

# MEDICINAL PLANTS |

## Structure

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### 8.1 INTRODUCTION

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In the unit 7 of this course you have studied about fibre yielding plants. In this unit we shall be discussing about some important medicinal plants. Medicinal plants have been used in traditional medicine practices since prehistoric times. Medicinal plants play an important role in the life of the people. In ancient Indian texts, all the plants on this earth are considered as medicinal (*Jivak* in *Astanga Hriday* (Sutra: 9-10)). The medicinal plants could be defined in the simplest way as the plants which are used in official and various traditional systems of medicine throughout the world. We can say that, the medicinal plants are the plants that provide people with medicines to prevent disease, maintain health or cure ailments.

India has one of the richest, oldest and most diverse cultural traditions associated with the use of medicinal plants. Plants and plant based products have been used traditionally in India from the time immemorial. References of the healing power of plants are depicted in Rig -Veda (4000-1500 B.C.), Atharvaveda (1500B.C.), Upanishada (1000 B.C.) and Mahabharata and Puranas (700-400 B.C.). Charaka Samhita and Sushruta Samhita are the two important compendia on medicinal plants published between 1000 and 600

B.C. The invasion of Greeks and Muslims had a considerable influence on the use of plant-based medicines. The rise of Buddhism also gave an impetus to the study of herbal medicines in ancient India.

At present, many systems of medicines such as Ayurveda, Siddha, Unani, Homeopathy, Tibetan, tribal medicines, folk medicines constituting the Indian systems of medicine (ISM) are being practiced in India. Medicinal plants are used by majority of rural population in self help mode for their primary health care requirements. In recent years, demand for herbal medicines and cosmetic products is increasing globally. It has created a quantum jump in volume of plant material traded within and outside the country.

In modern medicine about 25 percent of drugs prescribed to patients are derived from medicinal plants. We can define medicinal plants more appropriately as a plant that possess therapeutic properties or exert beneficial pharmacological effect on human or animal body.

## Objectives

After studying this unit, you should be able to:

- ❖ define the medicinal plants and outline the importance of medicinal plants;
- ❖ identify the sources of availability and distribution of these groups of plants;
- ❖ explain the origin, morphology, chemical composition and ecology of some important medicinal plants; and
- ❖ appreciate the uses of mentioned medicinal plants.

## 8.2 DISTRIBUTION OF MEDICINAL PLANTS

About 70 per cent of India's medicinal plants are found in natural habitat of Himalayas, tropical forests of Western and Eastern Ghats, the Vindhyas, Chotta Nagpur plateau and Aravalis. A large percentage of known medicinal plants occur in the dry and moist deciduous vegetation area compared to evergreen and temperate regions. About one third of all medicinal plants are trees, 32 per cent are herbs, 20 per cent are shrubs, 12 per cent creepers and 3 per cent are other forms.

Various plant parts like roots, bark, wood, stem or the whole plant in case of herbs are used for preparation of various medicines and related products (Fig.8.1).

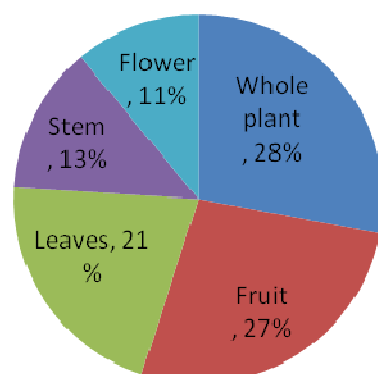


Fig. 8.1: Percentage of different plant parts used in Indian Medicines.

## 8.3 IMPORTANT MEDICINAL PLANTS

The Food and Agriculture Organization (FAO) estimated in 2002 that more than 50000 medicinal plants are used across the world. However the Royal Botanical Garden, Kew, in 2016, more precisely estimated that 17,810 plant species have a medicinal use.

Plants synthesize hundreds of chemical compounds for various purposes like defence against insects, fungi, pathogenic microbes, diseases and grazing by herbivores. A medicinal plant is grown for its secondary metabolites. Secondary metabolites are responsible for the therapeutic or aromatic properties of the plants. Alkaloids, steroids and essential oils are some of the examples of secondary metabolites. As medicinal plants are used for preparation of medicines, even a small quantity of pesticides or heavy metal is harmful to them. Therefore, the World Health Organization (WHO) has recommended development of Good Agricultural Practices (GAP) for medicinal plants to guarantee quality of drug. A large number of laboratories in the State Agricultural Universities, Indian Council of Agricultural Research (ICAR) and Council of Scientific and Industrial Research (CSIR) are engaged in developing GAP for medicinal plants.

Many ancient plant remedies for diseases have in some way or another played a significant role in modern medicine, for example, aspirin, is the most widely used medicine in the world and is entirely synthetic (a -, from acetyl; and - spirin, from *Spiracea* species of family Rosaceae, one of the sources of salicylic acid); but knowledge of the pain-relieving agent we know today as aspirin is traceable to the use of willow (*Salix* species, Salicaceae) bark by the ancient Greeks to alleviate pain. An active ingredient, salicin was isolated in 1827 from the leaves of willow. Salicin could not be taken internally, but a derivative, acetylsalicylic acid produced in Germany in 1899, provided relief from all types of pains. It is important to know here that the prototype of this drug was infact, a natural product obtained from plants. Similarly, many synthetic drugs have a botanical history - in the use of some sort of crude extract. The classical medical systems, such as Ayurveda of India and Chinese medicine depend on plant drugs. Although once viewed with a lot of scepticism by the western World, these systems have created lot of interest in the recent times as a source of alternative medicine. An inventory of medicinal plants used by people in different countries has been compiled by the World Health Organisation.

Modern drugs contain plant products like fatty acids and essential oils, gums, resins, alkaloids and steroids. Oils and gums are used as emulsifiers in many of the present drug preparations. Volatile oils and resins are often used to help penetrate tissues and also as antiseptics. The two major classes of plant-derived compounds used in medicine are: (1) steroids, and (2) alkaloids (see boxes 8.1 and 8.2). They can occur with one or more sugar molecules attached. Such forms are called glycosides and these are generally the medicinally active forms of the compound.

### Box 8.1: Steroids

Steroids are complex compounds which have the following fundamental structure comprising four carbon rings called the steroid backbone.

The addition of different chemical moieties at different places of the backbone leads to the production of a variety of different steroidal compounds. Addition of sugar molecules to the steroidal backbone produces steroidal glycosides. These are also called secondary products, and no direct physiological functions of steroids in plants

have been found. On the contrary, they have a pronounced effect on animals, particularly vertebrates. Many biologists believe that the production of these compounds is for the protection of the plants from animals. The monarch butterfly in its larval stage (as a caterpillar) feeds on milkweeds, i.e., the members of Asclepiadaceae. Milkweeds are toxic to humans because they contain steroidal glycosides. Monarch larvae store these compounds in parts of their bodies and are not poisoned by the glycosides. When the caterpillars metamorphose into butterflies, these stored glycosides occur primarily in their wings. Thus, the butterflies become toxic to their vertebrate predators such as birds. Interestingly the birds quickly learn to avoid these toxin-containing butterflies.

### Box 8.2: Alkaloids

Alkaloids as a group have no specific definition. The word alkaloid means alkaline but there is no uniform model for an alkaloid molecule. Alkaloid molecules generally have single or multiple rings and contain nitrogen. In plants, alkaloids have in the past been considered as waste products or secondary products of metabolism with no clarity about their roles. However, there is strong evidence to show that unlike steroids, alkaloids enter the primary metabolism of plants. They have also been found to play an important role in chemical defense in plants, specifically in controlling animal predation. In animals especially in mammals, the effect of many alkaloids, even in minute quantities, can be profound. The consideration of a plant as poisonous versus medicinal is often only one of dosage.

There are various methods to categorize or group medicinal plants. They can be classified in terms of i) chemical nature of the compounds involved, ii) effect they produce or iii) the source from which the drugs are obtained.

For convenience, we have grouped the plants on the basis of the source from which the drug is obtained.

#### 8.3.1 *Digitalis* spp.

Family: Plantaginaceae (Scrophulariaceae)

Vernacular name: "Witch's Bells", foxglove

n = 7

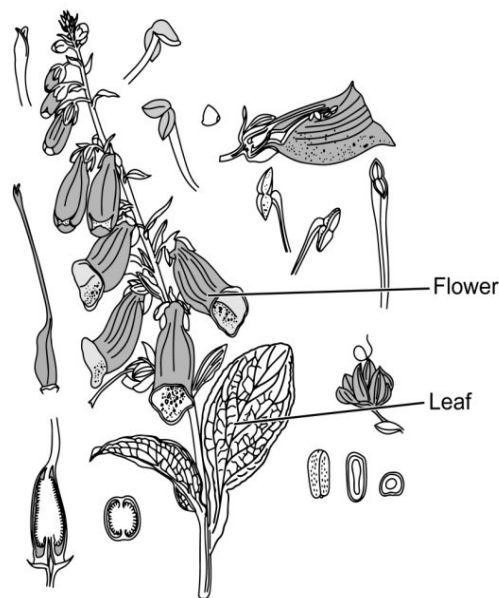
**Origin and Distribution:** *D. purpurea* – Europe, United Kingdom and *D. lanata* – Austria, United States of America, Central Europe, England and Argentina are cultivated or well distributed. In India, *D. purpurea* is cultivated chiefly in Kashmir and the Nilgiri hills; while *D. lanata* is grown in Kashmir (at altitudes of above 2100 m) and Uttar Pradesh (Chakrata).

**Cultivation:** For cultivation, disease-free strains of the seeds are selected to produce healthy plants. Soil should contain manure and leaf mould. Seedlings are hand transplanted.

**Morphology:** The plants are biennial (rarely perennial) herbs (height 45-150cm). Leaves are simple, dorsiventral, lance-shaped to oval, alternate or opposite and covered with gray white pubescent hairs. A rosette of long-stalked leaves is formed in the first year. Inflorescence is raceme (Fig 8.2 a). Flowers are arranged in showy terminal elongated clusters, purple or yellowish, hermaphrodite, zygomorphic with protruding lower lip. The flowers are conspicuously spotted on the inner bottom surface of the tube (Fig. 8.2b). The fruit is a capsule.

**Digitoxigenin**

It is a cardenolide and aglycone found in digitoxin, obtained from foxglove plant. The compound Digitoxigenin obtained by hydrolysis of digitoxin. It is highly cytotoxic.



(a)

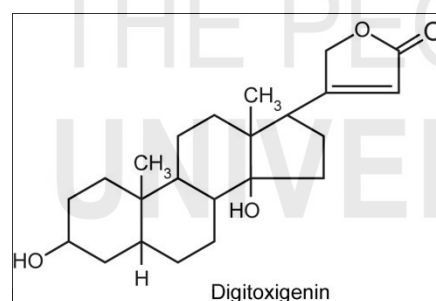


(b)

Fig. 8.2: a) A twig of *Digitalis purpurea* plant showing inflorescence; b) photograph showing a bunch of flowers in *Digitalis*.

**Box 8.3: Glycosides**

Glycosides are non-reducing organic substances which on hydrolysis yield aglycone usually known as genin, and sugar (occur as oxide rings). All cardiac glycosides are steroids or cyclopentanophenanthrene derivatives; they have an unsaturated lactone at C17 position. Digitalis glycosides are C 23 glycoside and have 5-membered lactone ring. Addition of sugar molecules to the steroidal backbone produces steroidal glycosides.



Harvesting of crop is done before flowering and then they are thoroughly dried at temperatures not exceeding 600° C.

**Chemical composition** - The active constituents of *Digitalis* are mainly confined to the epidermal and subepidermal collenchyma and the endodermal cells. *D. purpurea* leaves contain 0.2 - 0.45 per cent of a mixture of cardenolides. The physiologically active glycosides digitoxin, gitoxin and gitalin are derived from the naturally occurring purpurea glycoside A, B and C respectively by the loss of a glucose residue.

Digitoxin is the most potent of the *Digitalis* glycosides. Its activity is 1000 times that of powdered digitalis. Digitalin is another active cardiac glycoside obtained from the seeds of *D. purpurea*. *Digitalis lanata* has stronger medicinal properties and its side effects are not as toxic as *D. purpurea*. The active glycosides of the leaves are digitoxin, gitoxin and digoxin.

## Uses

1. Cardiac glycosides have a strong effect on the cardiac (heart) muscles.
2. When used medicinally they can also improve: (a) blood circulation in general, (b) relieve oedema (dropsy) which is often associated with heart attack, (c) reduce swelling in hands and ankles and (d) help renal secretion.

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## SAQ 1

Fill in the blanks.

- a) Seeds of *Digitalis purpurea* are the source of a glycoside ..... used in the treatment of cardiac disorders.
- b) Alkaloids and ..... are two major plant derived compounds used in medicine.
- c) In many drug preparations oils and gums are used as .....
- d) To guarantee the quality of drugs WHO has recommended the development of ..... for medicinal plants.

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### 8.3.2 *Papaver somniferum*

Family: Papaveraceae

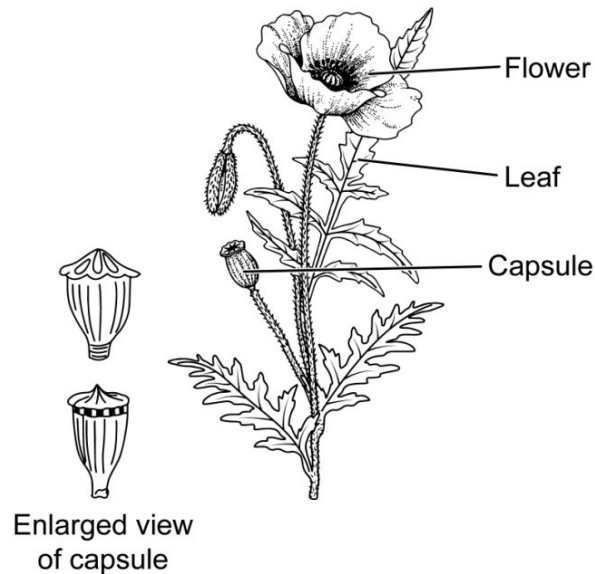
Vernacular names: Opium, poppy Pasto, Post, Afim, Kashakasha, Khuskhus, Abini

n = 11

**Origin and Distribution:** The plant is native to Eastern Europe and Western Asia. It is widely distributed in Nepal, India, Turkey, Russia, Laos and Cambodia. In India it is cultivated in the states of Madhya Pradesh, Uttar Pradesh and Rajasthan.

**Cultivation:** In India, the opium poppy is cultivated as a rabi (winter) crop. The seeds are sown in October-November and the latex is collected the following March-April. The plants prefer a well drained sandy loam. It cannot tolerate extreme cold. Propagation is from seeds, and flowering starts after 90 - 115 days. Three to four days after flowering, petals fall and capsule development begins. When the capsule turns from green to yellowish, lancing (incisions are made in the capsule from starting, the bottom upwards with the help of specially designed tools) and is carried out in the afternoon and the opium is collected in the early morning.

**Morphology:** It is an erect, annual, glaucous herb (height 30- 100 cm). The leaves are ovate-oblong, with leaf bases embracing the stem. They are often shallowly pinnately lobed. Flowers are solitary, bisexual and actinomorphic (Fig. 8.3). Fruit is a capsule; seeds small with minute embryo, endosperm oily. All parts of the plant contain latex.



**Fig. 8.3: A part of flowering twig of *Papaver somniferum*.**

**Chemical Composition :** Opium (latex obtained from the capsules) is a complex blend of dextrose, pectin, wax, pigments, volatile oil, triterpenoids and alkaloids (20-30 per cent on a dry weight basis) occurring as salts derived from a number of acids including meconic, lactic, citric, succinic, sulphuric and phosphoric acid.

Crude opium contains about 40 alkaloids, and some of the important ones from the commercial and medicinal points of view are (as percentage of opium on a dry weight basis):

- i) morphine [named after Morpheus- the god of dreams] (9 -14 per cent).
- ii) codeine (2 – 3 per cent)
- iii) thebaine (5 – 7 per cent)
- iv) narcotine (noscopine, 5 – 8 per cent)
- v) papaverine (1 per cent)

#### **Box 8.4: Morphine and its derivatives.**

In an attempt to develop a non-addicting pain-killer, scientists discovered that morphine could be chemically altered by the addition of two acetyl groups. The end product is a semisynthetic compound known as heroin. It is an even more powerful analgesic than morphine, but it is physically addictive and produces pronounced withdrawal symptoms once the habit has become established. The main cause of death for heroin addicts is by overdose.

#### **Uses**

- Morphine is a powerful analgesic and narcotic, which also stimulates the central nervous system.
- Codeine is an important analgesic and an anticough agent, which is less sedative and less toxic in comparison to morphine.
- Thebaine is a convulsant (that induces violent irregular motions of the body), poison and is used only as a raw material for the manufacture of codeine or other semisynthetic analgesics and narcotic antagonists (neutralize the effect of narcotic) such as nalorphine and etorphine.

- Narcotine is generally used in the preparation of cough medicines.
- Papaverine is a smooth muscle relaxant and cerebral vasodilator. It has been used in the treatment of asthma and angina pectoris.
- The poppy seeds are quite nutritious and have a pleasant nutty flavour, and are often sprinkled on breads and cakes. The seeds are also a source of fatty oil called poppy oil used in the preparation of sweetmeats.

### **8.3.3 Rauwolfia serpentina**

Family: Apocynaceae

Vernacular names: Snake root, Serpent wood, Chandrabhaga, Sarp Gandha

n = 10, 11, 12, 22

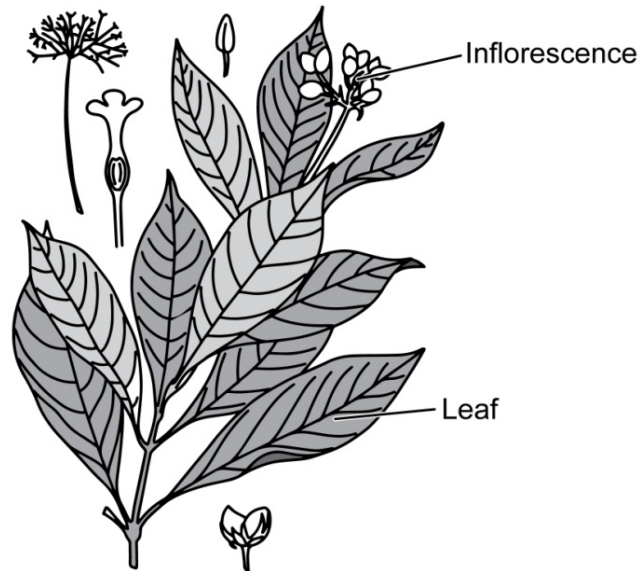
The genus *Rauwolfia* was named after the 16th century German physician and explorer Dr Leonhard Rauwolf.

**Cultivation:** The plants grow in tropical or sub-tropical regions and flourish in hot humid conditions. These are best raised from root cuttings. Seeds and stem cuttings are also used for propagation. Although pharmaceutical companies have tried to mass cultivate the plants, they have not been successful and commercial supplies still come from nature. Indonesia was once a major source, but now its supplies have been exhausted. Presently, the leading producers are India and Thailand.

**Morphology:** *R. serpentina* is an erect, evergreen, perennial glabrous undershrub. The roots are greyish brown, tuberous and have a characteristic slightly wrinkled and coarse surface. The cylindrical, tapering and twisted taproot is of commercial value. The bark of the root is considered more valuable than the wood. Roots are harvested from 2- 3 year old plants after they have shed their leaves. At this stage they are richer in alkaloids than the roots dug at earlier stages. The leaves are simple, glabrous, lanceolate or obovate; and arranged in whorls of 3 or 4, crowding the upper part of the stem. The leaves and stems too contain small amounts of alkaloids. Leaves are simple, glabrous, lanceolate or ovate in shape and arranged in the whorls of 3 or 4. Inflorescence is generally terminal but sometimes axillary. cyme. Flowers are tubular, pinkish white or greenish white in colour. Fruits are small (0.5 cm), oval, fleshy drupes, they become shiny black when ripe (Fig. 8.4 and 8.5).



**Fig. 8.4** Photograph of a flowering twig of *Rauwolfia serpentina*.



**Fig. 8.5: A twig of *Rauwolfia serpentina* with inflorescence and a single flower.**

*Rauwolfia* species contain about 80 or more alkaloids, of which reserpine, rescinnamine, ajmaline, ajmalicine and serpentine are of commercial importance. Of these, the most important is reserpine. It is chemically similar to serotonin, a substance in the brain and structurally is related to LSD (Lysergic acid diethylamide).

### Uses

- For centuries in India, powdered taproots have been used for the treatment of "moon disease", or lunacy, and also against snakebites (hence the common names Chandrabhaga, Chota-chand and Sarpghandha) and insect stings. Reserpine was also used as medicine in U.S. in the treatment of the mental disorder known as schizophrenia.
- As a result of the discovery that reserpine was hypotensive and that it could lower blood pressure, it found even greater use in the treatment of high blood pressure (often in combination with other drugs) than of schizophrenia. The use of reserpine in hypertension therapy is based on the action of the drug in dilating blood vessels thereby reducing pressure.
- An extract of the leaves has been used as a cure for the opacity of the cornea.
- Extracts of roots are used for intestinal disorders; sometimes they are mixed with other plant extracts and used in the treatment of cholera, colic and fever;
- Root extract also stimulates uterine contraction and is used in child-birth.

### **8.3.4 *Artemisia annua***

Family: Asteraceae

Vernacular name- Mugwort, Wormwood, Sagebrush, Hindi name Nagdauna

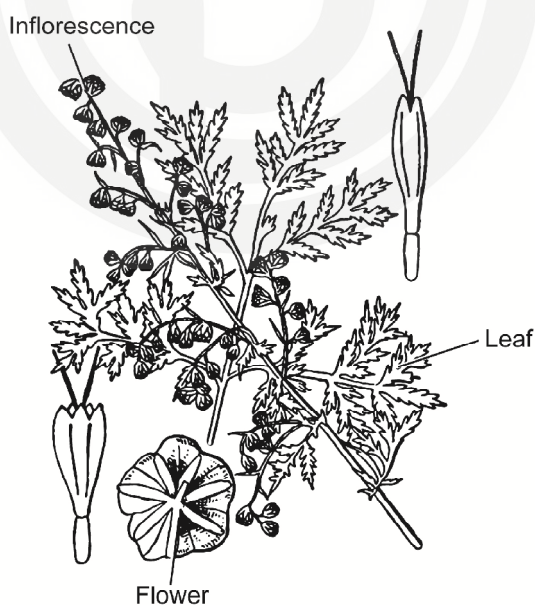
**Origin and Distribution** *Artemisia* comprises of a large genus with more than 200 species. *Artemisia annua* is a native of temperate areas covering Europe, Asia, Northern Africa and Alaska. It is a common invasive weed in North America. According to a saying it is named after the Greek goddess of the hunt, forests, and childbirth named Artemis.

### Cultivation

The plant prefers sunny and warm conditions. Its optimal growth temperature lies within 20 and 25 °C. The rainfall of about 600 mm is required for the growth of the plant. *Artemisia* species grow usually in dry or semiarid habitats .It commonly grows on nitrogenous soils at wastelands and roadsides. Notable species include *A. vulgaris* (common mugwort), *A. annua* (sagewort), *A. absinthium* (wormwood), and *A. abrotanum* (southernwood). Drugs obtained from Roots, leaves and flowers.

### Morphology

*Artemisia* plants are hardy, tall, perennial, herbs and shrubs. The plant grows from 30 to 100 cm in height. The stem is erect brownish or violet brown. The leaves have a length of 3-10 cm and are divided by deep cuts into two or three small leaflets. The leaves are dark green, pinnate, sessile with dense white tomentose hairs on underside. Inflorescence is capitulum. Small florets (5 mm. long) are radially symmetrical with many yellow or dark red petals. Numerous heads spreads out in racemose panicles (Fig. 8.6). The plant flowers from midsummer to early autumn.



(a)



(b)

**Fig 8.6 a) A flowering twig of *Artemisia annua*; b) Photograph of *A. annua* plant.**

These plant spp. are known for the powerful chemical constituents in their essential oils which is used in folk and modern medicine, and in the cosmetics and pharmaceutical industry. Most species have strong aromas and bitter tastes due to the presence of terpenoids and sesquiterpene

lactones, which discourage herbivory. *Artemisia* species are used as food plants by the larvae of a number of *Lepidoptera* species.

**Chemical Composition:** A sesquiterpene lactone, Artemisinin is produced in the glandular trichomes present on the leaves and floral buds of *A. annua*. Artemisinin is the therapeutic agent used for treating malaria. Traditionally, *A. annua* was used by the Chinese as a tea to treat “fever”. More recently, investigators have shown that tea infusions and oral consumption of the dried leaves of the plant have prophylactic and therapeutic efficacy. The essential oils of this aromatic medicinal plant contain volatile compounds like thujone (*A. vulgaris* plants are rich in an isomer alphathujone and camphor), isothujone, alpha pinene, beta pinene, myrcene, camphor, camphene, caryophyllene, cineole and artimesia ketone besides terpenes, terpenoids, and phenolic compounds.

### Uses

- Different *Artemisia* oils and their compounds have been reported as effective antimicrobial, insecticidal, and antioxidant agent. It is also used for treatment of parasitic infections such as roundworms, pinworms, tapeworms, hookworms and flukes.
- Chinese mugwort, *Artemisia argyi*, is used in traditional Chinese medicine.
- Mugwort roots are general tonic and boost physical as well as mental strength. It is known to stimulate the secretion of gastric juices and improves digestion. Mugwort is helpful in relief from rheumatic pain. Excess dosages can cause some side effects like acidity and heartburn.
- Leaves and flower tops are used for therapeutic purposes. It is used for pain relief, treatment of fever and as a diuretic agent. It also stimulates bile secretion which corrects fat metabolism and improves intestinal movements and cures constipation.
- Plant contains sedatives, antidepressants and compounds having calming action on mind relieving mental stress, depression and anxiety.
- Use of mugwort is unsafe during pregnancy as it can stimulate uterine contraction increasing the chances of spotting and bleeding and in extreme cases may cause miscarriage.
- The aromatic leaves of some species are used for flavouring. *Artemisia arborescens* (tree wormwood, or *sheeba* in Arabic) is an aromatic herb indigenous to the Middle East used in tea, usually with mint.
- Artemisinin derived from *Artemisia annua* is used to treat malaria. Artemisinin derivatives are used for treatment of malaria caused by *Plasmodium falciparum* worldwide.
- *Artemisia cina* and other Old World species are the source of the antihelminthic drug, santonin.

**SAQ 2**

State whether the following statements are T (True) or F (False).

- The chief source of the alkaloid reserpine is *Claviceps purpurea*.
- The powerful analgesic and narcotic morphine and codeine are obtained from *Papaver somniferum*.
- Poppy seeds are very nutritious and obtained from *Rauwolfia spp.*
- Two important anticancer alkaloids vincristine and vinblastine are obtained from *Artimisia* leaves.
- The most abundant alkaloid found in crude opium is papaverine.
- Mugwort relieves mental stress, depression and anxiety.

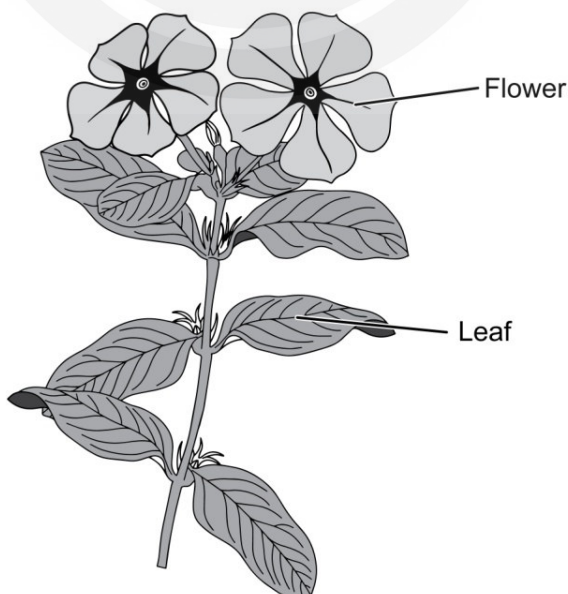
**8.3.5 *Catharanthus roseus***

Family: Apocynaceae

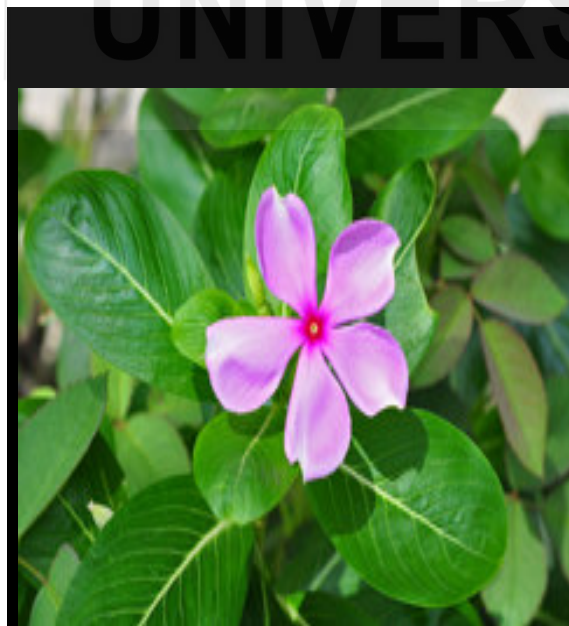
Vernacular name: Madagascar Periwinkle, Sadabahar

n = 12

**Origin and Distribution** The plant *Catharanthus roseus* (*Vinca rosea*, Fig. 8.7) is native to West Indies and Indian Ocean island of Madagascar. It is cultivated as an ornamental plant throughout the world and on commercial basis in India, Israel and the USA. In India it is cultivated on commercial scale chiefly in Ramnathpuram, Triunelveli, and Madurai districts of Tamil Nadu.



(a)



(b)

**Fig. 8.7: a) Flowering twig of *Catharanthus roseus* b) Photograph of *Catharanthus* flower.**

**Cultivation:** Fresh seeds are used for its propagation. The plant is well adapted to all types of soils and tropical climate. Annual rainfall of about 100 cm or more is ideal for its cultivation.

**Morphology:** It is a perennial, erect subshrub of height 1 m; it branches near the base and spreads over an area of some 60- 70 cm in diameter. Leaves are smooth, glossy, dark green up to 5 cm long. There are two flower varieties, alba (white) and roseus (pink) in the natural state, and several hybrids. The flowers are borne at the ends of the branching stems. The flowers are fragile, and have purplish-red or yellowish circular nectar guide at the mouth of the corolla tube. The fruit is a cylindrical follicle containing many black seeds.

**Chemical Composition:** The interest of the scientific community arose in this plant in 1950's after hearing of a "periwinkle tea" that was drunk in Jamaica for its antidiabetic properties. All parts of the plant contain alkaloids but leaves are used as a commercial source for the isolation of the two important anticancer alkaloids - vincristine and vinblastine. These are known to inhibit the growth of tumors. Today, we know that periwinkle is endowed with other medicinal properties also. In all, it contains more than 90 known alkaloid agents.

### Uses

1. Vinblastine sulphate is mainly used for the treatment of Hodgkin's disease (cancer of the lymphatic system).
2. Vincristine sulphate is useful for treatment of leukaemia and lymphocytic leukaemia.
3. Long before modern researchers learned of this plant's medicinal properties, folk healers in faraway places used the Madagascar periwinkle for a number of medicinal uses. In India, wasp sting was treated with the juice from the leaves.
4. In Hawaii, an extract of the boiled plant is used to stop bleeding.
5. In Central America, it is used for gargle to ease sore throats and chest ailments.
6. In Cuba, Puerlo Rico, Jamaica, and other islands, an extract of the flowers is commonly used as eyewash.

### **8.3.6 *Adhatoda vasica* L. (syn. *Justicia adhatoda*)**

Family: Acanthaceae

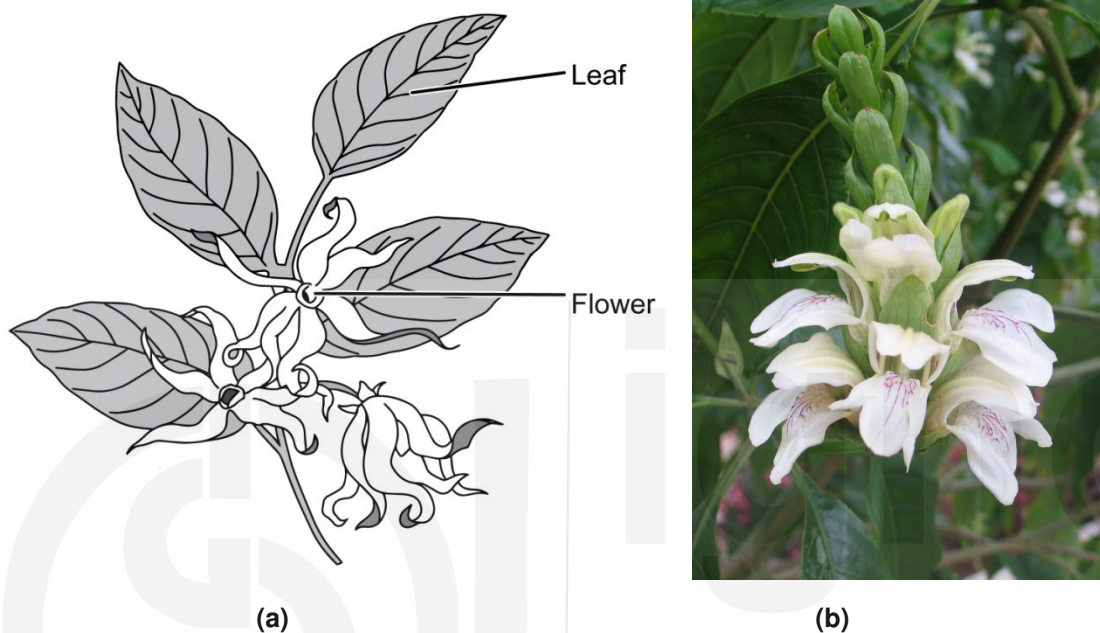
Vernacular name: Malabar nut, Adulsa and Vasakat.

n = 17

**Origin and Distribution** This medicinal plant is native to Asia and widely distributed in India, Bangladesh Nepal, Srilanka and Myanmar. It has been introduced elsewhere and used in Siddha Medicine, Ayurvedic, homeopathy and Unani systems of medicine. Plant grows in crowded areas along wasteland and roadsides throughout India.

**Morphology** *Adhatoda* is a large, perennial, evergreen shrub which reaches the average height of 3 m. Leaves are simple, ovate or lance-shaped about 10 to 15 cm in length and 4 cm. wide. They are oppositely arranged, smooth-edged, and borne on short petioles. Bark is yellowish in colour. Flowers are usually white arranged in large, dense, axillary spike inflorescence with large attractive white petals having purple line on lower lip. Fruits are small ovate or club-shaped capsules (Fig. 8.8).

**Cultivation:** The plant thrives well in loamy soil of hills and plains. The growth of the plant is best at temperature range of 20-27° C.



**Fig. 8.8:** a) A twig of *Adhatoda vasica* showing flowers; b) inflorescence in *Adhatoda*

**Chemical composition** The leaves of *Adhatoda vasica* contain phytochemicals such as alkaloids, tannins, saponins, phenolics and flavonoids. The most important alkaloids include vasicine, vasicol and adhatodinine. The vasicine yield of the herbage has been measured as 0.541 to 1.1% by dry weight.

### Uses

This shrub has a number of traditional medicinal uses in Siddha Medicine, Ayurvedic, Homeopathy and Unani systems of medicine.

- In Ayurveda *A. vasica* is used for treating respiratory diseases. It is a main ingredient in medicines for cough, cold and asthma. It reduces the inflammation of lung airways.
- Vasicine compound found in *A. vasica* is bronchodilator which eases the breathing and reduces wheezing due to asthma.
- *Adhatoda vasica* also possess antibacterial and antimicrobial properties.
- According to Ayurveda it is beneficial in bleeding disorders and ulcerations. Its use can also be helpful in peptic and duodenal ulcer.
- *A. vasica* reduces hyperacidity in stomach. It also has shown good results in treatment of dyspepsia and gastritis. It is an appetite stimulant and improves appetite.

- It is a mild anti-hypertensive that is it reduces blood pressure.
- *A vasica* also reduces joint inflammation. In combination with other herbs it helps in reducing raised uric acid and pain and tenderness associated with gout. In gouty arthritis it is used in combination with giloy (*Tinospora cordifolia*) and amaltas (*Cassia fistula*)
- *Vasica* root decoction is found beneficial in decreasing the urea level and other nitrogenous wastes in blood.

### 8.3.7 *Ephedra sinica* L.

Family: Ephedraceae

Vernacular name: Joint Pine, Mahuang

n = 7

**Origin and Distribution** *Ephedra* is a genus of gymnosperms and the only genus of family Ephedraceae and order Ephedrales. This plant is of Chinese origin. Various species of *Ephedra* are widespread in arid and semi arid regions of South Western America, Southern Europe, Northern Africa, South west and Central Asia northern China and Mangolia. It grows in dry climate and is found worldwide except Australia. In India plant is found in dry parts of Punjab, Haryana, Rajasthan, Sikkim and Jammu and Kashmir.

**Cultivation** *Ephedra* is well adapted to arid and semi arid regions. Most *Ephedra* species grow on shores or on sandy soils with direct sun exposure. It is easily propagated by its rhizomes.

**Morphology** Plant is an evergreen shrub but some species are climbers, vines and rarely trees too. The prominent underground tap root system with many adventitious roots is present in *Ephedra*. The stems are green, ribbed, profusely branched, hard and photosynthetic. Leaves are scale like or needles upto 3 cm. long, opposite or whorled. Scale like leaves fuse at their base to form a sheath. Plants are mostly dioecious with male strobili in whorls of upto 10 cones, each consisting of a series of decussate bracts (Fig.8.9a). Female cones also occur in whorls. They have bracts which fuse around a single ovule. Each strobilus contains 1 or 2 yellow to dark brown seeds (Fig.8.9b).

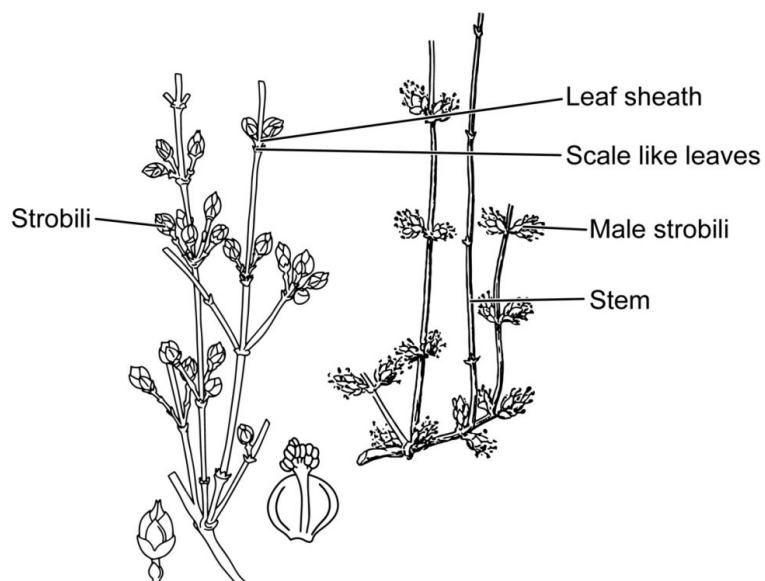


Fig.8.9: *Ephedra* plants showing male strobili, flowers, fruit and seed.

**Chemical composition:** Dried stem and leaves of the plant are used as medicine. *Ephedra* contains the alkaloids ephedrine, pseudoephedrine, nor pseudoephedrine, methyl ephedrine tannins, amino acids and phenolic compounds.

### Uses

- *Ephedra* (*E. sinica*) has been used for centuries in traditional Chinese medicine primarily for treatment of hay fever, asthma and bronchitis.
- *Ephedra* is used for treatment of flu, cold, nasal congestion and headache. The dried stem and leaves of the plant have been used to make tablets, capsules, extracts and teas.
- *Ephedra* is also used for weight loss and obesity, sometimes in combination with aspirin and caffeine.
- The plant is known for enhancing energy level and sometimes taken by athletes to enhance their performance.
- According to recent researches by U S Food and Drug Administration (FDA) there is little evidence of Ephedra effectiveness except short term weight loss but it increases the risk of heart problems and stroke, so its use is banned in America.
- Adverse effects of *Ephedra* consumption may include severe skin reactions, irritability, nervousness, dizziness, trembling, headache, insomnia, profuse perspiration, dehydration, itchy scalp and skin, vomiting etc. More serious potential side effects include irregular heartbeat, seizures, heart attack, stroke, and even death.

### SAQ 3

- a) Fill in the blanks with appropriate words
- Adhatoda* contains an alkaloid ....., which is a bronchodilator and eases in breathing.
  - Leaves of *Catharanthus* are the source of two anticancer alkaloids. .... and .....
  - Periwinkle is known for its ..... and ..... properties.
  - In Chinese medicine ..... is used for treatment of hayfever, bronchitis and asthma.
  - ..... is used for weight loss and obesity.
- b) Correctly match the medicinal plants given in column 1 with their use in column 2:

#### Column 1

#### Column 2

- |                              |                           |
|------------------------------|---------------------------|
| i) <i>Papaver somniferum</i> | 1. weight loss            |
| ii) <i>Catharanthus</i>      | 2. moon disease           |
| iii) <i>Adhatoda vasica</i>  | 3. analgesic and narcotic |

iv) <i>Ephedra</i>	4. anticancer drug
v) <i>Digitalis purpurea</i>	5. cardiac disorders
vi) <i>Rauwolfia</i>	6. bronchodilator and ease in breathing
vii) <i>Artemisia</i>	7. antimicrobial and insecticidal

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## 8.4 SUMMARY

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- *Digitalis* sp. (Foxglove) is a biennial rarely perennial herb belonging to the family Plantaginaceae (Former Scrophulariaceae). The leaves contain active glycosides digitoxin, gitoxin, and digoxin. These glycosides increase cardiac contractibility and are used for treatment of heart diseases.
- *Papaver somniferum* (Opium poppy) is an erect glaucous, annual herb of family Papaveraceae and yields opium. Crude opium contains about 40 alkaloids. Some important ones are morphine, codeine, thebaine, narcotine and papaverine known for their powerful analgesic and narcotic properties.
- *Rauwolfia* sp. (Serpentwood or Sarpagandha) belonging to the family Apocynaceae is an erect, evergreen, perennating, glabrous undershrub. Roots especially the bark of root is rich in alkaloids of which reserpine, rescinamine, ajmaline, ajmalisine and serpentine are of commercial importance. Powdered taproots are used for treatment of Moon disease, snake bite and also for mental disorder named Schizophrenia.
- *Artemisia* (Mugwort) belonging to the family Asteraceae is a tall herbaceous perennial plant with extensive rhizome system. Mugwort root extract is used as a general tonic. *Artemisia* contains sedatives, antidepressants and has calming effect on mental stress, depression and anxiety.
- *Catharanthus roseus* (Periwinkle) of family Apocyanaceae is a perennial erect shrub of about 1m. It is used for its antibiotic properties. Leaves of the plant contain two anticancer alkaloids – Vincristine and Vinblastin. Besides, this plant also possesses many other therapeutic properties.
- *Adhatoda vasica* (Malabar nut) of family Acanthaceae is a large shrub. It is used for treatment of respiratory ailments. It contains an alkaloid Vasicine which is bronchodilator and eases breathing. It also contains antibacterial and antimicrobial properties.
- *Ephedra* sp. (Joint pine) of Gymnosperm family Ephedraceae grows in arid and semi arid regions on shores and sandy soils. Plants are evergreen shrubs. It contains ephedrine alkaloids and used for treatment of cold, fever, flu, nasal congestion and headache. It is also taken for weight loss and as energy boosting drug.

## 8.5 TERMINAL QUESTIONS

1. Give the botanical names, family, general morphology and uses of any two: Poppy, Mugwort, Sarpagandha.
2. Discuss in brief the morphology, chemical composition and therapeutic uses of *Ephedra*. Why its use is banned in America?
3. Describe in brief the morphology, chemical composition and uses of *Digitalis purpurea*.

## 8.6 ANSWERS

### Self-Assessment Questions

1. a) Digitalin; b) Steroids; c) Emulsifiers; d) good agricultural practices
2. a) False; b) True; c) False; d) False; e) False; f) True
3. a) i) Vasicine; ii) Vincristine, vinblastine; iii) Antidiabetic, anticancer  
iv) *Ephedra sinica*; v) *Ephedra*  
b) i) analgesic and narcotic; ii) anticancer drug; iii) bronchodilator and ease in breathing  
iv) weight loss; v) cardiac disorders; vi) moon disease;  
vii) antimicrobial and insecticidal

### Terminal Questions

1. Refer to Section 8.3.
2. Refer to Subsection 8.3.7.
3. Refer to Subsection 8.3.1.

### Acknowledgements

**Fig. 8.2 b** : Source:  
[https://www.google.co.in/imgres?imgurl=https%253A%252F%252Fwww.verywellhealth.com%252Fthumb%252FCYs0kiHH-dozBXFz0xsNq\\_2OeM%253D%252F2018x2018%252Fsmart%252Ffilters%253Ano\\_upscale\(\)%252FGettyImages-646988534-5a5653bc980207003721e35f.jpg&imgrefurl](https://www.google.co.in/imgres?imgurl=https%253A%252F%252Fwww.verywellhealth.com%252Fthumb%252FCYs0kiHH-dozBXFz0xsNq_2OeM%253D%252F2018x2018%252Fsmart%252Ffilters%253Ano_upscale()%252FGettyImages-646988534-5a5653bc980207003721e35f.jpg&imgrefurl)

**Fig. 8.4:** : Source:  
<https://www.google.co.in/imgres?imgurl=https%3A%2F%2Fi.pimg.com%2F474x%2Fff%2F47%2F73%2Fff477367ad2d1e54df8d5b554ef1ee0e.jpg&imgrefurl>