

## Chapter 19

### Medicinal Plants

#### INTRODUCTION

**Friedrich Serturmer** isolated morphine from the opium poppy plant in 1806. In 1839, **salicylic acid** was extracted from many plants that were used for pain relieving. This knowledge led to the synthesis of **aspirin as a pain reliever drug**. Aspirin is synthesized from the bark of **white willow** (*Salix alba*). The bark of white willow plants can be boiled to obtain the extract for tea. This has been used to treat gout, fever, pain, rheumatism, and malaria symptoms. The active ingredient is the **salicin**, which is a **glycoside of salicylic acid**. Other plants that salicin can be extracted from include meadow sweet, poplars, and wintergreen. Aspirin is **anti-inflammatory, antipyretic** (fever reducing), and **analgesic** (pain relieving). Aspirin is known to prevent colon cancer, stroke, heart attack, and suppresses the aggregation of platelets thereby preventing blood clotting. Aspirin suppresses pain by suppressing the release of prostaglandins (a pain impulse neurotransmitter).

**Quina quina tree** (*Rubiceae family*) is an evergreen tree, well known as the fever tree. From the bark of this tree has been extracted a drug called quinine, used to treat malaria sickness. It was later discovered that there is the wild type of this plant called Cinchona tree, a lot of quinine was extracted from these plants for the treatment of malaria parasites. The plants are alkaloids. Medicinal plants can be classified as Alkaloids or Glycosides.

#### Alkaloids

About 3,000 plants have been identified as alkaloids. They are mainly herbaceous dicots plants and fungi. Among these plants include Fabaceae (legume family), Solanaceae (night shade family) and Rubiceae (coffee family). Alkaloids are alkaline in nature, they are bitter and they contain nitrogen. Their main effect is on the nervous system. Here, they alter the physiological and psychological activities of the body. Many alkaloids are known to be poisonous and hallucinogenic in action. Common alkaloids are caffeine, nicotine, cocaine, morphine, quinine, and ephedrine. Some alkaloid plants have reserpine as the active chemical; an example is the plant, Snakeroot, (*Rauwolfia serpentina*).

**Reserpine** is a sedative, it depresses the central nervous system. It is used as a tranquilizer for schizophrenia. Its side effect is the reduction of blood pressure.

Reserpine is known to suppress the activities of the sympathetic division of the nervous system and therefore suppresses the constriction of the blood vessels thereby lowering the blood pressure.

**Ephedrine** is another alkaloid produced by the gymnosperm plant Ephedra. The extract from this plant is used to relieve asthma, bronchitis and other respiratory illness. Ephedrine stimulates the sympathetic division of the nervous system. Ephedrine elevates the heart rate, blood pressure, respiration, and it is regarded as a dangerous drug if taken unsupervised.

## **Glycosides**

The glycosides can be subdivided into 3 subgroups: cyanogenic glycoside, cardioactive glycoside and saponins.

### **Cyanogenic glycoside**

This glycoside contains cyanides, an example is the cassava plant. The seeds, pits and barks of many common plants (apples, pears, almonds, apricots, cherries, peaches, and plums) contain amygdalin, a common cyanogenic glycoside.

**Cardioactive glycosides** and saponins contain steroids.

The cardioactive glycosides are used to regulate the heart muscle contractions, an example is digitalis, an extract from a plant called foxglove (*Digitalis purpurea*).

Saponin is known to contain diosgenin, a chemical found in yams. Diosgenin is a precursor for the synthesis of many steroid hormones; an example is progesterone and cortisone.

Other glycosides include the Burn plants –Aloe vera (*Aloe Barbadensis*). The sap from the leaves of this plant is used for the treatment of many skin ailments, from rashes, sunburn to and minor wounds. It is used by the cosmetic industries as an active ingredient for moisturizer in skin creams and lotions.

### **Key Points**

1. Medicinal plants are divided into 2 major groups: alkaloids and glycosides.
2. Alkaloid plants are herbaceous dicots. Examples of alkaloid family plants are legume, night shade, and coffee.
3. Alkaloids are alkaline, bitter and contain nitrogen. They affect the nervous system.
4. They are poisonous and hallucinogenic. Examples of common alkaloids are caffeine, nicotine, cocaine, morphine, guinine and ephedrine.
5. Alkaloids that contain a chemical known as reserpine act as sedatives; an example is the common snakeroot. It can be used as a tranquilizer.
6. Ephedrine is another common alkaloid from the plant ephedra (gymnosperm). Used to make bronchiole dilator drugs to relieve asthma, bronchitis and other respiratory illnesses. It stimulates the sympathetic nerves to raise heart beats, blood pressure, and respiration.]
7. The glycoside drugs can be subdivided into cyanogenic glycosides (contain cyanide poison), cardioactive glycosides (regulate heart muscle contractions) and saponins (contains steroid compound).
8. The cyanogenics are poisonous, the seeds and barks of many plants contain this poison, an example the cassava plants.

9. The cardioactives regulate the heart contraction, an example is digitalis extract from foxglove plant. Saponins are steroids. They contain diosgenin, a precursor for progesterone, cortisone and other steroid hormones. It is an extract of yam.
10. Other common glycosides are burn plants (aloe vera) used for treatment of skin diseases including burn. It is used for making cosmetics (skin lotions & creams)
11. Other plant products include aspirin from the bark of white willow plant. The active ingredient is salicin which is salicylic acid (a glycoside). Salicin can be obtained from poplars and wintergreen plants. It is a glycoside.
12. Quinine is extracted from Quina quina tree (an evergreen tree). It is used to lower fever and treat malaria. It is an alkaloid.

### Study Questions

1. Name a plant from which you can extract the following:

morphine

aspirin

salicylic acid / salicin

Quinine

10. State 3 characteristics of alkaloids.
11. Name 5 common alkaloid drugs.
12. Describe briefly how aspirin functions to relieve pain.
13. Reserpine is a sedative; in what ways does it function?
14. List the 3 groups of glycosidic drugs.
15. Name any 3 plants' organs that contain cyanogenic glycosides.
16. Name any cardioactive glycoside plant; and any saponin glycoside.
17. Name 5 common uses each of alkaloid and glycoside plants.
18. List the medicinal plants that are alkaloids and the ones that are glycosides.

## Chapter 20 Psychoactive Plants

Psychoactive plants have the ability to numb pains, relieve fatigue and hunger. These drugs are known to affect the central nervous system by influencing the release of neurotransmitters or by mimicking them. Apart from marijuana most psychoactive drugs have active chemical alkaloids. Many angiosperm plants are psychoactive, among them include plants from these families: coffee, coca, nutmeg, nightshade, and morning glory. Psychoactive plants can be classified as **stimulants, hallucinogens or depressants**.

**Morphine and cocaine** can be medicinal depending on the dosage; high dosage uses of these drugs are abusive and make them psychoactive. Cocaine, and caffeine are classified as stimulants; Marijuana and LSD as hallucinogens; these drugs alter the perception, mood, and produce dreamlike state of mind. Depressants suppress mental awareness, reduce physical performance, and induce sleep; Opium and its derivatives are depressants. Among opiate derivatives are morphine and codeine. **Morphine** has high analgesic potential and can deaden pain easily. Morphine is known to depress the perception of pain by binding to receptors of pain reducing neurotransmitters like endorphins. It is addictive and therefore classified as a narcotic. **Codeine** is most common opiate derivative use for pain.

**Narcotic** is a term used to classify all psychoactive drugs that induce central nervous system depression and also dangerously addictive. Among them include cocaine, and opiates.

**Heroin** is more addictive than opiate, it is not produced in United States, however other countries for example India produces it for medicinal purposes. It is used to control severe pain.

### **Marijuana (Cannabis sativa)**

The psychoactive component of marijuana is known as delta 9-tetrahydrocannabinol (THC) present in the resins produced by the plant. The concentration of THC varies with the weather conditions of growing the plants. Hot dry conditions produce concentrated resins and ultimately highly potent THC. Marijuana from Mexico, Columbia and India has high market value because of the high THC concentration. THC is known to be mind altering, including loss of sense of time. Use of marijuana can impair learning, and memory. It can lower testosterone level in males and can cause damage to the fetus in pregnant women. It is a fat-soluble substance so it can remain in the system for a lot longer time than opiate derivatives that can easily be excreted out in the urine. Marijuana is use for the treatment of glaucoma, to reduce pain associated with, AIDS, cancer and multiple sclerosis patients.

### **Cocaine**

It is extracted from coca plant originally from South America. It is an alkaloid. It has been used for the treatment of cold; in this case it helps to shrink the mucus tissues and

drains the sinuses. Coca plant also grows best in hot countries; the leaves can be harvested every 35 days. These leaves are placed in a dilute solution of sulfuric acid to extract the cocaine. This extract is processed through various ways to obtain pure cocaine. This cocaine is 12% cocaine hydrochloride; from this, **crack** can be obtained by heating it with baking soda. Crack is cheaper and produces high within seconds. Cocaine is used medically to numb pain by blocking impulse transmission. Most pain suppressant prescription synthesized drugs are structurally similar to cocaine; examples include novocaine (procaine), and xylocaine (lidocaine). Cocaine stimulates the central nervous system; it can produce a burst of energy and alertness however this is later followed by depression and lethargy. It stimulates the sympathetic division of the nervous system causing the release of adrenaline. This causes the burst in energy and the production of all the sympathetic responses (elevated heart rate, respiratory rate, pulse rate, blood pressure, and pupil dilation).

### **Tobacco**

Nicotine is a major alkaloid in tobacco, it addictive. The plant is of *Nicotiana* species, examples include *Nicotiana tabacum* and *Nicotiana rustica*. The nicotine is synthesized in the roots of these plants and translocated to the leaves where is stored. Leaves of these plants are harvested and used for cigarettes, or chewing or ground for snuf. Nicotine also stimulates the sympathetic division of the nervous system and also the central nervous system. It produces all the symptoms of the sympathetic responses (elevated heart rate, respiratory rate, blood pressure and pulse rate). It inhibits pain and hunger. Tobacco also contains tar and organic substance that is produced during the burning of the tobacco leaves. The tar is known to be carcinogenic. Dangerous gases are produced from cigarette smoking; among them are carbon monoxide, hydrogen cyanide and formaldehyde. Carbon monoxide causes fetal growth retardation and also coronary heart disease.

### **Peyote**

This is a hallucinogen. The plant is a cactus *Lyphophora williamsii*. It contains up to 30 alkaloids including mescaline which is highly potent hallucinogen. The plant extract can induce intoxication causing visual distortion called pleasant vision; accompanying that include vomit, tremors, chills and nausea. In some native American churches, peyote is used in rituals.

### **Kava *Piper methysticum***

This is a small shrub plant in the pepper family. The root extracts are used for beverages. It is a pungent taste, however it is used as a depressant. It helps people relax, be friendly and induce sleep. The plant has thick root but has soft woods. Normally the plant grows for 2 to 3 years before harvest. The active chemical substances in kava plants are the lactones. Kava acts as a muscle relaxer and in Germany it is used as anti-anxiety medication. Evidence indicates that high levels can be toxic causing liver damage.

### **Key Points**

1. These are plants that can numb pains, relieve fatigue and hunger. They affect the central nervous system.

2. They are classified as stimulants, hallucinogens, or depressants. Among them include morphine, cocaine, marijuana, LSD; opiates and heroin.
3. Cocaine is a stimulant. Marijuana and LSD are hallucinogenic. Opium and its derivatives are depressant.
4. All drugs that depress the central nervous system and addictive are called narcotics. Examples are cocaine, opiates (morphine) and heroin.
5. The active component of marijuana is THC (tetrahydrocannabinol). Hot climates produce concentrated THC in the plants. Marijuana from Mexico, Columbia & India have high market values, because of high THC concentration. Marijuana is fat soluble so it remains longer in the system than cocaine or opiates (morphines).
6. Cocaine is from the coca plant. It grows best in hot countries. The leaves are harvested every 35 days, placed in dilute sulfuric acid for extraction of cocaine (the extract contains 12% cocaine hydrochloride). Heating this extract with baking soda produces crack that is cheaper and more potent. Cocaine stimulates the brain producing alertness that is followed by depression. Cocaine also stimulates the sympathetic nerves causing the energy burst.
7. Tobacco contains nicotine (an alkaloid) Nicotine stimulates the sympathetic nerves. It is addictive. It suppresses hunger and pain. The leaf used to make cigarettes when burned produces a chemical known as tar that is carcinogenic

### Study Questions

1. Name four psychoactive drugs and state their uses and possible side effects.
2. State 3 functions of psychoactive plants' extracts.
3. Name 3 possible classifications of psychoactive plants.
4. How can medicinal drugs become psychoactive?
5. Name any 2 common stimulants, 2 common hallucinogens and any 2 depressants.
6. Briefly explain the term Narcotic.
7. Name any 5 narcotic drugs.
8. Briefly describe the mechanism of action of each of these drugs: morphine, marijuana, LSD, and cocaine.
9. State 5 consequences of addictive use of marijuana and any 2 medicinal uses of marijuana and cocaine.
10. Briefly discuss the action of cocaine in the body
  19. In 2 sentences, describe how cocaine plant can be cultivated
  20. In 2 sentences, describe how cocaine can be extracted from the coca leaves.
  21. What is the difference between crack and cocaine?
  22. Which plant leaves produce Nicotine?
  23. State the mechanism of action of nicotine in the body.
  24. State 5 consequences of Nicotine / tobacco.

## Chapter 21

### Poisonous and Allergy Plants.

#### Wild Poisonous Plants

**Strychnine** is an alkaloid extract obtained from the seeds of *Strychnos nux-vomica* trees. It is a stimulant of the central nervous system. It induces muscle spasms and convulsions and stimulates the general and special sense receptor (vision, hearing, smell and touch). It is used in the treatment of neurological diseases. It is used for rodent poisons.

**Curare** is a poison that is usually placed in arrows to hunt animals. It can be extracted from the bark of *Strychnos toxifera* plants. Curare is known to block nerve impulse transmission at neuromuscular junctions. It causes skeletal muscle paralysis; movement, swallowing, breathing, and speaking become difficult. Curare is used as a muscle relaxant in surgery. It is used also in the treatment of cerebral palsy, myasthenia gravis, polio and tetanus.

**Conine** is an alkaloid extract from *Conium maculatum* (poison hemlock). It acts as nicotine overdose; it stimulates the Central Nervous System and also causes paralysis of the skeletal muscles, diaphragm and ultimately death.

**Cicutoxin** is an extract from the roots of water hemlock (*Cicuta* spp). If taken by mouth, it produces convulsion and causes death.

**Milkweed** produces milky juice, when cut. The milkweed contains some cardioactive glycosides similar to digitalis. When eaten by man it can produce symptoms of digitalis overdose (elevated heart beats).

#### Local Poisonous Plants

Oleander plants (*Nerium Oleander*) contain cardioactive glycosides.

**Yews** (*Taxus* spp.) contains taxine toxin that acts on the central nervous system causing dizziness, dry mouth, fibrillation and ultimately respiratory failure.

**Rhododendrons** contain Grayanotoxins that cause fibrillation of the heart muscles.

**Legumes Family** (Fabaceae). The following are poisonous legumes: Rosary Pea (*Abrus precatorius*), Lupines (*Lupinus* spp.), black locust (*Rhobinia pseudoacacia*), and *Sophora secundiflora*. The *Sophora secundiflora* is known to produce hallucination. It contains cytisine toxin that causes paralysis of skeletal and respiratory muscles.

**Members of the Lily family** (*Liliceae*). The following are the members of the lily family that are poisonous: tulip, hyacinth, star-of-Bethlehem, and daffodil. They contain high concentrations of glycosides and saponins. Saponins cause irritation to the digestive tract

resulting in diarrhea and vomiting; they also contain cardiac glycosides, an example is convallotoxin.

### **Euphorbiaceae Family**

Poinsettia (*Euphorbia pulcherrima*), crown-of-thorns (*E. milli*), pencil tree cactus (*E. tirucalli*) and snow-on-the-mountain (*E. marginata*), these can cause skin irritation.

**Castor bean** (*Ricinus communis*) bears seeds that contain high level of ricin protein that causes clumping of red blood cells. Castor oil does not contain the ricin protein.

### **Phelodendrons spp. and Monstera spp.**

These are the most popular house plants that are poisonous. They contain crystals of calcium oxalate that can cause swelling of the upper digestive tract if swallowed.

### **Eupatorium rugosum** (white snakeroot)

The plant has white flowers and contains toxic tremetol, when animals eat them, they become sluggish and have muscular weakness with acetone smelling breath. Tremetol is known to cause the accumulation of lactic acid in the liver.

### **Astragalus spp. and Oxytropis spp.** (locoweeds)

When eaten by animals cause paralysis. Locoweeds contain some toxic alkaloids.  
Plants That Cause Physical Injury to animals / man

### **Cactaceae Family**

Plants in the cactus family have spines that are modified leaves that easily cause injury to animals and man. There are other plants that also have modified epidermal hairs that can cause injury to the skin.

### **Hippomane mancinella** (Manacheel tree)

This plant produces latex that causes blindness to the eye.

### **Insecticides from Plants**

Chemicals (alkaloids and saponins) produced by plants make the plants repellent to insect. In some cases, the effect may be secondary; for example, cyanogens produced by some plants cause toxicity to the insects by affecting their life cycle. This also acts as a defense mechanism for the plants against predation.

Some plants release chemical compounds that are toxic to other plants, this is known as chemical warfare or Allelopathy.

Many insecticides are developed from plants. Among them include Pyrethrum and Rotenone. Pyrethrum is a powdery chemical from flowers of *Chrysanthemum cinerifolium*



**Pyrethrum extracts** are sold as pyrthrin 1, pyrethrin 2, cinerin1 and cinerin 2. They act as nerve poisons; they are found in flea killers, or aerosol sprays.

They are not harmful to humans. Rotenone insecticides are extracts from a group of plants called retinoids. These are found in the roots of legumes.

These extracts also act on the nerves of fishes and common pests (example, caterpillars).

### **Allergy and the Immune System**

Allergies are inherited disorders, many plants' products cause allergic reactions in some people. Ragweed pollen, mold spores are all possible allergens to some people. Common allergies include hay fever, and allergic asthma. Hay fever or allergic rhinitis symptoms include running nose, nasal congestion, red and itchy eyes. Symptoms of asthma include bronchial constriction, mucus secretion, wheezing, coughing and choking. Exposure to pollen, mold spores, dust can produce respiratory allergies.

Plants that cause this allergic reactions release a high amount of pollen into the air, they are lightweight, wind pollinated and widely distributed. The pollen contains a glycoprotein in its' wall; this glycoprotein triggers the allergic reaction. Ragweed (*Ambrosia* sp.) is the most common cause of hay fever. Other trees that can cause hay fever include oak, maple, elm, birch, pecan, walnut, and mulberry. Among angiosperms are conifers, example is cedar (*Juniperus ashei*), and grasses. Treatment of these allergies include use of antihistamines, also avoid places where there could be contact with the allergens.

### **Other Types of Allergies:**

**Skin allergies.** An example is poison Ivy (*Toxicodendron radicans*) which is a member of the cashew family. It bears yellow clusters of berries. Other species are poison oak and poison sumac. Many people are allergic to poison ivy or poison oak, when in contact with the skin, it causes itching and within 24 to 48 hours, rashes appear. The extract in the poison ivy plant or poison oak plant that is the allergen is called Uroshiol. Uroshiol causes dermatitis, and even smoke from the poison ivy plant causes skin rash and affects the lungs.

### **Food allergies**

Anaphylactic reactions (severe allergy reactions that can cause, problems in the respiratory, and cardiovascular functions) can occur in food allergies.

### **Latex allergy.**

Some people are allergic to latex gloves made from plant latex.

### **Key Points**

1. Wild Poisonous Plants: Strychnine that causes muscle spasms and convulsion.
2. Curare placed in arrows for hunting animals. It blocks nerve impulse transmission causing paralysis.
3. Conine from poison hemlock plant causes paralysis of the skeletal muscles & diaphragm, and ultimately causing death.

4. Cicutoxin is an extract from water hemlock. It causes convulsion and ultimately death.
5. Milkweed that produces milky juice when cut, the milk produces symptoms of digitalis overdose.
6. Others include Rhododendron that causes heart fibrillation. Poisonous legume family includes rosary pea, lupines, black locust that contains cytosine toxin that cause respiratory muscle paralysis. Poisonous lily family (include tulip, hyacinth, star-of-Bethlehem, and daffodil) cause diarrhea and vomiting. Castor bean seeds contain ricin protein that causes red blood cells clumping (the castor oil does not contain ricin).
7. The house plant, Philodendron contains calcium oxalate crystals that cause digestive tract swelling.
8. Ragweed releases a large amount of pollen that produces allergy that cause hay fever. Other plants also cause allergies: oak, maple, lm, pecan, cedars, and grapes.
9. Poison ivy, poison oak, and poison sumac cause skin allergy. The allergen is the uroshil.

### **Study Questions**

1. Explain how strychnine and curare extracts from plants are used in the society.
2. How are circuitoxin and milkweed extracts used in the society?.
3. Give any example of a cardioactive glycoside that is a plant poison.
4. If you were to swallow any rhododendron's or yew's extract, what will be the symptoms?
5. Mention any plant that causes hay fever allergy.
6. Mention any plant extract that makes the plant produce skin allergic reaction.
7. Which is the common plant extract that is used as insecticides?
8. Briefly discuss the strychnos plants.
9. State the uses of the following: strychnine, and curare.
10. In one sentence describe the following: conine, cicutoxin, milkweed, Oleander, yews, and rododendrons.
11. Mention any 4 poisonous plants from the legume's family.
12. Mention any 4 poisonous plants from the Lily's family.
13. State one symptom of the legume poisoning, and that of the lily poisoning.

14. Mention any 4 poisonous plants of Euphorbiaceae family.
15. If a patient who was fed a meal of castor beans was later found to have clumping of red blood cells. Explain these symptoms.
16. Name 3 most popular poisonous houseplants. State any symptoms of these houseplants' poison.
17. What happens to animals that eat locoweed plants or white snakeroot plants?
18. State in one sentence what effect each of these plants' families can have to man / animals: cactaceae family, and manacheel tree.
19. State the economic importance of pyrethrum and rotenone.
20. Mention 2 common Ragweed pollen allergies, and list the symptoms of each.
21. Apart from Ragweed, name 10 other plants that produce pollen that can cause similar allergies.
22. Mention any plant that can cause skin allergy