDED YARN which has irregular arrangement of

fibres, the ends of which usually project from the surface of yarn.

CHARACTERS

Cotton occurs as white, soft, fine, filament like hairs, it is odourless and tasteless

MICROSCOPY

Cotton consists of unicellular, non-glandular hairs, resembling empty, flattened, twisted fire hoses.(Cotton hair is Cylindrical, when young; but becomes flat and twisted, as it matures).

Length: up to 50 mm

Diameter: from 9 to 24 µ

Number of twists-

Indian: 150 twists/inch

Sea Island: 300 twists/inch

Apex is rounded and solid.

Lumen is large and elongated

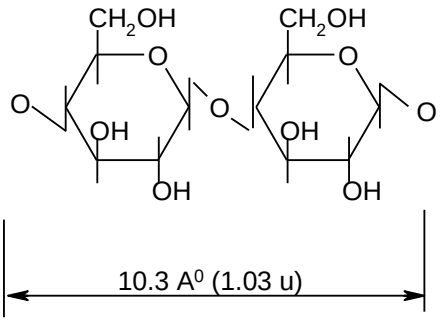
Each hair is covered with thin waxy cuticle, which makes it Non-absorbable.

The fibre swells at right angle to long axis and also has tensile strength along the long axis.

CHEMICAL NATURE

Raw cotton consists of 90% cellulose, nearly 7% moisture and remaining is Wax, Fat, Remains of Protoplasm and Sand.

Absorbent cotton consists of up to 94% cellulose 6 to 7% moisture and very little of sand.



Cellobiose

Cellulose molecule is made up of glucose molecules linked by 1,4 β-glucosidic linkage. It is a polysaccharide composed of elongated chain like molecules, which are repeating units of CELLOBIOSE and are oriented in spiral manner.

ABSORBENT COTTON WOOL

Absorbent cotton wool is also known as COTTON WOOL or ABSORBENT WOOL. It is prepared from comber waste and cotton linters. Comber waste gives best quality cotton wool.

The comber waste is loosened using machines and heated with dilute caustic soda (NaOH) and soda ash (NA_2CO_3) solution at 1 to 3 atmospheric pressure for 10 to 15 hrs. This removes much of waxy cuticle and colouring matter. It is then washed with water and then bleached using dil. Sodium Hypochlorite solution (NaOCl). It is then treated with dil. HCl, it is then washed, dried and changed into continuous sheets of fairly even thickness. Several such layers are super imposed and packed in paper as rolls

USES

- Cotton is used as Surgical dressing (Absorbs blood, mucus, pus and protects wound from infection)
- It is also used as filtering medium.

ANIMAL FIBRES

WOOL

Source: Wool fibres are obtained from fleece of sheep Ovis aries

Family: Bovidae

Geographical source: Argentina, Australia, Russia, USA and India.

PREPARATION

The hairs forming the fleece of sheep are removed at shearing time. Wool fat and dirt are removed. Hairs are now subjected to bleaching, washing and drying.

CHARACTERS

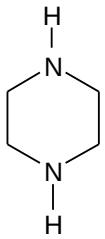
Wool hairs are smooth, elastic, lustrous, curly, hygroscopic and slippery to touch Wool hairs have tendency to cling together. Wool is insoluble in 66% H_2SO_4, Conc. HCl and Cuoxam solution.

MICROSCOPY

Wool hairs are from 2 to 50 cms in length and from 5 to 100 µ (Usually 13 to 40µ) in Diameter. The tapering ends (also known as 'Lamb ends) are found only in 1st shearing. Under high power, the hair shows three distinct region, known as CUTICLE, CORTEX and MEDULLA

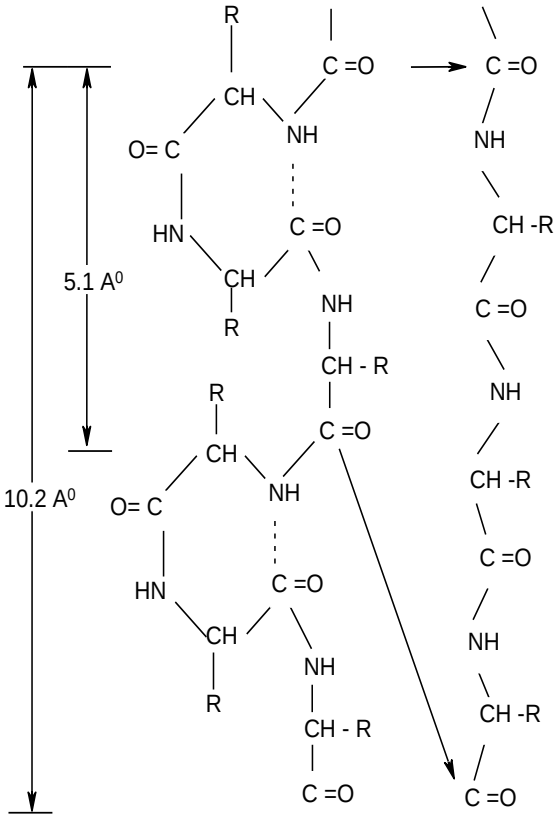
CHEMICAL NATURE

Wool fibres are composed of protein Keratin. This protein has elasticity, due to reversible, intra-molecular transformation of fibre substance α-keratin to β- keratin and back. The α-keratin is stable substance while β- keratin is its unstable form.



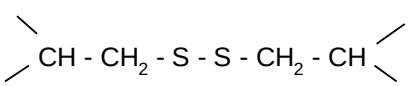
Piperazine

The α- keratin has pseudo diketopiperazine ring which opens reversibly to form unstable β- keratin; hence expanding to double its original length. This explains the elasticity of wool. Protein Keratin is rich in Cystine which joins the adjacent polypeptide chain as shown.



a-Keratin
(Stable)

B-Keratin
(Unstable)



Cystine

USES

Wool is used to prepare domette crepe bandages and flannel.

Used as filtering and straining medium.

SILK

Biological Source: Silk is obtained from cocoon of mulberry silk worm, Bombyx mori; other species of Bombyx and that of Antheraea (In India mainly A, myllita and A. assama are reared.

Family: Bombycidae

Geographical Source: China, France, India, Italy and Japan.

PREPARATION

While passing from caterpillar (larva stage) to pupal stage, the worm secretes a 2.5 to 5 cm long oval cocoon around itself. Cocoon consists of about 1200metre continuous long thread. The thread consists of two silk or fibroin fibres, glued together by a layer of silk glue called SERICIN. This double fibre of cocoon is known as BAVE while constituent threads are called BRIN.

The insect, inside the cocoon, is killed by exposing to 50 to 60^0 C using steam. The cocoon is placed in hot water and beaten. This removes the outer layer and softens the silk glue.

The raw silk is reeled by taking loose ends of bave from 2 to 15 cocoons (usually 5 cocoons) and twisting these into single thread. The sericin (Silk glue) is removed by treatment with hot soap solution or dilute Na_2CO_3 solution. This process is named as STRIPPING or DEGUMMING

CHARACTERS

Silk thread is very fine, solid, smooth and usually yellow coloured. Silk is soluble in Cuoxam solution, 66% Sulphuric acid and conc. HCl.

MICROSCOPY

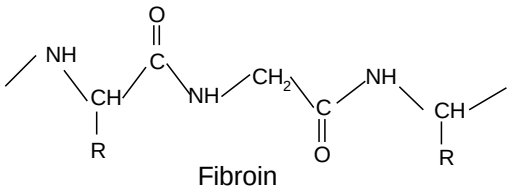
Upon mounting in water, the raw silk shows number of brins, devoid of any cellular structure The sericin (Silk glue), if present can be removed by treatment with hot soap solution or dilute Na_2CO_3 solution. This removes the glue completely and constituent brins becomes very clear and can be counted.

The brins of mulberry silk measures 10 to 21µ (usually 16µ) while wild silk measures 30 to 60µ. The wild silk also shows well marked longitudinal striations.

CHEMICAL NATURE OF SILK

Silk is composed of a protein called FIBROIN. This protein, upon hydrolysis yields Amino acids- GLYCINE and ALANINE. Serine, Tyrosine and other amino acids have also been reported.

Fibroin actually consists of repeating units, each being 7.0 A^0 long (0.7µ). this unit is actually two fully extended amino acids as shown.



Fibroin

$H_2N - CH_2 - COOH$

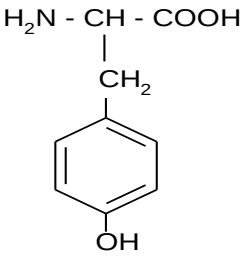
Glycine (44%)

$H_2N - CH(CH_3) - COOH$

Alanine (27%)

$H_2N - CH(CH_2OH) - COOH$

Serine (11%)



Tyrosine (5%)

USES

Silk is used to prepare special type of Sutures, Ligatures and Sieves.

5f. Gross anatomical studies of Senna, Datura, Cinnamon, Cinchona, Fennel, Clove, Ginger, Nux vomica & Ipecacuanha.

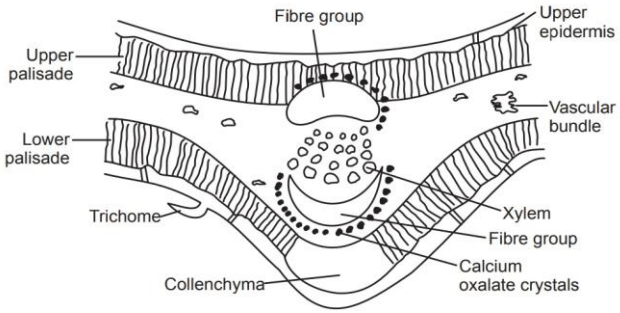
GROSS ANATOMY

ANATOMICAL STRUCTURE OF SENNA LEAF

Botanical Source: Senna consists of dried leaflets of *Cassia acutifolia (Cassia senna)* known as **Alexandrian senna** and leaflets of *Cassia angustifolia* known as **Tinnevelly senna.**

Family: Leguminosae

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 following structure-

Epidermis: These are two- Upper and lower epidermis with straight wall cells, few of which contain mucilage. Paracytic stomata and non-lignified unicellular trichomes are found on both the surfaces.

Palisade: 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.

Spongy Parenchyma: Palisade is followed by spongy mesophyll which contains cluster crystals of calcium oxalate and vascular strands.

Midrib: 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. Below the midrib is the collenchyma.

CHEMICAL CONSTITUENT

Senna has 2 to 3 % Sennosides A, B, C & D. Senna also contains free Chrysophanol, Aloe-emodin, Rhein and their glycosides. Mucilage is also present.

USES

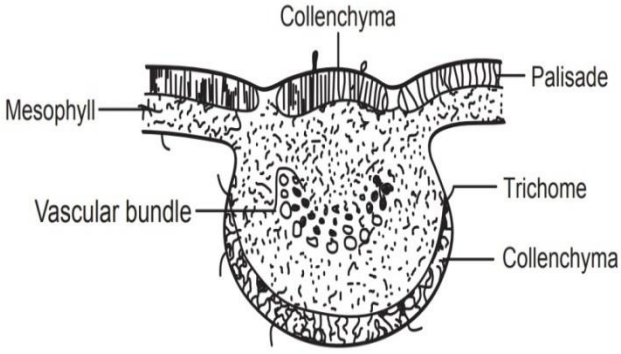
Cathartic and Purgative. Due to its gripping action it is usually prescribed with Carminatives.

ANATOMICAL STRUCTURE OF DATURA LEAF

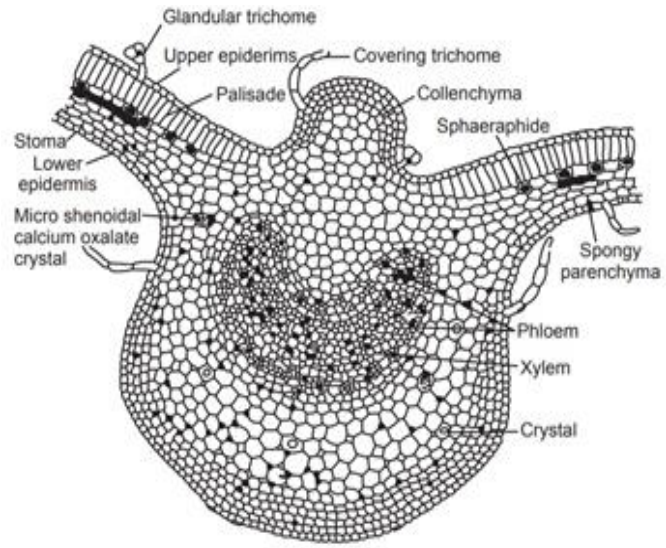
Biological Source: Datura consists of the dried leaves and flowering tops of *Datura metel.*

Family: Solanaceae.

MICROSCOPY



T.S. (schematic) diagram of datura leaf



Transverse Section of Datura leaf

Transverse section shows a Dorsi-ventral (bifacial) structure. The lamina and the midrib region of the leaf show following structure-

Upper epidermis: It is single layered having rectangular cells covered with cuticle. Both covering and glandular trichomes are present. The covering trichomes are uni-seriate, multicellular, warty and with blunt apex. The glandular trichomes have one stalk consisting of one cell and multicellular head.

Mesophyll: It has spongy parenchyma and palisade parenchyma in it. Palisade cells are single layered and compactly arranged. Spongy parenchyma are several layers, loosely arranged consisting of micro-sphenoidal crystals and vascular strands.

Lower epidermis: is similar to that of the upper one but has more number of trichomes and stomata when compared with upper epidermis.

Midrib: It consists of strips of collenchyma appearing; below the upper and above the lower epidermis followed by the cortical parenchymatous cells containing calcium oxalate.

Chemical Constituents

Datura herb contains up to 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.

USES

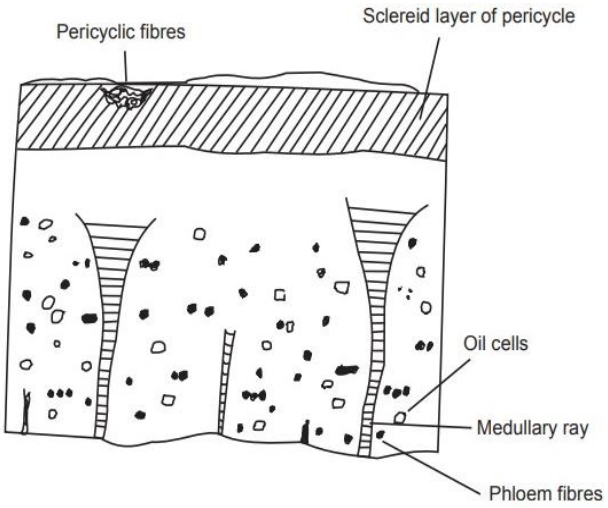
In Ayurveda black datura is considered more efficacious or more toxic. *D. metel* is used in the manufacture of hyoscine or scopolamine. It exhibits parasympatholytic with anticholinergic and CNS depressant effects. The drug is used in cerebral excitement, asthma and in cough. The Rajpoot mothers are said to smear their breasts with the juice of the *D. metel* leaves, to poison their newly born female infants.

ANATOMICAL STRUCTURE OF CINNAMON BARK

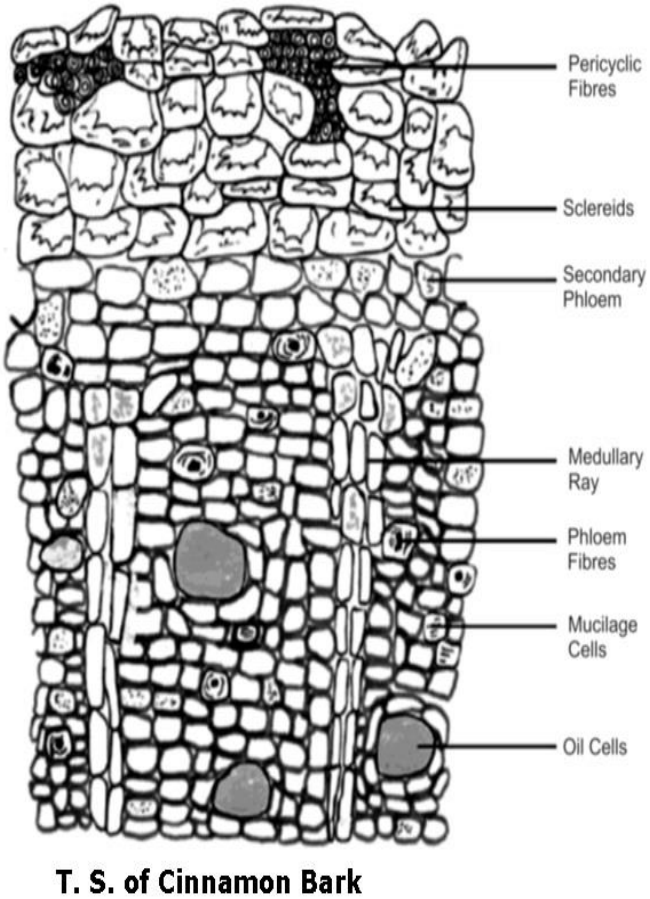
Bot. Source: Cinnamon is dried inner bark of coppiced tree of cinnamomum zeylanicum

Family: Lauraceae

MICROSCOPY



TS of CINNAMON BARK



T. S. of Cinnamon Bark

The transverse section of cinnamon shows following structure

Sclerids: These are present as three to four layers of sclereids which are horse shoe shaped consisting of starch grains.

Pericyclic Fibres: 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;

Phloem fibres: These are lignified phloem fibres, arranged as tangential rows of four to five cells.

Medullary rays: Medullary rays are biseriate with needle-shaped calcium oxalate crystals;

Oil cells: Longitudinally elongated idioblast cells consisting of volatile oil.

Parenchyma: These are sub-rectangular parenchyma cells with starch grains and calcium oxalate crystals.

CHEMICAL CONSTITUENTS

The bark has Volatile oil and Phloba-tannins, Calcium oxalate crystals, starch and mucilage. The main constituents present in volatile oil are- Cinnamaldehyde and Eugenol.

USES

Carminative, Stomachic, Flavouring agent, Anti-bacterial and Anti-fungal.

Useful in diabetes, weight loss and healing of wounds

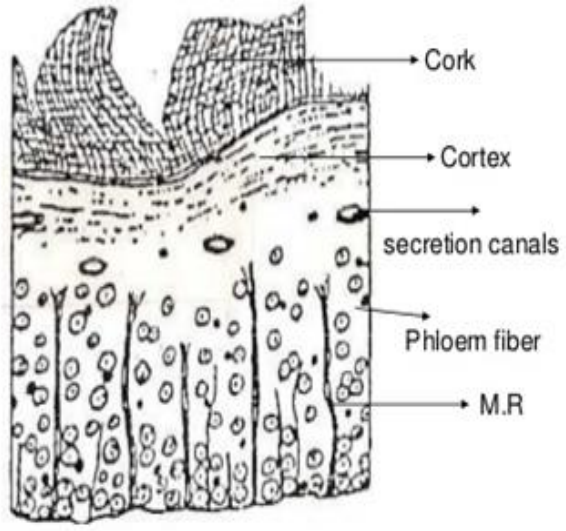
ANATOMICAL STRUCTURE OF CINCHONA BARK

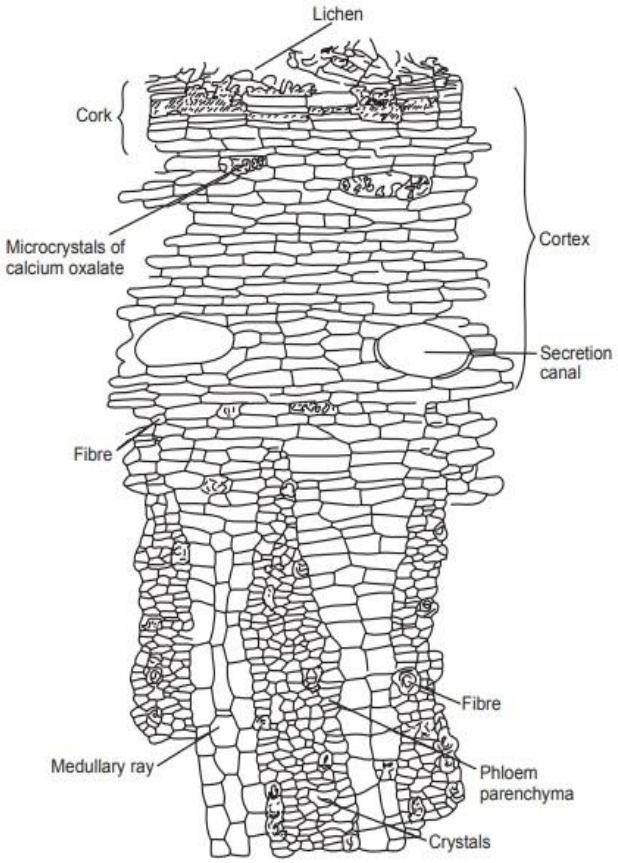
Cinchona Bark; Peruvian Bark

Bot. Source: Cinchona is dried stem and root bark of Cinchona calisaya, Cinchona ledgeriana, Cinchona succirubra and Cinchona officinalis or hybrids of first two species with last two species.

Family: Rubiaceae

MICROSCOPY





TS CINCHONA BARK

CORK: It is composed of several layers of thin walled cells, arranged in radial rows and appears polygonal in surface view. These have reddish brown cell content and are coated with Suberin.

PHELLODERM: Cork is followed by Phelloderm consisting of several layers of regular cells with dark cell walls.

CORTEX: Cortex consists of thin walled tangentially elongated parenchymatous cells containing amorphous reddish brown matter. These also contain small starch grains. In cortex are scattered the Idioblast cells; which contain the micro crystal of Calcium oxalate.

PHLOEM: Phloem is wide and consists of sieve tubes, parenchyma and Phloem fibres. These fibres are spindle shaped, lignified and have conspicuously striated walls. These occur isolated or in ir-regular radial rows. Medullary rays are two to three cells wide and somewhat radially elongated.

CHEMICAL CONSTITUENTS

Cinchona bark has about 6.5% alkaloids. These are 25 in number. Important alkaloids are- Quinine, Quinidine, Cinchonine and

Cinchonidine. These are mainly used as Sulphate

It also contains Quinic acid and Cinchotannic acid.Cinchotannic acid decomposes to Cinchona red.

USES

Antipyretic, Analgesic and Anti-malarial.

Also used as Bitter tonic and appetite stimulant.

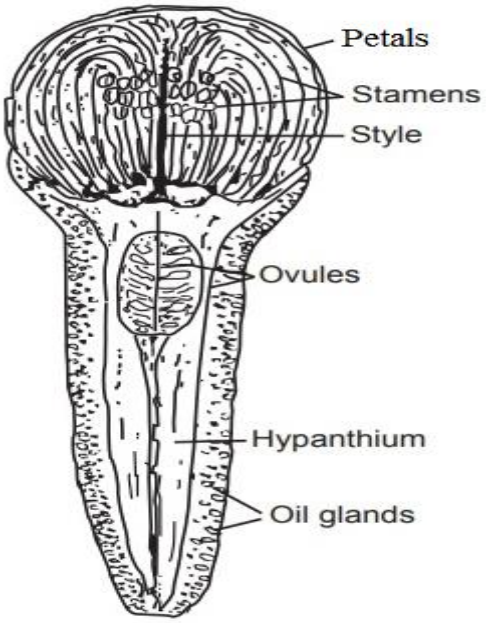
Quinidine is used in Cardiac arrhythmia and Atrial fibrillation.

ANATOMICAL STRUCTURE OF CLOVE BUD

SOURCE- Clove consists of dried Flower buds of *Eugenia caryophyllus (Syzygium aromaticum)*

FAMILY- Myrtaceae

MACROSCOPIC CHARACTERS



Appearance- Each flower bud consists of upper dome shaped structure called CROWN or CAP and lower stalk shaped body called HYPANTHIUM.

Size- 16 to 20 mm long

Colour- Reddish brown to blackish brown

Odour- Strong, Spicy and aromatic

Taste- Pungent and aromatic, followed by slight numbness of tongue.

Hypathium- It is sub-cylindrical, slightly flattened and tapering below. It is 10 to 13 mm long and 2 mm thick

Crown or Cap- It consists of Calyx, Corolla, Androecium and Gynoecium

Calyx- 4, thick walled spreading sepals

Corolla- 4, dome shaped membranous petals

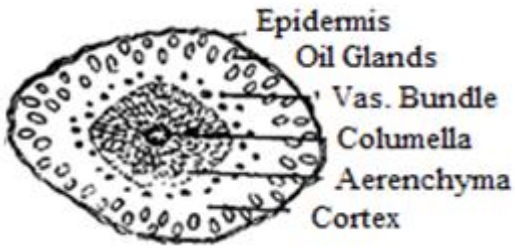
Androecium- Numerous and free stamens, incurved

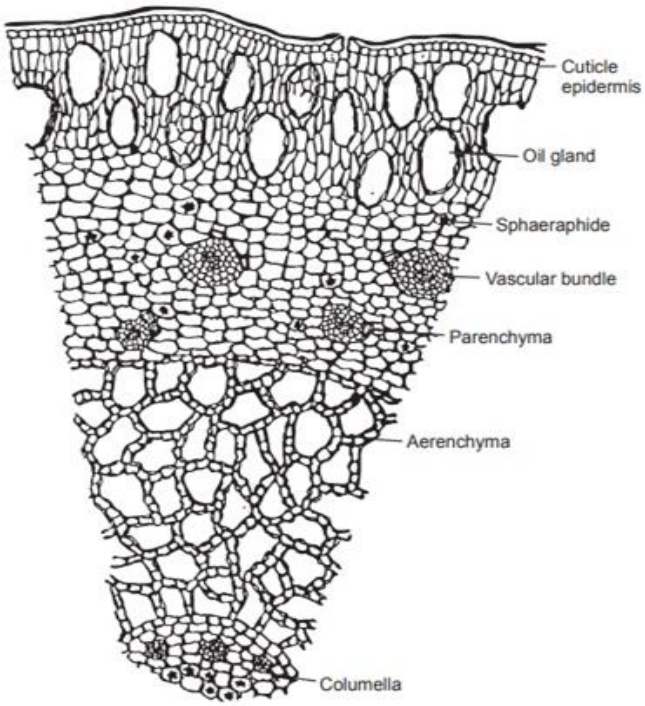
Gynoecium- Inferior bilocular ovary embedded in hypanthium. It has axile placentation and many ovules. Style reaches up to center of crown. Style is spine like and erect

Other Characters- Sinks when added to freshly boiled and cooled water and exudes volatile oil when pressed with fingernail.

MICROSCOPY

TS of clove through Hypanthium reveals following structure





TS OF CLOVE BUD

Epidermis- Heavily cuticularised, single layer of straight walled cells with few Anomocytic stomata having sub-stomatal space.

Cortex- It can be divided into three zones-

Outer zone- It consists of roughly radially elongated parenchymatous cells with 2 to 3 inter mixed layers of schizolysigenous ellipsoidal oil glands.

Middle Zone- It consists of a ring of bi-collateral vascular bundles with occasional isolated pericyclic fibres.

Inner Zone or Aerenchyma- It consists of zone of parenchyma having air spaces, separated by lamellae which are only one cell thick (Aerenchyma). This zone surrounds the central COLUMELLA.

Columella- It is parenchymatous rich in cluster crystals of calcium oxalate and has a ring of vascular bundles towards its periphery.

CHEMICAL CONSTITUENTS

Clove contains 14 to 21% volatile oil. This oil contains up to 90% Eugenol. Clove also contains tannins and fixed oil.

USES

Carminative, Aromatic, Stimulant, Anti-septic, Flavouring agent and Dental analgesic. Also used in microscopic work.

ANATOMICAL STRUCTURE OF FENNEL FRUIT

SOURCE- Fennel consists of dried ripe fruits of Foeniculum vulgare.

FAMILY- Umbelliferae

MACROSCOPIC CHARACTERS

Appearance- Entire cremocarp with long pedicel and short bifid stylopod at the top.

Shape- Straight, slightly curved, oblong oval or elliptical

Size- 5 to 10 mm long and 2 to 4 mm wide

Colour- Greenish to yellowish brown

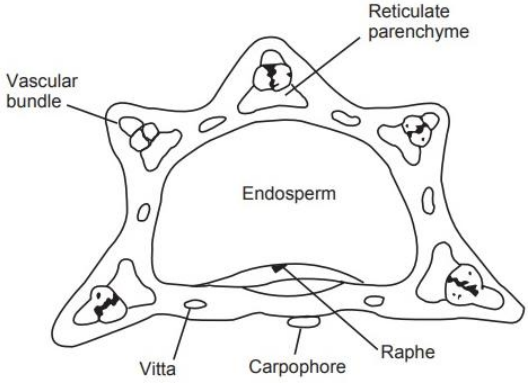
Odour- Pleasantly aromatic

Taste- Characteristic, strongly aromatic

External surface- Glabrous, 5 prominent pale coloured ridges, from stylopod to pedicel, are present on the surface of each Mericarp (10 on each Cremocarp)

MICROSCOPY

TS of fennels reveals following structure



PERICARP- it consists of following three layers

Epicarp- Single layer of polygonal or quadrangular cells with smooth cuticle and few stomata (anomocytic)

Mesocarp- In this region, below each primary ridge, is present a bi-collateral vascular bundle

(Total five). Above and below each vascular bundle, is present reticulate lignified parenchyma.

Total 6 vittae (schizogenous oil ducts) four on dorsal and two on ventral or commissural surface, are present. These appear yellowish brown in colour.

Endocarp- It consists of narrow elongated cells showing PARQUETRY arrangement.

SEED- It consists of following parts

Testa- It is single layered having yellowish brown colour.

Endosperm- It consists of thick walled cellulosic parenchymatous cells containing oil globules (fixed oil) aleurone grains (Protein) and calcium oxalate crystal (rosette).

Raphe- It is present as single layer of vascular strand, in the middle of the commissural surface.

CARPOPHORE

This structure is present on commissural surface containing very thick walled sclerenchyma in two strands. It joins the two mericarps.

CHEMICAL CONSTITUENTS

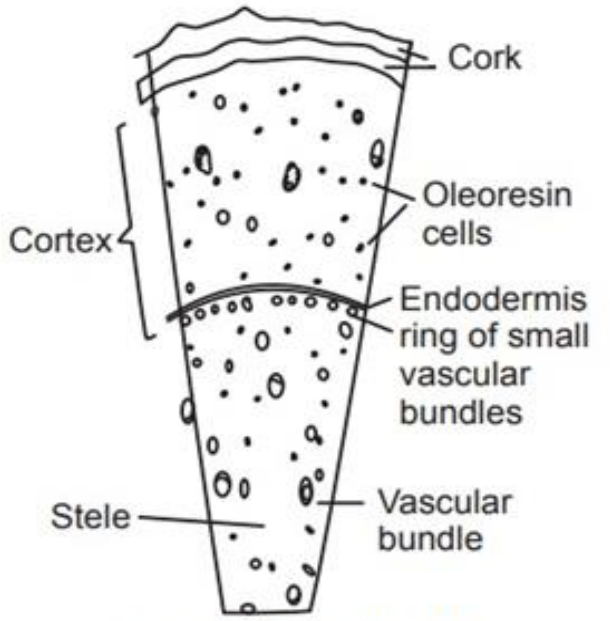
Fennel contains 4 to 6% volatile oil. It contains a phenolic ether- Anethole (50 to 60%) and a ketone- Fenchone (about 10%). Anethole is sweet in taste while Fenchone is pungent in taste. Fennel also contains fixed oil (12 to 18%) and proteins (14 to 22 %)

USES

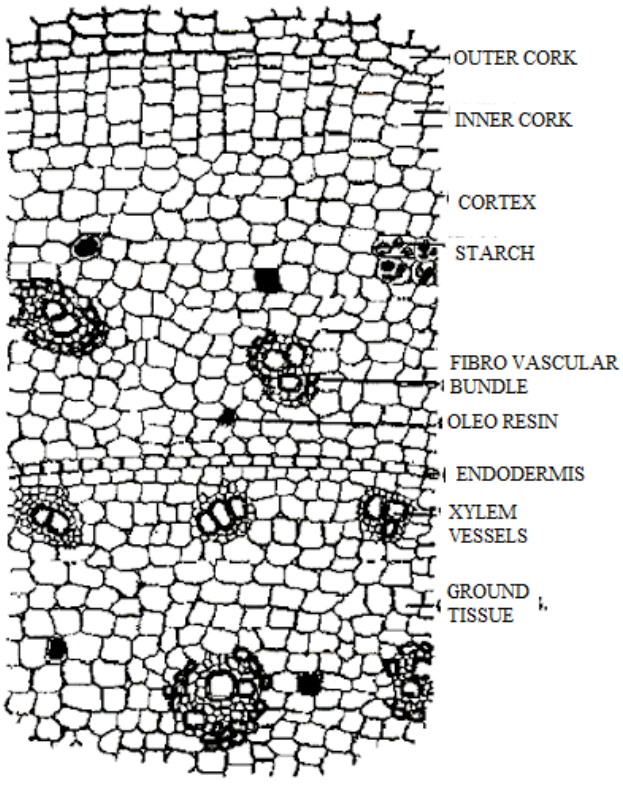
Carminative, Flavouring agent and respiratory stimulant.

ANATOMICAL STRUCTURE OF GINGER RHIZOME

TS of GINGER shows following structure from outward to inwards



TS of GINGER RHIZOME



TS OF GINGER RHIZOME

CORK

Cork is present in two parts; Outer cork and Inner cork

Outer cork: It consists of few layers of irregularly arranged, dark brown coloured parenchymatous cells.

Inner cork: It consists of few layers of radially arranged colourless parenchymatous cells.

PHELLOGEN

It is in distinguished from cork and cortex.

CORTEX

Cortex consists of Isodiametric, thin walled cellulosic cells. These cells have Starch grains. Cortex also contains fibro vascular bundles and idioblast cells containing yellowish to reddish brown oleo-resin.

ENDODERMIS

It consists of single layer of tangentially elongated cells.

CHEMICAL CONSTITUENT: Ginger contains 1.0 to 2.0% volatile oil, 5 to 8% resin along with starch and mucilage. Important

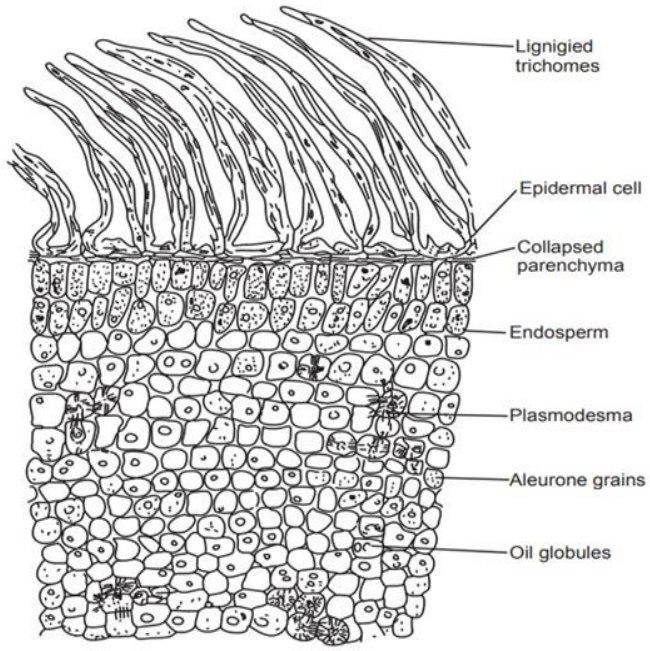
USES: Stomachic, Stimulant and Carminative
Anti-emetic
Used as an important condiment

ANATOMICAL STRUCTURE OF NUX VOMICA SEEDS

Bot. Source: Nux-vomica consists of dried ripe seeds of *Strychnos nux-vomica*

Family: Loganiaceae

TS of Nux-Vomica shows TESTA and ENDOSPERM. These have following structure



TESTA

LIGNIFIED TRICHOMES: These are long, thick walled trichomes emerging from EPIDERMAL CELLS. These are twisted and bent outward about 600µ long and 25µ in diameter.

EPIDERMAL CELLS: It is single layer of thick walled cells which give rise to lignified trichomes.

COLLAPSED PARENCHYMA: This layer consist of two layers of collapsed parenchyamatous cells.

ENDOSPERM

Endosperm consists of Thick walled cellulosic parenchymatous cells. These cells are connected through protoplasmic strands called Plasmodesmata and contains Alerone grains and Oil globules.

CHEMICAL CONSTITUENTS

Nux-vomica contains mainly Strychnine (1.25%) and Brucine (1.5%). Brucine is actually dimethoxy strychnine.

Minor alkaloids are Vomicine and Pseudo-strychnine. Other constituents are-Caffeotannic acid (Chlorogenic acid), Loganin (A glycoside), fixed oil and aleurone grains.

USES

Bitter stomachic

Stimulant for Respiratory and Cardio-vascular system

Used to improve Reflux action

Nerve and sex tonic

Strychnine is used as rodent killer

Brucine (Four times as bitter as Strychnine) is used as denaturant for Alcohol and non-edible fat and as dog poison.

ANATOMICAL STRUCTURE OF IPECAC ROOT

IPECAC

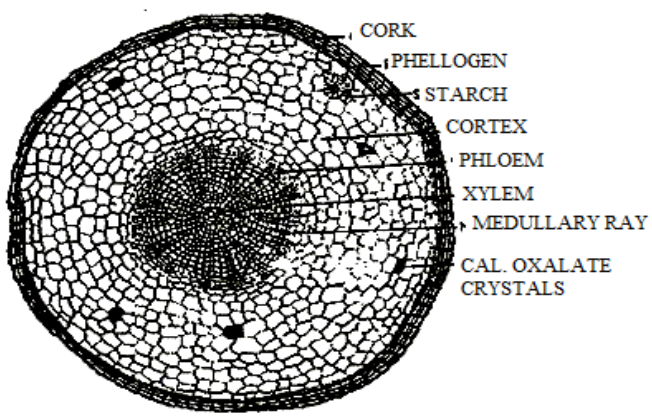
(Syn: Ipecacuanha)

Botanical Source: Ipecac consists of dried roots or dried roots and rhizomes of *Cephaelis ipecacuanha* and *Cephaelis acuminata*

containing not less than 2.0% of ether soluble alkaloids.

Family: Rubiaceae

MICROSCOPICAL CHARACTERS



TS OF IPECAC ROOT

PERIDERM

It consists of Cork and Phellogen-

Cork: 3-5 layered, tangentially elongated cells filled with brown matter.

Phellogen: 2 layered, immediately below the cork, shining and cells tangentially elongated.

CORTEX

Several layered with thin walled polyhedral parenchyma with small intercellular spaces. The cortical parenchyma contains acicular raphides (Calcium oxalate crystals) either in bundles or scattered all over.

VASCULAR BUNDLES

It consists of Phloem

Phloem

Several thin patches around the well-developed xylem and consists of perforated sieve tubes.

Xylem:

Cells are lignified. Because of their lignifications, it is difficult to differentiate medullary rays from other wood elements in a cross section. Each medullary rays cell, is radially elongated and contains starch. The dense secondary xylem consists of tracheids, tracheidal vessels, fibres and parenchyma. Starch grains are also seen in the xylem parenchyma.

CHEMICAL CONSTITUENTS

Ipecac contains 2.0% Isoquinoline type of alkaloids. These alkaloids are grouped into phenolic (Psychotrine and Cepheline) and non-phenolic alkaloids (Emetine, O-methyl psychotrine and emetamine)

Ipecac also contains a resin called Ipecacuanhin and Ipecacuanhic acid. Even starch and Calcium oxalate are also present.

USES

Expectorant, Emetic, Anti-amoebic and Anti tumor.