Pharmacognosy – I

(Unit – I)

(Defination , History & Scope Of Pharmacognosy)

By: Md. Shakeel Alam

(Assistant Professor)

S.N.S. COLLEGE OF PHARMACY, MOTIHARI

INTRODUCTION

Definition:

In simple words: Pharmacognosy is the study of plants or other natural sources as a possible source of drugs.

The term comes from two Greek words: "*pharmakon*" meaning drug or medicine, and *"gnosis*" meaning knowledge. Pharmacognosy is "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". Pharmacognosy is the study of medicinal uses of various naturally occurring drugs and its history, sources, distributions, method of cultivation of active chemical constituents, medicinal uses, identification test, preservation methods, substituents and adulterants. Plant preparations are said to be medicinal or herbal when they are used to promote health beyond basic nutrition. The study of drugs from plants includes the subjects of botany, chemistry and pharmacology. Botany includes the identification (taxonomy), genetics, and cultivation of plants. Chemical characterization of includes the isolation, identification and quantification of constituents in plant materials. Pharmacology is the study of the biological effects that the chemicals in medicinal plants have on cell cultures, animals and human practical perspectives as follows;

- Quality control (identity, purity, consistency)
- Efficacy (therapeutic indications, pharmacological investigations)
- Safety (adverse reactions, drug interactions, contraindications, precautions)

Crude Drugs:

Crude drugs are the drugs, which are obtained from natural sources like plant, Animals, minerals, marine, microorganisms and they are used as they occur in nature without any processing except, drying & size reduction. Crude drugs is referred to the natural product that has not been in advanced in value or improved in condition by any process or treatment beyond that which is essential for its proper packaging and prevention from deterioration.

History of Pharmacognosy:

The term "pharmacognosy" was used for the first time by the Austrian physician J.A. Smith in 1811 and 1815 by C.A. Sydler (Medical Student) in his work titled ‘’Analecta Pharmacognostica’’.

Originally—during the 19th century and the beginning of the 20th century—"pharmacognosy" was used to define the branch of medicine or commodity sciences, 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.

As late as the beginning of the 20th century, the subject had developed mainly on the botanical side, being particularly concerned with the description and identification of drugs both in their whole state and in powder form. Such branches of pharmacognosy are still of fundamental importance, particularly for pharmacopoeial identification and quality control purposes, but rapid development in other areas has enormously expanded the subject. The advent of the 21st century brought a renaissance of pharmacognosy and its conventional botanical approach has been broadened up to molecular and metabolomic level.

Drug discovery from natural products have played and continue to play an invaluable role sources of drugs or lead compounds in the prophylaxis and treatment of diseases. Plants, especially those with pharmacological uses have been the primary sources of medicines and have an advantage over other sources in drug discovery for various reasons.

In about 77 AD, Dioscorides, a Greek doctor, kept a record of about 600 kinds of crude drugs in his compiled book De Materia Medica, a book that had played an important role in pharmacology and botany.

In 1815, CA. Seydler, a German who used the word 'Pharmakognosie" in his book named Analecta Pharmacognostica , he was also referred to as the father of pharmacognosy.

Work of Galen: -(131 -200)

Galen was Greek pharmacist; he worked on extraction of chemical constituent from the plants. He developed various methods of extraction therefore the branch of pharmacy which deals with extraction of chemical constituent from plants & animals is called as Galenical Pharmacy.

Hippocrates (460 - 360. B.C.)

Before the birth of Jesus. He was Greek scientist; He worked on human anatomy & physiology Particularly on circulatory system & nervous system. He prepared famous oath for physicians, which is still taken by the physicians, He is known as father of medicine.

Indian History of pharmacognosy:

It is about 5500 years old, the suktas of Rigveda & Atharwaveda medicinal property of plant is given. There are several medicinal plants, which are given with their use. The old Ayurveda Books, Charak samhita & Sushrutsamtita described many medicinal plants.

HISTORY:

History of pharmacognosy is as old as mankind. Human being came to know medicines from nature itself. Table 1.1 is explaining various historical developments which together contributed to the progress of Pharmacognosy. Various traditional systems of medicines from different corners of world also played vital role in development of pharmacognosy.

Table 1.1

Name	***Profession***	***Work***	***Period***
Hippocrates *Father of Medicine*	Greek scientist	Studied human anatomy and Physiology	460-360 B.C
Aristotle *Father of Biology*	Greek Philosopher	Animal kingdom	384-322 B.C.
Theophrastus *Father of Botany*	Greek Philosopher	Plant kingdom	370-287 B.C.
Pedanius Dioscorides	Greek physician	De Materia Medica book is compilation of several plants	78 A.D.
Gaius Plinius Secundus or Pliny the Elder	Roman naturalist	Encyclopedic work Entitled	25-70 A.D.
Aelius Galenus or Claudius Galenus or Galen	Greek pharmacist	Galenical Pharmacy	131–200 A.D.

Carl Linnaeus *Father of Taxonomy*	Swedish botanist	Binomial classification	1753
C A Seydler	German scientist	Coined wordPharmacognosy	1815
Sir Joseph D. Hooker	British botanist	Plant nomenclature	1817-1911
George Bentham	English botanist	Plant nomenclature	1800-1884
Charles Darwin	English naturalist	Evolutionary theory	1809-1882
Friedrich Sertürner	German chemist	Isolated first alkaloid morphine from opium	1804
Mikhail Tsvet	Russian scientist	Separation of plant pigments by chromatography	1900

Alternative Systems of Medicine

Ayurveda System

It is about 5000-year-old system of medicine native to India. It is holistic system of medicine which considers whole body while treating disease and not just a diseased part of body. Ayurveda has thousands year's evidence-based history so it can be just complete system rather alternative system or complementary system. Ayurveda is a Sanskrit word which means (Ayur-life and veda – to gain knowledge or science) science of life. Ayurveda deals with different types of plants, minerals and animal products. Charak samhita by Charak includes the principle components or theory of Ayurveda. Sushrut samhita edited by Sushrut is about the surgical treatments in Ayurveda.

Theory and principles: Ayurveda involves following fundamental principles:

- ***Triguna***: Satva (good), Raja (aggressive), Toma (dullness).
- ***Tridosha:*** (Kapha- lubrication, Vatarespiration and Pitta-metabolism),
- ***Panchshil: (Rasa :*** Therapeutically active substances, Guna : Quality Virya : Active principle and potency, Vipaka : The end product of digestion, Prabhava : Actual effect of drug on body),
- ***Panch Mahabhuta:*** (earth, water, sky, fire and air),
- ***Saptadhatu*** [(Rasa (Plasma), raktam (Blood), mamsa (Muscles), meda (Fat), asthi (Bone), majja (Bone marrow and nerves), shukra (Reproductive fluid or Semen)]

Diagnosis: When non-equilibrium between any of above principles causes to person suffers from diseases. Ayurveda cures the cause of disease by considering to mental, physical, social and spiritual welfare of human beings. Observation of body color, tongue, nail, eyes, pulse and investigation of blood, urine and fecal matter is criteria of diagnosing actual cause of disease.

Treatment: Panchakarma is an important treatment in Ayurveda which includes snehan (massage), swedan (steam), vaman (vomit), virechan (expulsion) and basti (medicated enemas). The medicines are given in the form of powder (churna, bhasma), liquid (asava, arishta and taila), semisolid (leha or paka) and tablets (gutika, vati). Treatment of ayurveda involves use of drugs obtained from plant, animal and mineral sources. Dosage forms of ayurveda are powders (churna), bhasma (oxides of metals), quath (extracts), gutika (pills), lep (ointment), asava and arishtha (alcohol containing liquids) or taila (medicated oils). There are eight branches of Ayurveda: 1. Kayachikitsa (internal medicine) 2. Kumarbhritya (pediatrics) 3. Trachchikitsa (psychology medicine) 4. Shalakya Tantra (ear, nose and throat) 5. Shalya Tantra (surgery) 6. Agada Tantra (toxicology) 7. Rasayana Tantra (geriatrics) 8. Vajikaran Tantra (gynecology)

Siddha System

Siddha system of medicine is one of the oldest medical systems known to mankind even before ayurvedic system which was flourished in Vedic culture, Dravidian culture and Indus Valley Civilization. This system of medicine originated from Tamil traditional medicine. The most of literature of this system is given in Tamil Language. 18 "Siddhas" (Spiritual persons) developed this system so it is called as Siddha. Sage Agathiyar is considered the guru of all Sidhas. According to Palm Leaf manuscript, it is believed that it was first described by Lord Shiva to his wife Parvathy and then to their son Lord Muruga. Then he taught all their knowledge to his disciple sage Agasthya. Agasthya taught 18 Siddhars and they spread this knowledge to human beings. Siddhars have to get Siddhi means attainment of supernatural powers.

Theory and principles:

Generally, the basic principles of the Siddha medicine are almost similar to ayurveda. The only difference appears is that the siddha system explains in detail about various basic treatments of diseases while Ayurveda where surgeries like modern treatments are practiced and written in detail. Siddha system is based on 96 principles and out of these Triguna theory, i.e., vata, pitta and kapha is more prominent. Under normal conditions, the ratio between Vata, Pitta, and Kapha is 4:2:1, respectively. Siddha deals with thousands of herbs, animal, mineral and metals. Like in Ayurveda, in Siddha medicine also, the physiological components of the human beings are classified as vata (air), pitta (fire) and kapha (earth and water). Siddha system believes that health is perfect state of physical, mental, social, moral and spiritual component. It is based on Andapinda Thathuvam means relationship between universe and human body. Siddhas are called as Vaithiyars.

Diagnosis: A Siddha physician studies eight important things of body i.e. nadi (pulse), kan (eyes), swara (voice), sparisam (touch), varna (colour), na (tongue), mala (faeces) and neer (urine).

Guna	***Personalities***	***Complications***
Vata	Stout, black, cold and inactive healthy	Increased Vata shows arrogant behavior paralysis, heart attack.
Pitta	Lean, whitish complexion and perfectionist	Increased Pitta shows graying of hair, anemia and instability.
Kapha	Well built, good complexion and well behaved	graying of hair, causes jaundice, heart attack.

Treatment:

Internal as well as external medicines are divided into 32 categories each separately. Pressure or massage techniques, are also part of treatment and called as Thokkanam. There are 108 varma points for pressure techniques. Treatment is classified into three categories: devamaruthuvum (Divine method); manuda maruthuvum (rational method); and asura maruthuvum (surgical method). In Divine method medicines like parpam, chendooram, guru, kuligai made of mercury, sulphur and pashanams are used. In the rational method, medicines made of herbs like churanam, kudineer, vadagam are used. In surgical method, incision, excisions, use of heat or leech are used. Treatment in this system emphasizes preparation of fresh medicine. It is then prepared and administered with some Pathya (some restriction). E.g., Day time sleeping is not allowed or some food material is restricted like chicken, mango, coconut, mustard, groundnut, almond, tobacco etc. Medicine can be kashayam (extract), churnam (powder), tailams (medicated oil), gulligai (pills), chenduram (metal), bhasmam (calcination product) and or ghritam (medicated ghee)

Unani System

This system is also called as unani-tibb or yunani medicine which was developed by arab and persian physicians such as Rhazes (al-Razil), Avicenna (ibn sena), Al-zahrawi, and Ibn nafis.

Book: Ibn Sina's The Canon of Medicine

Theory and principles:

Unani medicine involves concept of the four humours (akhlat) i.e. Phlegm (Balgham), Blood (Dam), Yellow bile (bafrâ') and Black bile (Saudâ'). These "humors" are believed to have its roots in the appearance of a blood sedimentation test made in open air, which exhibits a dark clot at the bottom (black bile), a layer of unclotted erythrocytes (blood), a layer of white blood cells (phlegm) and a layer of clear yellow serum (yellow bile). Abnormality in humor leads to disease condition in body.

Diagnosis:

The human body is considered to be made up of seven components, which have direct bearing on the health status of a person. They are 1. Elements (Arkan) 2. Temperament (Mijaz). 3. Humors (Aklat) 4. Organs (Aaza) 5. Faculties (Quwa) 6. Spirits (Arwah) 7. Functions (Afaal). These components are taken in to consideration by the physician for diagnosis and also for deciding the line of treatment. In diagnosis Unani Physican (Hakim) ask a patient a lot questions to know history and decides treatment.

Treatment:

After diagnosing the disease, treatment involves either to eliminate cause (Izalae sabab), normalize humors (tadeele akhlat) or to normalise tissues or organs (tadeele aza). Method of treatment involves modification of essential pre-requisites of health (Ilaj-bil-tadbeer) or panchkarma like in Ayurveda (Ilaj-bil-tadbeer) or pharmacotherapy (Ilaj-bil-advia) or surgery (Ilaj-bil-yad). As far as possible unani medicine therapy attempts to use simple physical means to cure a disease. Some of the techniques used in Ilaj-bil-tadbeer (regimental therapy) include hijamah (cupping), fasd (venesection), tareeq (sweating), idrar-e-baul (diuresis), hamam (turkish bath), dalak (massage), kai (cauterization), ishal (purging), qai (vomiting), riyazat (exercise) and taleeq (leeching).

The bases are generally purified by adding aab leemun (lemon juice), sat leemun (lemon extract) or shibb-e-yamani (alum) etc., before making the qiwam. Afterwards, the ingredient drugs are mixed in qiwam to prepare majun, itrifal, laboob, tiryaqat or mufarreh. For making majun or any of its preparations, the consistency of qiwam for majun is three Tars. The consistency of qiwam for laooq is two tars.

Word Majun is derived from Ajn, which means to mix. In this preparation powder of drugs is mixed well in qiwam (basic solution of particular consistency) of sugar or asl (honey). Their names are given on the name of inventor, chief ingredients or action. Like majun sheikhurrais is named on inventor. majun mullein is named due to its laxative action. Majun azaraqi, as azaraqi is chief ingredient. So itrifal (triphala), jawarish (digestive tonic), yaqooti (ruby containing), bershasha are all majun but according to composition use ingredient preparation method, and other properties, their names are different.

Homeopathy System

Homeo means 'similar' and Pathos means 'suffering' so homeopathy is the "system of similar suffering". German physician Samuel Hahnemann first stated the basic principle of homeopathy in 1796, known as the "law of similars" (let like be cured by like").

Theory and principle:

Homeopathy emphasises the root cause of the disease and the nature's law of its cure that is 'like cures like'. Thus, homeopathy deals with the following seven principles which are outlined below:

- Individualization: No two individuals in the world are alike, i.e., the disease affecting two individuals cannot be similar though they may share common symptoms. Therefore, the medicines used to cure the same disease in different individuals are different.
- Principle of similar: Use of the medicine will produce similar symptoms of disease in a healthy individual. For example, an onion is a substance, which makes your eyes water and your nose burn. If you are having an attack of hay fever with watering eyes and a burning nose, a homeopathic remedy made from onion can relieve it.
- Principle of simplex: Only one single simple medicine at one time and no combination is allowed.
- Minimum dose: Minimum medicine at a time.
- Law of proving: Medicine should have the capacity to produce disease state in a healthy individual.
- Law of dynamisation: Medicine should preserve the normal state of healthy body.
- Vital force: Medicine should have the capacity to arouse sufficient energy to maintain a healthy body.

Diagnosis:

It involves knowing of complete hereditary history as well as observation of moods, habits, skin, eyes, tongue, blood, urine etc., of patients.

Treatment:

When the symptoms picture matches with the drug picture, the physician always attempts to identify a single medicine. In producing remedies for diseases, homeopaths use a process called "dynamisation" or "potentiation", whereby a substance is diluted with alcohol or distilled water and then vigorously shaken in a process called "succussion". Three logarithmic potency scales are in regular use in homeopathy for dilution. Hahnemann created the "centesimal" or "C scale", diluting a substance by a factor of 100 at each stage. Homeopathic pills are made from an inert substance (often sugars, typically lactose), upon which a drop of liquid homeopathic preparation is placed. Hahnemann began to test what effects substances produced in humans, a procedure that would later become known as "homeopathic proving".

The Scope of Pharmacognosy:

- Pharmacognosy gives a sound knowledge of the vegetable drugs under botany and animal drugs under zoology.
- It also includes plant taxonomy, plant breeding, plant pathology, plant genetics and by this knowledge one can improve the cultivation methods for both medicinal and aromatic plants.
- Now a days phytochemistry (plant chemistry) has undergone the significant improvement.
- This includes a variety of substances that accumulated by plants and synthesized by plants.

A vital link between pharmacology and medicinal chemistry:

- ✓ Newly detected plant drugs are converting into medicine as purified phytochemicals
- ✓ Pharmacognosy is essential for the evolution of new medicines because crude drugs are used for the preparation of galenical or as a source of therapeutically active metabolites.
- ✓ In short Pharmacognosy is an important link between pharmaceuticals and basic science well as ayurvedic and allopathic system of medicines.
- ✓ Pharmacognosy is a science of active principles of crude drugs and which can be help in dispensing, formulating, and manufacturing of dosage forms.
- ✓ In other way the complete knowledge of pharmacognosy will help in recent trend that is in industries.
- ✓ As a research tools and in drug delivery systems, and all the departments of pharmaceuticals and one can improve the healthcare facilities across the world.

Role of Pharmacognosy

- ➢ Pharmacognosy is important branch of pharmacy which is playing key role in new drug discovery and development by using natural products. Pharmacognosy has given many leads for new drug discovery and development.
- ➢ It is an important link between modern medicine systems (allopathy) and traditional system of medicine. It is a part of medicinal system which is affordable as well as accessible to common man. As part of integrative system of medicine, pharmacognosy can help to increase effectiveness of modern medicine system.
- ➢ It is acting as a bridge between pharmacology, medicinal chemistry and pharmacotherapeutics and also pharmaceutics. It also bridges pharmaceutics with other pharmacy subjects.
- ➢ More than 60 percent of world population is still using natural product for their primary healthcare needs. Pharmacognosy can provide safe and effective drugs in combination with modern medicine system.
- ➢ Pharmacognosy includes knowledge about safe use of herbal drugs including toxicity, side effects, drug interaction thereby increasing effectiveness of modern medicine.
- ➢ Pharmacognosy is an important link between pharmacology and medicinal chemistry. As a result of rapid development of phytochemistry and pharmacological testing methods in recent years, new plant drugs are finding their way into medicine as purified phytochemicals, rather than in the form of traditional galenical preparations.
- ➢ Pharmacognosy is the base for development of novel medicines. Most of the compounds obtained from natural product serve as prototype or base for development of new drug which are more active and less toxic.
- ➢ By means of pharmacognosy, natural products can be dispensed, formulated and manufactured in dosage forms acceptable to modern system of medicine.
- ➢ There are vast number of plant and animal species which are not studied systematically.
- ➢ Development of pharmacognosy also leads to development of botany, taxonomy, plant biotechnology, plant genetics, plant pathology, pharmaceutics, pharmacology, phytochemistry and other branches of science.

(Unit – 2)

Pharmacognosy – I

[SOURCES OF DRUGS]

By: Md. Shakeel Alam
(Assistant Professor)

S.N.S. COLLEGE OF PHARMACY, MOTIHARI

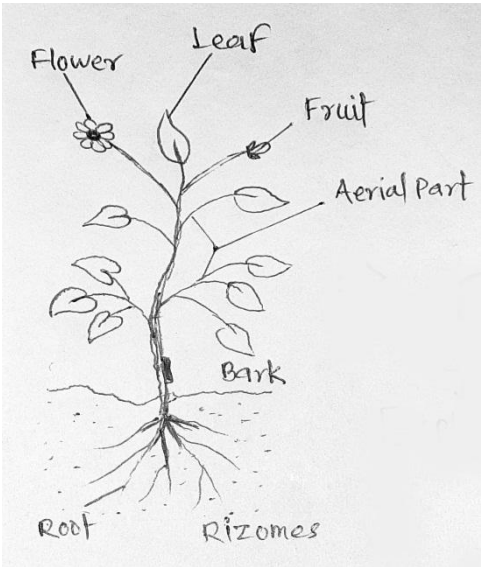
SOURCES OF DRUGS

Drugs are obtained from six major sources:

1. Plant sources
2. Animal sources
3. Mineral/ Earth sources
4. Microbiological sources
5. Marine Sources
6. Plant Tissue Culture

➢ Plant Sources:

Plant source is the oldest source of drugs. Most of the drugs in ancient times were derived from plants. Almost all parts of the plants are used i.e. leaves, stem, bark, fruits and roots.



Leaves:

1. The leaves of Digitalis Purpurea are the source of *Digitoxin and Digoxin*, which are cardiac glycosides.
2. Leaves of Eucalyptus give oil of *Eucalyptus*, which is important component of cough syrup.
3. Tobacco leaves give *nicotine.*
4. Atropa belladonna gives *atropine.*

Flowers:

1. Poppy papaversomniferum gives *morphine (opioid*)
2. Vincarosea gives *vincristine and vinblastine*
3. Rose gives rose water used as tonic.

Fruits:

1. Senna pod gives *anthracene*, which is a purgative (used in constipation)
2. Calabar beans give *physostigmine*, which is cholinomimetic agent.
3. Amla gives vit-C used as antioxidant

Seeds:

1. Seeds of Nux Vomica give *strychnine*, which is a CNS stimulant.
2. Castor oil seeds give *castor oil*.
3. Calabar beans give *Physostigmine*, which is a cholinomimetic drug.

Roots:

1. Ipecacuanha root gives *Emetine*, used to induce vomiting as in accidental poisoning. It also has amoebicidal properties.
2. Rauwolfia serpentina gives *reserpine*, a hypotensive agent.
   Reserpine was used for hypertension treatment.

Bark:

1. Cinchona bark gives *quinine and quinidine*, which are antimalarial drugs. Quinidine also has antiarrhythmic properties.
2. Atropa belladonna gives *atropine*, which is anticholinergic.
3. Hyoscyamus Niger gives *Hyoscine*, which is also anticholinergic.

Part Uses	Name of Medicinal Plant	Active Chemical Constituents	Uses
Leaves	Digitalis	Digitoxin	Cardiotonic
	Senna	Sennosides	Laxative
Flowers	Clove	Eugenol	Dental Analgesic
Fruits	Opium	Morphine	Potent Analgesic
	Amla	Vitamin C	Antioxidant
	Bael	Marmesin, Acgelin	Antidiarrheal, Hepatoprotective Properties
Seeds	Castor Oil	Ricinoleic Acid	Laxative
	Mustard Oil	Oleic Acid	Antarthritic
Roots	Rouwolfia	Reserpine	Antihypertensive
	Ipecac	Emetine	Emetics
	Ashvgandha	Withenolides	Anti stress Property

- **Animal Sources:**

1. Pancreas is a source of Insulin, used in treatment of Diabetes.
2. Urine of pregnant women gives human chorionic gonadotropin (HCG) used for the treatment of infertility.
3. Sheep thyroid is a source of thyroxin, used in thyroid deficiency eg. Goiter,Hypo & Hyper thyroidism.
4. Cod liver is used as a source of vitamin A and D.
5. Anterior pituitary is a source of pituitary gonadotropins, used in treatment of infertility.

6. Blood of animals is used in preparation of vaccines.
7. Stomach tissue contains pepsin and trypsin, which are digestive juices used in treatment of peptic diseases in the past. Nowadays better drugs have replaced them.

S.No.	Animal Part/Product uses as drug	Hormones/Chemicals	Uses
1.	Pancreas	Insulin	Diabetes
2.	Blood	Vaccines	Several type of Disease treatments
3.	Sheep Thyroid	Thyroxine	Thyroid Insufficiency
4.	Cod liver Oil	Vitamin A & D	Vit. A is useful for Vision & Vit, D is for Immune system
5.	Stomach Tissue	Pepsin & Trypsin	Used in Peptic Disease
6.	Posterior Pituitary gland (Source: Adrenal Gland)	Oxytocin	Labor pain & Lactation
7.	Epinephrine/Adrenaline	Adrenaline	Acute Asthma Treatment
8.	Urine of Pregnant Women & Horse Serum	Human Chorionic Gonadotropin (HCG)	Treatment of Infertility
9.	Pancreas of pig	Pancreatin	Pancreatitis Treatment
10.	Human Plasma	Fibrinolysin	Thrombosis Treatment

- **Mineral Sources:**

1. **Metallic and Nonmetallic sources:**

1. Iron is used in treatment of iron deficiency anemia.
2. Mercurial salts are used in Syphilis.
3. Zinc is used as zinc supplement. Zinc oxide paste is used in wounds and in eczema.
4. Iodine is antiseptic. Iodine supplements are also used.
5. Gold salts are used in the treatment of rheumatoid arthritis.

2. Synthetic Sources:

When the nucleus of the drug from natural source as well as its chemical structure is altered, we call it synthetic.

Examples include Emetine Bismuth Iodide

3. Semi Synthetic Source:

When the nucleus of drug obtained from natural source is retained but the chemical structure is altered, we call it semi-synthetic.

Examples include Apomorphine, Diacetyl morphine, Ethinyl Estradiol, Homatropine, Ampicillin and Methyl testosterone.Most of the drugs used nowadays (such as antianxiety drugs, anti-convulsant) are synthetic form.

4. Miscellaneous Sources:

1. Fluorine has antiseptic properties.
2. Borax has antiseptic properties as well.
3. Selenium as selenium sulphide is used in anti-dandruff shampoos.
4. Petroleum is used in preparation of liquid paraffin

5. Clay Minerals:

1. Calamine:
2. Bentonite:

} Both are used in preparation of Talcum Powder, Cream, Beauty Products Cosmetic Preparations.

➢ Microbiological Sources:

- Several types of bacteria play an important role in the production of several types of life saving drugs.
- These are obtained from microorganisms and they used to kill the microbes & to stop the growth of microbes.

1. Penicillium notatum is a fungus which gives penicillin.
2. Actinobacteria give Streptomycin.
3. Aminoglycosides such as gentamicin and tobramycin are obtained from streptomyces and micromonosporas.

S.No.	Drugs	Obtained from Microorganism
1.	Penicillin	Penicillium Notatum
2.	Chloramphenicol	Streptomyces Venezuelance
3.	Griseofulvin	Penicillin Grisofullivum
4.	Streptomycin	Streptomyces griseus
5.	Neomycin	Streptomyces Fradiae

➢ Marine Sources

Drug Obtained from Marine (Sea/Ocean)

Examples: Seaweed, Soft coral, Sponges, Fish, Microorganism

1) Anti-microbial agents: [Cholera (Haiza), Tuberculosis (TB), Pneumonia]

- Cephalosporin: - Obtained from Marine Fungus [Cephalosporium Acremonium]
- Istamycin A & B: - Marine Streptomycin

2) Anti-viral Agents: [Hepetitis, Rebies, Small pox, Chiken pox, Flu, HIV, Ebola]

- Ara A (Vidarabine): -Caribbean Sponge [Tethya Crypta]
- Avarol&Avarone: - Sponge [Disideaavara] used in AIDS Treatment
- Fucoidan: - Brown Algea [FucusVesiculosus]

3) Anti-Parasitic Agents:[Malaria, Diarrhea, Hookworm]

- Domoic Acid: - Red Algae [ChondriaAsmata] used in the treatment of anthelmintic
- α- kainic Acid: - Red Algae [ChondriaAsmata]

4) Cardio Vascular Agents: -

- Laminine : - Specific type of reg algae [hypotensive effect]
- Octopamine: - Octopus [Octopus Vulgaris]
- Spongosine: - Caribbean Sponge [Cryptotethya Crypta]

5) Anti-Cancer Agents: -

- Ara C (Cytarabine) : - Caribbean Sponge [Tethya crypta] used in treatment of leukemia
- Crassin Acetate: - Caribbean Gorgonian [Pseudo PlexauraPorosa]

➢ **Plant tissue culture:**

Invitro Cultivation of plant Cell/tissue/Organ in nutrient media/growth media (Solid/Liquid/ Semi Solid) under aseptic conditions and controlled environment (light, PH, temperature). This type of work / culture is called plant tissue culture.

- Sterile/Aseptic: - free from Microorganism
- Invitro Cultivation: - plant tissue Culture

Plant tissue culture is based on Totipotency (Cell Potency)
Totipotency: Ability or power of a single plant cell to develop in entire plant.

Advantages:

1. Huge amounts of drugs can be produced.
2. Drug can be obtained in pure form.
3. It is less antigenic.

Disadvantages:

1. Well-equipped lab is required.
2. Highly trained staff is required.
3. It is a complex and complicated technique.

Application of Plant Tissue Culture: -

1. Production / Regeneration
2. Endangered plant Species conservation
3. Large Scale Production of Bio- active compounds.
   Examples:
   - ✓ Digitalis (leaf) ➟ Digoxin
   - ✓ Rauwolfia (root) ➟ Reserpine
   - ✓ Atropa Belladonna (leaf) ➟ Atropine
   - ✓ Papaya (Fruits) ➟ Papain
4. Herbicide resistance / Disease resistance plant
5. Hybrid Plant/ Regeneration of Transgenic plant

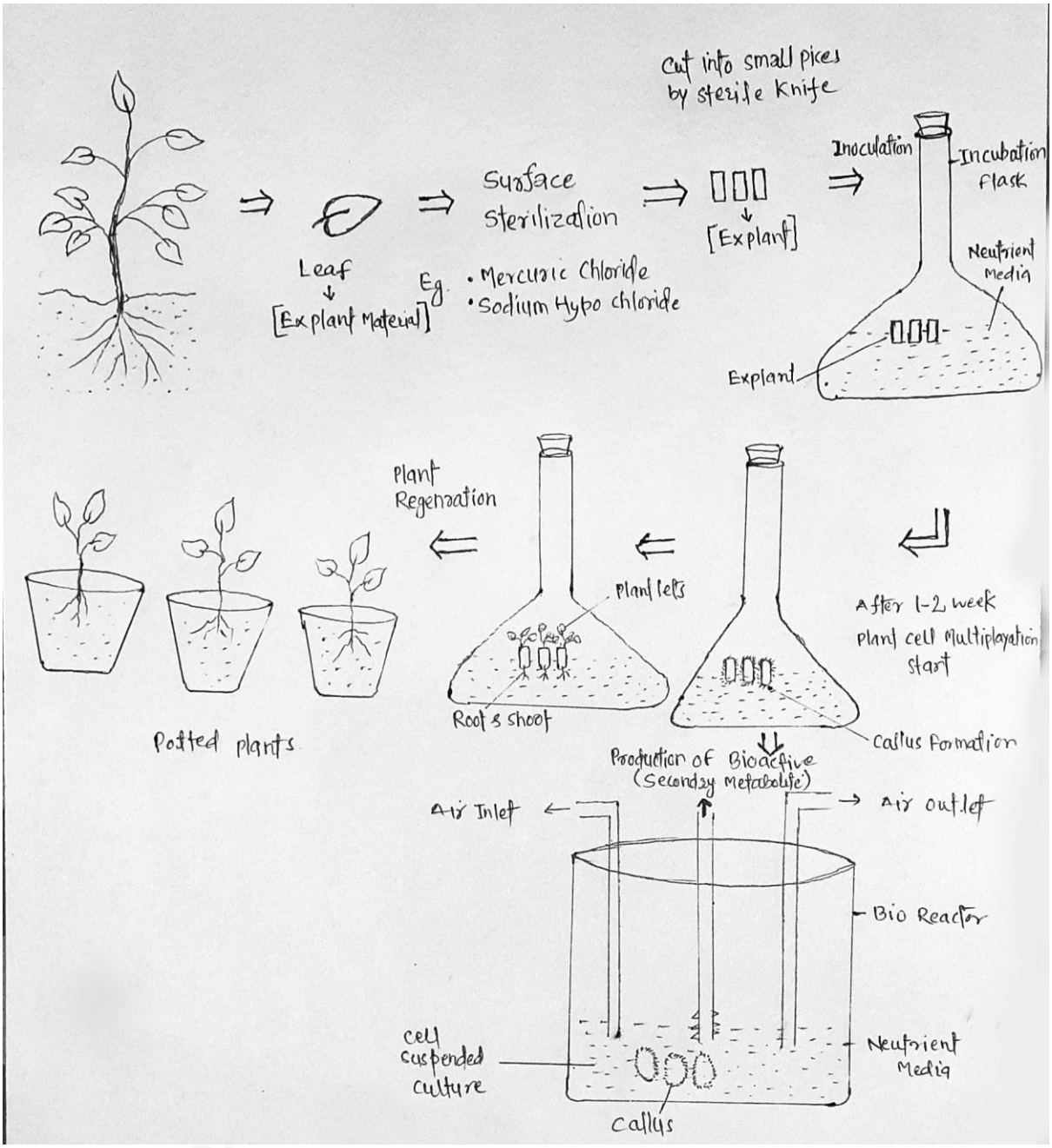


Figure :- Step by Step Procedure of Plant Tissue Culture

Pharmacognosy – I

(Unit – 3)

(Classification Of Drugs)

By: Md. Shakeel Alam

(Assistant Professor)

S.N.S. COLLEGE OF PHARMACY, MOTIHARI

CLASSIFICATION

Vegetable drugs can be arranged for study under the following headings:

- Alphabetical
- Morphological
- Taxonomical / Biological
- Pharmacological / Therapeutic
- Chemical

1. Alphabetical

- Either Latin or vernacular names may be used.
- This arrangement is employed for dictionaries,pharmacopoeias, etc.
- Although suitable for quick reference it gives noindication of inter-relationships between drugs.

In this classification drugs are classified in alphabetical order using either their Greek name or Latin name. Though pharmacopoeias, formulary, encyclopedias of various countries follow this classification, but due to lack of scientific value now-a-days this classification is not preferred.

Example: Acacia, Bael, Cinchona, Dill, Ergot, Fennel, Ginger, Henbane, Ipecac, Jalap, Kurchi, Licorice, Myrrh, Nux-Vomica, Opium, Podophyllum, Quassia, Rauwolfia, Senna, Tea, Urgenia, Vasaka, Wool Fat, Yam, Zedoary etc.

- Major Advantage of this method is that it provides quick reference.

2. Morphological

Drugs are arranged according to their morphological or external characters of the plantparts or animal parts, i.e. which part of the plant is used as drug.

This is most simple classification method where crude drugs are grouped into two major classes: organized (having specific parts of plant like root, rhizome, flower, leaf, fruit, bark, seed, wood etc.,) and unorganized drugs (dried lattice, juice, gum, wax, oil etc.). But many crude drugs are very similar morphologically and hence difficult to distinguish. Many times, crude drug available in powder form that time morphological classification is not so suitable and acceptable.

- Organized drugs:

obtained from the direct parts of the plants and containing cellular tissues.

e.g. leaves (digitalis, Senna, belladonna),

flowers (clove, saffron),

fruits (amla, cardamom, cumin),

seeds (ispaghula, linseed, Phyto stigma),

herbs (ergot, vinca),

barks (cinchona),

rhizomes and roots (aconite, ginseng, ipecac, rauwolfia),

hair &fibers (flax)

❖ Unorganized drugs:

prepared from plants by some intermediate physical processes such as incision, drying or extraction with a solvent and not containing any cellular plant tissues.

e.g. latex (opium),

dried juice (aloe),

extracts (agar, catechu, pectin),

waxes (beeswax),

gums (acacia, guar gum),

resins (benzoin, colophony, tolu balsam),

volatile oil (turpentine, cinnamon, peppermint, clove),

fixed oils & fat (arachis, castor, olive, cod liver),

➢ Advantage:

More convenient for practical study especially when the chemical nature of the drug is not clearly understood.

➢ Disadvantage:

there is no correlation of chemical constituents with the therapeutic actions.

Organised crude drugs		***Un-organised crude drugs***	
Obtained from parts of plants		Obtained from parts of plants& Animal	
Well defined structure		Not well-defined structures	
Solid in nature		Semisolid, solid, liquid in nature	
Microscopic studies are useful in quality control		Chemical tests are more useful in quality control	
Examples		***Examples***	
Parts	**Example**	**Class**	**Example**
Leaves	Senna, digitalis, vasaka, eucalyptus	Resins	Balsam of tolu, myrrh, asafoetida, benzoin
Barks	Cinchona, kurchi, cinnamom, quaillia	Gums and mucilages	Acacia, tragacanth, guar gum
Woods	Quassia, sandalwood	Dried latices	Opium
Roots	Rauwolfia, ipecacuanha, aconite	Dried juices	Aloes, kino
Rhizomes	Turmeric, ginger, valerian, podophyllum	Volatile oils	Cinnamon oil
Seeds	Nux-vomica, strophanthus	Fixed Oil	Castor oil and lard
Fruits	Coriander, colocynth, fennel, bael	Extracts	Catechu
Entire plant	Vinca, belladonna	Saccharine substances	Honey

3. Taxonomic / Biological

Drugs are arranged according to the plants from which they are obtained, in kingdom, subkingdom, division, class, order, family, genus and species.

In this classification crude drugs are arranged according to taxonomic order i.e., phylum, division, class, sub-class, orders, families, genus and species. Precise and orderly arrangement of drugs has no ambiguity in this classification. But again, this type of classification lacks scientific value and unorganized crude drugs are difficult to classify.

- Advantage:

It allows for a precise and ordered arrangement and accommodates any drug without

ambiguity; helpful for studying evolutionarydevelopments.

- Disadvantage:

does not correlate in between thechemical constituents and biological activity of thedrugs.

Example:

- Phylum - Spermatophyta
- Division - Angiospermae
- Class - Dicotyledons
- Sub-class - Sympetalae
- Order - Tubiflorae
- Family - Solanaceae
- Genus - Atropa
- Species – belladonna

❖ Class

— Angiospermae (Angiosperms): plants that produceflowers

Examples: Rose, Sunflower, Mustard Oil etc.

— Gymnospermae (Gymnosperms): Plants which do notproduce flowers

Examples: Pinus, Gnetum, Cycads etc.

❖ Subclass

– Dicotyledonae (Dicotyledons, Dicots): plants with twoseed leaves

Examples: Peanut, Marigold, Sunflower etc.

– Monotyledonae (Monotyledons, Monocots): plantswith one seed leaf

Examples: Palm tree, Grasses, Bananas, Orchids etc.

❖ Suborder

A group of related plant families,classified in the order in which they arethought to have developed their differencesfrom a common ancestorEach superorder is further divided into severalorders; the names of the orders end in -ales

❖ **Family**

- Each order is divided into families
- These are plants with many botanical features incommon, and are the highest classification normallyused.
- The names of the families end in —aceae

Examples: Apocynaceae

Lamiaceae

Liliaceae

Solanaceae

Papaveraceae

Roseaaceae

❖ **Subfamily**

The family may be further divided into a number ofsubfamilies, which group together plants within the family that have some significant botanicaldifferences.

— Subfamilies end in -oideae

❖ **Genus**

Part of the plant name that ismostfamiliar; the normal name that you give a plant

- Papaver (Poppy)
- Arachis (Peanut)

❖ **Species**

- Level that defines an individual's plant.
- The name describes some aspects of the plant.
- The color of the flowers, size and shape of the leaves, and it may be named after the place where it was found.
- Should be written after genus name, in small latter.

4. Pharmacological/ Therapeutic

Drugs acting on G.I.T.

- Carminative - Fennel, Cardamom, Mentha
- Emetic - Ipecac
- Antiamoebic - Kurchi, Ipecac
- Laxative Agar, Isabgol, Banana
- Purgative - Senna, Castor oil

Cathartic - Senna

Drugs acting on Respiratory System

- Antitussive - Opium (codeine)
- Bronchodilators - Ephedra, Tea
- Expectorant - Vasaka, Liquorice, Ipecac

Drugs acting on Autonomic Nervous System

- Adrenergic- Ephedra
- Cholinergic - Physostigma, Pilocarpus
- Anticholinergic- Datura, Belladonna

Drugs acting on Cardiovascular System

- Cardiotonic - Digitalis, Strophantus, Squill
- Cardiac depressant - Cinchona, Veratrum
- Vasoconstrictor - Ergot
- Antihypertensive – Rauwolfia

Drugs acting on Central Nervous System

- Central analgesic - Opium (morphine)
- CNS depressant- Belladonna, Opium,Hyoscyamus
- CNS stimulant - Tea, Coffee
- Analeptic - Nux vomica, Camphor, Lobelia

Miscellaneous

- Antispasmodic- Datura, Hyoscyamus, Opium, Curare
- Anticancer -Vinca, Podophyllum, Taxus
- Antirrheumatic - Aconite, Colchicum, Guggal
- Anthelminthic-Quassia, Vidang
- Astringent- Catechu, Myrobalans
- Antimalarial - Cinchona, Artemesia
- Immunomodulatory- Ginseng, Ashwagandha, Tulsi
- Immunizing agent- Vaccines, Sera, Antitoxin
- Drugs acting Skin Membrane - Beeswax, Wool fat, Balsamof Tolu, Balsam of Peru
- Local anesthetic – Coca

5. Chemical

- Crude drugs are classified depending upon theactive constituents
- Irrespective of the morphological or taxonomicalcharacters, the drugs with similar chemicalconstituents are grouped together

This classification is purely based on chemistry of constituents. Different crude drugs are classified according to the presence of major active constituents. This is most preferred method of classification.

- Advantage:

it is a popular approach forphytochemical studies

- Disadvantage:

ambiguities arise when particulardrugs possess a number of compounds belongingto different groups of compounds.

Chemical Constituent Group

- Alkaloids- Cinchona, Datura, Vinca, Ipecac, Nux vomica
- Glycosides - Senna, Aloe, ginseng, Digitalis
- Carbohydrates & its derivatives - Acacia, Starch, Isabgol
- Volatile oil - Clove, Coriander, Fennel, Cinnamon,Cumin
- Resin and Resin Combination - Benzoin, Tolu Balsam,Balsam of Peru
- Tannins- Catechu, Tea
- Enzymes- Papain, Casein, Trypsin
- Lipids - Beeswax, Kokum butter, Lanolin

Parameters involved in pharmacognostic study of crude drug

Parameters	***Description***
Chemical constituents	major and minor chemical constituents present
Chemical tests	To Identify crude drug and its chemistry
Uses and pharmacological	actions Various therapeutic applications
Adulterants and Commercial varieties	Useful for quality control
Formulations available in Market	To understand market potential
Quality control and standardization	To establish qualitative and quantitative standards with the help of sophisticated instruments.
Common names	Names in various languages
Biological source	Genus, species and family
Geographical source	Location
History	Discovery of crude drug
Cultivation, collection and preparation for market	Time and method of cultivation, irrigation, climate, fertilizers, collection time, processing etc.
Morphological description	Color, odor, taste, size, shape, extra features
Microscopical description	Cell, tissue type and arrangement, cell inclusions, special characters etc

Pharmacognosy – I

[Unit – 4]

(Plant Taxonomy)

By: Md. Shakeel Alam

(Assistant Professor)

S.N.S. COLLEGE OF PHARMACY, MOTIHARI

PLANT TAXONOMY

Definition

- Taxonomy or systematic is the study or description on variations among organisms in order to come out with a classification system.
- Organisms that are arranged into groups enable a large population to be categorized and understood.
- Taxonomy began about 300 years before christ by Theophratus (370-285 BC)
- Carolus Linneaus (1707-1778) is regarded as the founder of taxonomy (father of taxonomy) till today.

Importance of Plant Taxonomy

- To arrange elements or taxa of plants into a more systematic manner so that they can be better understood and could be used easily and more effectively.
- To arrange data or information and knowledge about plants.
- To indicate the source and genetic relationship (phylogenetic), ancestry and origin of plants.
- To indicate the distribution and habitat of plants on earth and their benefits.

Taxonomic Components

Classification

Plants are arranged into groups of similar characteristics. The groups are considered as categories or taxa and form the taxonomic system.

Identification

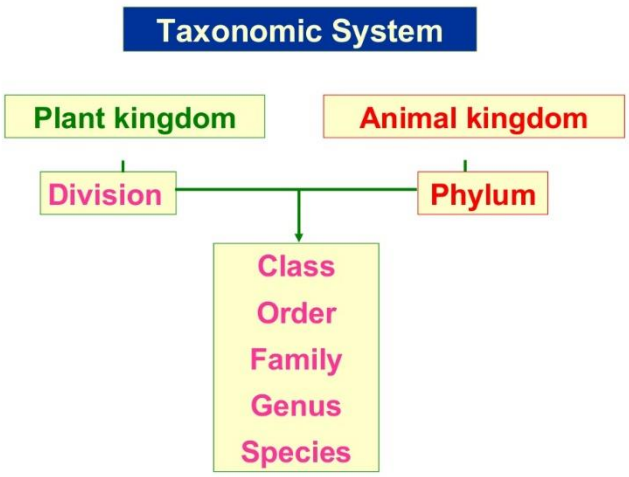
To identify and derive the name of an organism by referring to an existing classification.

Nomenclature

To provide a scientific name to an organism.

Description

To describe the characteristics of a taxon e.g. a family.



Plant Taxonomy

Introduction

- Taxonomy or systemic is the study of description on variation among organisms in order to come out with the classification system.
- Organisms that are arranged in to group enable a large population to be categorized and understand.
- Taxonomy begins about 300 years before Christ by Theophratus (370-285 BC)
- Carolus Linneaus (1707-1778) is regarded as the founder of taxonomy (Father of taxonomy) till today.

Importance

To arranged data or information and knowledge about plants.

To arrange elements or plants into in to a more systemic manner. So, they can be better understood and could be used easily, and more effectively.

Protista

A Protista is a eukaryotic organism that is not an animal, plant or fungus.

Eg. Paramecium, rhizaria, Forame, Gaint Kelp.

Eukaryotic organism

It having defined neuclous, chromosomes and ribosomes

Eg. Fungi, plant and animal.

Prokaryotic organism

Lake of neucleous, chromosomes and ribosomes

Eg. Eubacteris, archaes

Binomial Nomenclature

In this system, each name has two compounds.

Eg.	Mango	Mangifera	Indica
		(Generic Name)	(Species)
		Genus	Special Name

Spore

Is a cell/unit of sexual or asexual reproduction,

Eg. Algae, Fungi, Protozoa

Cultivar

- A unique species of a plant that is developed with special characters.
- But cultivar do not transfer the characteristics to offspring.

Apocynaceae Family

Introduction

- The apocynaceae family is one of the most medicinally diverse families in the plant kingdom and is a rich source for drugs that have found use both traditionally and in conventional medicine.
- The medicinal activity of these plants was due to the presence of alkaloids which were either indoline alkaloids or steroidal alkaloids.
- The family Apocynaceae consists of tropical trees, shrubs and vines.
- Characteristic features of the family are that almost all species produce milky sap.
- In traditional medicine, Apocynaceae species are used to treat gastrointestinal ailments, fever, malaria, pain and diabetes, including skin and ecto-parasitic diseases.
- Non-medicinal uses include food, poisons, fodder, wood, ornamentals, dye and perfume.
- A total of 4600 species under 415 genera belonging to the family Apocynaceae were collected and identified.
- Species of Apocynaceae have been reported to possess anticancer and antimalarial properties.
- Species having cytotoxic activity include those of Catharanthus,
- Catharanthus roseus is the most medicinally important plant in this family due to its use in the treatment of various types of cancers,
- Other agents that have been derived from this family include the alkaloids reserpine and rescinamine which have been used against hypertension, others are the cardiac glycosides.

Important plants of this family are,

1. Carissa carandas linn.
2. Catharanthus roseus linn.
3. Nerium oleander linn.
4. Plumeria alba linn.
5. Tabernaemontana divaricata linn.

Solanaceae Family

General characters, Distribution, Important plants

Systematic classification

Class: Dicotyledonae
Sub class: Gamopetalae
Series: Bicarpellate
Order: Polemoneales
Family: Solanaceae

General Information

Common name: Potato family or Night shade family

Number of genera: This family includes 90 genera and about 3000 species

Propagation type: Fruit (dehisced) or seed

Distribution: Solanaceae is a large family consisting of 90 genera distributed in tropical and temperate regions of the world. They are mainly found in Central and South America. In India, this family is represented by 15 genera and 88 species. Most of the species are cultivated throughout India and a few are found in Himalayas, Southern and Eastern India.

Vegetative characters of *Datura metel*

Vegetative characters

Habitat: Members of this family are mostly mesophytes and some are xerophytes (Solanum suratense).

Habit: The habit of the members of this family is variable. Some plants are annuals or perennial herbs (Solanum nigrum, Solanum surattense). Few plants are shrubs (Solanum torvum) and small trees (Solanum verbascifolium) and rarely climbers (Solanum dulcamara)

Root system: The members of this family have tap root system.

Stem: The stem is aerial, erect and mostly herbaceous. It is covered either by prickles (some species of Solanum) or spines (Lycium), spines are modified branches. In Solanum tuberosum the stem is an underground tuber.

Leaf: Leaves are simple, entire, lobed and petiolate. Leaves show alternate or terminal phyllotaxy in the vegetative regions. And in the region of inflorescence, leaves appear to be opposite or whorled due to the fusion of petiole with the internode. They are usually simple or pinnately lobed. Venation is reticulate.

Rutaceae Family

- The "Rue" family of flowering plant (order – Sapindales), composed of 160 genera and about 2070 species.
- Rutaceae includes woody shrubs, tree and few herbaceous perennials and distributed throughout the world. Especially in warm temperate and tropical regions.
- The largest no. is found found in Africa and Australia, often in semiarid woodlands.
- The family contains a no. of economically importance fruit tree as well as several ornamental species.
- Members od this family often feature aromatic leaves with oil glands on the surfaces.
- The flowers are generally containing both male & female reproductive organs in the same flower (Bisexual) or some time unisexual.
- They are arranged in inflorescences, which facilitates pollination by insects such as small flies and bees.
- The flowers are conspicuous for their color, fragrance and nectar.
- A citrus fruit is modified section berry known as hesperidium.

Mandarin orange:

The blossom and fruit of the orange (citrus).

The family contains economically important fruits.

Citrus species,

- Lemon – (Citrus limon)
- Sourorange – (C. aurantium)
- Sweetorange – (C. sinesnis)
- Lime – (C. aurantifolia)

Others,

- Beal Fruit (Aegle marmelos)

Umbelliferae Family

- The umbelliferae family is named after the its shape of flower which are called umbels.
- The umbels are unique in their floral uniformity.
- These distinctive umbrella shaped blooms are attractive in arrangements and loved by numerous beneficial insects.
- They pollinate freely which allow it to increase its natural distribution.
- Seed dispersal occurs through wind.
- It is an Angiosperm plant.
- Its plants are use as important herbs.
- Many are poisonous.
- Members of this family are loaded with vitamins, minerals and antioxidants. Many are indispensable in favorite recipes and a treat raw or cooked.
- Type / Habit : Annual, biennial, perennial herbs or woody shrubs.
- Worldwide No. : 3000 species in 300 genera.
- Aroma : often pleasant or aromatic.
- The plants are erect.
- Roots : Either tape root or fusiform, branched.
- They passes alternate, undivided or divided leaves.
- The flowers are small, usually less then 1.2 cm in diameter, regular polygamous in umbels, rarely in heads.

Important drugs belonging from this family.

- Coriander (Coriandrum sativum)
- Fennel (Foeniculum vulgare)
- Carraway (carum carvi)
- Dill (Anethum graveolens)
- Anise (Pimpinella anisum)
- Asafetida (Ferula assa-foetida)

Leguminosae/Fabacea

- Fabaceae are mostly herbs but include also shrubs, trees, vines, woody and climbers found in both temperate, sub-tropical and tropical areas.
- They comprise one of the largest families of flowering plants.
- This family having 670-700 genera and 20000 species.
- Leaves are stipulate nearly always alternate.
- Leaves/flowers having 5 calyx and corolla.
- Its also called pea, bean or pulse family or Legume family of flowering plant.
- This family having flowering plant.
- Plant are perennial or annual in the family.
- Many legumes have characteristics flowers and fruits.
- Worldwide 3rd largest family in Angiosperms (Flowering plant).
- Flowers are bisexual, some are unisexual.

- Fabaceae has three sub-families.
    1. Mimosoideae
    2. Caesalpinioideae
    3. Foboidea (Papilionoideae)
- The family having vary economically importance species.

Names of plants comes under this family

- Acacia
- Alfalfa
- Beans
- Cassia
- Clove
- Pea
- Peanut
- Redbud
- Mimosa
- Lupine
- Licorice
- Smoke tree
- Silk tree
- Soybean

Rubiaceae

- It is commonly called as coffee family.
- It has largest species 13150 and about 611 genus that makes it 4th largest angiosperm family.
- Rubiaceae family plant found worldwide in most habitats.
- Pollination of rubiaceae flower is almost always by animals, including insects, birds and bats.
- The family is represented by the several genera in our country eg. Cinchona, coffea, adina, hamelia, gardenia, rubia, morinda, and many others.
- Rubiaaceae contains a verity of commercially important plants.
- Common plants : Coffea arebica (Coffee Plant)

  Cinchona officinalis (used in quinine production – used in fever)
- Habit : majority of the plants either tree or shrubs, but climbing habit is also found in this family.
- It is flowering family, It also known as Madder or Bedstraw family.
- It having three sub-families.
    - Cinchonoideae
    - Ixoroideae
    - Rubioideae
- Uses : Cinchona (Genus) – produce alkaloids (2^{ndry} metabolites)

  ↓

  Most common – { Quinine } – used in malaria

➢ Crude Drugs: Cultivation, Collection, Processing and Storage

Cultivation of Crude Drugs:

Cultivation of medicinal plants requires intensive care and management. The conditions and duration of cultivation required vary depending on the quality of medicinal plant materials required.

Methods of Propagation:

➢ **Vegetative propagation (Asexual propagation):**

Vegetative propagation can be defined as regeneration or formation of a new individual from any vegetative part of the plant body. The method of vegetative propagation involves separation of a part of plant body, which develops into a new plant.

Methods of vegetative propagation:

They are two types:

1. Methods of natural vegetative propagation:

2. Methods of artificial vegetative propagation.

A.) Methods of natural vegetative propagation:

Vegetative propagation by stem:

Examples: Runner: peppermint.

(i) Bulb:
Allium, Squill.
(ii) Corms:
Colchicum.
(iii) Tuber:
Potato, aconite.
(iv) Offset:
Valerian.
(v) Rhizome:
Ginger and haldi.

Vegetative propagation by root:

Examples: Asparagus

B.) Methods of artificial vegetative propagation:

Various parts developed for natural vegetative propagation have also been used for artificial vegetative propagation.

Following methods are used:

1. Cutting:
These are the parts of the plant (stem, root or leaf) which, if grown under suitable' conditions, develop new plants. Stem cutting are generally used to obtained new plants. Examples: Sugarcane and rose, etc.

2. Layering:
Roots are induced on the stem while it is still attached to the parent plant. This part of stem is later detached from the parent plant and grown into a new plant.

3. Grafting:
New variety is produced by joining parts of two different plants. The rooted shoot of one plant, called stock, is joined with a piece of shoot of another plant known as scion. Examples: Rose, citrus and rubber, etc.

4. Micro propagation:
This method consists of growing cell, tissue and organ in culture. Small pieces of plant organs or tissues are grown in a container with suitable nutrient medium, under sterilized conditions. The tissue grows into a mass of undifferentiated cells called callus which later differentiates into plantlets. These are then transferred into pots or nursery beds and allowed to grow into full plants.

Importance of asexual propagation:

1.) It is a cheaper, easier and rapid method of multiplication. Many fruit trees usually require 4-5 years to bear the fruits when developed from seeds. The plants developed by vegetative methods, take only a year to bear fruits.

2.) Plants like roses and chrysanthemum, etc do not form viable seeds. Thus, vegetative propagation is the only method of propagation is the only method of reproduction and continuation of species in such plants.

3.) All the plants developed by these methods will be generally similar to the parent plant.

4.) Micro propagation is useful in raising disease free plants, homozygous diploids, and those without viable seeds.

- **Seed Propagation (Sexual Propagation):**

The process of sexual propagation:

(i) Microsporogenesis:
Microspores are formed from microspore mother cells inside the anther.

(ii) Pollination:
This is the transfer of pollen grains from the anther to the stigma.

(iii) Micro gametogenesis:
This involves the formation of male gametes from microspore.

(iv) Mega sporogenesis:
This process leads to the formation of megaspores from megaspore mother cell, inside the ovule.

(v) Mega gametogenesis:
The events involving the formation of embryo sac from megaspore are included in this process.

(vi) Fertilization:
Fusion of male and female gametes takes place, resulting in the formation of zygote.

(vii) Embryogeny:
The process involves development of embryo from zygote.

- **Collection of drugs:**

Medicinal plant materials should be collected during the appropriate season or time period to ensure the best possible quality of both source materials and finished products. It is well known that the quantitative concentration of biologically active constituents varies with the stage of plant growth and development.

This also applies to non-targeted toxic or poisonous indigenous plant ingredients. The best time for collection (quality peak season or time of day) should be determined according to the quality and quantity of biologically active constituents rather than the total vegetative yield of the targeted medicinal plant parts.

In general, the collected raw medicinal plant materials should not come into direct contact with the soil. If underground parts (such as the roots) are used, any adhering soil should be removed from the plants as soon as they are collected.

Collected material should be placed in clean baskets, mesh bags, other well aerated containers or drop cloths that are free from foreign matter, including plant remnants from previous collecting activities. After collection, the raw medicinal plant materials may be subjected to

appropriate preliminary processing, including elimination of undesirable materials and contaminants, washing (to remove excess soil), sorting and cutting.

The collected medicinal plant materials should be protected from insects, rodents, birds and other pests, and from livestock and domestic animals. If the collection site is located some distance from processing facilities, it may be necessary to air or sun-dry the raw medicinal plant materials prior to transport.

If more than one medicinal plant part is to be collected, the different plant species or plant materials should be gathered separately and transported in separate containers. Cross-contamination should be avoided at all times.

Collecting implements, such as machetes, shears, saws and mechanical tools, should be kept clean and maintained in proper condition. Those parts that come into direct contact with the collected medicinal plant materials should be free from excess oil and other contamination.

Time of collection:
The period of growth or development at which medicinal activity is highest has been carefully determined for many plants. The proportion, of alkaloid in the leaves of Hyocyamus Niger and of belladonna is largest at the beginning of flowering, whilst with Stramonium the peak coincides with full bloom.

Example:
Stramonium leaves, gathered in the morning, contain a higher proportion of alkaloids than those collected in the evening.

Harvesting:

The best time for harvest (quality peak season/time of day) should be determined according to the quality and quantity of biologically active constituents rather than the total vegetative yield of the targeted medicinal plant parts during harvest, care should be taken to ensure that no foreign matter, weeds or toxic plants are mixed with the harvested medicinal plant materials.

Medicinal plants should be harvested under the best possible conditions, avoiding dew, rain or exceptionally high humidity. If harvesting occurs in wet conditions, the harvested material should be transported immediately to an indoor drying facility to expedite drying so as to prevent any possible deleterious effects due to increased moisture levels, which promote microbial fermentation and mould.

Cutting devices, harvesters, and other machines should be kept clean and adjusted to reduce damage and contamination from soil and other materials. They should be stored in an uncontaminated, dry place or facility free from insects, rodents, birds and other pests, and inaccessible to livestock and domestic animals.

Contact with soil should be avoided to the extent possible so as to minimize the microbial load of harvested medicinal plant materials where necessary, large drop cloths, preferably made of clean muslin, may be used as an interface between the harvested plants and the soil.

If the underground parts (such as the roots) are used, any adhering soil should be removed from the medicinal plant materials as soon as they are harvested.

The harvested raw medicinal plant materials should be transported promptly in clean, dry conditions they may be placed in clean baskets, dry sacks, trailers, hoppers or other well-aerated containers and carried to a central point for transport to the processing facility.

When containers are not in use, they should be kept in dry conditions, in an area that is protected from insects, rodents, birds and other pests, and inaccessible to livestock and domestic animals. Any mechanical damage or compacting of the raw medicinal plant materials, as a consequence, for example, of overfilling or stacking of sacks or bags that may result in composting or otherwise diminish quality should be avoided. Decomposed medicinal plant materials should be identified and discarded during harvest, post-harvest inspections and processing, in order to avoid microbial contamination and loss of product quality.

As per WHO Guidelines:

1. Medicinal plants/herbal drugs should be harvested when they are at the best possible quality for the proposed use.

2. Damaged plants or parts plants need to be excluded.

3. Medicinal plants/herbal drugs should be harvested under the best possible conditions avoiding wet soil, dew, rain or exceptionally high air humidity. If harvesting occurs in wet conditions possible adverse effects on the medicinal plant/herbal drug due to increased moisture levels should be counteracted.

4. Cutting devices or harvesters must be adjusted such that contamination from soil particles is reduced to a minimum.

5. The harvested medicinal plant/herbal drug should not come into direct contact with the soil. It must be promptly collected and transported in dry, clean conditions.

6. During harvesting, care should be taken to ensure that no toxic weeds mix with harvested medicinal plants/herbal drugs.

7. All containers used during harvesting must be clean and free of contamination from previous harvests. When containers are not in use, they must be kept in dry conditions free of pests and inaccessible to mice/rodents, livestock and domestic animals.

8. Mechanical damage and compacting of the harvested medicinal plant/herbal drug that would result in undesirable quality changes must be avoided. In this respect, attention must be paid to

(a) overfilling of the sacks,

(b) Stacking up of sacks.

9. Freshly harvested medicinal plants/herbal drugs must be delivered as quickly as possible to the processing facility in order to prevent thermal degradation.

10. The harvested crop must be protected from pests, mice/rodents, livestock and domestic animals. Any pest control measures taken should be documented.

Primary processing:

Harvested or collected raw medicinal plant materials should be promptly unloaded and unpacked upon arrival at the processing facility. Prior to processing, the medicinal plant materials should be protected from rain, moisture and any other conditions that might cause deterioration. Medicinal plant materials should be exposed to direct sunlight only where there is a specific need for this mode of drying.

Medicinal plant materials that are to be used in the fresh state should be harvested/collected and delivered as quickly as possible to the processing facility in order to prevent microbial fermentation and thermal degradation.

The materials may be stored under refrigeration, in jars, in sandboxes, or using enzymatic and other appropriate conservation measures immediately following harvest/collection and during transit to the end-user. The use of preservatives should be avoided if used, they should conform to national and/or regional regulations for growers/collectors and end-users.

Medicinal plant materials that are to be employed fresh should be stored under refrigeration, in jars, in sandboxes, or using enzymatic or other appropriate conservation measures, and transported to the end-user in the most expeditious manner possible.

The use of preservatives should be avoided. If used, this should be documented and they should conform to national and/or regional regulatory requirements in both the source country and the end-user country.

All medicinal plant materials should be inspected during the primary-processing stages of production, and any substandard products or foreign matter should be eliminated mechanically or by hand.

For example, dried medicinal plant materials should be inspected, sieved or winnowed to remove discoloured, mouldy or damaged materials, as well as soil, stones and other foreign matter. Mechanical devices such as sieves should be regularly cleaned and maintained.

All processed medicinal plant materials should be protected from contamination and decomposition as well as from insects, rodents, birds and other pests, and from livestock and domestic animals.

Drying:

When medicinal plant materials are prepared for use in dry form, the moisture content of the material should be kept as low as possible in order to reduce damage from mould and other microbial infestation.

Medicinal plants can be dried in a number of ways:

1. In the open air (shaded from direct sunlight);

2. Placed in thin layers on drying frames, wire-screened rooms or buildings.

3. By direct sunlight, if appropriate.

4. In drying ovens/rooms and solar dryers.

5. By indirect fire; baking; lyophilization; microwave; or infrared devices.

6. Vacuum drying

7. Spray dryer: Examples: Papaya latex and pectin's, etc.

When possible, temperature and humidity should be controlled to avoid damage to the active chemical constituents. The method and temperature used for drying may have a considerable impact on the quality of the resulting medicinal plant materials.

For example, shade drying is preferred to maintain or minimize loss of colour of leaves and flowers; and lower temperatures should be employed in the case of medicinal plant materials containing volatile substances. The drying conditions should be recorded. In the case of natural drying in the open air, medicinal plant materials should be spread out in thin layers on drying frames and stirred or turned frequently.

In order to secure adequate air circulation, the drying frames should be located at a sufficient height above the ground. Efforts should be made to achieve uniform drying of medicinal plant materials and so avoid mould formation.

Drying medicinal plant material directly on bare ground should be avoided. If a concrete or cement surface is used, medicinal plant materials should be laid on a tarpaulin or other appropriate cloth or sheeting. Insects, rodents, birds and other pests, and livestock and domestic animals should be kept away from drying sites.

For indoor drying, the duration of drying, drying temperature, humidity and other conditions should be determined on the basis of the plant part concerned (root, leaf, stem, bark, flower, etc.) and any volatile natural constituents, such as essential oils.

If possible, the source of heat for direct drying (fire) should be limited to butane, propane or natural gas, and temperatures should be kept below 60°C. If other sources of fire are used, contact between those materials, smoke and medicinal plant material should be avoided.

Vacuum drying:
This is conducted in steam- heated ovens with perfect closure, and a pump is used to exhaust the air. The low pressure maintained within the oven ensures rapid and complete drying.

Example:
Digitalis

Advantages of vacuum drying:
(i) Rapid drying.
(ii) Relatively low temperature.
(iii) Cleanliness and freedom from odour and dust.
(iv) Independence of climate conditions.
(v) Control of temperature.
(vi) Elimination, of risk of fire.

- **Storage of crude drug:**

1. Storage facilities for medicinal material should be well aerated, dry and protected from light, and, when necessary, be supplied with air-conditioning and humidity control equipment as well as facilities to protect against rodents, insects and livestock.

2. The floor should be tidy, without cracks and easy to clean. Medicinal material should be stored on shelves which keep the material a sufficient distance from the walls; measures should be taken to prevent the occurrence of pest infestation, mould formation, rotting or loss of oil; and inspections should be carried out at regular intervals.

3. Continuous in-process quality control measures should be implemented to eliminate substandard materials, contaminants and foreign matter prior to and during the final stages of packaging. Processed medicinal plant materials should be packaged in clean, dry boxes, sacks, bags or other containers in accordance with standard operating procedures and national and/or regional regulations of the producer and the end-user countries.

4. Materials used for packaging should be non-polluting, clean, dry and in undamaged condition and should conform to the quality requirements for the medicinal plant materials concerned. Fragile medicinal plant materials should be packaged in rigid containers.

5. Dried medicinal plants/herbal drugs, including essential oils, should be stored in a dry, well-aerated building, in which daily temperature fluctuations are limited and good aeration is ensured

6. Fresh medicinal plant materials should be stored at appropriate low temperatures, ideally at 2-8°C; frozen products should be stored at less than -20°C.

7. Small quantity of crude drugs could be readily stored in air tight, moisture proof and light proof container such as tin, cans, covered metal tins or amber glass containers.

8. Wooden boxes and paper bags should not be used for storage of crude drugs.

Factors Influencing the Cultivation of Medicinal Plants

- **The following factors are influencing of cultivation:**

1. Light:
Light is the only external source of energy for the continuation of life of the plant. It influences photosynthesis, opening and closing of stomata, plant movements, seed germination, flowering and vegetative growth like tuber formation. Dry sunny weather increases the proportion of glycosides in digitalis and of alkaloids in belladonna.

2. Temperature:
Temperature is the major factor influencing the cultivation of the medicinal plant. The sudden decrease in temperature caused the formation of the ice crystals in intercellular spaces of the plant. As a result, water comes out of the cells and ultimately plants die due to drought and desiccation. The ice crystals also mechanical injury to the cells temperature stimulates the growth of seedlings. Water absorption decreases at low temperatures. The rate of photosynthesis is affected by change in temperature. The rate of respiration increases with increase in temperature. Examples; Cinchona- 58-73°F; Tea- 75-90°F and coffee- 55-70°F

3. Atmosphere humidity:
It is present in the form of water vapors. This is called atmospheric humidity. Clouds and fog are the visible forms of humidity. The major sources of water vapors in the atmosphere are evaporation of water from earth surface and transpiration from plants the major effect of humidity on plant life and climate. Evaporation of water, its condensation and precipitation depend upon relative humidity and humidity affects structure, form and transpiration in plants.

4. Altitude:

The altitude is the most important factor influencing of cultivation of medicinal plants. The increase the altitude, the temperature and atmospheric pressure decreases while the wind velocity, relative humidity and light intensity increases.

Thus, as the climatic conditions change with height, they also produce change in the vegetation pattern. The bitter constituents of Gentiana lutea increase with altitude, whereas the alkaloids of Aconitum nacelles and lobelia inflate and oil content of thyme and peppermint decrease. Pyrethrum gives the best yield and Pyrethrum at high altitude. Examples: Tea- 9500-1500 meters; cinnamon- 300-1000 meters and saffron- up to 1250 meters.

5. Rainfall:

The rainfalls are most important factor influencing of cultivation of medicinal plants. The main source of water for the soil is rain water. Rainfall and snowfall have a large effect the climate condition. The water from rainfall flows into the rivers and lakes percolates into the soil to form ground water and remaining is evaporated. The minerals in the soil get dissolved in water and are then absorbed by plants. Water influences morphological and physiology of plant. Examples: continuous rain can lead to a loss of water- soluble substance from leaves and root by leaching; this is known to apply to some plants producing glycoside and alkaloids.

- **Soil:**

Soil is defined as surface layer of the earth, formed by weathering of rocks. The soil is formed as a result of combined action of climate factors like plants and microorganisms. The soil should contain appropriate amounts of nutrients, organic matter and other elements to ensure optimal medicinal plant growth and quality. Optimal soil conditions, including soil type, drainage, moisture retention, fertility and pH, will be dictated by the selected medicinal plant species and/or target medicinal plant part.

The soil made of five components:

(i) Mineral matter.

(ii) Soil air.

(iii) Soil water.

(iv) Organic matter or humus.

(v) Soil organisms

Plants depend on soil for nutrients, water supply and anchorage. Soil influences seed germination, capacity of plant to remain erect, form, vigour and woodiness of the stem, depth of root system, number of flowers on a plant, drought, frost, etc.

Classification of soil particles:

S. No.	Type of Particle	Size (mm in diameter)
1.	Clay	Less than 0.002
2.	Silt	0.002-0.02
3.	Fine sand	0.02-0.2
4.	Coarse Sand	0.2-2.0
5.	Stone or Gravel	2.0 and more

1. Clay
2. Loamy.
3. Silt loam
4. Sandy loam
5. Sandy soil.
6. Calcareous soil.

1. Clay soil:

Clay particle are very small. These fit together very closely and therefore, leave very less pore space. These spaces get filled up with water very easily. Hence, the clay soil becomes quickly waterlogged. Such soil has practically no air, therefore, the plants growing in these soils are not able to absorb water. This soil known as physiologically dry soil clay soil is plastic and forms a colloid when moist. It cracks and shrinks when conditions are dry the soil rich in nutrient elements and therefore, acts as a negatively charged colloidal system.

2. Sandy soil:

Sand particles are large sized. These leave large pore spaces which do not have capillary action and therefore, water is not retained by them. Most of the water is quickly drained off and reaches deep into the soil. As a result, roots spread and also reach a great depth. The sandy soil is poor in nutrient elements; it is less fertile and plants growing in this soil have less dry weight.

3. Loam soil:

The mixture of clay, silt and sand is known as loam. Loam is very useful for growth. It is fertile soil because it contains available nutrient elements in sufficient amounts. It has a high water retention capacity and appropriate amount of soil air is also present. The plants growing in loam are vigorous and have very high weight.

4. Sandy loam:

The amount of sand particles is more than other types of loam.

Silt loam:

Silt loam is considered to be the most fertile as it contains more amount of organic substances than others.

➢ Fertilizer:

The fertilizers are two types:
1. Biological origin fertilizer.
2. Synthetic fertilizers
3. Chemical fertilizer

1. Biological origin fertilizer:

Soil is generally poor in organic matter and nitrogen. The substances of biological origin used as fertilizer are thus selected if these could provide the elements required. These are two types:

(i) Green manures:
Manure is material, which are mixed with soil. These supply almost all the nutrients required by the crop plants. This results in the increase in crop productivity.

Manures are three types:

Farmyard manure:
This is a mixture of cattle dung and remaining unused parts of straw and plants stalks fed to cattle.

Composited manure:
This consists of a mixture of rotted or decomposed and useless parts of plants and animals.

Green manure:
It is a herbaceous crop ploughed under and mixed with the soil while still green to enrich the soil. The plants used as green manure are often quick growing. These add both organic as well as nitrogen to the soil. It is also forms a protective soil cover that checks soil erosion and leaching. Thus, the crop yield increases by 30-50%.

(ii) Bio-fertilizer:
It can be defined as biologically active products or bacteria, algae and fungi which useful in bringing about soil nutrient enrichment. These mostly include nitrogen fixing microorganisms.

Some of the Bio-fertilizer are as follows:
(i) Legume- Rhizobium symbiosis
(ii) Azolla- Anabaena symbiosis.
(iii) Free- living bacteria.
(iv) Loose association of nitrogen fixing bacteria.
(v) Cyanobacteria (blue green algae).
(vi) Mycorrhiza.

1) Ectomycorrhizae. Increase the interface surface between plant root and soil. Mycorrhizae absorb and store nitrogen, phosphorous, potassium and calcium.
2) Endomycorrhizae

2. **Chemical fertilizers:**

(i) Macronutrients:

a) Nitrogen
b) Phosphorous
c) Potassium
d) Calcium
e) Magnesium
f) Sulpher.

(ii) Micronutrients:

a. Iron
b. Magnese
c. Zinc
d. Boron
e. Copper
f. Molybdenum

Carbon, oxygen, hydrogen and chorine are provided from water and air.

Examples:
Urea, Potash etc.

- **Polyploidy:**

Plants whose cells contain two sets of chromosomes, derived at fertilization from the union of one set from the pollen and one set from the egg cells, are described as diploids and denoted by "2n". The term polyploidy is applied to plants with more than two sets of chromosomes in the cells; when four sets are present the plants are described as tetraploids and denoted by "4n".

Tetraploidy is induced by treatment with colchicine, which inhibits spindle formation during cell division, so that the divided chromosomes are unable to separate and pass to the daughter cells. The two sets of chromosomes remain in one cell and this develops to give tetraploids plant.

Treatment with colchicine may be applied in various ways, but all depend on the effects produced in the meristem. The seeds may be soaked in a dilute solution of colchicine, or the seedlings, the soil around the seedling or the young shoot treated with colchicine solution. Fertile seed and robust, healthy tetraploid plants were obtained, the tetraploid condition being indicated by the increased size of the pollen grains and stomata; chromosome counts in root-tip preparations confirm the tetraploid condition.

The average increase in alkaloids content compared with diploid plants of Datura stromonium and Datura tatula was 68%, with a maximum increase of 211.6%. Similar results were obtained with Atropa belladonna and Hyoscyamus niger, the average increase in belladonna being 93%.

Increased Alkaloidal content of tetraploids plants has been confirmed for Datura stromonium and Datura tatula. The diploid of Acorus calamus is 2.1% of volatile oil content but they are converted into tetraploid, they produce 6.8% of volatile oil contents.

- **Mutation:**

Definition: Sudden heritable change in the structure of a gene on chromosome or change the chromosome number.

Type of mutations:

1. Spontaneous and induced mutations.

2. Recessive and dominant mutations.

3. Somatic and germinal mutations.

4. Forward, back and suppressor mutation.

5. Chromosomal, genomic and point mutations.

Mutations can be artificially produced by certain agents called mutagens or mutagenic agent. They are two types:

a.) Physical mutagens:

(i) Ionizing radiations:

X-rays, gamma radiation and cosmic rays.

(ii) Non-ionizing radiation:

U.V. radiation,

b.) Chemical mutagens:

1) **Alkylating and hydroxylating agents:**
   Nitrogen and Sulphur mustard; methyl and ethylsulphonate, ethylethane sulphonates.
2) **Nitrous acid:**
3) **Acridines:**
   Acridines and proflavines. Ionizing radiation cause breaks in the chromosome. These cells then show abnormal cell divisions. If these include gametes, they may be abnormal and even die prematurely. Non-ionizing radiation like Ultra Violet rays are easily absorbed by purine and pyrimidines. The changed bases are known as photoproducts. U.V. rays cause two changes in pyrimidine to produce pyrimidine hydrate and pyrimidine dimmers. Thymine dimer is a major mutagenic effect of U.V. rays that disturbs DNA double helix and thus DNA replication.

Example:
Penicillin, as an antibiotic was first obtained from Penicillium. However, the yield was very poor and the preparation was commercially expensive. Since then mutants with higher yield of penicillin have been selected and produced. Penicillium chrysogenum used in the production of penicillin yielded about 100 units of penicillin per ml of culture medium.

By single-spore isolation, strains were obtained which yielded up to 250 units per ml of medium, X-ray treatment of this strain gave mutants which produce 500 units per ml and ultraviolet mutants of latter gave strain which produced about 1000 unit per ml. Similarly, improvements have been obtained with other antibiotic- producing organism. Mutant strains of Capsicum annum with increasing yields (20-60%) of capsaicin have been isolated from M_3 and M_4 generations originating from seed treated with sodium azide and ethyl methane sulphonate.

- **Hybridization:**

It is mating or crossing of two genetically dissimilar plants having desired genes or genotypes and bringing them together into one individual called hybrid. The process through which hybrids are produced is called hybridization.

Hybridization particularly between homozygous strains, which have been inbred for a number of generations, introduces a degree of heterozygosis with resultant hybrid vigour often manifest in the dimensions and other characteristic of the plants. A hybrid is an organism which results from crossing of two species or varieties differing at least in one set of characters.

The following steps are involved in hybridization of plant:

1. Choice of parents:
The two parents to be selected, at least one should be as well adopted and proven variety in the area. The other variety should have the characters that are absent in the first chosen variety.

2. Emasculation:
Removal of stamens or anthers or killing the pollen grains of a flower without affecting the female reproductive organs is known as emasculation. Emasculation is essential in bisexual flowers.

3. Bagging:
Immediately after emasculation, the flowers or inflorescences are enclosed in bags of suitable sizes to prevent random cross-pollination.

4. Pollination:
In pollination, mature, fertile and viable pollens are placed on a receptive stigma. The procedure consists of collecting pollens from freshly dehisced anthers and dusting them on the stigmas of emasculated flowers.

5. Raising F_1 plants:

Pollination is naturally followed by fertilization. It results in the formation of seeds. Mature seeds of F_1 generation are harvested dried and stored these seeds are grown to produce F_1 hybrid. Hybrids of cinchona yield more amount of quinine. A hybrid developed by crossing Cinchona succirubra with Cinchona ledgering yields a bark, which contains 11.3% of alkaloids. The parent species produced 3.4% and 5.1% of alkaloids, respectively.

Pyrethrum hybrids have been used for Pyrethrum production; these hybrids are produced either by crossing two clones assumed to be self- sterile or planting a number of desirable clones together and bulking the seed. The hybridization of plant to increase the Pyrethrin contents.

- **Greenhouse effect:**

Normal conditions sun rays reach the earth and heat is radiated back into space. However, when carbon dioxide concentration increases in the atmosphere, it forms a thick cover and prevents the heat from being re-radiated. Consequently, the atmosphere gets heated and the temperature increases.

This is called greenhouse effect. In recent past, amount of carbon dioxide has increased from 290 ppm to 330 ppm due to cutting of forests and excessive burning of fossil fuels. The rate at which the amount of carbon dioxide in the atmosphere is increasing, it is expected to cause rise in global temperature.

The global warming by two or three degrees would cause polar ice caps to melt, floods in coastal areas, change in hydrologic cycle and islands would get submerged. The following gases produce greenhouse effect like carbon dioxide, sulphur dioxide, oxide of nitrogen, chlorofluorocarbons, etc.

- **Plant Growth Regulators (PGR):**

Plant Growth Regulators

Plant growth regulators (also called plant hormones) are numerous chemical substances that profoundly influence the growth and differentiation of plant cells, tissues and organs. Plant growth regulators function as chemical messengers for intercellular communication . There are currently five recognized groups of plant hormones: auxins, gibberellins, cytokinins, abscisic acid (ABA) and ethylene. They work together coordinating the growth and development of cells. Ethylene is mainly involved in abscission and flower secscence in plants and is rarely used in plant tissue culture. In addition to the five principal growth regulators, two other groups sometimes appear to be active in regulating plant growth, the brassinosteroids and polyamines.

Auxins:

Auxins stimulate cell elongation and influence a host of other developmental responses, such as root initiation, vascular differentiation, tropic responses, apical dominance and the development of auxiliary buds, flowers and fruits. Auxins are synthesized in the stem and root apices and transported through the plant axis. The principal auxin in plants is indole-3-acetic acid (IAA). Several other indole derivatives, all as precursors to IAA, are known to express auxin activity, probably by converting to IAA in the tissue. Auxins in plant tissue culture are used to induce callus from explants , and cause root and shoot morphogenesis . Auxins are often most effective in eliciting their effects when combined with cytokinins.

Cytokinins:

Cytokinins are able to stimulate cell division and induce shoot bud formation in tissue culture. They usually act as antagonists to auxins. (Cytokinins are N6 substituted derivatives of the nitrogenous purine base adenine.) Cytokinins most used in tissue culture include zeatin, adenine, 6-(g,g-dimethylallylamino)purine (2 iP) and kinetin. Cytoknins often inhibit embryogenesis and root induction.

Gibberellins:

The main effect of gibberellins in plants is to cause stem elongation and flowering. They are also prominently involved in mobilization of endosperm reserves during early embryo growth and seed germination. Gibberellins are an extensive chemical family based on the ent-gibberellane structure. There exit over 80 different gibberellin compounds in plants but only giberrellic acid (GA3) and GA4+7 are often used in plant tissue culture. In tissue culture, gibberellins are used to induce organogenesis, particularly adventitious root formation.

***Abscisic Acid*:**

Abscisic acid (ABA) in plants is a terpenoid involved primarily in regulating seed germination, inducing storage protein synthesis and modulating water stress. In plant tissue culture, it is used to help somatic embryogenesis, particularly during maturation and germination.

Ethylene:

Ethylene is a simple gaseous hydrocarbon with the chemical structure H2C=CH2. Ethylene is apparently not required for normal vegetative growth. However, it can have a significant impact on development of root and shoots. Usually, ethylene is not used in plant tissue culture.

4

DRUG ADULTERATION

An adulterated drug means one which does not conform to the official requirements. Adulteration involves incorporation of impurities. spoilage, deterioration, admixture, sophistication and substitution. The genuine drugs are substituted with spurious, inferior, defective or harmful substances. The spoiled or deteriorated drugs represent the greatest percentage of drug adulteration. In some cases the dealers substitute the drugs with cheap materials in case of scarcity or when the price of a drug is high. The adulteration may be due to faulty collection, imperfect perparation and incorrect storage as described hereunder :

FAULTY COLLECTION : In some cases the proportion of medicinally-active constituent reaches a maximum at a particular season, stage of development, or age. But collection of correct part of genuine plant without regard to time factors causes adulteration. The following are some examples:

(i) Season

Drug	**Season of Maximum Activity**
Solanaceous leaves	Flowering stage of the drug (Summer)
Wild Cherry bark	Autumn
Colchicum corm	Early summer
Male fern	Late autumn.

INCORRECT STORAGE : Incorrect storage spoils many drugs. The quality, value or usefulness of the drug has been impaired or destroyed by the action of moisture, light, temperature and microorganisms (fungi and bacteria) and the article becomes unfit for human consumption. Many examples of spoilage are found in food industry. All drugs which are unfit for human or animal consumption are legally considered as adulterated. The impairment of the quality or value of an article by the abstraction or destruction of valuable constituents by distillation, extraction, aging, moisture, heat, fungi, insects or other means deteriorate the drugs considerably. A few examples are :

5

EVALUATION OF DRUGS

Evaluation of drugs deals with the correct identification of the plant and determination of quality and purity of the crude drugs. Actual collection of the drug is done from the identified plant or animal. For this purpose research gardens have been maintained. The characters of an unknown sample are compared with the authentic monographs written in the pharmacopoeia. The high quality of the drug is maintained by collection of the drug from the correct natural source at proper time; preparation of samples of the collected drugs by proper cleaning, drying and to free from dirt, and proper preservation of the cleaned, dried and pure drug.

The evaluation of a drug is done by studying its organoleptic, microscopic, biological, chemical, and physical properties.

ORGANOLEPTIC EVALUATION

Organoleptic evaluation means study of a drug with the help of organs of sense which includes its external morphology, colour, odour, taste, sound of its fracture, etc.

Morphological Characters : To study morphology of a drug, its shape and size, colour and external markings, fracture and internal colour, odour and taste are examined. The organized drugs are classified into :

1. **Barks :** Which are tissues in a woody stem outside the inner fascicular cambium, e.g., Cinnamon, Cinchona, Quillaia, Ashoka and Kurchi.

2. **Underground Structures** : Which may be rhizomes, roots, bulbs, corm, and tubers; they are often swollen due to storage of carbohydrates and other chemicals, e.g., roots (Podophyllum, Liquorice, Jatamansi, Rauwolfia), rhizomes and stolons which are underground stems and have buds, scale leaves and scars, (Ginger, Turmeric, Dioscorea).
3. **Leaves** : These are photosynthetic organs arising from a node on a stem. The shape, margin, base, apex and venation of leaves help in the identification of the drugs. Senna, Tulsi, Vasaka and Digitalis leaves can be easily identified.
4. **Flowers** : These are reproductive organs of a plant and possess different shapes, size and colour, e.g., Saffron, Banafsha, Pyrethrum.
5. **Fruits** : Fruits arise from the ovary and contain seeds, e.g. Cardamom, Colocynth, Almond, Vidang, Bahera, Amla and Bael.
6. **Seeds** : Seeds are developed from the ovules in carpels of the flowers and characterized by the hilum, micropyle and sometimes raphe. The seed drugs are Ispaghula, Linseed, Nux-vomica, Psoralia.
7. **Herbs** : The whole aerial part is sometimes used as a drug, e.g. Brahmi, Chirata, Kalmegh, Pudina, Shankhpushpi, etc.

The shape of a drug may be cylindrical (Sarsaparilla), sub-cylindrical (Podophyllum), conical (Aconite); fusiform, ovoid or pyriform (Jalap), and terete or disk-shaped (Nux-vomica). The drug may be simple, branched, curved or twisted. The length, breadth and diameter are measured in millimeters or centimeters. In case of conical drugs the size of both parts is mentioned.

External markings are mentioned as :

1. furrows, ridges, etc.,
2. wrinkles,
3. annulations,
4. fissures,
5. nodules,
6. projections,
7. scars of leaf, stem-base, root, bud, bud-scale, etc.

The fractures may be complete, incomplete, short, fibrous, splintery (breaking irregularly), brittle (easily broken), tough and weak.

Sensory Characters : Colour, texture, odour and taste are useful in the evaluation of drugs. This method is especially applicable to drugs containing volatile oils or pungent principles (e.g. Capsicum), and to the detection of the effects of inadequate drying or damp storage. The external colour varies from white to yellowish grey, brown, orange or brownish black. The colour of some drugs changes if they are dried in sunlight in place of shade.

The odour of a drug may be either distinct (characterisic) or indistinct. The terms used to define odour are aromatic, balsamic, spicy, alliaceous (garlic-like), camphoraceous (camphor-like), terebinthinate (turpentine-like) and others. Leaves of different species of *Mentha* can be distinguished by smell. Clove and exhausted clove are differentiated by odour. Deteriorated Cantharides have ammonical smell while spoiled Ergot has rancid and ammonical smell.

Taste is a particular sensation production by certain substances when these come into contact with taste buds present in epithelial layer of the mouth. The taste may be sour (acidic), salty (saline), sweet (saccharine), bitter, alkaline and metallic. Substances possessing no taste are mentioned as tasteless. The tastes due to a characteristic odour are grouped as aromatic, balsamic, spicy, alliaceous, camphoraceous and terebinthinate. The taste produced by distinctive sensations to the tongue are classified as mucilaginous, oily, astringent (producing a contraction of the tissues of the mouth), pungent (warm biting sensation), acrid (unpleasant, irritating sensation) and nauseous (causing vomiting).

The drugs like Ginger and Capsicum have pungent taste; Gentian, Chirata and Kalmegh have bitter taste; Glycyrrhiza and Honey are sweet in taste. Linseed and Isphagula are mucilaginous; fixed oils have bland taste; calcium oxide is astringent; Podophyllum, Kaladana, Jalap and Ipomoea are acrid; while Ipecac, Acorus, and *Tylophora indica* contain nauseous taste.

Glycyrrhiza has hard and fibrous fracture due to the presence of fibrous and woody tissues. Aconite has a horny fracture due to gelatinization of starch.

Colour of drugs are standardized and determined by the Inter-Society Colour Council-National Bureau of Standard method. For example, reserpine is described as a "white or pale buff to slightly yellowish, odourless crystalline powder".

MICROSCOPIC OR ANATOMICAL EVALUATION

Schleiden (1847) used microscope for the examination of drugs. Microscopic examination of section and powder drugs, aided by stains, helps in distinction of anatomy in adulterants. Further, microscopical examination of epidermal trichomes and calcium oxalate crystals is extremely valuable, especially in powdered drugs. In the powdered drugs the cells are mostly broken, except lignified cells. The cell contents such as starch, calcium oxalate crystals, aleurone, etc. are scattered in the powder. Some fragments are specific for each powder which may consist of parts of cells or groups of cells.

Plant parts are made up of specific arranged tissues, spores (Lycopodium) or hairs (Lupulin). Histological characters are studied from very thin transverse, or longitudinal sections properly mounted in suitable stains, reagents or mounting media.

The size, shape and relative positions of the different cells and tissues, chemical nature of the cell walls and of the cell contents are determined. The basic arrangement of tissues in each drug is fairly constant. Fibres, sclereids, tracheids, vessels and cork are least affected by drying. Starch, calcium oxalate, epidermal trichomes and lignin are examined carefully.

Microscope is also used for a quantitative evaluation of drugs and adulterated powders. This is done by counting a specific histological feature such as stomatal index, vein-islets and vein termination numbers, palisade ratio, etc. These features are compared with the standard samples.

Palisade Ratio : The average number of palisade cells beneath each epidermal cell is called as palisade ratio. It is determined from powdered drugs with the help of camera lucida.

Stomatal Number : The average number of stomata per square millimeter of the epidermis is known as stomatal number. The range and average value for each surface are recorded.

Stomatal Index : The percentage proportion of the number of stomata form to the total number of epidermal cells of a leaf is termed the stomatal index :

S.I. = S/E+S x 100; where S = number of stomata per unit area, E = number of ordinary epidermal cells in the same unit area.

Stomatal number varies considerably with the age of the leaf but the stomatal index is highly constant for a given species.

Vein-Islet Number : The word 'Vein-islet' is used for the minute area of photosynthetic tissue encircled by the ultimate divisions of the conducting strands. *Vein-islet number* is defined as the number of vein-islets per square mm calculated from four contiguous square mm in the central part of the lamina, midway between the midrib and the margin. The average range of vein-islet numbers for Senna are : *Cassia senna* (26), *C. angustifolia* (21); for Coca: *Erythroxylum coca* (11), *E. truxillense* (20); for Digitalis. *Digitalis purpurea* (3.5) *D. lanata* (2.7); *D. lutea* (4.4), *D. thapsi* (1.2).

Veinlet Termination Number : It is defined as the number of veinlet terminations per mm^2 of leaf surface. A vein termination is the ultimate free termination of a veinlet or branch of a veinlet. By this character different Coca leaves and Senna leaflets are differentiated.

CHEMICAL EVALUATION

Chemical evaluation involves the determination of active constituents by a chemical process. Chemical tests are used to identify certain crude drugs to determine purity. Chemical tests for alkaloids, carbohydrates, steroids, phenolic compounds, saponins, proteins, amino acids, fixed oils and volatile oils are performed. Titrimetric assay, iodine value, saponification value, acid value, acetyl value, ester value, peroxide value, hydroxyl value and ash value are determined. Tropane alkaloids in Datura, Belladonna and Stramonium are determined by Vitali-Morin reaction. Potassium chlorate and hydrochloric acid are used to estimate emetine in Ipecac. Strychnine in Nux-vomica is detected with ammonium vanadate and sulphuric acid. Bornträger's test is useful for detecting anthraquinone glycosides, present in Senna, Rhubarb, Cascara and Aloe. Alkaloid contents can be evaluated by determining total alkaloidal contents by acid-base titration.

Preparation of an extract by an appropriate solvent is sometimes applied to determine the quality of drugs. The solvent may extract a single constituent, e.g. fixed oil from crushed Linseed. Further examples of the use of extractive tests are in cases of Gentian, Colocynth seeds, Indian hemp, Ginger, Calumba, Rhubarb, Glycyrrhiza and Myrrh.

Drugs containing volatile oils are examined for authenticity and quality by determining the percentage of volatile oil yielded by steam distillation in a suitable apparatus. Standards for content of volatile oil in drugs usually allow a somewhat smaller percentage from powdered drugs as compared with the whole drug due to inevitable loss on grinding, volatilization and decomposition.

On ignition of crude drugs a residue of mineral substances or ash remains, derived from the cell wall and cell contents. The ash value is useful in determining authenticity and purity of drugs. For a number of official drugs, a limit is placed on the yield of acid-insoluble ash, i.e. the ash remaining after extraction of the total ash with dilute acid. This residue consists chiefly of silica, partly derived from the constituents of the cells and their walls and partly from foreign mineral matters, mainly soil. Acid-insoluble ash limits are imposed especially in cases where foreign silica may be present or when the calcium oxalate

contents of the drug is high. Pharmacopoeial limits for acid insoluble ash vary from 0.5 (Agar) to 12 percent (Hyoscyamus). Glandular trichomes present in Hyoscyamus have a capacity of retaining clay and thus the acid insoluble ash value is higher in such cases. In case of Glycyrrhiza the total ash figure is of importance which indicates the care taken in the preparation of the drug. For the determination of total ash values the carbon must be removed below 450°C, since alkali chlorides would be lost due to volatile at high temperature. The total ash usually consists of carbonates, phosphates, silicates and silica. In case of Ginger a minimum percentage of water-soluble ash is determined to detect the presence of exhausted ginger.

PHYSICAL EVALUATION

Physical constants such as elasticity in fibres, viscosity of drugs containing gums, swelling factor of mucilage containing materials, froth number of saponin drugs, congealing point of volatile and fixed oils, melting and boiling points and water contents (loss on drying at 110°C) are some important parameters used in the evaluation of drugs. Ultraviolet light is also used for determining the fluorescence of extracts of some drugs (Gambir, Senna) and colours of alkaloids as : aconite (light blue), berberine (yellow), emetine (orange) and quinine (dense fluorescence in dilute sulphuric acid). The florescence of Belladonna leaf and root, Wild Cherry bark and Jalap is due to the presence of a coumarin, β-methyl asculetin. Pale Catechu shows fluorescence in alkaline solution due to gambir-fluorescin. Aloe exhibits a green fluorescence in a solution containing borax. Many other drugs show a marked intensity of colour or a characteristic colour under UV light. Rhubarb is differentiated from Rhapontic, Chinese or Indian Rhubarb by its marked fluorescence in UV light.

Physical constants are extensively applied to the active principles of drugs, such as alkaloids, volatile oils, fixed oils, etc. Solubility expresses number of ml of solvent require to dissolve one gram of the drug. For example, 1 g of codeine sulphate is soluble in 30 ml of water, and in 1300 ml of alcohol. Alkaloids and other nitrogenous compounds are soluble in dilute hydrochloric acid. Melting points are recorded for solid fixed oils (fats) and alkaloids.

Most of the monoterpenes have asymmetric carbon.

BIOLOGICAL EVALUATION

The drugs, which cannot be assayed satisfactorily by chemical or physical means, are evaluated by biological methods. Tests are carried out on intact animals, animal preparations, isolated living tissues or micro-organisms. Since living organisms are used, the assays are called 'biological assays'. Biological standardization procedures are generally less precise, more time consuming and more expensive to conduct than chemical assays. Therefore, they are generally used if the chemical identity of the active principle has not been fully elucidated; if, no adequate chemical assay has been derived for the active principle as in case of insulin; if the drug is composed of complex mixture and activity, e.g. Digitalis; if the purification of crude drug is not possible, e.g. separation of vitamin D from irridiated oils; and if the chemical assay is not a valid indication of biological activity.

A biological assay measures the actual biological activity of a given sample. In any one test the animals of only one strain are used. For some assays a specific sex must be used. The male rat has faster growth rate than the female. Therefore, use of both male and female in a growth test

CARBOHYDRATES

The Carbohydrates includes simple sugars and poly saccharides. They are carbonyl alcohols containing the element Carbon, Hydrogen, And Oxygen. The last two elements are usually present in some proportion as in water. Carbohydrates are the primary product of photosynthesis and form them the plant synthesizes various chemical constituents by subsequent organic reactions. They are most abundant component of both plants (cellulose, starch, sugar) and animals (glycogen). Sugar are united with many compounds to form glycosides.

- Group of compounds composed of carbon, oxygen, and hydrogen

Examples: (Ch_2o) Hydrates of carbon

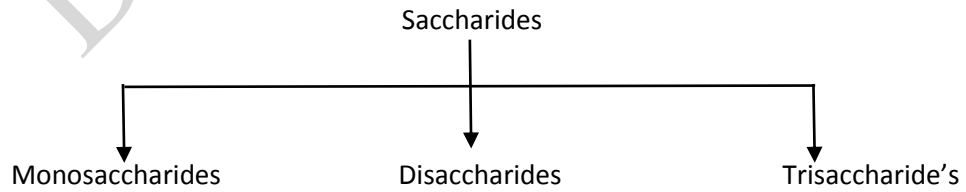
(Ch_3COOH) Acetic Acid

(CH_3-CHOHCOOH) Lactic Acid

- It is defined as polyhydroxy aldehydes or polyhydroxy ketones that on hydrolysis produce either of the above.
- They are substance of universal occurrence and are much abundant in plant, rather than in animals.
- Carbohydrates are divided into Two parts

Simple sugar (Saccharides) Polysaccharides

A. Simple Sugar: - (low molecular weight, less energy produce)
   It is crystalline soluble in water, Sweet in taste
   e.g. Glucose, Fructose, and Sucrose
B. Polysaccharides (High molecular weight t and also more energy produce)
   It is amorphous, tasteless & relatively less soluble in water.
   e.g. Starch, Cellulose, Gums, Pectin



a) Monosaccharides: -
   It has sugar, which cannot be further hydrolyzed to simple sugar.
   e.g. Bioses
   Trioses
   Tetroses
   Pentoses

b) Disaccharides: -

Which upon hydrolysis two molecules of monosaccharides are called as disaccharides.

e.g. Sucrose $\xrightarrow{\text{Hydrolysis}}$ Glucose + Fructose

Maltose $\xrightarrow{\text{Hydrolysis}}$ Glucose + Glucose

Lactose $\xrightarrow{\text{Hydrolysis}}$ Glucose + Galactose

c) Trisaccharide: -

As the name indicates, these liberates 3 molecules of monosaccharides on hydrolysis.

e.g. Raffinose $\xrightarrow{\text{Hydrolysis}}$ Glucose + Fructose + Galactose

Gentionose $\xrightarrow{\text{Hydrolysis}}$ Glucose + Glucose + Fructose

❖ Polysaccharides: -

- When hydrolysis they give an indefinite no. of mono saccharides.
- By Condensation $\xrightarrow{\text{Elimination}}$ water
- Polysaccharides are produced from monosaccharides.

CHEMICAL TESTS FOR CARBOHYDRATES

1. ***Fehling's Solution test:***
   The substance is heated with dil. HCl to hydrolyzed a polysaccharide. The reaction mixture is neutralized by addition of sodium hydroxide solution and then Fehling's solution 1 & 2 is added. Red precipitate of cuprous oxide is produced on heating in case of reducing sugar (all monosaccharides and many disaccharides like lactose, maltose, cellobiose and gentiobiose) Non reducing sugars including some disaccharides (sucrose & trihalose) which on boiling with acid are converted into reducing sugars.
2. ***Molisch Test:***
   A solution of carbohydrates is prepared in water containing α-naphthol. On addition of conc. H_2SO_4 Along with the side of test tube a purple ring is formed on the junction blew aqueous layer. With insoluble carbohydrates (e.g. Cellulose) the color is produced on shaking the reaction mixture.
3. ***Osazone Formation:***
   A sugar on heating with phenyl hydrazine HCL, sodium acetate, and acetic acid forms yellow crystal of osazone.
4. ***Test for pentose:***
   A solution of material is heated with aqueous volume of HCl containing a little phloroglucinol. A red color is formed in case of pentose.
5. ***Keller Kiliani test for Deoxy sugars:***
   A deoxy sugars (found in Cardiac Glycosides) is dissolved in acetic acid containing a trace of ferric chloride and transferred to the surface of conc. H_2SO_4. A reddish-brown color is formed at the junction which turns blue latter on.
6. ***Furfural Test:***
   A carbohydrates sample is heated in a test tube with a drop of syrupy phosphoric acid to convert it into furfural. A disk of filter paper moistened with a drop of 10% solution of aniline in 10 % acetic acid is placed over the mouth of the test tube. the bottom of the test tube is heated for 30-60 Seconds. A pink or Red stain appears on the reagent paper.

Agar

Synonyms:
Agar-agar, Japanese isinglass.
Biological source:
Agar is the dried, hydrophilic, colloidal polysaccharide complex extracted from [Gelidium Cartilagineum L.]
Family: Gelidiaceae
Geographical source:
Agar is obtained mainly from Japan, Korea, South Africa, U.S.A., China, Indonesia, Australia and India.
Chemical Constituents:
On hydrolysis agar yields galactose and subplate ions obtained. It is heterogenous polysaccharides, agarose, responsible for gel strength.
It also contains L-Galactose and D- Galactose.
Uses:
1. It is uses as a bulk laxative (an agent to induce active movement of the bowels) and in chronic constipation (unmanageable constipation). Generally, it is given in combination with other Anthraquinones vegetable drugs.
2. In the preparation of vaginal capsules and suppositories (a cone shaped capsule like structure with the medicine in it, to be introduced into rectum, urethra or vagina).
3. To prepare nutrient media in bacteriological culture.
4. In industrial applications like emulsion, sizing, silk textiles, adhesives and thickening ice cream.

Guar Gum

Synonyms:
Guar Flour, Jaguar, Jaguar gum
Biological source:
Guar gum obtained from the refined endosperm of the seeds of [Cyamopsis tetragonolobus L] Taub.
Family: Leguminosae.
Geographical source:
It is commercially grown in India, Pakistan, and U.S.A. and to limited extent in South Africa, Brazil and Australia. In India, Rajasthan is the major guar-gum growing state.
Description:
i. Colour white or yellowish white free flowing powder.
ii. Odour odourless.
iii. Taste Characteristic.
iv. It is soluble in cold and hot water and forms neutral colloidal solution.
v. Guar gum is insoluble in alcohol, oils hydrocarbons, ketone, etc. Guar gum contains much thickening capacity than that of starch.

Chemical constituents:

i. Carbohydrate

ii. Gum- Guaran, the water-soluble portion of the gum and yields on hydrolysis galactose 35% and mannose 60-65%.

iii. Small quantity of protein.

Uses:

1. Protective colloids.
2. Used as binding agent and disintegrating agent in tablet formulations.
3. In bulk laxatives.
4. As appetite depressant.
5. It is used in peptic ulcer therapy.
6. It is also reducing blood glucose concentration in diabetic patients and serum concentration in hyper lipidaemia.
7. It is a good emulsion stabilizer.

Acacia

Synonyms:

Gum Arabic, Gum acacia, Babul and Gondu.

Biological source:

It consists of the dried gummy exudation obtained from the stem and branches of Acacia arabica Wild]. (Acacia Senegal)

Family: Leguminosae.

Geographical source:

It is found in Sudan, India, Morocco, Sri Lanka and Africa.

Chemical constituents:

i. Polysaccharide Arabin (Mixture of calcium, magnesium and potassium salts of arabic acid).

ii. Arabic acid on hydrolysis gives D-galactose, L-arabinose, L-rhamnose and D-glucoronic acid.

iii. Also contain enzyme oxidase and peroxidase.

Uses:

1. Demulcent.
2. Emulsifying agent.
3. Suspending agent.
. Binding agent.
5. Used in inflammation of intestinal mucosa.
6. Used to cover inflamed surfaces such as bums, sore nipples, etc.
7. Used in the manufacture of adhesive and ink.

Honey

Biological source:

Honey is the saccharine liquid prepared from the nectar of the flowers by the hive-bee [Apis mellifica] and bees of other species of Apis.

Family: Apidae

Geographical source:

Honey is produces in certain parts of West Indies, California, Chile, Africa, Australia, and New Zealand and also in India.

Description:

(i) Honey is viscid, translucent, and white to pale yellow or yellow brown- coloured liquid. On keeping it crystals of glucose separate. Odour is pleasant and characteristic and taste is sweet.

(ii) The odour and taste depend on the flowers from which nectar is sucked.

(iii) Specific rotation of honey is +3° to -10° and total ash 0.1 to 0.8%.

Chemical constituents:

(i) Honey consists chiefly a mixture of dextrose and laevulose (70-80%) and water (14-20%). contains sucrose (1.2-4.5),

(ii) Dextrin (0.06-1.25%), volatile oil, pollen grains enzymes

(iii) Vitamins

(iv) Amino acids

(v) Proteins

(vi) Colouring matters, etc.

Uses:

1. Honey is used as nutritive.
2. Demulcent
3. Mild laxative.
4. It is used as an important component of linctuses and cough mixtures.
5. It is a sweetening agent.
6. It is used as antiseptic and bactericidal.
7. This is also used as a vehicle in Ayurvedic and Unani preparations.
8. As a pill recipients

Isapaghula

Synonyms

Ispaghula, Isapgol, Spogel seeds, Isabghol.

Biological source:

It consists of dried seeds of [Plantago ovata Forsk]

Family: Plantaginaceae.

Geographical source:

Plant is cultivated largely in Gujarat, Punjab, Southern Rajasthan, Maharastra and Karnataka. The variety P. psyllium Linn is cultivated in Spain, Cuba and France.

Chemical Constituents:

(i) Ispaghula seeds and husk contains 10-30% of hydrocolloids as mucilage.

(ii) Chemically, it contains pentosan and aldobionic acid, Rhamnose, arabinose and galactouronic acids are hydrolyzed products of mucilage.

(iii) Fixed oils and proteinsare also present in the drug.

Uses:

1. Demulcents (Soothing property).
2. It is use in treatment of chronic constipation.
3. It is used in chronic dysentery of amoebic and bacillary origin.
4. It is used in chronic diarrhea.
5. It is also used as a stabilizer in ice cream industry.
6. Recently, it is used in the preparation of creams, lotions, soft drink and candies also.

Pectin

Biological source:

Pectin is a carbohydrate and is present in the cell wall as the calcium salt or methyl ester in the middle lamina. These are obtained from the inner portion of the rind of citrus fruits like lemon, orange, etc. and vegetative matter like sunflower, papaya, guavas, mangoes, etc.

Geographical source:

U.S.A., India, Switzerland and other European countries. Preparation: Pectin present in the cell wall is insoluble in nature known as prospecting, when the fruit pulp is treated with dilute acid at 90°C and pH 3.5-4 for 30 minutes. The solution is filtered and alcohol is added to filtrate, pectin precipitates out. This is separated and dried under reduced pressure.

Description:

Pectin is available as coarse or fine powder. It is yellowish white in colour, taste is mucilaginous and odourless. With water it forms colloidal solution. It is mild acidic in nature. It is stable at slightly acid pH and depolymerisation takes place in strong acidic or basic conditions.

Chemical constituents:

(i) Chemically pectins are polygalacturonic acids in which some of the carboxyl groups are present as methyl esters.

(ii) Pectic acid is an aldobionic acid, which on hydrolysis gives galacturanic acid, arabinose, galactose, and methyl pectose.

(iii) Pectin is a methoxy ester of pectic acid. It is hydrolysed by pectase of dilute caustic soda, produce pectic acid and methyl alcohol, component of pectin and cellulose. It is insoluble in water.

(iv) Alkaline hydrolysis of pectose forms pectin and cellulose.

Uses:

1. It is used in the treatment of diarrhea and gastroenteritis.
2. It is used in the treatment of wounds (2% sterile solution).
3. As a substitute for blood plasma.
4. In conjugation with kaolin as an absorbent of intestinal toxins. .
5. To dampen and mask the taste

Starch

Synonyms:
Amylum.
Biological source:
Starch consists of polysaccharide granules obtained from the grains of Maize [Zea mays L], or of rice [Oryza sativa L] or of wheat [Triticum aestivum L].
Family- Graminae
Geographical source:
Starch is commercially produced in tropical and subtropical countries. Argentina, U.S.A, China, India and Japan are the main starch producing countries of the world.
Chemical constituents:
(i) Starch contains generally a mixture of two polysaccharides, amylopectin (α- amylose) and amylose (β-amylose).
(ii) Amylopectin it is the main constituent of most of the starches (more than 80%) and is present in outer parts of granules. It contains both strait chained and branched glucose unit. It is insoluble in water and is responsible for gelatinizing property. It gives bluish black colour with iodine solution.
(iii) Amylose most starches contain 20% amylose. It contains straight chained glucose units and is present in inner parts of granules. It is soluble in water and produces blue colour with iodine solution.
Uses:

1. It is mainly used as a dusting powder.
2. As a Pharmaceutical aid.
3. Used as an antidote for iodine poisoning.
4. Source of Food-nutrition.
5. Protective and demulcent.
6. In paper-sizing and textile industry and in laundry practice etc.
7. It is the starting product form which liquid glucose, dextrose, dextrin are made.
8. Acts as a basis for identification of drugs in Pharmacognosy.
9. It is also used as a tablet disintegrating agent and diluents.

Tragacanth

Synonyms:
Gum Tragacanth, Hindi.-Anjira.
Biological source:
Tragacanth is dried gummy exudation obtained from the stem of [Astragalus gummifer Labill].
Family: Leguminosae.

Geographical source:
It is a native of Southern and Eastern Europe. The plant is widely distributed in Iran, Afghanistan, Iraq, Syria, Anatolia and India. In India, few species of Astragalus are available in Garhwal, Shimla, and Kashmir and Hilly region of Kumaon.

Macroscopical characters:
(i) Form-flattened, lamellate, tough ribbon shaped pieces of horny structures, more or less curved or contorted
(ii) Colour-white or faint yellow
(iii) Size-about 2.5 cm length
(iv) Facture-Short
(v) Odour-None

Chemical constituents:
It contains a complex polysaccharide carbohydrate.
a. Water-soluble Tragacanthin (30-40%)
b. Water insoluble Bassorin (60-70%)
Tragacanth in turn consists of (a) tragacanthic acid + (galacturonic acid + xylose + fructose + galactose) and (b) Arabinogalactan + (arabinose + galactose + galacturonic + Rhamnose in small quantities). It is also contains 3% starch and cellulose.

Uses:
1. It is used as a demulcent (soothing).
2. Suspending agent.
3. Binding agent.
4. Emulsifying agent.
5. Laxative.
6. It is used in adhesive
7. In textile industry.

Sterculia Gum

Synonyms:
Kadaya, Kullo, Gum Karaya, Karaya Gum

Biological source:
Sterculia is the dried gummy gummy exudate of the tree [Sterculia Urens Roxb]

Family: Sterculiaceae.

Geographical source:
The tree is found in Pakistan and South Africa, in India (Guajrat, Maharastra, Madras, Rajasthan M.P. and Chota Nagpur

Chemical constituents:
Sterculia gum consists heteropolysaccharide with a high composition of D-galacturonic acid and D-glucuronic acid

Uses:
1. Bulk Laxative
2. Emulsifying and suspending agent
3. Dental adhesives
4. Used in skin lotions, textiles and printing industries.

Beeswax

Synonyms

Bees wax; Cera-flava; Ben. And Hin.- Mom; Guj.- Min.; Kan.- Mena.

Biological source:

Yellow bees wax is purified wax and obtained from the honey comb of the bees [Apis mellifera] and other species of Apis.

Family: Apidae.

Geographical source:

It is prepared in California, Africa, France, Italy, West Africa and India.

Preparation:

Combs and capping of honey comb is kept in boiling water, for melting. The water-soluble impurities are dissolved and other impurities sinks in the water. On cooling, the melted wax gets solidity and floats on the water surface. Wax is removed and process is repeated several times to get pure yellow beeswax. This is bleached with charcoal, potassium per-magnate, chlorine, ozone, chromic acid or hydrogen peroxide to obtained white beeswax. Natural bleaching is done by exposing thin layer of yellow beeswax to sun light.

Description:

(i) Colour – White or Yellow
(ii) Odour – honey like
(iii) Taste – Waxy
(iv) Fracture – brittle and granular
(v) Solubility – Soluble in chloroform, ether and in both essential and fatty oils, but insoluble in water

Chemical constituents:

(i) Lipids like wax- myricyl palmitate (80%).
(ii) Wax -acid such as cerotic acid (15%).
(iii) Aromatic substances: Cerolein.
(iv) Cholesteryl ester.

Uses:

- As a pharmaceutical aid.
- It is used in the preparation of plasters, ointments and polishes.
- It is used in ointment for hardening purpose and in the manufacture of candles,
- Moulds and in dental and electric industries.
- It is also used in cosmetic for the preparation of lip-sticks and face creams.

Castor Oil

Synonyms

Ben. – Bherenda; Guj. – Diveli; Hindi- Erand; Kan. – Haralenne.

Biological source:

Castor oil is the fixed oil obtained by cold expression from the seeds of [Ricinus communis L].

Family: Euphorbiaceae.

Geographical source:

India and other tropical and subtropical countries

Characters:

(i) Colour – Colourless or pale yellow.
(ii) Nature – Viscid liquid
(iii) Odour – Faint
(iv) Taste – Acrid and nauseating;
(v) Solubility – Soluble in alcohol in all proportions, chloroform and solvent ether.

Chemical constituents:

i. Lipids- Fixed oils (45-55%).
ii. A mixture of triglyrides.
iii. Triricinolein (75%), which on hydrolysis yields ricinoleic acid responsible for the cathartic effect.

Uses:

- Cathartic (increases the movement of the bowels)
- In soap industry.
- As a lubricant.
- Castor oil is used as plasticizer and in preparation flexible collodion.

Cocoa butter

Synonyms:

Theobroma oil; Cacao butter

***Biological* source:**

It is obtained from roasted seeds of [Theobroma cacao L].

Family: Sterculiaceae.

Geographical source:

Gold Coast, Nigeria, Brazil, Ecuador, Ceylon, and British, West Indies, Mexico, Sri Lanka, India

Description:

(i) Colour – yellowish-white solid.
(ii) Odour – Pleasant chocolate;
(iii) Taste – pleasant;
(iv) It is insoluble in water, but soluble in ether, chloroform, benzene and petroleum ether.

Chemical constituents:

It contains of glycerides of stearic acid (34%), oleic acid (37%), Palmitic acid (25%), and small quantity of arachidic acid and linoleic acids. The non-greasiness of product is due to its glycerides structure.

Uses:

- Used as a base for suppositories and ointments,
- Manufacture of creams and
- Manufacture toilet soaps.

Cod Liver Oil:

Synonyms:

Oleum morrhi

Biological source:

It is processed from fresh liver of cod fish, [Gadus morrhua] and other species of Gadus.

Family: Gadidae

Geographical source:

They are prepared in Scotland, Iceland, Germany, Denmark and Britain.

Description:

Colour – Pale yellow thin liquid

Taste – Slightly fishy

Odour – Fishy

It is freely soluble in chloroform, ether, carbon disulphide, and petroleum ether and slightly soluble in alcohol.

Chemical constituents:

i. It contains of vitamin A and D.

ii. The oil contains glyceryl ester of oleic, linoleic, gadoleic, myristic. Palmitic and other acids.

iii. Cod liver oil also contains 7% eicosapaenoic acid and docosahexanoic acid.

Uses:

- The oil is used as source of vitamins
- As a nutritive
- Treatment of Rickets and Tuberculosis.

Hydnocarpus Oil

Synonyms:

Chaulmoogra oil, Gynocardia oil

Biological source:

Chaulmoogra oil is the fatty oil obtained by cold expression from the fresh ripe seeds of [Hydnocarpus anthelmintica].

Family: Flacourtiaceae.

Geographical source:

It found in East India, Burma, Thailand and Indochina.

Characters:

- Colour – Yellow or brownish yellow.
- State – below 25° a white soft solid;
- Odour – Characteristic, somewhat similar to that of rancid butter;
- Taste – Acrid.

Chemical constituents:

Mixture of glycerides

i. Fatty acid
ii. Hydnocarpic acid:
iii. Chaulmoogric acid
iv. Gorlic acid

Uses:

- It is used in the treatment of tuberculosis.
- Leprosy.

Kokum Butter

Synonyms:

Goa butter, kokum oil, Mangisteen oil

Biological source:

It is fat expressed from the seeds of [Garcinia indica]

Family: Guttiferae

Geographical source:

Thailand, Cambodia, China India

Chemical constituents:

- Glycerides of stearic (55%),
- Oleic (40%),
- Hydroxy capric acid (10%).

Uses:

- It is used as nutritive, demulcent astringent.
- locally it is used in fissures of lips and hand.
- It is used in the preparation of ointments and suppositories.

Lard: Sources

Synonyms:
Adeps.
Biological source:
It is purified internal fat obtained from the abdomen of the Hog [Sus Scrofa Linn]
Family: Suidae.
Description:

- Colour – white, homogenous fatty mass unctuous to rough;
- Odour – slight;
- Taste – bland;
- It is insoluble in alcohol and in benzene, carbon disulphide, ether and chloroform.

Chemical constituents:

i. Olein
ii. Stearin
iii. Palmitin.

Uses:

- It is used as an ointment base and in formulations where more effective absorption is desired.
- Benzoinated lard contains benzoin resin as preservative.

LINSEED OIL

Synonyms*:*
Flax seed, alsi (Hindi).
Biological Source*:*
Linseed is the dried, ripe seed of [Linum usitatissimum Linn]. Linseed oil is obtained by expression of linseeds, belonging to
Family*:* Linaceae.
Geographical Source*:*
Linseed is cultivated in many sub-tropical countries such as South America, India, United States, Canada, England, Russia, Greece, Italy, Spain, and Algeria.
Chemical Constituents*:*
Linseed contains fixed oil (30–40%), mucilage (6–10%), protein (25%) (linin and colinin), small amount of enzyme lipase, and linamarin which is a cyanogenetic glycoside. The carbohydrates present are sucrose, raffinose, cellulose, and mucilage.
Uses*:*
Linseed is used as demulcent and in form of poultices for gouty and rheumatic swellings. Internally it is used for gonorrhoea and irritation of the genito-urinary system.
Linseed oil has emollient, expectorant, diuretic, demulcent, and laxative properties

Nonstaining iodine ointment soap, linoleum, greases, polishes, polymers, varnishes, paints, putty, oil cloths, printing inks, artificial rubber, tracing cloth, tanning and enamelling leather, etc. are also prepared from Linseed oil. The mucilaginous infusion is used internally as a demulcent in colds, coughs, bronchial affections, inflammation of the urinary tract, gonorrhoea, and diarrhoea.

Rice Bran Oil

Synonyms:
Rice oil.
Biological source:
Rice bran is the cuticle existing between the rice and the husk of the paddy and consists of embryo (germ) and endosperm of the seeds of [Oryza sativa]. It is obtained as a byproduct in rice mill during polishing of rice obtained after de-husking of paddy.
Family: Graminae.
Description:
It is golden yellow oil difficult to bleach, and not affected by temporary heating to 160°C. It is insoluble in water but soluble in organic solvent.
Chemical constituents:

1. **Fatty acid:**
    i. Oleic acid
    ii. Linoleic acid.
    iii. Palmitic acid.
2. **Squalene.**
3. **Tocopherol.**

Uses:

- Antioxidant.
- Emollient.
- Manufacture of cosmetics.
- Preparation of vegetable ghee.

Shark Liver Oil

Synonyms:
Oleum Selachoids.
Biological source:
Shark liver oil is obtained from the fresh or carefully preserved livers of the shark [Hypoprion brevirostris]. It contains in 1 g not less than 6000 international Units of Vitamin A activity.
Family: Carcharhinidae
Geographical source:
In India, the shark livers are processed and oil is obtained on commercial scale in Tamil Nadu, Maharashtra, and Kerala, European countries.
Description:

- Color – Pale yellow to brown yellow
- Odour – fishy
- Taste – Fishy and bland;
- Solubility – Miscible in light petroleum (50-60°), ether, chloroform and slightly soluble in alcohol.

Chemical constituents:
Vitamin A and glycerides of saturated and unsaturated fatty acids. The concentration of Vitamin A ranges from 15000 to 30000 units per gram.
Uses:

- Source of vitamin A.
- In the treatment of xerophthalmia (abnormal dryness of the surface of the conjunctiva)
- In combination with vitamin D, it is given as a tonic and nutritive in cases of TB. It is used in burn and sunburn ointments.

Storage:
Preserve shark liver oil in a well-filled, well closed container, protected from light.

Wool Fat

Synonyms:
Adeps Lanae, Lanolin
Biological source:
Hydrous wool fat is the purified fat like substance obtained from the wool of [Ovries aries Linn]
Family: Bavidae
Geographical source:
Lanolin is commercially manufactured in Australia, U.S.A. and also in India
Chemical constituents:
It content mainly esters of cholesterolsand iso cholesterol with caranubic oleic, myristic, palmitic, and lanopalmitic acid
Uses:

- Used as water absorble oinment base.
- Used as a common ingriient and base of water soluble creams and cosmetics,