PHARMACOGNOSY

SKILL BASED ELECTIVE II

DEPARTMENT OF PLANT BIOLOGY AND PLANT BIOTECHNOLOGY

ST. XAVIER'S COLLEGE (AUTONOMOUS), PALAYAMKOTTAI -627 002

COURSE MATERIAL

COMPILED AND EDITED BY

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Under Graduate Skill Based Elective -II

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SYLLABUS

Pharmacognosy:

Definition, scope; morphology and therapeutic classification of crude drugs.

A brief account on the botanical name, family, useful part, chemical constituents and uses of the following drugs:

Stem	- Ephedra
Rhizome	- Zinger
Bark	- Cinnamon
Leaves	- Digitalis
Bud/flower	- Cloves
Seeds	- Isapgol
Resins /Gums	- Asafoetida
Fruits	- Fennel

Drug adulteration: Methods of drug evaluation, collection and processing of crude drugs.

DEFINITION AND SCOPE:

Meaning of the word 'Pharmacognosy'

The word "pharmacognosy" is derived from the Greek words *φάρμακον* pharmakon (drug), and γνῶσις *gnosis* or "knowledge". The term pharmacognosy was used for the first time by the Austrian physician Schmidt in 1811 and 1815 by Crr. Anotheus Seydler in a work titled *Analecta Pharmacognostica.*

Scientific definition of 'Pharmacognosy':

Pharmacognosy is the study of medicines derived from natural sources. The American Society of Pharmacognosy defines pharmacognosy as "the study of the physical, chemical, biochemical and biological properties of drugs, drug substances or potential drugs or drug substances of natural origin as well as the search for new drugs from natural sources.

Crude drugs:

A crude drug is any naturally occurring, unrefined substance derived from organic or inorganic sources such as plant, animal, bacteria, organs or whole organisms intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease in man or other animals. Pharmacognosy is the study of the proper horticulture, harvesting and uses of the raw medications found in nature.

Raising, harvesting and selling crude drugs was how many large pharmaceutical companies started out. Companies such as Eli Lilly and Company sold crude drugs to pharmacists to save them time and money, but the early pharmacy graduate would know how to raise their own crude drugs if need be.

Originally—during the 19th century and the beginning of the 20th century—"pharmacognosy" was used to define the branch of medicine or commodity sciences (*Warenkunde* in German) which deals with drugs in their crude, or unprepared, form. Crude drugs are the dried, unprepared material of plant, animal or mineral origin, used for medicine.

Various fields of Pharmacognosy:

The contemporary study of pharmacognosy can be divided into the fields of

- **Medical ethnobotany:** The study of the traditional use of plants for medicinal purposes;
- **Ethnopharmacology:** The study of the pharmacological qualities of traditional medicinal substances;
- **Phytotherapy:** The medicinal use of plant extracts;
- **Phytochemistry:** The study of chemicals derived from plants (including the identification of new drug candidates derived from plant sources).
- **Zoopharmacognosy:** The process by which animals self-medicate, by selecting and using plants, soils, and insects to treat and prevent disease.
- **Marine pharmacognosy:** The study of chemicals derived from marine organisms.

Classification of Crude Drugs: (Showkat Rasool Mir, 2007)

The most important natural sources of drugs are higher plant, microbes and animals and marine organisms. Some useful products are obtained from minerals that are both organic and inorganic in nature. In order to pursue (or to follow) the study of the individual drugs, one must adopt some particular sequence of arrangement and this is referred to a system of classification of drugs. A method of classification should be:

(a) Simple

(b) Easy to use

(c) Free from confusion and ambiguities.

For the purpose of study, the drugs are classified in the following different ways:

1. Alphabetical classification
2. Morphological classification
3. Taxonomic classification
4. Pharmacological classification
5. Chemical classification
6. Chemotaxonomical classification

1. Alphabetical Classification:

Alphabetical classification is the simplest way of classification of any disconnected items. Crude drugs are arranged in alphabetical order of their Latin and English names (common names) or sometimes local language names (vernacular names).

Some of the pharmacopoeias, dictionaries and reference books which classify crude drugs according to this system are as follows.

1. Indian Pharmacopoeia.
2. British Pharmacopoeia
3. British Herbal Pharmacopoeia
4. United States Pharmacopoeia and National Formulary

Merits:

- It is easy and quick to use
- There is no repetition of entries and is devoid of confusion.
- In this system location, tracing and addition of drug entries is easy.

Demerits: There is no relationship between previous and successive drug entries.

Examples: Acacia, Cinchona, Ergot, Fennel, Gentian, Hyoscyamus, Ipecacuanha, Jalap, Kurchi, Liquorice, Mints, Nuxvomica, Rauwolfia, Senna, etc. There is no relationship with each other. Each drug has its own chemical components and uses are also different.

Morphological Classification:

In this system, the drugs are arranged according to the morphological or external characters of the plant parts or animal parts i.e. which part of the plant is used as a drug e. g. leaves, roots, stem etc. The drugs obtained from the direct parts of the plants and containing cellular tissues are called as *organized* drugs e. g. Rhizomes, barks, leaves, fruits, entire plants, hairs and fibres. The drugs which are prepared from plants by some intermediate physical processes such as incision, drying or extraction with a solvent and not containing any cellular plant tissues are called as *unorganized* drugs. Aloe juice, opium latex, agar, gambir, gelatin, tragacanth, benzoin, honey, beeswax, lemon grass oil etc. are examples of unorganized drugs.

Organised Drugs:

Woods: Sandalwood.

Leaves: Digitalis, Eucalyptus, Gymnema, Mint, Senna, Tulsi, Tea etc.

Barks: Arjuna, Ashoka, Cassia, Cinchona, Cinnamon etc.

Flowering parts: Clove, Pyrethrum, Saffron etc.

Fruits: Amla, Capsicum, Cardamom, Coriander, Cumin, Tamarind, etc.

Seeds: Black Mustard, Cardamom, Colchicum, Ispaghula, Linseed, Nutmeg, Nux vomica, etc.

Roots and Rhizomes: Ashwagandha, Calamus, Colchicum corm, Dioscorea, Garlic, Ginger, Ginseng, Glycyrrhiza, Rauwolfia, Turmeric, etc.

Plants and Herbs: Ergot, Ephedra, Bacopa, Andrographis, Vinca, Datura, Centella etc.

Hair and Fibres: Cotton, Hemp, Jute, Silk, etc.

Unorganised Drugs:

Dried latex– Opium, Papain

Dried Juice– Aloe,

Dried extracts– Agar, Alginate,

Waxes - Beeswax,

Gums – Acacia, Guar Gum, Indian Gum, Sterculia,

Resins– Asafoetida, Colophony, Coal tar, Tar, Tolu balsam,

Volatile oil– Turpentine, Coriander, Peppermint, Rosemary, Sandalwood, Cinnamon, Lemon, Clove, Eucalyptus, Camphor.

Fixed oils and Fats– Arachis, Castor, Coconut, Cotton seed, Linseed, Olive, Sesame, Cod-liver,

Animal Products – Bees wax, Cod-liver oil, Gelatin, Honey, Shark liver oil, shellac,

Fossil organism and Minerals– Bentonite, Kaolin, Kiesslguhr, Talc.

Difference between organized and unorganized drugs

Organized Drugs	Unorganized Drugs
These may be of plant or animal origin.	These may be of plant, animal or mineral origin.
These are direct part of plant or animal.	These are the product of plant or animals.
These have cellular structure.	These do not have well defined cellular structure.
Generally identified by morphological character.	Generally identified by organoleptic properties.
Examples: Digitalis leaf, cinchona bark and ephedra stem.	Examples: Agar, gelatin, honey.

Merits: Morphological classification is more helpful to identify and detect adulteration. This system of classification is more convenient for practical study especially when the chemical nature of the drug is not clearly understood.

Demerits:

- The main drawback of morphological classification is that there is no co-relation of chemical constituents with the therapeutic actions.
- Repetition of drugs or plants occurs.

Taxonomical Classification:

Taxonomical classification is purely a botanical classification and is based on principles of natural relationship and evolutionary developments. They are grouped in Kingdom, phylum, order, family genus and species. As all the entire plants are not used as drugs, part of the plant is used as a drug, for example, cinnamon bark. Thus it is of no significance from identification point of view to put plants in a taxonomic order. Table 1 give the account of main characters of various taxon that contribute crude drugs while as Table 2 gives the taxonomical classification of some drugs.

Table 1: Main Characters of Various Taxon that Contribute Crude Drugs Plant Kingdom			
Thallophyta	**Pteridophyta**	**Gymnosperm**	**Angiosperm**
• Alage and fungi are consider together • They differ in mode of nutrition • Alage exhibit autotropic and fungi exhibit heterotrophic nutrition. Example: Rhodophyta (Red algae) agar	• This group of plant derives its name from the fern, *Pteris* which also represent salient features of group (Pterido- *pteris*, Phyton-plant) • They occur is humid and tropical climates and usually ground on soil, rocks, in ponds etc. • These plant are also raised in pots as ornamentals Example: Male fern	• The gymnosperm (Gymnos-naked and sperma-seed i.e. plant with a naked seeds) are comparatively more ancient than the angiosperm in evolutionary terms • The living gymnosperms are widely distributed in the cold climates • The plant body is sporophyte and differentiated into roots, stem and leaves. Example: Ephedra, Colophony	• The term angiosperm means enclosed seed because the ovules or potential seed are enclosed within a hallow ovary. • The angiosperms constitute the most dominant and ubiquitous vascular plants of present day flora • Dicots and monocots are its sub divisions. **Dicot:** They have two cotyledons Example: Coriander, Capsicum **Monocot: They have only one cotlydon. Example: Vanilla, Colchicum**

Merits:- Taxonomical classification is helpful for studying evolutionary developments.
Drawback: This system also does not co-relate in between the chemical constituents and biological activity of the drugs.

Pharmacological Classification
Grouping of drug according to their pharmacological action or of most important constituent or their therapeutic use is termed as pharmacological or therapeutic classification of drug. This classification is more relevant and is mostly followed method. Drugs like digitalis, squill and strophanthus having cardiotonic action are grouped together irrespective of their parts used or phylogenetic relationship or the nature of phytoconstituents they contain. Table gives an outline of pharmacological classification of drugs.

Classification of Drugs based on Pharmacological action.

Pharmacological Action	Drugs
Anticancer	Vinca, Podophyllum, Taxus
Anti-inflammatory	Colchicum, Turmeric
Antiamoebic	Ipecac root, Kurchi bark
Antiasthmatic	Ephedra, Lobelia
Anthelminthic	Male fern, Quassia wood
Antispasmodic	Datura, Hyoscyamus
Astringent	Catechu
Analgesic	Opium, poppy
Bitter tonic	Quassia wood, Nux-vomica, Gentian
Carminatives	Coriander, fennel, clove, peppermint
Purgatives	Senna, Rhubarb
Expectorant	Tulsi, Balsam of Tolu, Vasaka
Cardiotonic	Digitalis, Squill, Strophanthus
Tranquilizers	Rauwolfia Roots

Merits: This system of classification can be used for suggesting substitutes of drugs if they are not available at a particular place or point of time.

Demerits: Drugs having different action on the body gets classified separately in more than one group that causes ambiguity and confusion. Cinchona is an antimalarial drug because of presence of quinine but can be put under the group of drug affecting heart because of antiarrythymic action of quinidine.

Chemical Classification: The crude drugs are divided into different groups according to the chemical nature of their most important constituent. Since the pharmacological activity and therapeutic significance of crude drugs are based on the nature of their chemical constituents. The chemical classification of drugs is dependent upon the grouping of drugs with identical constituents. An out of this classification is as follows:

1. Carbohydrates– Carbohydrates are polyhydroxy aldehydes or ketones containing an unbroken chain of carbon atoms. **Gums:** Acacia, Tragacanth, Guargum; **Mucilages:** Plantago seed; **Others:** Starch, Honey, Agar, Pectin, Cotton

2. Glycosides – Glycosides are compounds which upon hydrolysis give rise to one or more sugars (glycone) and non-sugar (aglycone).

Anthraquinone Glycosides: Aloe, Cascara, Rhubarb, Senna
Saponins Glycosides: Quillaia, Arjuna, Glycyrrhiza
Cyanophore Glycosides: Wild cherry bark
Isothiocyanate Glycosides: Mustard
Cardiac Glycosides: Digitalis, Strophantus
Bitter Glycosides: Gentian, Calumba, Quassia, Chirata, Kalmegh

3. Tannins– Tannins are complex organic, non-nitrogenous derivatives of polyhydroxy benzoic acids. Examples- Pale catechu, Black catechu, Ashoka bark, Galls, Myrobalan, Bahera, Amla

4. Volatile oils– Monoterpenes and sesquiterpenes obtained from plants. Examples- Cinnamon, Fennel, Dill, Coriander, Cardamom, Orange peel, Mint, Clove.

5. Lipids: Fixed oils – Castor, Olive, Almond, Shark liver oil; **Fats –** Theobroma, Lanolin; **Waxes –** Beeswax, Spermaceti.
6. Resins– Complex mixture of compounds like resinols, resin acids, resinotannols, resenes. Examples Colophony, Podophyllum, Cannabis, Jalap, Capsicum, Turmeric, Balsam of Tolu and Peru, Asafoetida, Myrrh, Ginger
7. Alkaloids – Nitrogenous substance of plant origin
Pyridine and Piperidine – Lobelia, Nicotiana
Tropane - Coca, Belladonna, Datura,
Quinoline – Cinchona
Isoquinoline – Opium, Ipecac, Calumba
Indole – Ergot, Rauwolfia
Amines – Ephedra
Purina – Tea, coffee
8. Protein – Gelatin, Ficin, Papain
9. Vitamins - Yeast
10. Triterpenes – Rasna, Colocynth

Merits : It is a popular approach for phytochemical studies
Demerits: Ambiguities arise when particular drugs possess a number of compounds belonging to different groups of compounds.

Chemotaxonomic Classification:

This system of classification relies on the chemical similarity of a taxon i.e. it is based on the existence of relationship between constituents in various plants. There are certain types of chemical constituents that characterize certain classes of plants. This gives birth to entirely new concept of chemotaxonomy that utilizes chemical facts/characters for understanding the taxonomical status, relationships and the evolution of the plants. For example, tropane alkaloids generally occur among the members of Solanaceae thereby, serving as a chemotaxonomic marker. Similarly other secondary plant metabolites can serve as the basis of classification of crude drugs. The berberine alkaloid in Berberis and Argemone; Rutin in Rutaceae members, ranunculaceous alkaloids among its members etc are other examples.

It is the latest system of classification and gives more scope for understanding the relationship between chemical constituents, their biosynthesis and their possible action.

Ephedra – stem:

Ephedra andina

Ephedra andina

Ephedra distachya

Botanical detail:

Ephedra is a genus of gymnosperm shrubs, the only genus in its family, **Ephedraceae**, and order, **Ephedrales**. *Ephedra* grows in dry climates over wide areas of the northern hemisphere, including southwestern North America, Europe, north Africa, and southwest and central Asia, and, in the southern hemisphere, in South America south to Patagonia. In temperate climates, most *Ephedra* species grow on shores or in sandy soils with direct sun exposure. Common names in English include **Joint-pine**, **Jointfir**, **Mormon-tea** or **Brigham Tea**.

Chemical composition:

The alkaloids ephedrine and pseudoephedrine are the active constituents of the plant. Some species in the *Ephedra* genus have no alkaloid content and are therefore essentially inert; however, the most commonly used species, *E. sinica*, has a total alkaloid content of 1–3% by dry weight. Ephedrine constitutes 40–90% of the alkaloid content, with the remainder consisting of pseudoephedrine and the demethylated forms of each compound.

Pseudoephedrine is used in over-the-counter decongestants. Derivatives of ephedrine are used to treat low blood pressure, but alternatives with reduced cardiovascular risk have replaced it for treating asthma. Ephedrine is also considered a performance-enhancing drug and is prohibited in most competitive sports.

Effects and uses:

Plants of the *Ephedra* genus, including *E. sinica* and others, have traditionally been used by indigenous people for a variety of medicinal purposes, including treatment of asthma, hay fever, and the common cold. The alkaloids ephedrine and pseudoephedrine are active constituents of *E. sinica* and other members of the genus. These compounds are sympathomimetics with stimulant and decongestant qualities and are related chemically to the amphetamines.

Ephedra is both a stimulant and a thermogenic; its biological effects are due to its ephedrine and pseudoephedrine content. These compounds stimulate the brain, increase heart rate, constrict blood vessels (increasing blood pressure), and expand bronchial tubes (making breathing easier). Their thermogenic properties cause an increase in metabolism, evidenced by an increase in body heat.

In traditional Chinese herbology, *E. sinica* is included in many herbal formulas used to treat cold and flu such as *ma huang tang* (ephedra decoction) or *ma xing shi gan tang* (ephedra, apricot kernel, gypsum, and licorice decoction). *Ephedra* is used therapeutically as a diaphoretic to help expel exterior pathogens and regulate the proper functioning of the lungs.

Ephedra is widely used by athletes, despite a lack of evidence that it enhances athletic performance. Ephedra may also be used as a precursor in the illicit manufacture of methamphetamine.

Ephedra has also been used for weight loss, sometimes in combination with aspirin and caffeine. Some studies have shown that ephedra, when taken in a regulated and supervised environment, is effective for marginal short-term weight loss (0.9kg/month more than the placebo), although it is unclear whether such weight loss is maintained. However, several reports

have documented the large number of adverse events attributable to unregulated ephedra supplements.

Side effects of ephedra may include severe skin reactions, irritability, nervousness, dizziness, trembling, headache, insomnia, profuse perspiration, dehydration, itchy scalp and skin, vomiting, hyperthermia, irregular heartbeat, seizures, heart attack, stroke, or death.

Zinger – Rhizome:

Ginger	
Scientific classification	
Kingdom:	Plantae
clade:	Angiosperms
clade:	Monocots
clade:	Commelinids
Order:	Zingiberales
Family:	Zingiberaceae
Genus:	*Zingiber*
Species:	***Z. officinale***
Binomial name	
Zingiber officinale	

Ginger is the rhizome of the plant ***Zingiber officinale***, consumed as a delicacy, medicine, or spice. It lends its name to its genus and family (Zingiberaceae). Ginger cultivation began in South Asia and has since spread to East Africa and the Caribbean. It is sometimes called **ginger root** to distinguish it from other things that share the name *ginger*.

Ginger plants can grow to about 1 m tall. The upright shoots sprout from the rhizome at the base of the plant. Rhizomes - knobbly and fleshy, covered in ring-like scars. This is the important part

for food and medicine. Although the rhizomes grow underground, they are swollen stems, not roots. This is why fresh ginger is often referred to as 'stem ginger'.

Chemistry and pharmacological effects:

The characteristic odor and flavor of ginger is caused by a mixture of zingerone, shogaols and gingerols, volatile oils that compose one to three percent of the weight of fresh ginger. In laboratory animals, the gingerrols increase the motility of the gastrointestinal tract and have analgesic, sedative, antipyretic and antibacterial properties. Ginger oil has been shown to prevent skin cancer in mice and a study at the University of Michigan demonstrated that gingerols can kill ovarian cancer cells. [6]-gingerol (1-[4'-hydroxy-3'-methoxyphenyl]-5-hydroxy-3-decanone) is the major pungent principle of ginger. The chemopreventive potentials of [6]-gingerol present a promising future alternative to expensive and toxic therapeutic agents.

Ginger contains up to three percent of a fragrant essential oil whose main constituents are sesquiterpenoids, with (-)-zingiberene as the main component. Smaller amounts of other

sesquiterpenoids (β-sesquiphellandrene, bisabolene and farnesene) and a small monoterpenoid fraction (β-phelladrene, cineol, and citral) have also been identified.

The pungent taste of ginger is due to nonvolatile phenylpropanoid-derived compounds, particularly gingerols and shogaols, which form from gingerols when ginger is dried or cooked. Zingerone is also produced from gingerols during this process; this compound is less pungent and has a spicy-sweet aroma. Ginger is also a minor chemical irritant, and because of this was used as a horse suppository by pre-World War I mounted regiments for feaguing. Ginger has a sialagogue action, stimulating the production of saliva, which makes swallowing easier.

Culinary use - <u>Gari (ginger)</u>

Ginger produces a hot, fragrant kitchen spice.

Young ginger rhizomes are juicy and fleshy with a very mild taste. They are often pickled in vinegar or sherry as a snack or just cooked as an ingredient in many dishes. They can also be steeped in boiling water to make ginger tea, to which honey is often added; sliced orange or lemon fruit may also be added. Ginger can also be made into candy.

Mature ginger roots are fibrous and nearly dry. The juice from old ginger roots is extremely potent and is often used as a spice in Indian recipes, and is a quintessential ingredient of Chinese, Japanese and many South Asian cuisines for flavoring dishes such as seafood or goat meat and vegetarian cuisine.

Ginger acts as a useful food preservative.

Fresh ginger can be substituted for ground ginger at a ratio of 6 to 1, although the flavors of fresh and dried ginger are somewhat different. Powdered dry ginger root is typically used as a flavoring for recipes such as gingerbread, cookies, crackers and cakes, ginger ale, and ginger beer. Candied ginger is the root cooked in sugar until soft, and is a type of confectionery.

Regional uses:

In Western cuisine, ginger is traditionally used mainly in sweet foods such as ginger ale, gingerbread, ginger snaps, parkin, ginger biscuits and speculaas. A ginger-flavored liqueur called Canton is produced in Jarnac, France. Green ginger wine is a ginger-flavored wine produced in the United Kingdom, traditionally sold in a green glass bottle. Ginger is also used as a spice added to hot coffee and tea.

India and Pakistan, ginger is called *adrak* in Hindi, Punjabi and Urdu, *inji* in Tamil and Malayalam. Fresh ginger is one of the main spices used for making pulse and lentil curries and other vegetable preparations. Fresh, as well as dried, ginger is used to spice tea and coffee, especially in winter. Ginger powder is also used in certain food preparations, particularly for pregnant or nursing women, the most popular one being *katlu* which is a mixture of gum resin, ghee, nuts, and sugar. Ginger is also consumed in candied and pickled form. In Bangladesh, ginger is finely chopped or ground into a paste to use as a base for chicken and meat dishes alongside shallot and garlic.

In China, sliced or whole ginger root is often paired with savory dishes such as fish, and chopped ginger root is commonly paired with meat, when it is cooked. However, candied ginger is sometimes a component of Chinese candy boxes, and a herbal tea can also be prepared from ginger.

In Japan, ginger is pickled to make beni shoga and gari or grated and used raw on tofu or noodles. It is also made into a candy called *shoga no satozuke*. In the traditional Korean kimchi, ginger is finely minced and added to the ingredients of the spicy paste just before the fermenting process.

Cinnamon –Bark:

Cinnamomum verum, from Koehler's *Medicinal-Plants* (1887)

A number of species are often sold as cinnamon.

Cinnamomum verum
("True cinnamon", Ceylon cinnamon)
C. burmannii
(Korintje or Indonesian cinnamon)
C. loureiroi
(Saigon cinnamon or Vietnamese cinnamon)
C. aromaticum
(Cassia or Chinese cinnamon)

Scientific classification

Kingdom:	Plantae
	Angiosperms
	Magnoliids
Order:	Laurales
Family:	Lauraceae
Genus:	***Cinnamomum***

Chemical composition:

Its flavor is due to an aromatic essential oil that makes up 0.5% to 1% of its composition. This oil is prepared by roughly pounding the bark, macerating it in seawater, and then quickly distilling the whole. It is of a golden-yellow color, with the characteristic odor of cinnamon and a very hot aromatic taste. The pungent taste and scent come from cinnamic aldehyde or cinnamaldehyde (about 60 % of the bark oil) and, by the absorption of oxygen as it ages, it darkens in color and develops resinous compounds. Other chemical components of the essential oil include ethyl cinnamate, eugenol (found mostly in the leaves), beta-caryophyllene, linalool, and methyl chavicol.

Medicinal uses:

Cinnamon bark is widely used as a spice. It is principally employed in cookery as a condiment and flavoring material. It is used in the preparation of chocolate, especially in Mexico, which is the main importer of true cinnamon. It is also used in many desserts recipes, such as apple pie, donuts, and cinnamon buns as well as spicy candies, tea, hot cocoa, and liqueurs. True cinnamon, rather than cassia, is more suitable for use in sweet dishes. In the Middle East, it is often used in savory dishes of chicken and lamb. In the United States, cinnamon and sugar are often used to flavor cereals, bread-based dishes, and fruits, especially apples; a cinnamon-sugar mixture is even sold separately for such purposes. Cinnamon can also

be used in pickling. Cinnamon bark is one of the few spices that can be consumed directly. Cinnamon powder has long been an important spice in Persian cuisine, used in a variety of thick soups, drinks, and sweets. It is often mixed with rosewater or other spices to make a cinnamon-based curry powder for stews or just sprinkled on sweet treats (most notably *Shole-zard*, Persian. It is also used in sambar powder or Bisi Belebath powder in Karnataka, which gives it a rich aroma and tastes unique. It is also used in Turkish cuisine for both sweet and savory dishes.

Cinnamon has been proposed for use as an insect repellent, although it remains untested. Cinnamon leaf oil has been found to be very effective in killing mosquito larvae. The compounds cinnamaldehyde, cinnamyl acetate, eugenol, and anethole, that are contained in cinnamon leaf oil, were found to have the highest effectiveness against mosquito larvae.

Scientific research:

In a 2000 study published in The Indian Journal of Medical Research, it was shown that extracts of **Cinnamomum cassia** (bark) is *active against HIV-1*.

An oil known as **eugenol** that comes from the leaves of the cinnamon bush has been shown to have antiviral properties in vitro, specifically against both the **HSV-1 and HSV-2** (Oral and Genital Herpes) **viruses** according to a study published in the journal, Phytotherapy Research.

A study conducted in 2007 and published in the Journal of Medicinal Chemistry suggests that specific plant **terpenoids contained within cinnamon have potent antiviral properties.**

Pharmacological experiments suggest that the cinnamon-derived dietary factor cinnamic aldehyde (cinnamaldehyde) activates the Nrf2-dependent antioxidant response in human epithelial colon cells and may therefore represent an experimental chemopreventive dietary factor targeting colorectal carcinogenesis.[31] Recent research documents anti-melanoma activity of cinnamic aldehyde observed in cell culture and a mouse model of human melanoma.

Cinnamon bark, a component of the traditional Japanese medicine Mao-to, has been shown in a 2008 study published in the Journal of General Virology to have an antiviral therapeutic effect.

A 2011 study isolated a substance (CEppt) in the cinnamon plant which inhibits development of Alzheimer's in mice. CEppt, an extract of cinnamon bark, seems to treat a mouse model of Alzheimer's disease.

DIGITALIS –LEAVES:

Foxglove	
Digitalis purpurea (Common Foxglove)	
Scientific classification	
Kingdom:	Plantae
	Angiosperms
	Eudicots
Order:	Lamiales
Family:	Plantaginaceae
Genus:	***Digitalis*** L.

Other names: Foxglove, Dead Men's Bells, Dog's Finger, Fairy Fingers, Fairy Gloves, Finger Rower, Folks' Glove, Lion's Mouth, Ladies' Glove, Witches' Gloves, Gloves of Our Lady, Fairy Caps, Fairy Thimbles, Virgin's Glove.

Digitalis purpurea is an herbaceous biennial or short lived perennial plant. The leaves are spirally arranged, simple, 10-35 cm long and 5-12 cm broad, and are covered with gray-white pubescent and glandular hairs. The foliage forms a tight rosette at ground level in the first year.

The flowering stem develops in the second year, typically 1 to 2 m tall, sometimes longer. The flowers are arranged in a showy, terminal, elongated cluster, and each flower is tubular and pendent. The flowers are typically purple but some plants, especially those under cultivation, may be pink, rose, yellow, or white.

Chemical constituents:
Cardioactive steroid glycosides (cardenolides 0.5 to 1.5%).
Pregnane glycosides: including digipurpurin, diginin, digitalonin
Steroid saponin: including desgalactotigonin. digitonine, purpureagitoside
Anthracene derivatives: anthraquinones

The drug contains cardioactive cardenolide glycosides that are positively inotropic, negatively chronotropic and improve the contraction power of cardiac muscle. A group of pharmacologically active compounds are extracted mostly from the leaves of the second year's

growth, and in pure form are referred to by common chemical names such as ***digitoxin*** or ***digoxin***, or by brand names such as *Crystodigin* and *Lanoxin*, respectively. The two drugs differ in that Digoxin has an additional hydroxyl group at the C-3 position on the B-ring (adjacent to the pentane). Both molecules include a lactone and a triple-repeating sugar called a glycoside.

Medicinal use and mechanism of action:

In folk medicine, the drug's use originated in Ireland, then came to Scotland and England and finally to central Europe. It was used to treat ulcers in the lower abdomen, boils, headaches, abscesses and paralysis. Externally, the drug was used for the granulation of poorly healing wounds and to cure ulcers. Furthermore, the drug was used for cardiac insufficiency, especially high blood pressure. *Digitalis purpurea* is used for cardiac insufficiency and migraine.

Side effects / toxicity:

Digitalis toxicity (*Digitalis intoxication*) results from an overdose of digitalis and causes anorexia, nausea, vomiting and diarrhoea, as well as sometimes resulting in xanthopsia (jaundiced or yellow vision) and the appearance of blurred outlines (halos). Bradycardia also occurs. Because a frequent side effect of digitalis is reduction of appetite, some individuals have used the drug as a weight loss aid.

Depending on the species, the digitalis plant may contain several deadly physiological and chemically related cardiac and steroidal glycosides. Thus, the digitalis has earned several more sinister names: *Dead Man's Bells*, and *Witches' Gloves*.

The entire plant is toxic (including the roots and seeds), although the leaves of the upper stem are particularly potent, with just a nibble being enough to potentially cause death. Early symptoms of ingestion include nausea, vomiting, diarrhoea, abdominal pain, wild hallucinations, delirium, and severe headache. Depending on the severity of the toxicosis the victim may later suffer irregular and slow pulse, tremors, various cerebral disturbances, especially of a visual nature (unusual colour visions with objects appearing yellowish to green, and blue halos around lights), convulsions, and deadly disturbances of the heart. For a case description, see the paper by Lacassie.

There have been instances of people confusing digitalis with the relatively harmless *Symphytum* (comfrey) plant (which is often brewed into a tea) with fatal consequences. Other fatal accidents involve children drinking the water in a vase containing digitalis plants. Drying does not reduce the toxicity of the plant. The plant is toxic to animals including all classes of livestock and poultry, as well as felines and canines.

With overdosage, in addition to the already-mentioned symptoms, the following can also occur:

Heart: cardiac rhythm disorders, all the way up to life-threatening ventricular tachycardia, atrial tachycardia with atrioventricular block

Central nervous system: stupor, visual disorders, depression, confused states, hallucinations, psychoses

Lethal dosages lead to heart failure or asphyxiation. Administration over extended periods leads in rare cases to gynecomastia. Because of the difficulties in standardizing the drug, the administration of pure glycosides is to be preferred (digitoxin).

Medicinal Use

According to traditional herbalist cloves are beneficial in the following problems:

- Treats indigestion
- Diarrhea
- Hernia
- Ringworm
- Athlete's foot and other fungal infections.
- Respiratory.
- Used in anti-gout
- Relieves toothache.
- Helpful in insomnia and Curbs the desire for alcohol

Uses
Cloves are frequently used in dishes to impart its distinctive flavor. Since the aroma is strong hence only little is required to be used. They are generally used to "stud" hams and pork,. They are also frequently used in various North and South Indian dishes. In number of spice mixtures like ras el hanout, curry powders, mulling spices and pickling spices, cloves are utilized.
Clove Description

Clove is a small reddish brown flower bud of the tropical evergreen tree Syzygium aromaticum. The tree reaches the height of 14 m. The bark of the tree is gray whereas the leaves are dark green and have shiny appearance. The leaves of the tree are elliptical and are very fragrant. At the end of the branches small crimson flowers grow in triple clusters. Harvesting and curing is done in dry seasons. The cluster of the clove is picked by hand and then they are dried.

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Clove – Flower bud

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- Athlete's foot and other fungal infections.
- Respiratory.
- Used in anti-gout
- Relieves toothache
- Helpful in insomnia and Curbs the desire for alcohol

Botanical classification	
Kingdom:	Plantae
Phylum:	Angiosperms
Order:	Myrtales
Family:	Myrtaceae
Genus:	*Syzygium*
Species:	***S. aromaticum***
Binomial name	
Syzygium aromaticum (L.) Merrill & Perry	

Chemical composition:

The compound eugenol is responsible for most of the characteristic aroma of cloves. Eugenol comprises 72-90% of the essential oil extracted from cloves, and is the compound most responsible for the cloves' aroma. Other important essential oil constituents of clove oil include acetyl eugenol, beta-caryophyllene and vanillin; crategolic acid; tannins, gallotannic acid, methyl salicylate (painkiller); the flavonoids eugenin, kaempferol, rhamnetin, and eugenitin; triterpenoids like oleanolic acid, stigmasterol and campesterol; and several sesquiterpenes.

Eugenol has pronounced antiseptic and anaesthetic properties. Of the dried buds, 15 - 20 percent is essential oils, and the majority of this is eugenol. A kilogram (2.2 lbs) of dried buds yields approximately 150 ml (1/4 of pint) of eugenol. Eugenol can be toxic in relatively small quantities—as low as 5 ml.

Clove as spice in food prepration:

Cloves can be used in cooking either whole or in a ground form, but as they are extremely strong, they are used sparingly. Cloves have historically been used in Indian cuisine (both North Indian and South Indian). In North Indian cuisine, it is used in almost all rich or spicy dishes as an ingredient of a mix named *garam masala*, along with other spices, although it is not an

everyday ingredient for home cuisine, nor is it used in summer very often. In the Maharashtra region of India it is used sparingly for sweet or spicy dishes, but rarely in everyday cuisine. In Ayurvedic medicine it is considered to have the effect of increasing heat in system, hence the difference of usage by region and season. In south Indian cuisine, it is used extensively in biryani along with "cloves dish" (similar to pilaf, but with the addition of other spices), and it is normally added whole to enhance the presentation and flavor of the rice.

Traditional medicinal uses

Cloves are used in Indian Ayurvedic medicine, Chinese medicine, and western herbalism and dentistry where the essential oil is used as an anodyne (painkiller) for dental emergencies. Cloves are used as a carminative, to increase hydrochloric acid in the stomach and to improve peristalsis. Cloves are also said to be a natural anthelmintic.[4] The essential oil is used in aromatherapy when stimulation and warming are needed, especially for digestive problems. Topical application over the stomach or abdomen are said to warm the digestive tract. Clove oil, applied to a cavity in a decayed tooth, also relieves toothache.[5] It also helps to decrease infection in the teeth due to its antiseptic properties.

In Chinese medicine cloves or *ding xiang* are considered acrid, warm and aromatic, entering the kidney, spleen and stomach meridians, and are notable in their ability to warm the middle, direct stomach qi downward, to treat hiccough and to fortify the kidney yang. Because the herb is so warming it is contraindicated in any persons with fire symptoms and according to classical sources should not be used for anything except cold from yang deficiency. As such it is used in formulas for impotence or clear vaginal discharge from yang deficiency, for morning sickness together with ginseng and patchouli, or for vomiting and diarrhea due to spleen and stomach coldness. This would translate to hypochlorhydria.

Clove oil is used in various skin disorders like acne, pimples etc. It is also used in severe burns, skin irritations and to reduce the sensitivity of skin.Cloves may be used internally as a tea and topically as an oil for hypotonic muscles, including for multiple sclerosis. This is also found in Tibetan medicine. Some recommend avoiding more than occasional use of cloves internally in the presence of pitta inflammation such as is found in acute flares of autoimmune diseases.

In West Africa, the Yorubas use cloves infused in water as a treatment for stomach upsets, vomiting and diarrhea. The infusion is called Ogun Jedi-jedi.

Medicinal uses

Western studies have supported the use of cloves and clove oil for dental pain. However, studies to determine its effectiveness for fever reduction, as a mosquito repellent and to prevent premature ejaculation have been inconclusive. Clove may reduce blood sugar levels.

Tellimagrandin II is an ellagitannin found in *S. aromaticum* with anti-herpesvirus properties.

The buds have anti-oxidant properties.

Isabgol seeds

Psyllium plant (*Plantago ovata*)

Flower of *Plantago ovata*,

Flower of *Plantago arenaria*

Botanical Name : Plantago ovata Husk
Family Name : PLANTAGINACEAE
English Name : Spage Seed
Hindi : Isabgol,
Sanskrit Isabgolam,
Other Names Psyllium husk, Psyllium seeds,

Isabgol (Plantago ovata) is an annual herb that grows to a height of 12 to 18 in. Leaves are born alternately opposite, linear or linear lanceolate on the stem. The seeds are enclosed in capsules that open at maturity. Seeds are translucent and concavo-covex.Isagol. The root system has a well developed tap root with few fibrous secondary roots. A large number of

flowering shoots arise from the base of the plant. Flowers are numerous, small, and white. Plants flower about 60 days after planting. India's isabgol farms are spread over 55,000 acres in Gujarat and Rajasthan. Farmers in Madhya Pradesh are catching on. From about 97 mn kg isabgol seed, two dozen companies manufacture husk. The United States is the world's largest importer of psyllium "husk" with over 60% of total imports going to pharmaceutical firms for use in products such as "Metamucil", "Effersyllium" and "Fiberall".

Chemical composition:

Isabgol seeds contain 30 % mucilage. It also contains xylose, arabinose, galaecturonic acid, Rhanose, galactose, albumin, tannin and acetylecoline. The seeds pulp contains 14.7 % lilonic acid. Besides this it contains 5 % stable oil.

Actions according to Ayurveda:

- Mutrajananam: ***Isabgol*** enhances formation of urine thus helps in elimination of wastes from the body
- Daha Trishnaharam: ***Isabgol*** is useful in burning sensation and excessive thirst.
- Balyam: ***Isabgol*** increases body strength.
- Pravahika- Atisarahara: ***Isabgol*** is useful in management of diarrhea and dysentery
- Jwaraghnam: ***Isabgol*** is useful in fever.

Medicinal value:

- Recent study shows that use in high fiber breakfast cereals containing ***Isabgol*** are effective in reducing cholesterol. Several studies point to a cholesterol reduction attributed to a diet that includes dietary fiber such as ***Isabgol***.
- Research also indicates that ***Isabgol*** incorporated into food products is more effective at reducing blood glucose response than use of a soluble fiber supplement that is separate from the food.
- ***Isabgol*** is found to lower serum total cholesterol by 8.9%, LDL cholesterol by 13% and all-day and post lunch postprandial glucose where lowered by 11% and 19.2% after 8 weeks of 5.1 gm ***Isabgol*** in a randomized controlled study of 34 men with type-2 diabetes. (Pubmed - Anderson 1999)
- A double-blind trial reported that 7 grams of ***Isabgol***, an herb high in fiber, taken three times daily reduced the pain and bleeding associated with hemorrhoids. (Moesgaard F,

Nielsen ML, Hansen JB, Knudsen JT. High-fiber diet reduces bleeding and pain in patients with hemorrhoids. Dis Colon Rectum 1982;25:454–6).

- Decreases in total cholesterol (3.2%), LDL (5.4%) was found at 16.5 gm/day dosage of ***Isabgol*** for 3 months in study with 83 hypercholesterolaemia patients. (Pubmed - Tai 1999)
- Chronic constipation was improved by taking ***Isabgol***, 15-30 gm/day for 6 weeks in a study of 149 patients (Pubmed - Voderholzer 1997)
- Alabaster O, Tang ZC, Frost A, Sivapurkar N. Potential synergism between wheat brain and ***Isabgol***: enhanced inhibition of colon cancer. Cancer Lett. 1993;75:53–58.
- Rehydration of children with acute diarrheal diseases was faster than **WHO-ORS** (5.3 hr, n=117), with 50gm/liter of ***Isabgol*** powder and 3.5 gm/liter NaCl (4.9 hr, n=121). (Pubmed - Arias 1997)

- **Useful part:** Seed and seed covering

Recent studies on Isabgol shows the following medicinal uses: cholesterol reduction, reducing blood glucose, reduce the pain and bleeding associated with hemorrhoids, chronic constipation, inhibition of colon cancer and rehydration of children with acute diarrheal diseases.

Possible Adverse Effects:

- Possible adverse reactions include allergic reactions such as anaphylaxis, especially among those who have had regular exposure to ***Isabgol*** dust. Gastrointestinal tract obstruction may occur, especially for those with prior bowel surgeries or anatomic abnormalities, or if taken with inadequate amounts of water.
- The study was conducted on eleven healthy non-anemic adolescent girls of 16 to 18 years of age. Balance studies were conducted in two trials of three weeks each on low and high fiber diets. High fiber diet contained 25 g ***Isabgol*** husk in addition to low fiber diet. The mean diet and nutrient intakes of the subjects were approximately the same during both trials. Addition of ***Isabgol*** husk to low fiber diet significantly (P 0.05) increased fecal excretion of zinc, copper and manganese and lowered their apparent retention. The serum levels of these trace minerals decreased significantly (P 0.05). Thus the high level of ***Isabgol*** has undesirable effect on trace minerals.
    - Asha Kawatra, C. M. Bhat and Asha Arora Department of Foods and Nutrition, Haryana Agricultural University, 125 004 Hisar, Haryana, India

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ISABGOL

Plant Profile

Family : Plantaginaceae
English name : Blond psyllium , Spogel seeds
Indian name : Snigdhabijah, Snigdhajirakah (Sanskrit)
Isabgol, Isabgul (Hindi)
Iskol,Isphogol (Tamil)
Species : *Plantago ovata*
P. psyllium
Distribution : India, West Asia, Pakistan, Persia,
Mexico, Mediterranean Regions

_ India is the largest producer and exporter of this crop in the world.
_ It is grown as a cash crop in Gujarat, Punjab and Uttar Pradesh. Experimental cultivation of Bangalore has shown that this crop comes up well and gives yield comparable to the traditional areas of Gujarat.

MEDICINAL PROPERTIES AND USES

 The seed husk is used to cure inflammation of the mucus membrane of gastrointestinal
and genito-urinary tracts, chronic constipation, dysentery, duodenal ulcers, gonorrhea and piles.

 It is also used in calico printing, setting lotions and food industry.

Recent interest in psyllium has arisen primarily due to its use as an ingredient in high-fiber breakfast cereals, which is claimed to be effective in reducing blood cholesterol levels in those who consume it. Several studies point to a cholesterol reduction attributed to a diet that includes dietary fiber such as psyllium. Research reported in *The American Journal of Clinical Nutrition* concludes that the use of soluble-fiber cereals is an effective and well-tolerated part of a prudent diet for the treatment of mild to moderate hypercholesterolemia. Research also indicates that psyllium incorporated into food product is more effective at reducing blood glucose response than use of a soluble-fiber supplement that is separate from the food.[*citation needed*] Although the cholesterol-reducing and glycemic response properties of psyllium-containing foods are fairly well documented, the effect of long-term inclusion of psyllium in the diet has not been determined.

Choking is a hazard if psyllium is taken without adequate water as it thickens in the throat[1] (see Psyllium seed husks). Cases of allergic reaction to psyllium-containing cereal have also been documented.[2]

Psyllium is produced mainly for its mucilage content, which is highest in *P. ovata*.[*citation needed*] The term *mucilage* describes a group of clear, colorless, gelling agents derived from plants. The mucilage obtained from psyllium comes from the seed coat. Mucilage is obtained by mechanical

milling/grinding of the outer layer of the seed. Mucilage yield amounts to about 25% (by weight) of the total seed yield. Plantago-seed mucilage is often referred to as husk, or psyllium husk. The milled seed mucilage is a white fibrous material that is hydrophilic, meaning that its molecular structure causes it to attract and bind to water. Upon absorbing water, the clear, colorless, mucilaginous gel that forms increases in volume by tenfold or more.

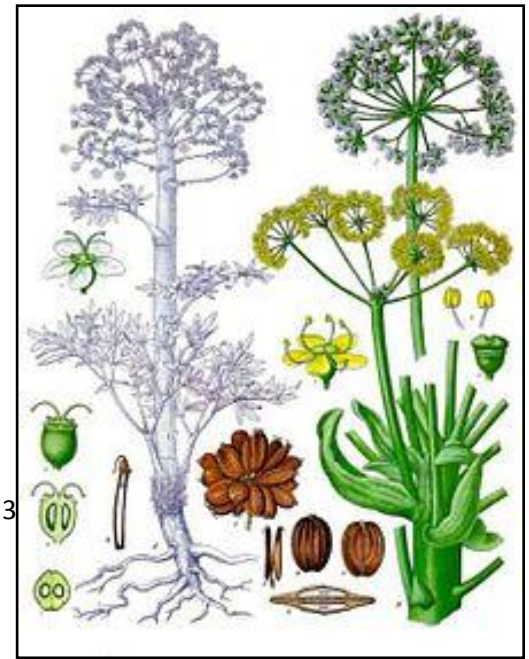
The United States is the world's largest importer of psyllium husk, with over 60% of total imports going to pharmaceutical firms for use in products such as "Metamucil". In Australia, psyllium husk is used to make "Bonvit" psyllium products. In the UK, ispaghula husk is used in the popular constipation remedy "Fybogel". In India, psyllium husk is used to make "Gulab Sat Isabgol" psyllium products. Psyllium mucilage is also used as a natural dietary fiber for animals. The dehusked seed that remains after the seed coat is milled off is rich in starch and fatty acids, and is used in India as chicken feed and as cattle feed.

Psyllium mucilage possesses several other desirable properties. As a thickener, it has been used in ice cream and frozen desserts. A 1.5% weight/volume ratio of psyllium mucilage exhibits binding properties that are superior to a 10% weight/volume ratio of starch mucilage. The viscosity of psyllium mucilage dispersions are relatively unaffected between temperatures of 20 and 50 °C (68 and 122 °F), by pH from 2 to 10 and by salt (sodium chloride) concentrations up to 0.15 M. These physical properties, along with its status as a natural dietary fiber, may lead to increased use of psyllium by the food-processing industry. Technical-grade psyllium has been used as a hydrocolloidal agent to improve water retention for newly-seeded grass areas, and to improve transplanting success with woody plants.

It is suggested that the isabgol husk is a suitable carrier for the sustained release of drugs and is also used as a gastroretentive carrier due to its swellable and floatable nature. The mucilage of isabgol is used as a super disintegrant in many formulations.

Asafoetida – Resin-Gum:

Scientific classification	
Kingdom:	Plantae
:	Angiosperms
:	Eudicots
Order:	Apiales
Family:	Umbelliferae



Genus:	*Ferula*
Species:	***F. assafoetida***
Binomial name	
Ferula assafoetida L.	

Asafoetida (*Ferula assafoetida*), (also known as devil's dung, stinking gum, asant, food of the gods, giant fennel, hing and ting) is the dried latex (gum oleoresin) exuded from the living underground rhizome or tap root of several species of *Ferula*, which is a perennial herb (1 to 1.5 m high). The species is native to India. Asafoetida has a pungent, unpleasant smell when raw, but in cooked dishes, it delivers a smooth flavor, reminiscent of leeks.

Asafoetid is indigenous to eastern Iran and western Afghanistan. Asafetida is the gum resin obtained from the roots and rhizomes of *F. asafoetida*. In Afghanistan, the plant grows wild at elevations of 0.61 to 1.22 km on plains that are arid in winter and where few other plants survive. The plant reaches a height of up to 2 m and bears clusters of pale, greenish-yellow flowers and an oval fruit. All parts of the plant have a distinctive fetid odor. Extraction of the gum begins just before flowering. After the stalks are cut close to the ground and the roots are exposed and slashed, a milky liquid oozes out. The liquid then dries to form a resin and a fresh cut is made. The process is continued for about 3 months from the first incision; a single plant may yield up to 1 kg of resin before it dries out. The fresh gum is a soft, semiliquid mass that undergoes a gradual color change from shimmering yellowish-white to reddish-brown.

Chemistry

Asafetida is composed of approximately 4% to 20% volatile oil, 40% to 60% resin, and 25% gum. The most striking features of the gum are its putrid odor and bitter, acrid taste caused by organic, sulfur-containing compounds found in the essential oil. Isolated sulfur compounds include disulfides (eg, asadisulfide, symmetric tri- and tetrasulfides). Several sesquiterpene coumarins have been identified, including assafoetidnol A and B, hydroxyumbelliumprenin, asafoetidin, and saradaferin. Characteristically, the plant also contains glucuronic acid, galactose,

arabinose, and rhamnose. Pinene, cadinene, and vanillin are found in the oil and umbelliferone, and asaresinotannol, foetidin, kamolonol, and ferulic acid are found in the resin. In addition, asafetida contains a number of terpenes and lipid-soluble substances that have not been well characterized. Caffeic acid cinnamyl ester with inhibitory actions on nitric oxide production and sesquiterpene dienones with cytotoxic activity have been identified.

Cooking

This spice is used as a digestive aid, in food as a condiment, and in pickles. When uncooked its odour is so strong the aroma will contaminate other spices stored near by if it is not stored in an airtight container. However, its odour and flavor become much milder and more pleasant upon heating in oil or ghee, acquiring a taste and aroma reminiscent of sautéed onion and garlic.

Antiflatulent: Asafoetida reduces the growth of indigenous microflora in the gut, reducing flatulence.

Medical applications:

- **Fighting flu** - Asafoetida was used in 1918 to fight the Spanish influenza pandemic. Scientists at the Kaohsiung Medical University in Taiwan report that the roots of Asafoetida produces natural antiviral drug compounds that kill the swine flu virus, H1N1. In an article published in the American Chemical Society's Journal of Natural Products, the researchers said the compounds "may serve as promising lead components for new drug development" against this type of flu.
- **Digestion** - In Thailand, and India it is used to aid digestion and is smeared on the abdomen in an alcohol or water tincture known as *mahahing*.
- **Asthma and bronchitis** - It is also said to be helpful in cases of asthma and bronchitis. A folk tradition remedy for children's colds: it is mixed into a pungent-smelling paste and hung in a bag around the afflicted child's neck.

- **Antimicrobial** - Asafoetida has a broad range of uses in traditional medicine as an antimicrobial, with well documented uses for treating chronic bronchitis and whooping cough, as well as reducing flatulence.
- **Contraceptive/abortifacient** - Asafoetida has also been reported to have contraceptive/abortifacient activity, and is related to (and considered an inferior substitute for) the ancient *Ferula* species Silphium.
- **Antiepileptic** - Asafoetida oleo-gum-resin has been reported to be antiepileptic in classical Unani, as well as ethnobotanical literature.
- **Balancing the *vata*** - In Ayurveda, asafoetida is considered to be one of the best spices for balancing the *vata dosha*.

Fennel: Fuits:

Scientific classification	
Kingdom:	Plantae
	Angiosperms

	Eudicots
Order:	Apiales
Family:	Apiaceae (Umbelliferae)
Genus:	*Foeniculum*
Species:	***F. vulgare***

Binomial name

Foeniculum vulgare Mill.

Tamil	**Perunjeeragam / Sombu**

Fennel flowerheads

Fennel -Fruits

Scientific classification	
Kingdom:	Plantae
	Angiosperms

	Eudicots
Order:	Apiales
Family:	Apiaceae (Umbelliferae)
Genus:	*Foeniculum*
Species:	***F. vulgare***

Binomial name

Foeniculum vulgare Mill.

Tamil	**Perunjeeragam / Sombu**

Botanical classification:

Kingdom : Plantae
: Angiosperms –Dicots
Order : Apiales
Family : Apiaceae (Umbelliferae)
Binomial : *Foeniculum vulgare* Mill.
Tamil : Perunjeeragam / Sombu

Fennel (***Foeniculum vulgare***) is a plant species in the genus *Foeniculum*. It is a member of the family Apiaceae (formerly the Umbelliferae). It is a highly aromatic and flavorful herb with culinary and medicinal uses, and, along with the similar-tasting anise, is one of the primary ingredients of absinthe. **Florence fennel** or **finocchio** is a selection with a swollen, bulb-like stem base that is used as a vegetable.

It is a hardy, perennial, umbelliferous herb, with yellow flowers and feathery leaves. It is indigenous to the shores of the Mediterranean, but has become widely naturalised in many parts of the world, especially on dry soils near the sea-coast India is the leader in production of fennel.

Chemicals constituents:

The content of essential varies strongly (0.6 to 6%); fruits in the center of an umbel are generally greater, greener and stronger in fragrance. Time of harvest and climate are also important.

The essential oil of the most important fennel variety (*var. dulce*) contains anethole (50 to 80%), limonene (5%), fenchone (5%), estragole (methyl chavicol), safrole, α-pinene (0.5%), camphene, β-pinene, β-myrcene and *p*-cymene. In contrast, the uncultivated form (*var. vulgare*) contains often more essential oil, but since it is characterized by the bitter fenchone (12 to 22%), it is of little value.

Medicinal uses - Fennel seeds

Fennel contains anethole, which can explain some of its medical effects: it, or its polymers, act as phytoestrogens.

Intestinal tract: Mrs. Grieve's Herbal states: On account of its carminative properties, fennel is chiefly used medicinally with purgatives to allay their side effects, and for this purpose forms one of the ingredients of the well-known compound liquorice powder. Fennel water has properties similar to those of anise and dill water: mixed with sodium bicarbonate and syrup, these waters constitute the domestic 'gripe water', used to correct the flatulence of infants. Volatile oil of fennel has these properties in concentration. Fennel tea, also employed as a carminative, is made by pouring boiling water on a teaspoonful of bruised fennel seeds.

Fennel can be made into a syrup to treat babies with colic (formerly thought to be due to digestive upset), but long term ingestion of fennel preparations by babies is a known cause of thelarche.

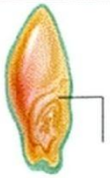
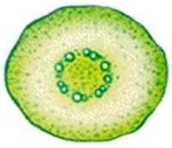
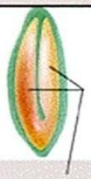
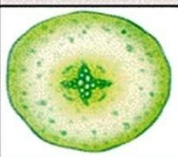
For adults, fennel seeds or tea can relax the intestines and reduce bloating caused by digestive disorders.

Eyes: In the Indian subcontinent, fennel seeds are also eaten raw, sometimes with some sweetener, as they are said to improve eyesight. Ancient Romans regarded fennel as the herb of sight. Root extracts were often used in tonics to clear cloudy eyes. Extracts of fennel seed have been shown in animal studies to have a potential use in the treatment of glaucoma.

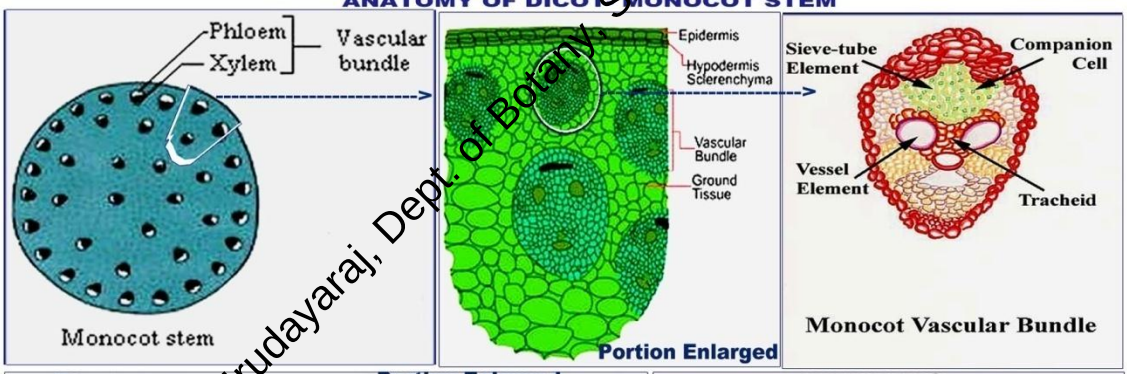
Blood and urine: Fennel may be an effective diuretic and a potential drug for treatment of hypertension.

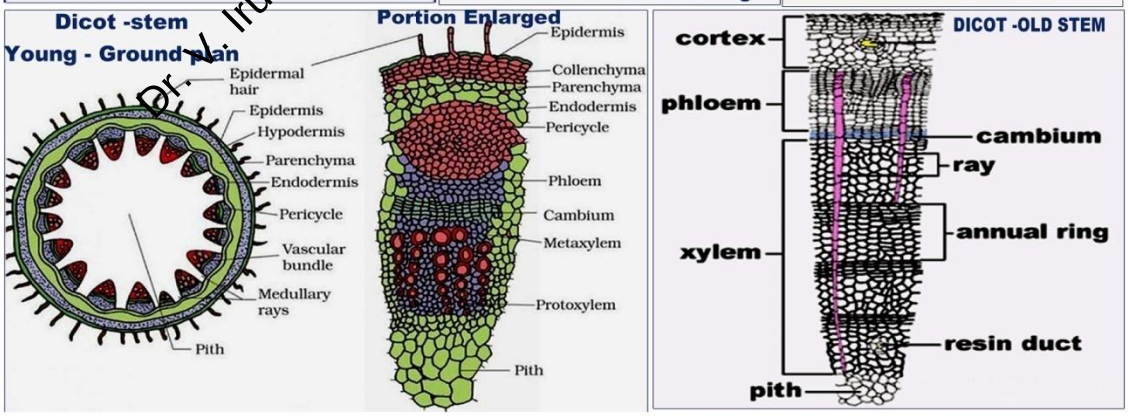
Breast-milk: There are historical notes that fennel is a galactagogue, improving the milk supply of a breastfeeding mother.

DIFFERENCE BETWEEN DICOT AND MONOCOT PLANTS

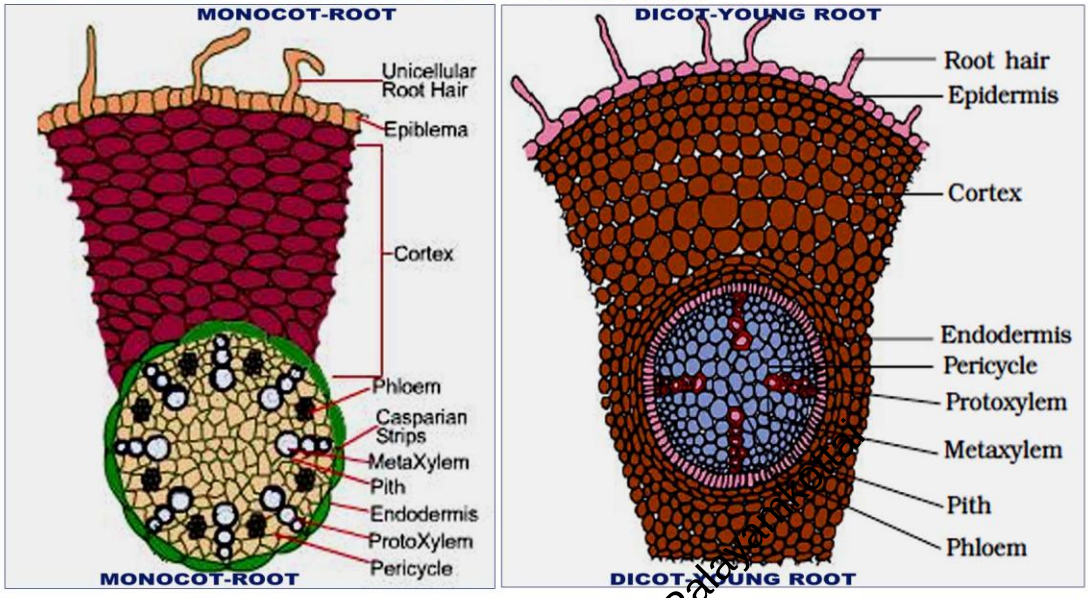
	Seed	Root	Stem	Leaf	Flower
Mono-cots					
		root xylem and phloem in a ring	vascular bundles scattered in stem	leaf veins form a parallel pattern	flower parts in threes and multiples of three
Eudi-cots					
		root phloem between arms of xylem	vascular bundles in a distinct ring	leaf veins form a net pattern	flower parts in fours or fives and their multiples

ANATOMY OF DICOT & MONOCOT STEM

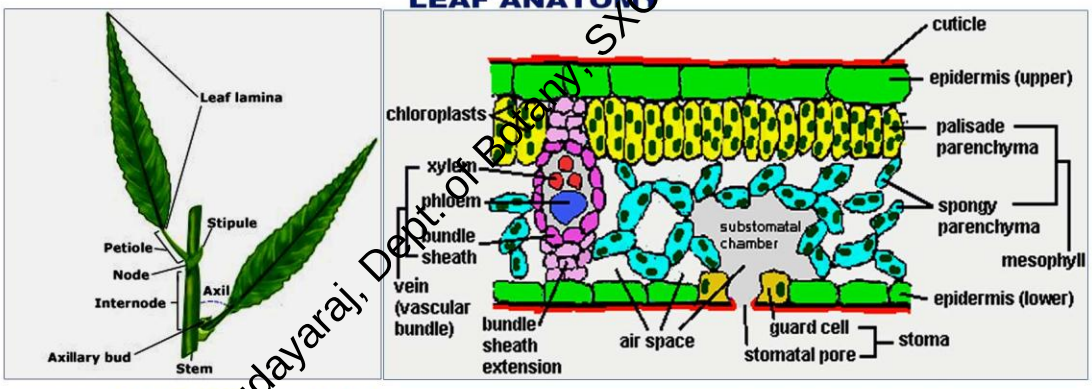


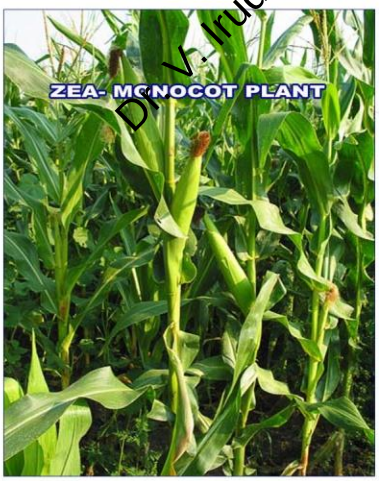


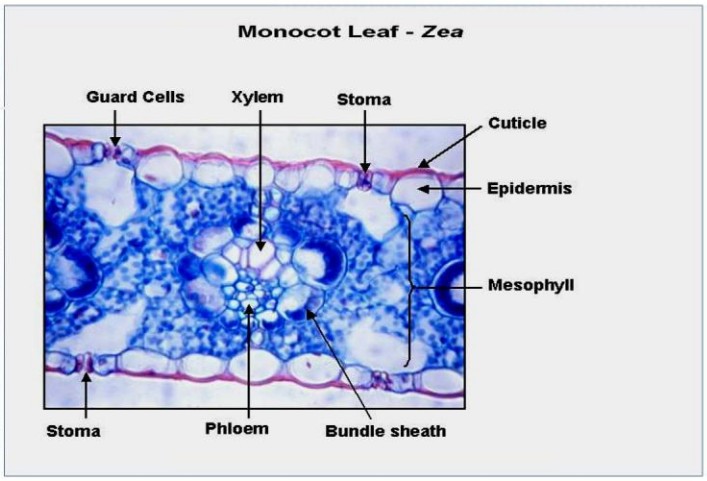
ROOT ANATOMY



LEAF ANATOMY







1. Collecting of medicinal plants

A. ***Suitable time for collection***

- The amount of a constituent is usually not constant throughout the life of a plant.
- The stage at which a plant is collected or harvested is, therefore, very important for maximizing the yield of the desired constituent.
  The differences are sometimes not only quantitative but also qualitative

B. ***Rules for collection***

- The following general rules are based on assuming that the material is best collected when the organ in question has reached its optimal state of development:

1. ***Roots and rhizomes*** are collected at the end of the vegetation period, i.e. usually in the autumn. In most cases they must be washed free of adhering soil and sand.
2. ***Bark*** is collected in the spring.
3. ***Leaves*** and ***herbs*** are collected at the flowering stage.
4. ***Flowers*** are usually gathered when fully developed.
5. ***Fruits*** and ***seeds*** are collected when fully ripe.

C. ***Methods of collection***

- Medicinal plants must be largely collected by hand. This is especially true in the case of wild plants.
- With cultivation on a large scale, it may be possible to use modern agricultural harvesters, but in many cases, e.g. barks, manual collection is unavoidable. Thus, the cost of drug production is largely the cost of the labor involved.

2. Preservation of plant material

- *The plant material must first be preserved so that the active compounds will remain unchanged during transport and storage.*
- The cells of living plants contain not only low molecular-weight compounds and enzymes, but they also have many kinds of barriers that keep these constituents apart. When the plant dies, the barriers are quickly broken down and the enzymes then get the opportunity to promote various chemical changes in the other cell constituents, e.g. by oxidation or hydrolysis. ***Preservation aims at limiting these processes as far as possible***.

A. ***Drying***

- The most common method for preserving plant material is drying.
- Enzymic processes take place in aqueous solution. Rapid removal of the water from the cell will, therefore, largely prevent degradation of the cell constituents.
- Drying also decreases the risk of external attack, e.g. by moulds.
- ***Living plant material has a high water content:*** **leaves** may contain **60-90%** water, **roots and rhizomes** **70-85%**, and **wood** **40-50%**. The lowest percentage, often no more than **5-10%**, is found in **seeds**.
- To stop the enzymic processes, the water content must be brought down to about 10 %.
- Drying must be done quickly, in other words at raised temperatures and with rapid and efficient removal of the water vapor.

- The most efficient drying is achieved in large driers of the tunnel type. The plant material is spread out on shallow trays, which are placed on mobile racks and passed into a tunnel where they meet a stream of warm air.
- The air temperature is kept at **20-40 °C** for thin materials such as **leaves**, but is often raised to **60-70 °C** for plant parts that are harder to dry, e.g. **roots** and **barks**.
- When the crude drug has been collected under primitive conditions, without access to a drier, it must be dried in the open. Even then, the material should be spread out in shallow layers with good ventilation to facilitate the drying. The choice of sunshine or shade is determined by the sensitivity to light of the constituents.
- *In a dried drug the enzymes are not destroyed but only rendered inactive due to the low water content. As soon as water is added, they become active again. Hence, dried drugs must be protected from moisture during storage.*

B. Freeze-drying

- Freeze-drying (lyophilization) is a very mild method.
- Frozen material is placed in an evacuated apparatus which has a cold surface maintained at -60 to -80 °C. Water vapor from the frozen material then passes rapidly to the cold surface.
- *The method requires a relatively complicated apparatus and is much more expensive than hot-air drying. For this reason, it is not used as a routine method, but it is very important for drying heat-sensitive substances, e.g.* ***antibiotics*** *and* ***proteins***.

- **In order to keep crude drugs as long as possible:**

1. It is essential to store them in a dry condition in carefully closed containers.
2. It is also advisable to exclude light, because - even if it does not affect the active constituents - it almost always causes changes in the appearance of the drug, especially loss of color.
3. It is also necessary to protect the drug against insect attack.

4. Grinding of crude drugs:

- Regardless of whether the crude drug is to be used for isolation of a pure compound or for manufacture of a simple preparation, the first operation that must be performed is grinding of the plant material to a powder of suitable particle size.
- It is important that the particles are of as uniform a size as possible.
- Excessive dust can clog percolators and result in a turbid extract which is hard to clarify.
- Large particles take a longer time for complete extraction than small ones and large differences in particle size thus slow down the extraction process.

- *Several types of machines are available for grinding crude drugs*:

1. ***Hammer mill***; a common type for grinding crude drugs.
2. ***Knife mill***; is useful for production of low-dust powders of leaves, barks and roots for subsequent percolation or maceration.
3. ***Tooth mill***; is used for production of very fine powders.

- Grinding produces a certain amount of heat which must be observed when grinding crude drugs containing heat-sensitive compounds.
- Mills cooled with liquid nitrogen are available for such purposes.

- Cold grinding is also preferable for crude drugs containing volatile oils.
- Following grinding, the material must be sifted to ensure the proper particle size.
- *Sifting can be performed according to two different principles*: ***sieving*** and ***blast sifting***.

- ***Sieving***

In sieving the material is passed through a sieve of suitable mesh size giving two fractions. The fraction passing the sieve consists of particles with a size smaller than or corresponding to the mesh size. The remaining fraction consists of coarser particles which are returned to the mill for continued grinding.

- ***Blast sifting***

In blast sifting the material to be classified is blown with compressed air into an apparatus which allows the particles to sediment according to their weight. Coarse, heavy particles settle fast whereas small, light particles stay for a long time in the air stream.

5. Extracts

Choice of solvent

- The ideal solvent for a certain pharmacologically active constituent should:

1. Be highly selective for the compound to be extracted.
2. Have a high capacity for extraction in terms of coefficient of saturation of the compound in the medium.
3. Not react with the extracted compound or with other compounds in the plant material.
4. Have a low price.
5. Be harmless to man and to the environment.
6. Be completely volatile.

- Aliphatic alcohols with up to three carbon atoms, or mixtures of the alcohols with water, are the solvents with the greatest extractive power for almost all natural substances of low molecular weight like alkaloids, saponins and flavonoids.
- According to the pharmacopoeias, ***ethyl alcohol*** is the solvent of choice for obtaining classic extracts such as tinctures and fluid, soft and dry extracts.
- The ethanol is usually mixed with water *to induce swelling of the plant particles* and *to increase the porosity of the cell walls* which facilitates the diffusion of extracted substances from inside the cells to the surrounding solvent.
- For extraction of ***barks, roots, woody parts*** and ***seeds*** the ideal alcohol/water ratio is about **7:3 or 8:2**. For ***leaves*** or ***aerial green parts*** the ratio **1:1** is usually preferred in order to avoid extraction of chlorophyll.

Extraction procedures

- *There are many procedures for obtaining extracts like:*

1. **Infusion**
2. **Maceration**
3. **Percolation**
4. **Digestion**
5. **Decoction**
6. **Continuous hot extraction**
7. **Solvent-solvent precipitation**
8. **Liquid-liquid extraction**
9. **Distillation**
10. **Specific procedures**

- ***Infusion:***

In this method, the plant material (herbal tea) is placed in a pot and wetted with cold water. Immediately afterwards, boiling water is poured over it, then left to stand, covered with a lid, for about fifteen minutes after which the tea is poured off.

- ***Maceration:***

This method is used frequently for water soluble active constituents. It consists of macerating the plant material in cold water (15-20°) for several hours.

- ***Percolation:***

In this method, the ground plant material is subjected to a slow flow of fresh solvent.

- ***Digestion:***

This method is suitable for hard barks or woods which are difficult for water to penetrate. Digestion is also considered as maceration but, at a relatively elevated temperature. *As a general rule the temperature of the extracting medium should be in the range from 35-40° but not exceeding 50°.*

- ***Decoction:***

If the plant material is boiled for ten minutes or if boiling water is poured over it and allowed to stand for thirty minutes, the result is called decoction.

- ***Continuous hot extraction method:***

This procedure is considered as the most common method used for the extraction of organic constituents from dried plant tissue. It can be used both on laboratory and industrial scales. In the lab, the powdered material is continuously extracted in a Soxhlet apparatus with a range of solvents of increasing polarity.

- ***Solvent-solvent precipitation:***

(I) The extract dissolved in a suitable solvent, is mixed with a less polar but miscible solvent causing the selective precipitation of the less soluble plant constituent, e.g. the precipitation of triterpenoid saponins from the methanol extract of *Phytolacca dodecandra* by the addition of acetone and the precipitation of gum from aqueous extracts of *Olibanum* by addition of alcohol.

(II) By the addition of the extract to a solvent in which the constituents is insoluble or very sparingly soluble e.g. precipitation of resins from the alcoholic extracts by the addition of distilled or acidulated water.

- ***Liquid-liquid extraction:***

Liquid-liquid extraction, also known as **solvent extraction** and **partitioning**, is a method to separate compounds based on their relative solubilities in two different immiscible liquids, usually water and an organic solvent. It is an extraction of a substance from one liquid phase into another liquid phase.

Liquid-liquid extraction is a basic technique in phytochemical laboratories, where it is performed using a separatory funnel.