

A Text Book of
**INTRODUCTION
TO PHARMACOGNOSY**

As per the New PCI Syllabus **NEP 2020**

BP105T



1st SEM.
Bachelor of Pharmacy



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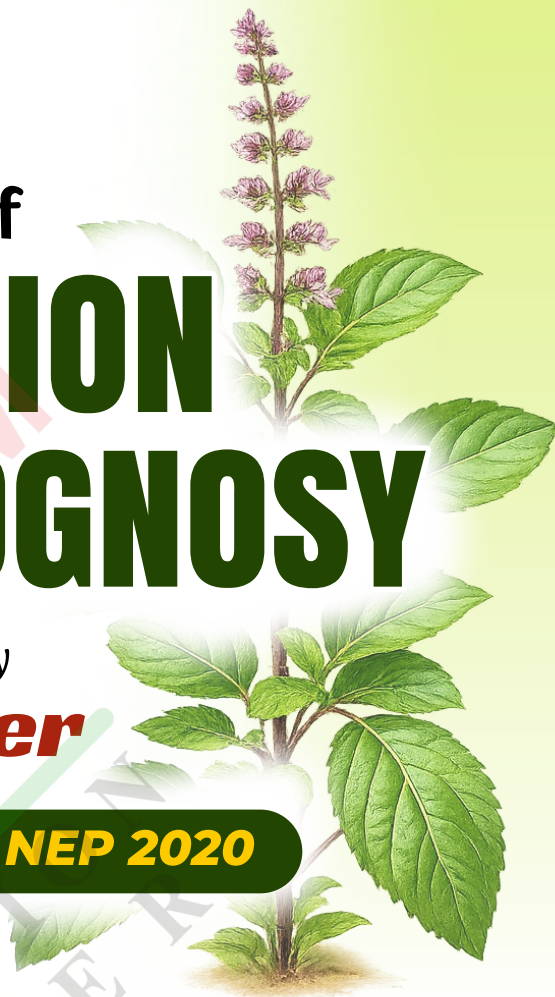
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A Text Book of **INTRODUCTION TO PHARMACOGNOSY**

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First Semester

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INTRODUCTION TO PHARMACOGNOSY

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PREFACE

The study of Pharmacognosy plays an important role in Pharmacy education by transforming traditional knowledge of natural drugs with allopathic medicine in reference to new scientific approaches. Pharmacognosy emphasizes drugs derived from natural sources such as plants, animals, minerals and marines contributing significantly to safe, effective, and affordable healthcare with less side effects. The textbook of Pharmacognosy is carefully designed in accordance with the new syllabus prescribed by the Pharmacy Council of India (PCI), New Delhi, bridging classical herbal knowledge with contemporary pharmaceutical science with artificial intelligence (AI).

In this era Pharmacists are involved in ensuring the quality, safety, and efficacy of herbal drugs and their natural compounds. A proper knowledge of crude drugs, their identification, cultivation, collection phytochemical constituents, and therapeutic applications is essential. This book presents the fundamental concepts of Pharmacognosy in a simple, and student-friendly manner, making it easier for learners to grasp both theoretical and practical aspects.

The book provides a systematic and comprehensive approach to the subject, emphasizing real-world pharmaceutical applications: Foundations of Pharmacognosy, covering history, scope, and significance of natural drugs in modern medicine. Classification of crude drugs, explaining various systems based on morphology, microscopy, and chemical constituents. Cultivation and collection of medicinal plants, highlighting factors affecting quality and sustainability. Evaluation of crude drugs, including organoleptic, Qualitative & Quantitative microscopic, physical, chemical, and biological methods. Phytochemistry, focusing on the study of active constituents such as Carbohydrates, resins, glycosides, Alkaloids, tannins, and volatile oils. In each unit Multiple choice types questions, short answer type questions and long answer types questions are added for better understanding of subjects.

This book has been prepared with valuable guidance from PCI recommendations. We express our sincere gratitude to all authors, academicians, researchers, and reviewers whose expertise has contributed to making this text informative, and student-oriented.

Ultimately, this textbook aims to develop competent Pharmacy professionals with a foundation in natural drug science, enabling them to contribute effectively to healthcare through the safe and rational use of natural herbal drugs.

Authors

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Fundamentals of Pharmacognosy



Syllabus

- Definition, history, present status, scope and development of pharmacognosy.
- Sources of drugs: Plants, animals, microbial, marine, mineral and plant tissue culture.
- Historical milestones in drug discovery : Morphine, quinine, aspirin, warfarin, penicillin, cephalosporin, taxol and artemisinin.
- Introduction to different herbal / traditional pharmacopoeias: Indian Pharmacopoeia, British Herbal Pharmacopoeia, United States Pharmacopeia – Herbal Medicines and Dietary Supplements, Ayurvedic Pharmacopoeia of India, Unani Pharmacopoeia of India and American Herbal Pharmacopoeia.
- Official and non-official; codified and non-codified drugs.
- Classification of crude drugs:



FUNDAMENTALS OF PHARMACOGNOSY



LEARNING OBJECTIVES

After studying this chapter, the learner will be able to:

- Understand the concept, origin, history, scope, and development of Pharmacognosy.
- Know the contributions of ancient civilizations, classical texts, and eminent scientists in the evolution of Pharmacognosy.
- Study the scope and importance of Pharmacognosy in modern medicine and drug discovery.
- Understand the role of plant, animal, mineral, marine, microbial, and tissue culture sources in drug development.
- Learn the historical milestones in drug discovery and the contribution of important plant-derived drugs to modern therapeutics.
- Understand the concept and importance of herbal and traditional pharmacopoeias and their role in ensuring the quality, safety, efficacy, and standardization of herbal medicines.

1.1 DEFINITION, HISTORY, SCOPE AND DEVELOPMENT OF PHARMACOGNOSY

□ Definition of Pharmacognosy

Pharmacognosy is the study of medicines or crude drugs produced from natural sources such as plants, animals, microbes, minerals and marine. It includes analysis of their biological, chemical, biochemical, and physical properties along with their history, identification, cultivation, collection, preparation for the market and preservation.

Definition: "It is defined as the scientific and systematic study of structural, physical, chemical and biological characters of crude drugs along with their history, identification, method of cultivation, collection and preparation of crude drugs for the market".

Thus, Pharmacognosy literally means to **acquire knowledge about drugs**. The term Pharmacognosy was first introduced by **C. A. Seydler, in 1815** in his doctoral thesis titled "*Analecta Pharmacognostica*". The word pharmacognosy is derived from two Greek words; **Pharmakon** and **Gignosco**.

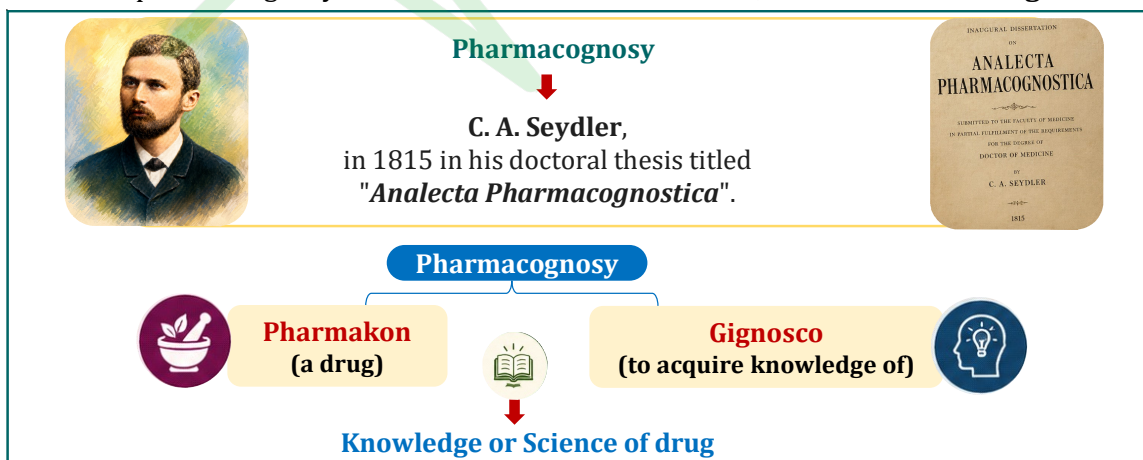


Fig. 1.1: Origin of the term "Pharmacognosy"

Pharmacognostical studies of plant drugs encompass the study of their synonyms, local names, biological sources, distribution, morphology, histology, chemical composition, qualitative and quantitative tests, various physicochemical properties, pharmacological effects, commercial varieties, substitutes, adulterants, and other quality control parameters.

In order to understand the fundamental idea of Pharmacognosy, the following are the general roles of Pharmacognosists :

- Identifying the sources of the drugs.
- Determining morphological and microscopical characters of drugs
- Examination of admixture, potency, and purity.
- Organizing and planning the production of therapeutic plants.
- Detailed instructions for the collection, drying, and preservation techniques.
- Understanding of the extraction and isolation processes.
- Understanding of the chemical composition, applications, phytoconstituents, and active ingredients.
- Understanding of the physical, chemical, biological, and microbiological aspects of drug evaluation.

❑ History of Pharmacognosy

- Pharmacognosy, the study of natural drugs derived from plants, animals, and other natural sources, has a long and rich history. It traces its origins back to ancient civilizations, where people used plants for medicinal purposes long before the development of modern pharmacology and chemistry.
- Herbal medicine is as old as human civilization, with early use in China, India, Egypt, and Greece before the Christian era. One of the earliest records is the *Papyrus Ebers*.

Here's a brief overview of the History of Pharmacognosy:



Fig. 1.2: Important ancient text

➤ *Papyrus Ebers:*

The Ebers Papyrus, also known as Papyrus Ebers, is an Egyptian medical papyrus of herbal knowledge dating back to 1550 B.C. Among the oldest and most important medical papyri of Ancient Egypt, it was purchased by the Georg Ebers. The Ebers Papyrus is a 110-page scroll, which is about 20 meters long. The scroll contains some 700 medicinal herb and 800 magical formulas and folk remedies.

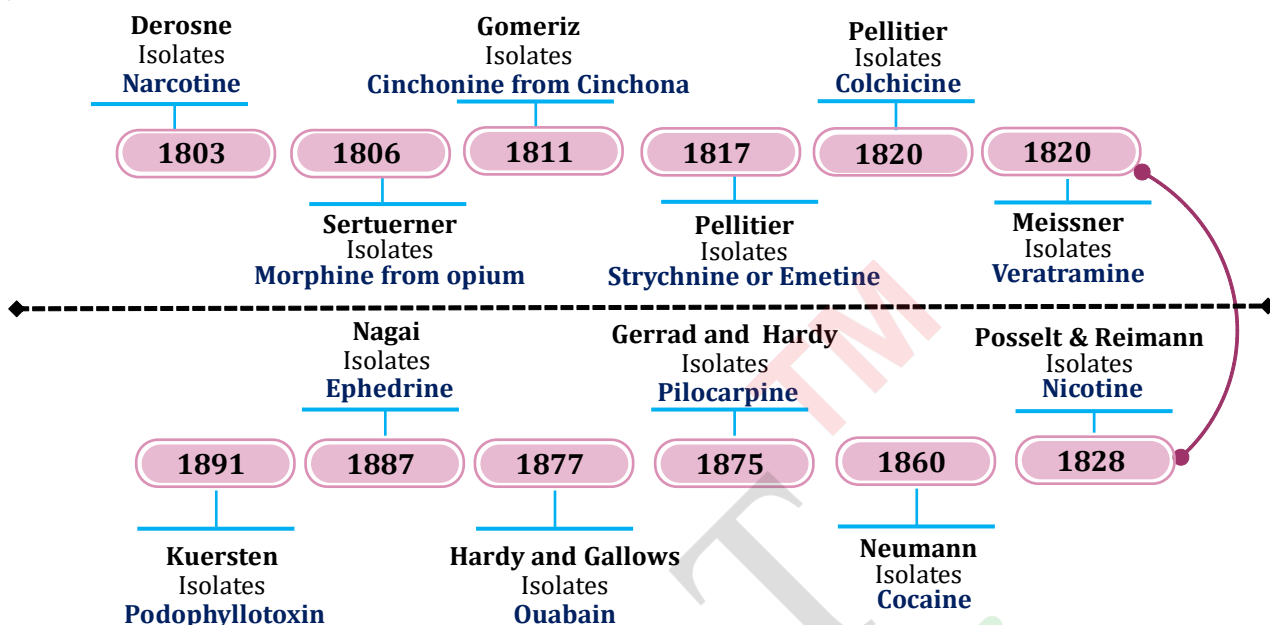


Fig. 1.4: Important isolation and discoveries

The key discoveries of the 20th century were the isolation of ergometrine, digoxin, reserpine, theophylline, and quinidine.

The progress achieved in botanical studies during 19th century had a direct influence on Pharmacognosy.

- Plant classification was developed by-
 - Bentham and Hooker** (1862-1863)
 - A.W. Eichler** (1883)
 - Engler and Prandtl** (1887-1898).
- In 1865, **G. Mendel's** important observations on plant hybrids were published.
- 'The Anatomical Atlas of Crude Drugs' was published by **Berg** in 1865.
- 'An Anatomical Atlas of Powdered Vegetable Drugs' was compiled by **Greenish and Collin** in 1904.

❑ Classification of Pharmacognosy field

Pharmacognosy may be divided into following fields:

Table 1.1: Pharmacognosy fields

FIELD OF PHARMACOGNOSY	DESCRIPTION
Medical ethnobotany	The study of the traditional use of plants for medicinal purposes.
Phytotherapy	The study of medicinal use of plant extracts to treat disease.
Ethnopharmacology	The study of the pharmacological qualities of traditional medicinal substance.
Phytochemistry	The study of chemicals derived from plants (including the identification of new drug candidates derived from plant sources).
Zoo pharmacognosy	The process by which animals self- medicate, by selecting and using plants, soil, and insects to treat and prevent disease.
Marine Pharmacognosy	The study of the chemicals derived from marine organisms.

- These plant compounds are widely used and very important in treatment.
- Examples of Plant-Based Drugs
 - i. Pain relievers (Analgesics) - Morphine, Codeine, Aspirin developed from salicin (from willow bark)
 - ii. Antimalarial drugs – Quinine
 - iii. Anticancer (Antitumour) drugs – Vincristine, Paclitaxel
 - iv. Anti-Asthmatic - Cromolyn sodium

❑ Morphine

- **Source:** It is obtained from dried latex obtained by incision of the unripe capsule of *Papaver somniferum*.
Family - Papaveraceae
- **Discovered by:** Friedrich Sertürner (1806)
- **Class:** Isoquinoline Alkaloid
- **Significance:** First pure drug isolated from a natural source, marked the beginning of alkaloid chemistry in medicinal drugs.
- **Uses:** Powerful analgesic (pain relief), Sedative and hypnotics, Morphine also produces respiratory depression & constipation.

History:



Friedrich Sertürner

Opium has been known to mankind since centuries due to its narcotic properties. It was first cultivated in Mediterranean regions and probably brought by Alexander in 327 B.C. to India.

It is known that Dioscorides and Theophrastus were aware of the medicinal properties of opium.

The earliest written record about opium is revealed from *Historia plantarum* (somewhere in 300 B.C.) and *De Materia Medica* (78 A.D.).

Milestones in the journey of morphine

- Segnin isolated morphine in 1804.
- Magendi and Bally first introduced it in medical practice in 1818.
- Gulland and Robinson elucidated the structure of morphine in 1923.
- In 1833, Robiquet isolated codeine from opium.
- In 1881, Grimaux reported that codeine is o-methyl derivative of morphine.



- In the early 1800s, medicine still relied heavily on crude plant extracts with variable potency. The German pharmacist Friedrich Sertürner set out to isolate the active principle of opium, which had been used for millennia as a pain relieving and sleep inducing agent. Around 1806, working in Paderborn, he succeeded in isolating a crystalline substance from opium which he named “principium somniferum,” and was marketed in Germany and the United States under the trade name Morphine. Morphine was a name derived from Morpheus, the god of sleep. To this day, morphine remains the single most widely used analgesic medication on earth and appears on the list of the World Health Organization’s essential medicines.



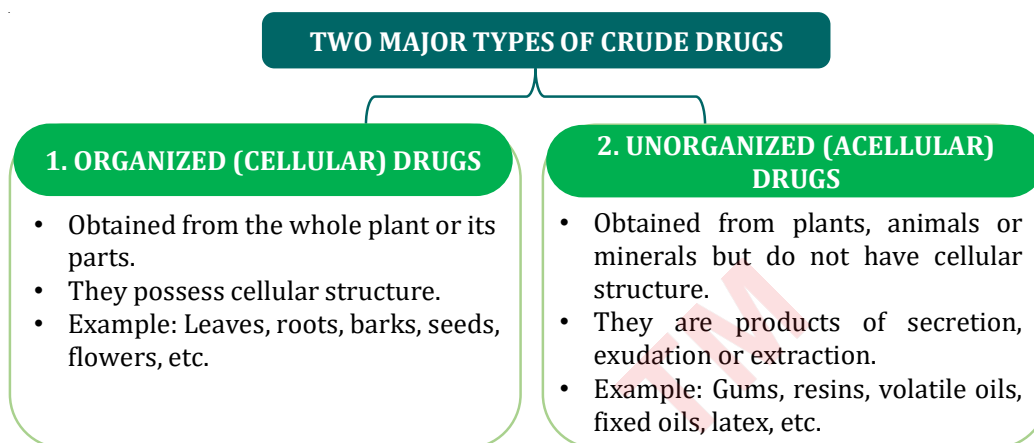


Fig. 1.7: Types of Crude drug

In Pharmacognosy the crude drugs are classified as follows-

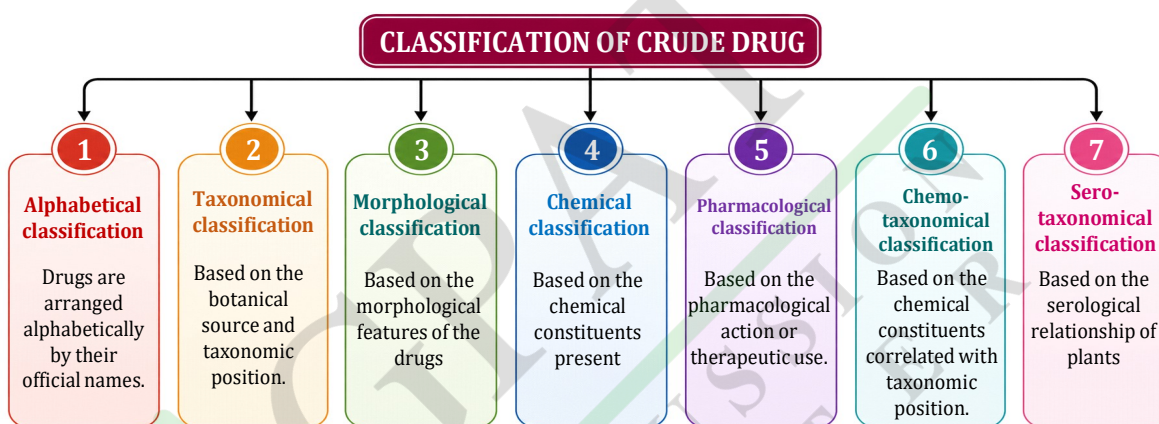


Fig. 1.8: Classification of crude drugs

❑ Alphabetical Classification

In this system of classification crude drugs are arranged in alphabetical order of their

- Local language names (vernacular names) or
- Latin and English names (common names)

Some pharmacopoeias, dictionaries, and reference books that use this technique to categorize crude medications include:

1. Indian Pharmacopoeia
2. British Pharmacopoeia
3. British Herbal Pharmacopoeia
4. United States Pharmacopoeia
5. British Pharmaceutical Codex
6. European Pharmacopoeia



Fig. 1.9: Different Pharmacopoeias



ASSESS YOURSELF



Multiple Choice Questions

- Which of the following statements is not true for 'Pharmacognosy'
 - It is a study of structural, physical, chemical and biological characters of crude drugs.
 - The synthetic drugs also come under its scope.
 - Most crude drugs come from plants.
 - A pharmacognosy expert should have knowledge of pharmacology as well
- The term "Pharmacognosy" was first introduced in 1815 by:
 - Dioscorides
 - Galen
 - C. A. Seydler
 - Tschirch
- "Pharmacognosy" is derived from two Greek words, "Pharmakon" and "Gignosco", the meanings of these two words are
 - Drug and to acquire knowledge of, respectively
 - Drug and to know, respectively
 - Drug and to aware of, respectively
 - Drug and to study, respectively
- Match the following correctly:

1. Shen Nung	a. Binomial nomenclature
2. Dioscorides	b. De Materia Medica
3. Galen	c. Pen-t'Sao
4. Linnaeus	d. Galenical pharmacy

 - 1-c, 2-b, 3-d, 4-a
 - 1-b, 2-c, 3-a, 4-d
 - 1-c, 2-d, 3-b, 4-a
 - 1-a, 2-b, 3-c, 4-d
- The oldest known Chinese herbal text containing 365 drugs is:
 - Charaka Samhita
 - Ebers Papyrus
 - Pen-t' Sao
 - De Materia Medica
- Which statement regarding the Papyrus Ebers is most accurate
 - It lists 365 drugs, one for each day of the year
 - It emphasizes 760 herbs classified on the basis of properties
 - It contains 800 formulae and roughly 700 crude drugs
 - It documents medicinal plants from 5000 B.C. China
- Who is regarded as the Father of Pharmacognosy?
 - Hippocrates
 - Aristotle
 - Dioscorides
 - Galen
- Which alkaloid was first isolated from opium by Sertürner in 1806?
 - Narcotine
 - Morphine
 - Quinine
 - Nicotine
- Which pair is INCORRECTLY matched about constituent and the scientist who isolate them
 - Ephedrine - Nagai
 - Cocaine - Neumann
 - Pilocarpine - Gerrard and Hardy
 - Morphine - Pelletier
- Theophrastus is known for studies on:
 - Human anatomy
 - Animal kingdom
 - Plant kingdom
 - Alkaloids
- The French pharmacist Pelletier is associated with the isolation of:
 - Morphine
 - Strychnine
 - Nicotine
 - Cocaine
- The Anatomical Atlas of Crude Drugs was published by:
 - Greenish
 - Collin
 - Berg
 - Tschirch
- Which field of pharmacognosy deals with the traditional medicinal use of plants?
 - Phytochemistry
 - Medical Ethnobotany
 - Marine Pharmacognosy
 - Zoo pharmacognosy
- The first pure drug isolated from a natural source was:
 - Quinine
 - Atropine
 - Morphine
 - Caffeine

Unit II

Cultivation, Collection, Processing and Storage of Drugs of Natural Origin



Syllabus

- Cultivation, Collection, Processing and Storage of Drugs of Natural Origin
- Methods of plant cultivation
- Good Agricultural and Collection Practices (WHO / GAP / GCP guidelines) for medicinal plants.
- Factors influencing cultivation, collection and storage of medicinal plants.
- Plant hormones and their applications in cultivation of medicinal plants.
- Application of polyploidy, mutation and hybridization concepts with reference to secondary metabolites.
- Ex-situ and in-situ conservation and strategies for value addition of medicinal plants.
- Role of eco-pharmacognosy in sustainable conservation of endangered medicinal plants.



CULTIVATION, COLLECTION, PROCESSING AND STORAGE OF DRUGS OF NATURAL ORIGIN



LEARNING OBJECTIVES

After studying this chapter, the learner will be able to:

- Understand the concept and importance of cultivation, collection, processing, and storage of crude drugs of natural origin.
- Study various methods of plant cultivation and propagation used for medicinal plants.
- Know the factors affecting cultivation, including climate, soil, altitude, fertilizers, and pest control.
- Understand the principles and methods of collection, harvesting, garbling, drying, packing, and storage of crude drugs.
- Learn the WHO Guidelines on Good Agricultural and Collection Practices (GACP) for medicinal plants.
- Understand the role and applications of plant growth regulators and plant hormones in cultivation.
- Study the concepts of polyploidy, mutation, and hybridization and their applications in medicinal plant improvement.
- Know the importance of conservation of medicinal plants and the strategies of in-situ and ex-situ conservation.

2.1 INTRODUCTION

Drugs of natural origin are obtained from plants, animals, microorganisms, minerals, and marine sources. Drugs can be naturally grown & collected from wild forest, fields & ocean etc., but their & purity with proper therapeutic values can't be guaranteed. Therefore Proper identification, cultivation, collection, processing, and storage are essential to maintain the quality, potency, purity and therapeutic value of crude drugs. Cultivation is the artificial /modified growing of medicinal plants under controlled conditions to obtain crude drugs of good quality and high yield.

Crude drugs like cardamom, clove, Indian hemp, poppy latex, tea, cinchona, ginger, linseed, isabgol, Ceylon cinnamon, saffron, peppermint, fennel, etc. are obtained from cultivated plants.

The cultivation of vegetable drugs involves convergence of various agricultural and pharmaceutical factors, such as soil, climate, rainfall, irrigation, altitude, temperature, use of fertilizers, pesticides, genetic manipulation and biochemical aspects of natural drugs. When all such factors are precisely applied, the new approach to scientific cultivation technology emerges out.

○ Objectives of Cultivation

- To obtain high-quality crude drugs
- To ensure continuous supply
- To avoid adulteration and substitution
- To improve yield of desire active constituents
- To conserve wild medicinal plants
- To maintain uniformity in drugs

Plants that are cultivated are of higher quality. When compared to natural sources, it facilitates the selection of species, variations, or hybrids with the appropriate phytoconstituents because of the controlled environmental growth process, which yields a better plant product and simplifies the collection and processing stages. Cultivation helps produce plants with a high concentration of secondary metabolites and ensures a consistent supply of medicinal plants for industrial use. It also serves as a valuable tool for research purposes.

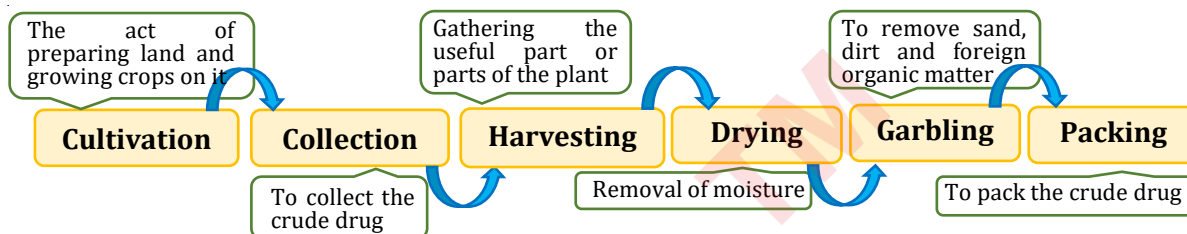
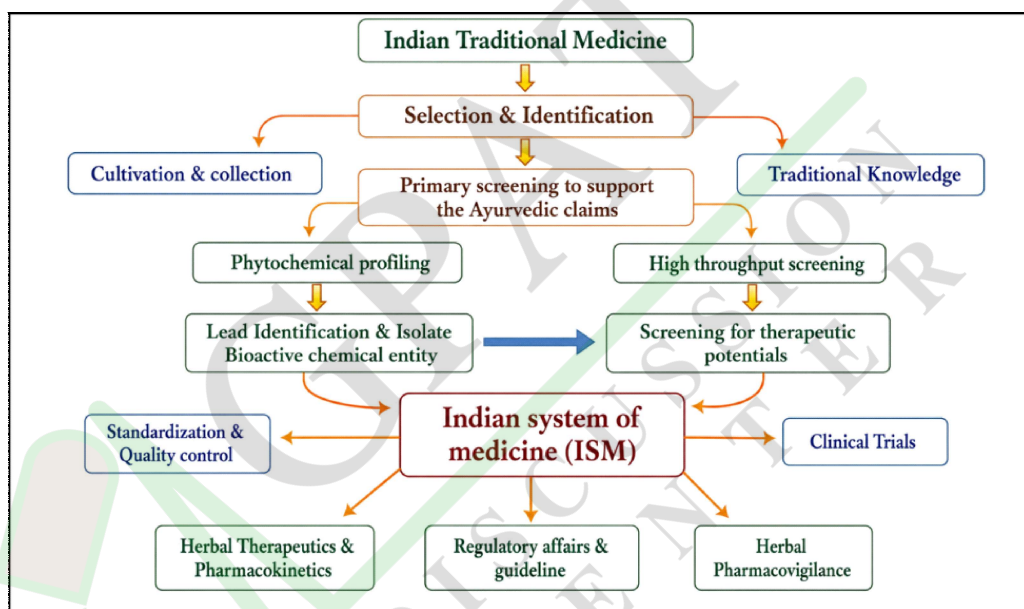


Fig. 2.1: Cultivation, collection, processing and storage of drugs

• **Modern Drug Discovery Process from Indian Traditional Medicine**



2.2 METHODS OF PLANT CULTIVATION

Cultivation is the process of growing and caring for plants by preparing the soil, sowing seeds, watering, fertilizing, weeding, and harvesting.

- Cultivation of medicinal plants requires intensive care and management.
- The conditions and duration of cultivation vary according to the quality of medicinal plant materials required.
- It is a scientific method for the large-scale, healthy growth of medicinal plants. Growth is described as the organs' progressive development in relation to different circumstances.

➤ **Steps involve in process of cultivation-**

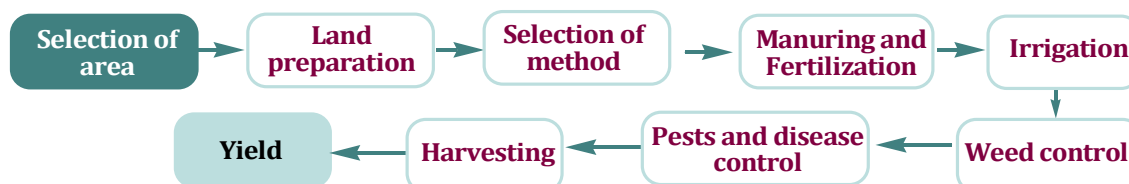


Fig. 2.2: Process of cultivation

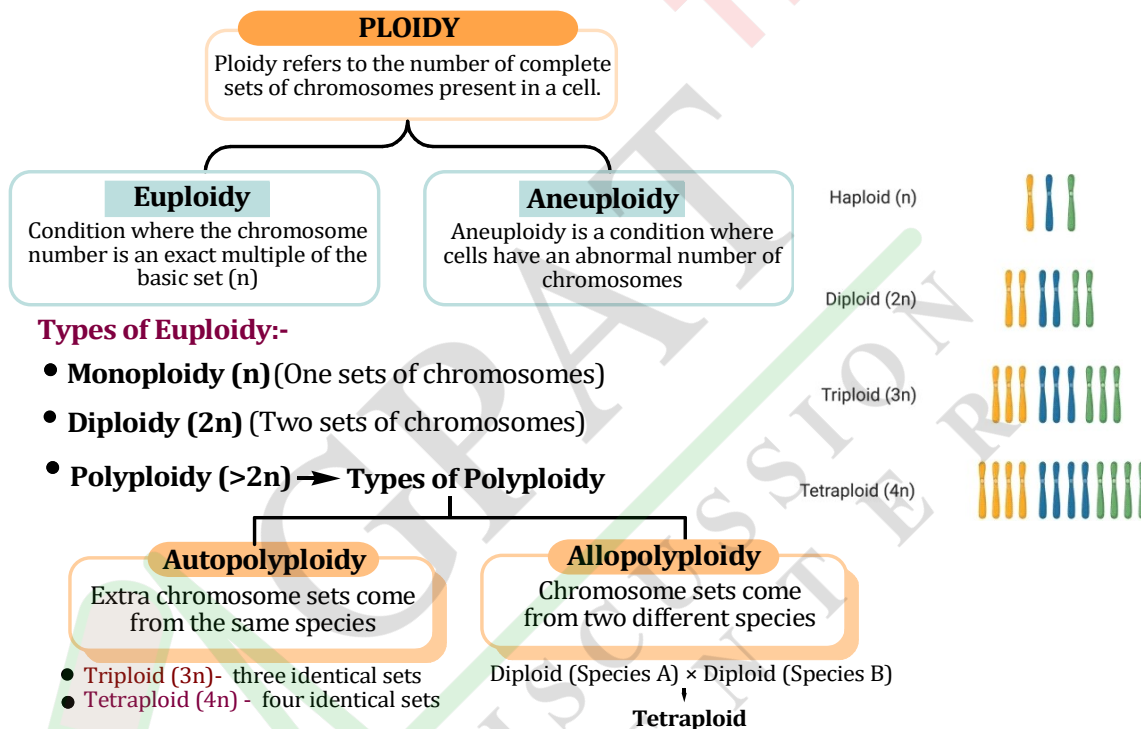
2. Allopolyploidy

- Occurs due to hybridization between two different species followed by chromosome doubling.
- Chromosome sets come from different species.
- Usually more fertile than the original hybrid.
- Examples: Wheat (*Triticum aestivum*), Cotton (*Gossypium hirsutum*), Triticale.

Example:

Species 1 (AA) × Species 2 (BB) → Hybrid (AB)

Chromosome doubling → Allopolyploid (AABB)



➤ Causes of Polyploidy

Polyploidy may be induced by the following agents:

1. Physical Agents

- X-rays
- Centrifugation
- Temperature shocks (heat or cold)

2. Chemical Agents

- Colchicine** (most important)
- Veratrine
- Sulphanilamide
- Hexachloro-cyclohexane
- Mercuric chloride

❖ Colchicine

- Colchicine, an alkaloid obtained from *Colchicum species*, is the most commonly used chemical to induce polyploidy.
- It inhibits spindle formation during mitosis, prevents chromatid separation at metaphase, and causes chromosome doubling, leading to polyploid cells.

➤ Mechanism of Action of Chemical Agents

- Chemical agents disturb the **mitotic spindle** during cell division
- Chromosomes replicate but **fail to segregate**
- This results in **chromosome doubling**
- Diploid cells (2n) are converted into **tetraploid cells (4n)**

➤ Significance of Polyploidy

- Formation of **new species**
- Increased **adaptability to different habitats**
- Enhanced **accumulation of vitamins**
- Increased **secondary metabolite production**
- Improvement in **medicinal value** of plants.
- Tetraploid (4n) forms of the following plants show increased yield of active constituents: **Lobelia, Cinchona, Belladonna, Acorus, Squill, Cannabis, Poppy**
- Polyploidy may reduce total glycoside content in: ***Digitalis purpurea, Digitalis lanata***
- Polyploidy may slightly increase **lanatosides A and B**
- Polyploidy significantly increases **tropane alkaloids**, especially in **stramonium**.

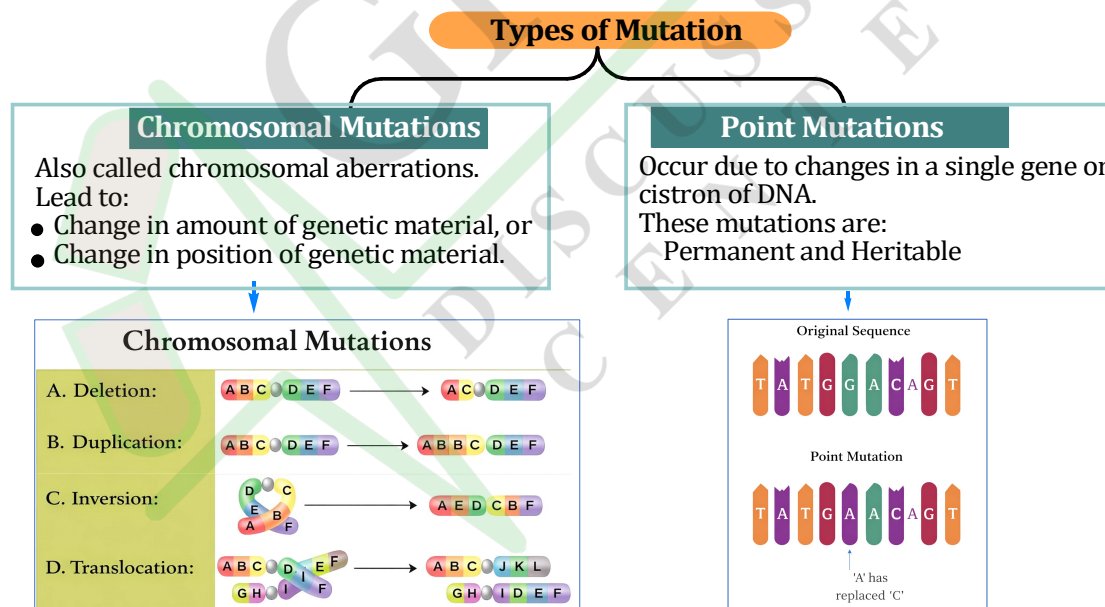
❑ Mutation

- Sudden heritable changes in **genetic material or variation in character of species**
- Mutations can also be induced by artificial means with certain reagents called **mutagens** and are called **induced mutations**.
- The various mutagens used are exposure to **UV rays, X-rays, ionizing radiations**, certain chemicals, abnormal environment etc.

○ It may be caused due to:

- ✓ Environmental changes, or
- ✓ Changes in hereditary constitution (genetic material).

➤ Types of Mutations



➤ Types of Mutations Based on Origin

1. Spontaneous Mutation	2. Induced Mutation
• Occurs due to unknown natural causes • Arises without any external influence • Occurs at a low but constant frequency	• Caused by artificial means • Produced using specific agents called mutagens • Used deliberately in research and plant breeding

➤ Mutagens Used for Induced Mutations

- A. **Physical Mutagens** - Ultraviolet (UV) rays, X-rays, Ionizing radiations, Abnormal environmental conditions.

Unit III

Quality Control of Drugs of Natural Origin (WHO Guidelines)



Syllabus

- **Quality Control of Drugs of Natural Origin (WHO Guidelines)**
- **Adulteration of drugs of natural origin.**
- **Evaluation of drugs using organoleptic, microscopic (qualitative and quantitative), physical, chemical and biological methods.**
- **Physicochemical parameters: extractive values, moisture content, foreign organic matter, ash values, bitterness value, foaming index, haemolytic potential, swelling index, viscosity, optical rotation, refractive index, acid value and saponification value.**
- **DNA barcoding.**



QUALITY CONTROL OF DRUGS OF NATURAL ORIGIN (WHO GUIDELINES)



LEARNING OBJECTIVES

After studying this chapter, the learner will be able to:

- Understand the importance of quality control of drugs of natural origin.
- Know the causes and types of adulteration and substitution of crude drugs.
- Identify various methods used for evaluation and standardization of crude drugs.
- Study organoleptic and microscopic techniques for authentication of crude drugs.
- Understand important microscopic parameters used in crude drug evaluation.
- Learn chemical tests used for the identification of phytoconstituents.
- Understand physical evaluation parameters of crude drugs.
- Study the significance of biological evaluation in assessing drug quality.
- Know the role of WHO guidelines and pharmacopoeial standards in herbal drug quality assurance.

3.1 INTRODUCTION

Quality control (QC) of natural drugs is essential to ensure the quality, safety and efficacy of the drugs. It involves a series of tests and evaluations to ensure that the raw materials, intermediates, and finished products meet the required specifications throughout the production process. These products often come from plants, animals, minerals or microorganisms, and their composition can vary significantly depending on cultivation and environmental factors, and on extraction methods.

Quality control for natural drugs is a multifaceted process that includes authenticating raw materials, ensuring purity and safety, standardizing chemical composition, conducting stability and biological testing, and complying with regulations. These steps ensure that the natural drug is safe and effective.

➤ Objectives

- To identify authentic drugs
- To detect adulteration & substitution
- To ensure uniform quality
- To maintain therapeutic efficacy
- To comply with Pharmacopoeial standards

3.2 ADULTERATION OF CRUDE DRUGS

Adulteration of crude drugs refers to the intentional or unintentional substitution, mixing, or contamination of plant, animal, or mineral-based raw materials with inferior, cheaper or harmful substances. This can significantly impact the quality and efficacy of the drug. Adulteration can occur at various stages, like collection, transportation, processing, or storage of crude drugs.

Adulteration is defined as substitution of the original crude drugs partly or fully with other substances which is either free from or inferior in therapeutic and chemical properties.

- Adulteration is a debasement of an article. The motives for intentional adulteration are normally commercial that involves incorporation of impurities, deterioration, admixture, sophistication, inferiority, spoilage and other unknown reasons.

- Adulteration involves conditions such as **substitution, sophistication, deterioration, admixture, inferiority and spoilage.**

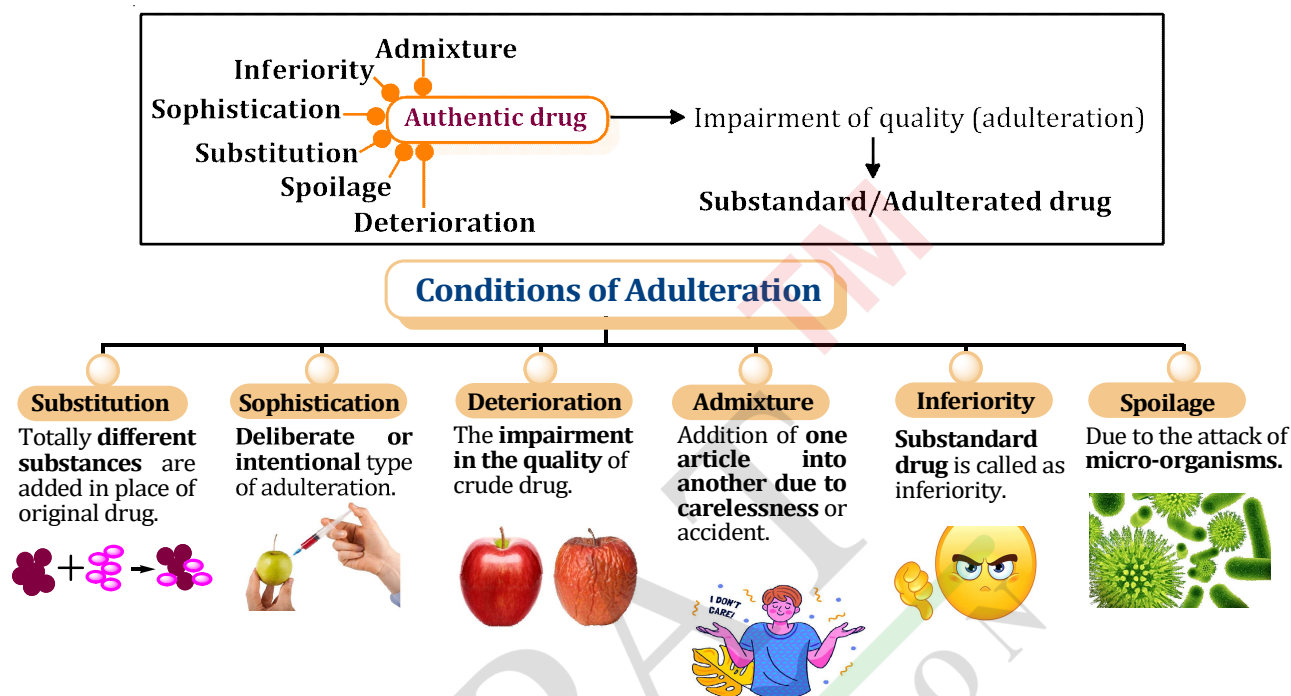


Fig. 3.1: Conditions of adulteration

Reasons of Adulteration

- Due to scarcity of crude drugs.
- Lack of knowledge about authentic sources.
- Due to high price of the crude drugs.
- To gain the high profit.
- To get more quantity.
- To fulfil the public demands.
- Confusion in vernacular names.
- Similar in morphology.
- Faulty collection.

Types of Adulteration

Adulteration can be classified into two types, Unintentional and Intentional adulteration

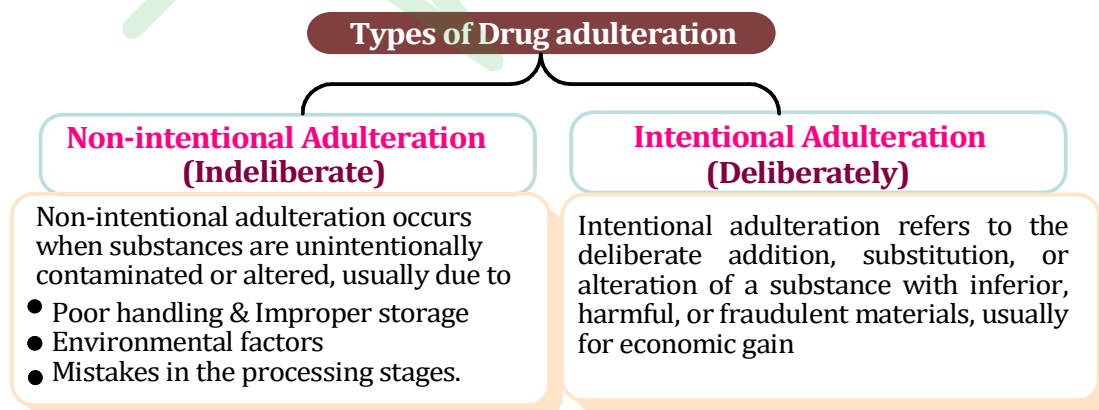
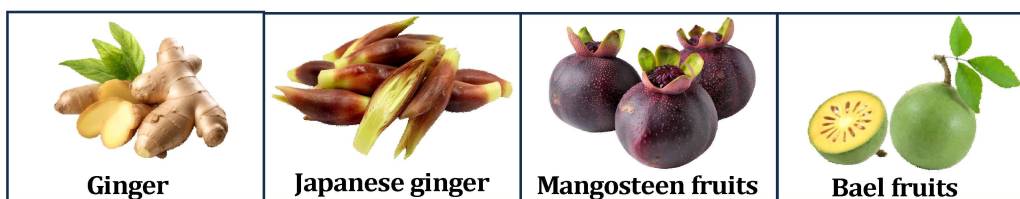


Fig. 3.2: Types of Adulteration

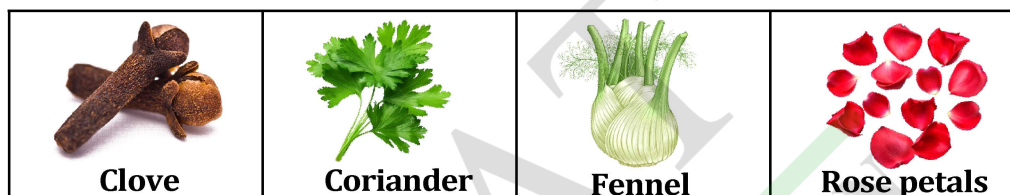


➤ **Substitution using exhausted drugs: -**

Medicinally active constituents are extracted out and these exhausted plant material is admixed with original. This technique is frequently used for the drugs containing volatile oils, such as clove, fennel etc.

Example: -

- After extraction, saffron and red rose petals are recoloured by artificial dyes.
- Cinnamic acid from Balsam of Tolu is extracted out and admixed.
- The bitterness of exhausted gentian is restored by adding aloes.



➤ **Substitution of superficially similar but inferior substances: -**

Due to morphological similarity, adulterants are substituted for the original drug, even though they may lack chemical or therapeutic value.

Example: -

- Peach kernels and apricot kernels are adulterated with almonds.
- Clove stalks and mother cloves adulterate with original cloves.
- Peach kernel oil is adulterated with olive oil.
- Chestnut leaves are adulterated with hamamelis leaves.
- Japan wax adulterated with beeswax.
- Belladonna leaves are substituted with Ailanthus leaves.
- Saffron is admixed with dried flowers of *Carthamus tinctorius*.
- Scented bdellium is used for myrrh.

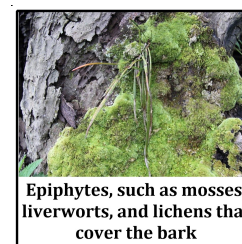


➤ **Adulteration using the vegetative part of the same plant: -**

Sometimes, unwanted materials growing along with medicinal plants get mixed with the drugs due to similarity in colour, odour, or constituents.

Example: -

- There may also be unusually high levels of epiphytes, such as mosses, liverworts, and lichens that cover the bark. e.g. cascara or cinchona.
- Excessive amount of stems in drugs like lobelia, stramonium, and hamamelis leaves etc.



➤ **Stomata**

- Stomata are **minute openings** usually found in the epidermis of the different plant organs
- These openings are surrounded with a pair of **Kidney-shaped** cells called **guard cells**.
- Guard cells are surrounded by varying number of Subsidiary cells, (epidermal cell) which are closure/ adjacent to Guard cell.
- Depending upon the type of the guard cells and arrangement of subsidiary cells, stomata are divided into four types: Moss type, Gymnospermous type, gramineous type, Dicotyledonous type.
- Dicotyledonous stomata are classified into following types depending upon the form and arrangement of subsidiary cells.

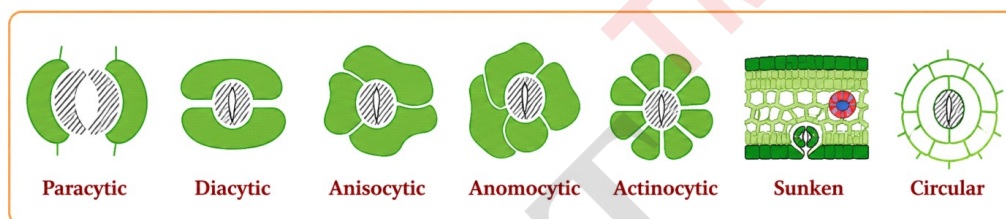


Fig. 3.4: Types of Stomata

Types of Stomata arrangements:

- Paracytic /Rubiaceous/ Parallel-celled stomata:** - These types of stomata comprise two guard cells covered by two subsidiary cells, the long axes of which are parallel to that of guard cell / stoma.
E.g. Coca and Senna leaves.
- Diacytic /Caryophyllaceous/ Cross-celled stomata:-**The guard cells are covered by two subsidiary cells, the long axes of which are at right angle to that of guard cell/ stoma.
E.g. Peppermint, Spearmint and Vasaka.
- Anisocytic/Cruciferous/ Unequal-celled stomata:** - Guard cells are covered by three subsidiary cells, out of which one is markedly smaller than the other two.
E.g. Belladonna, Datura and Stramonium.
- Anomocytic/Ranunculaceous/ Irregular-celled stomata:-** In this type, guard cells is surrounded by varying number of subsidiary cells(3-5 cells) resembling as epidermal cells.
E.g. Buchu, Digitalis and Lobelia.
- Actinocytic/Radiate celled stomata:-**The two guard cells are surrounded by a circle of radiating subsidiary cells.
e.g. *Uva ursi*
- Sunken stomata:-** Found in xerophytes, in a small pit, which **prevent loss through transpiration**
e.g. Ephedra
- Circular stomata:-** A circular pore with a hole in the middle for gas to enter or leave the plant
e.g. Colchicum, Squill

➤ **Trichomes or Plant hairs**

- Trichomes are the tubular **elongated or glandular outgrowth** of the epidermal cell.
- Trichomes are also known as **plant hairs**.
- Trichomes consist of two parts namely root (in the epidermis) and body (outside the epidermis).
- **Location:** Trichomes are present in most of the parts of the plant such as leaves upper & lower surface of epidermis (Senna and Digitalis), seeds (Nux vomica and Strophanthus), fruits (*Helicteris isora* and *Lady finger*),etc.
- **Function:** Trichomes are as such functionless, but sometimes, perform secretory function. The trichomes excrete water and at times, volatile oil as in case of peppermint. Trichomes are present in most of the aerial parts of the plant, but are not present on roots.

- **Standardization** is the process of prescribing a set of standards or inherent characteristics, constant parameters, definitive qualitative and quantitative values that carry an assurance of Quality, efficacy, safety and reproducibility.
 - Specific standards are worked out by experimentation and observations, which would lead to the process of prescribing a set of characteristics exhibited by a particular herbal medicine.
 - Hence standardization is an important tool in the quality control process.
- ❖ **Typical monograph for Herbal drugs as per WHO guidelines:**

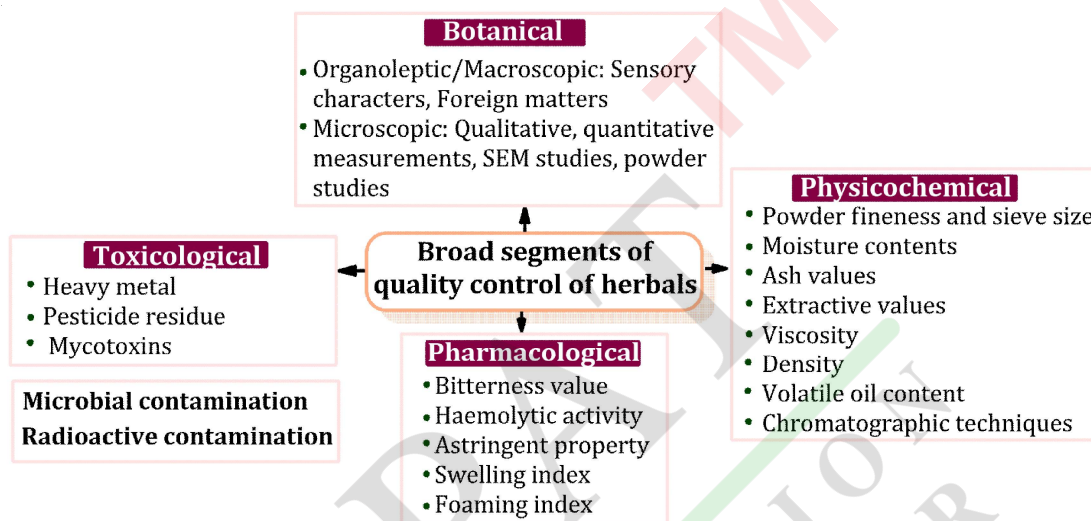


Fig 3.11: - Typical monograph for Herbal drugs as per WHO guidelines

- ❑ **Botanical** - Herbal ingredients must be authenticated by proper identification of their botanical source using the correct Latin binomial name.

Accurate identification of herbal material by macroscopic and microscopic examination by comparison with authentic material or descriptions of authentic herbs is the first important step.

- **Sensory evaluation** - Visual inspection in terms of shape, size, surface characteristics, colour, consistency, odour, taste, fracture and appearance of the cut surface of the drug provide the simplest and quickest means to establish its identity, purity and even quality.
- **Foreign matter** - Herbal materials should be entirely free from visible signs of contamination by moulds or insects and other contaminants including animal excreta. No abnormal odour, discolouration, slime or signs of deterioration should be detected.
- **Microscopic evaluation** - Establishment of identity of powdered drugs depends on the microscopic recognition of characteristic cell types and cell contents. Prior to microscopic examination the sample should be treated with chemical reagents.

Table 3.19: - Microscopic evaluation of herbal drug

PLANT PART	CHEMICAL REAGENTS	INFERENCE
Cellulose cell wall	Iodinated $\text{ZnCl}_2 + \text{I}_2 + \text{H}_2\text{SO}_4$	Blue stain
Lignified cell wall	Phloroglucinol + HCl	Red colour
Cuticular cell wall	Sudan red	Red colour
Aleurone grains	Ethanol + I_2	Brown colour
Ca- Oxalate	T.S. + Acetic acid T.S. + HCl	- Insoluble - Soluble without effervescence

- ❑ **Physicochemical** - Physicochemical evaluation involves quantitative determination of physical and chemical parameters of crude drugs to ensure Identity, purity, and quality.

It helps detect: Adulteration, Substitution, and Improper processing.

12. The fluorescence shown by emetine is:
 (a) Pink (b) Blue (c) Orange (d) Green
13. Diacytic or caryophyllaceous or cross celled stomata is present in
 (a) Vasaka (b) Spearmint
 (c) Peppermint (d) All of these
14. The microscopical examination of crude drugs involves
 (a) Determination of the size of different cells and tissues
 (b) Determination of the shape of different cells and tissues
 (c) Determination of the relative positions of different cells and tissues
 (d) All of these
15. Which type of trichome is present in *Calendula officinalis*
 (a) Unbranched triseriate
 (b) Unbranched biseriate
 (c) Unbranched uniseriate
 (d) None of the above
16. 1 milligram of powdered *Lycopodium* contains on an average
 (a) 95000 spores (b) 94000 spores
 (c) 10000 spores (d) 99000 spores
17. Foam test is specifically used for identification of
 (a) Tannins. (b) Saponins
 (c) Alkaloids (d) Glycosides
18. Identify the mismatched pair
 (a) Saponin - Hemolytic index
 (b) Tannins - Astringents
 (c) Cascara - Bitterness index
 (d) Plantago - Swelling index
19. One of the following is an example of chemical method of evaluation
 (a) Determination of volatile oil
 (b) Determination of refractive index
 (c) Detection of alkaloids
 (d) Determination of vascular bundles
20. Hydathode are the most important microscopical characters of the plant known as
 (a) *Piper betel* (b) *Digitalis*
 (c) *Ouabain* (d) *Senna*
21. Organoleptic evaluation is also called
 (a) Biological evaluation (b) Sensory evaluation
 (c) Chemical evaluation (d) Physical evaluation
22. Standards applicable to volatile and fixed Oils
 (a) Refractive index (b) Optical rotation
 (c) Chiral purity (d) All of these
23. Which reagent is commonly used for detection of starch in tissues?
 (a) Sudan red (b) Ferric chloride
 (c) Iodine (d) Ruthenium red
24. Sunken stomata are present in
 (a) *Coca* (b) *Ephedra*
 (c) *Senna* (d) *Belladonna*
25. Circular stomata are seen in
 (a) *Colchicum* (b) *Senna*
 (c) *Datura* (d) *Coca*
26. Find the incorrectly matched pair from the following
 (a) Frohde's reagent - Test for *Ipecac* alkaloids
 (b) Keller-Kiliani test - Cardiac glycosides
 (c) Halphen's test - Detects sesame oil
 (d) Murexide test - Detects purine bases
27. Which of the following is used for evaluation of powdered drugs containing starch grains?
 (a) Fluorescence analysis
 (b) *Lycopodium* spore method
 (c) Biological assay
 (d) Extractive value determination
28. Stellate trichomes occur in:
 (a) *Hamamelis* (b) *Cannabis*
 (c) *Calendula* (d) *Belladonna*
29. The bitterness value is determined organoleptically by comparison with a _____ solution which acts as the standard
 (a) *Bogbean* leaf & *Centaury*
 (b) *Gentian* and *Wormwood*
 (c) *Quinine* hydrochloride
 (d) *Quinidine* hydrochloride

Unit IV

PART-I

Introduction to Metabolite of Plant Origin



Syllabus

- Introduction to Metabolites of Plant Origin
- Definition and general properties of plant metabolites and secondary metabolites.
- Primary and secondary metabolites such as carbohydrates, proteins, lipids, alkaloids, glycosides, flavonoids, tannins, terpenoids, volatile oils and resins.

4.1.1 Types of Metabolites, Definition and General Properties

➤ Primary metabolites

Primary metabolites are the compounds that are directly involved in the metabolic pathways of an organism necessary for its growth, development, and reproduction.

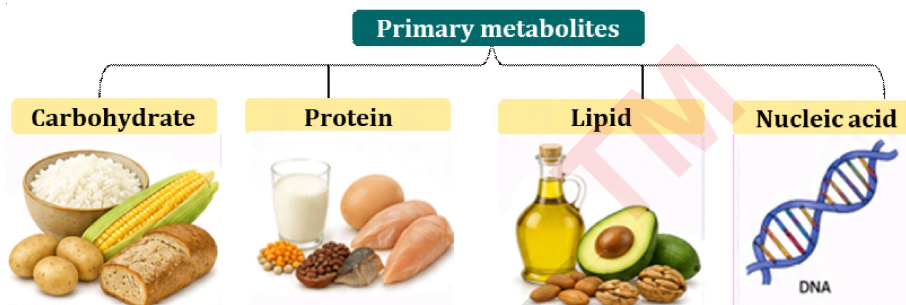


Fig 4.1.2: - Example of Primary metabolite

Characteristics of Primary metabolite:

- These metabolites are associated with the physiological processes occurring in the organism.
- Primary metabolites are produced in the organism during the growth phase, as a result of the growth mechanism.
- The production of primary metabolites is initiated when the nutrients necessary for the body are available in the medium.
- These are found in most cells throughout the body and are also termed central metabolites.
- Primary metabolites are crucial for various metabolic activities as some act as a substrate for these processes, while others act as catalysts.
- Some primary metabolites like amino acids are common throughout the organisms, whereas some are restricted to some cells or some organisms.
- Even though primary metabolites play an essential role in the growth and development of an individual, these do not have pharmacological actions or effects against other factors.
- The production of primary metabolites usually occurs at a high rate as these are constantly required for the body. These can also be extracted easily through simple extraction procedures.
- Primary metabolites are divided into two groups; primary essential metabolites and primary metabolic end products.
- Primary essential metabolites include compounds like proteins and carbohydrates that make up the structural and physiological organization of the organism. In contrast, primary metabolic end products include products like lactic acid and ethanol that are the end products of various metabolic pathways.

➤ Secondary metabolites

Secondary metabolites (or specialized metabolites) are organic compounds produced by organisms that are not essential for basic growth, development, or reproduction. Instead, they play crucial ecological roles such as defending against predators, attracting pollinators, and surviving environmental stress and are widely used by humans for medicine, agriculture, and industry.

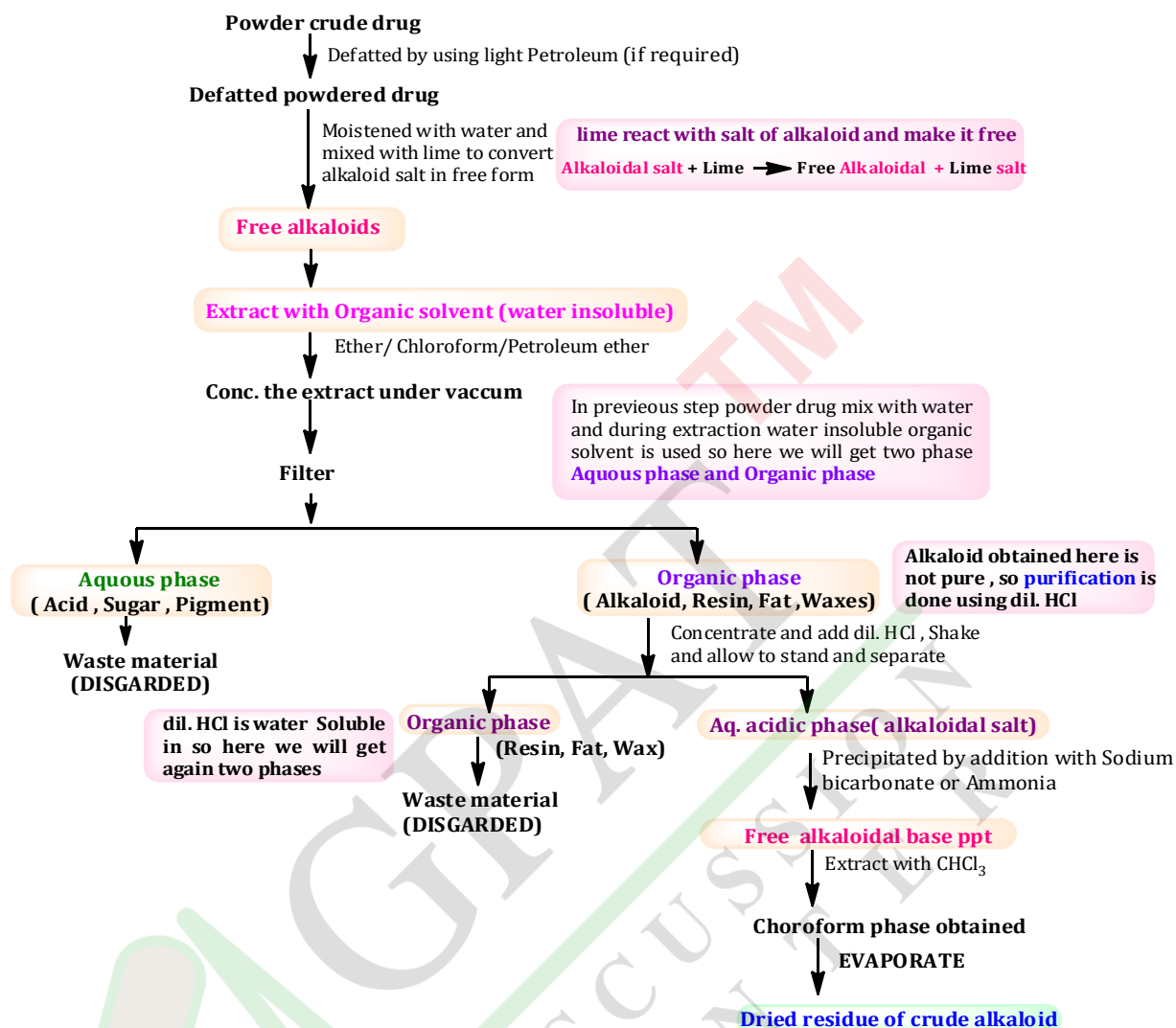


Fig 4.1.6: - Isolation and extraction of alkaloids

➤ **Classification of alkaloids: -**○ **Based on origin:**

1. **True alkaloids** - Nitrogen in heterocyclic ring and originate from amino acid eg - Atropine, Morphine, Nicotine
2. **Proto alkaloids (Amino alkaloids)** - Contains nitrogen but not in ring system and originate from amino acid eg - Mescaline, Ephedrine, Colchicine.
3. **Pseudo alkaloids** - Do not originate from amino acid eg - Purine alkaloids, Terpenes & Steroid like alkaloids.

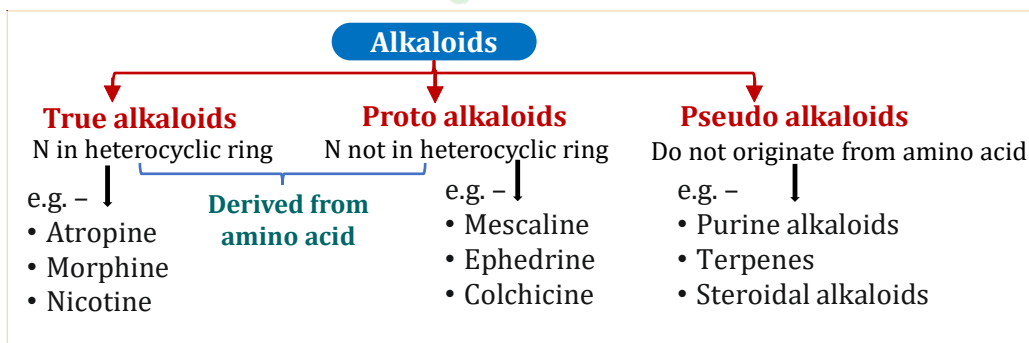


Fig 4.1.7: - Classification of alkaloids

➤ Therapeutic effects of Terpenoids

Terpenoids are present in all types of volatile oils so the therapeutic effects possess by the terpenoids similar as the volatile oils. Terpenoids are used in cosmetics, perfumes, soaps, and in foods also.

❑ VOLATILE OIL

Definition: The term "Volatile oils" refers to the pungent components found in both plant and animal sources. They are also referred to as "Ethereal oils" since they evaporate when exposed to air at room temperature. They are also referred to as "Essential oils" since they reflect the essence or active component of a plant or animal.

- ✓ Volatile oils are primarily composed of terpenes (i.e. Mono /Sesquiterpene) and their oxygenated derivatives (Terpenoids).
- ✓ They can also include a blend of eleoptenes (the more volatile components) and stearoptens (the more solid components).

➤ General properties of Volatile oil

- Lighter, less viscous, optically active with a specific optical rotation value.
- High refractive index.
- They evaporate at room temperature and do not leave any permanent spot on paper
- Partially soluble in H_2O and soluble in organic solvent like ether, $CHCl_3$, ethanol etc.
- The odour and taste of the oils is due to the oxygenated terpenoids.
- They are secreted in special structure → Schizogenous or lysigenous glands and trichomes etc.
- The specific gravity of volatile oils is less than 1 and are lighter than water.
- **Examples: Peppermint oil, Fennel oil, Coriander oil, Lemmon grass oil, Eucalyptus oil etc.**

Exceptions- Few volatile oils have specific gravity is more than one. Such as Volatile oils are commonly found in Labiatae, Rutaceae, Piperaceae, Zingiberaceae, Umbelliferae, Myrtaceae, Lauraceae.



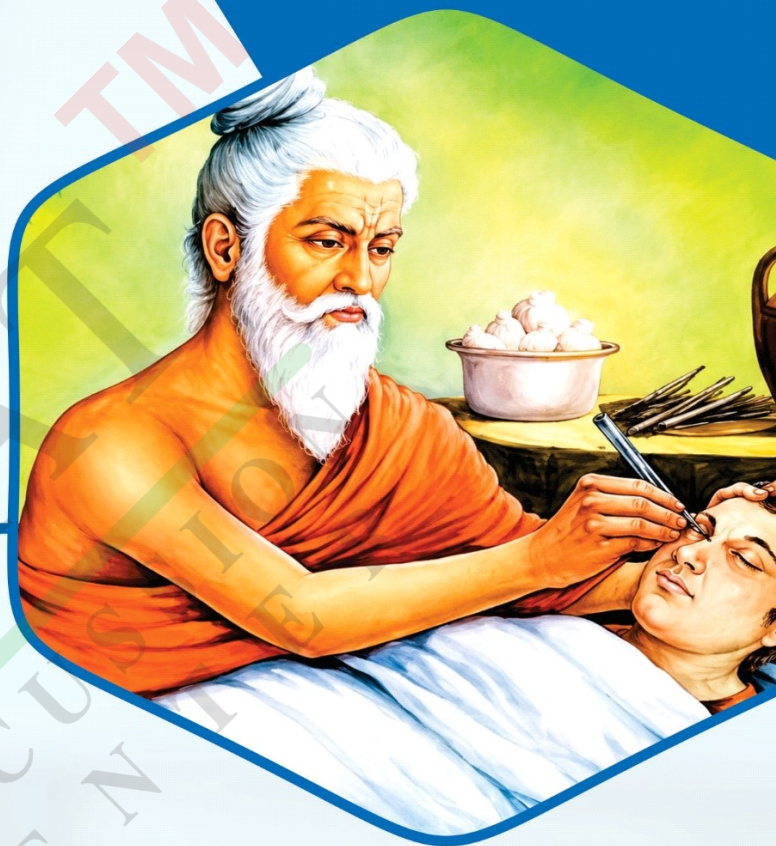
➤ Isolation of Volatile oil

Volatile oils are extracted by **steam-distillation, solvent extraction or mechanical means** such as **Ecuelle and Effleurage techniques-**

- **Hydro-distillation method** (for leaf drugs) –The fresh material is subjected to hydro-distillation use for the leaf drugs. Drugs are extracted by steam distillation.
- **Effleurage method** (for fresh flower petals) is used for extraction of delicate perfumes. The fresh flower petals are spread over the layer of fatty material, allowing for imbibing. then exhausted petals are replaced by fresh material.
- **Ecuelle method** (for citrus oils) is used for extraction of citrus oils, wherein oil cells in rind are ruptured mechanically using pointed projections.
- **Liquid carbon dioxide** Liquefied under pressure, it acts as a solvent reserving back to gaseous nature when pressure is reduced leaving no residue of solvent.

Unit
IV
PART-II

Traditional Systems of Medicine



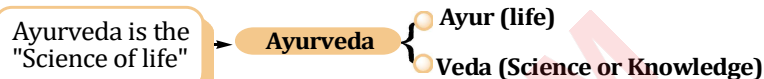
Syllabus

- **Traditional Systems of Medicine**
- **Basic principles of treatment of diseases in different systems of medicine including AYUSH and TCM.**
- **Types of dosage forms in AYUSH medicines.**
- **Role of pharmacognosy in allopathy and traditional systems of medicine such as AYUSH and TCM.**

4.2.1 Basic Principles of Treatment in Various Systems of Medicine

□ Ayurveda System of Medicine

- The word Ayurveda is derived from two Sanskrit words: "Ayur," meaning 'life,' and "Veda," meaning 'science' or 'knowledge.' Hence, Ayurveda is known as the "science of life."
- The Ayurvedic system of medicine began in the **Vedic era**, which was approximately 5000 years ago.



- Ayurveda is considered an Upaveda of the Atharva Veda. Rig Veda is the oldest literary document that presents the knowledge about medicinal herbs.
- Dhanvantari**- Divine founder of Ayurveda also known as Father of Ayurveda
- Charaka** - Principal exponent of Ayurveda.

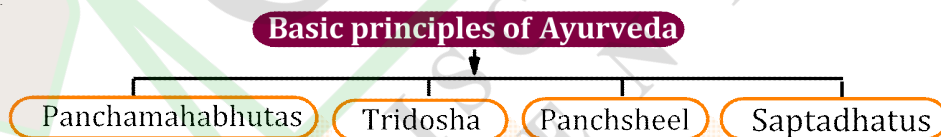
Important book with the concept of practice of Ayurveda are:-

- Charaka Samhita is considered one of the earliest and most important Ayurvedic texts describing the principles and practice of Ayurveda. It contains detailed information on medicinal plants and plant-based products used for therapeutic purposes.
- Sushruta Samhita mainly focuses on surgery and surgical procedures. It describes around 395 medicinal plants, 57 drugs of animal origin, and 4 minerals and metals used as therapeutic agents.

Objectives - The main objective of Ayurveda is the maintenance and promotion of positive health and the cure of disease through medicine, dietary restrictions, and a regulated lifestyle.

Basic Principles of Ayurveda -

Ayurveda is based on the following principles: -



○ Panchmahabhutas

According to ancient Indian philosophy, the universe is composed of five basic elements or panchabhutas: prithvi (earth), jal (water), teja (fire), vayu (air) and akash (space).

Everything in the universe, including food and the bodies were derived from these bhutas.



- They represent forms of energy and correspond to the five senses - hearing, touch, vision, taste, and smell, each linked to a specific sense organ.

Table 4.2.1: - Panchmahabhutas linked to a specific sense organ

BHUTA	BODY SENSE	SENSE ORGAN
Ether (Space /Akash)	Hearing	Ear
Air (Vayu)	Touch	Skin
Fire (Teja/Energy)	Vision	Eyes
Water (Jala/Liquid)	Taste	Tongue
Earth (Prithvi/Solid)	Smell	Nose

4.2.2 Types of Dosage Forms in Ayush Medicines

❖ Ayurvedic Dosage Form

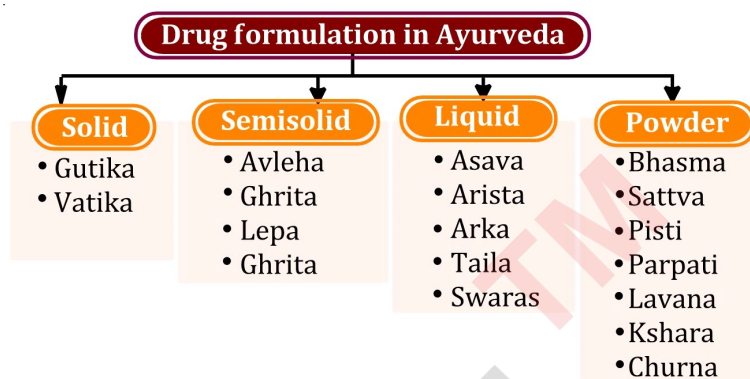


Fig 4.2.7: - Ayurvedic dosage form

➤ Arista

- The crude drugs are powdered and its **decoction (kashaya)** is prepared. The **decoction is filtered and transferred to fermentation vessel**. Sugar or jaggery as required is added to the vessel and boiled
- Preparation containing self generated alcohol (Alcoholic preparation)
Eg- Dasmularista, Asvagandha arista, Ashoka arista.

○ Method of Preparation for Arista

- The drugs are coarsely powdered and kasaya is prepared.
- The kasaya is strained and kept in the fermentation pot, vessel or barrel. Sugar, jaggery or honey, according to the formula, is dissolved, boiled, filtered and added.
- Drugs mentioned as praksepa dravyas are finely powdered and added.



Fig 4.2.8: - Method of Preparation for Arista

- At the end, dhataki puspa, if included in the formula, should be properly cleaned and added.
- The mouth of the pot, vessel, or barrel is covered with an earthen lid, and the edges are sealed with clay-smeared cloth wrapped in seven consecutive layers.
- The container is kept either in a special room, in an underground cellar or in a heap of paddy to ensure a constant temperature is maintained during fermentation, since varying temperatures may impede or accelerate the fermentation.
- After the specified period, the lid is removed, and the contents examined to ascertain whether the process of fermentation (sandhana) has been completed.
- The fluid is first decanted and then strained after two or three days. When the fine suspended particles settle down, it is strained again and bottled.



Short Answer Questions

1. Define Ayurveda and mention its objectives.
2. Write a short note on Panchmahabhutas.
3. Define Tridosha with examples.
4. What is Panchsheel in Ayurveda?
5. Explain Ashta Sthana Pariksha.
6. Write a note on Siddha system of medicine.
7. Explain the role of Vatham in Siddha medicine.
8. Define Homeopathy and write its basic principle.
9. What is potentization in Homeopathy?
10. Define mother tincture.
11. Explain the Hippocratic theory of four humours.
12. Write a short note on Ilaj-bit-Dawa.
13. Explain Yin and Yang theory.
14. Define Qi in Chinese medicine.
15. Write a note on Arista dosage form.
16. Explain the preparation of Avaleha.
17. Define Bhasma and mention its methods of preparation.
18. What are medicated globules?
19. Write a note on Arka dosage form.
20. Explain the role of Pharmacognosy in allopathy.

Long Answer Questions

1. Explain the basic principles of Ayurveda with suitable diagrams.
2. Describe Panchmahabhutas, Tridosha, Saptadhatu, and Panchsheel in detail.
3. Discuss diagnosis and treatment methods in Ayurveda.
4. Explain the Siddha system of medicine and its Tridosha theory.
5. Describe the fundamental principles of Homeopathy in detail.
6. Explain the Unani system of medicine with its principles and methods of treatment.
7. Describe the Chinese system of medicine with special reference to Yin-Yang theory.
8. Explain in detail the preparation methods and characteristics of Ayurvedic dosage forms such as Arista, Asava, Avaleha, and Arka.
9. Discuss the preparation of Bhasma with detailed explanation of Shodhana and Marana processes.
10. Explain the role of Pharmacognosy in Ayurveda, Siddha, Homeopathy, Unani, and Allopathy.

Unit V

Phyto- Therapeutic Agents



Syllabus

- **Phyto-therapeutic Agents**
- **Adaptogens and Immunomodulators:** Ashwagandha,
- **Tulsi, AmlaHepatoprotectives:** Milk thistle, Kutki
- **Cardiovascular drugs:** Garlic, Arjuna and **Antidiabetics:** Gymnema, Fenugreek
- **Anti-inflammatory and analgesics:** Turmeric, Boswellia
- **CNS drugs:** Brahmi and **Antimicrobial and antivirals:** Giloy, Neem,
- **Andrographis Gastrointestinal drugs:** Psyllium
- **Dermatological agents:** Aloe and **Drugs used in women's health:** Chasteberry, Shatavari
- **Respiratory drugs:** Vasaka



PHYTO-THERAPEUTIC AGENTS



LEARNING OBJECTIVES

After studying this chapter, the learner will be able to:

- Understand the concept, classification, and importance of Phyto-therapeutic agents in healthcare.
- Know the advantages, disadvantages, and applications of Phyto-therapeutic agents.
- Understand the concepts of adaptogens, immunomodulators, hepatoprotectives, cardiovascular drugs, antidiabetics, anti-inflammatory agents, CNS drugs, and antimicrobial agents.
- Study the biological source, family, chemical constituents, and uses of important Phyto-therapeutic plants.
- Learn the therapeutic importance of Ashwagandha, Tulsi, Amla, Milk Thistle, Kutki, Garlic, Arjuna, Gymnema, Fenugreek, Turmeric, Boswellia, Brahmi, Giloy, Neem, and Andrographis.
- Understand the role of medicinal plants in the prevention and treatment of various diseases.
- Know the Pharmacological activities and health benefits of important herbal drugs.
- Appreciate the significance of Phyto-therapeutic agents in traditional and modern systems of medicine.

5.1 INTRODUCTION

Phyto-therapeutic agents are medicinal substances obtained from plants and used for the prevention, treatment, or cure of diseases. These agents contain biologically active constituents known as phytochemicals.

The term:

- Phyto = Plant
- Therapeutic = Healing or treatment

Thus, Phyto-therapeutic agents are plant-based therapeutic substances used in healthcare.

These agents contain biologically active constituents known as **phytochemicals** such as carbohydrates, alkaloids, glycosides, flavonoids, tannins, terpenoids, volatile oils, and resins.

Phyto-therapeutic agents, also known as phytomedicines, are plant-derived medicinal products used to treat or prevent health conditions through bioactive compounds from herbs or extracts. They form the basis of phytotherapy, an ancient practice now integrated into modern healthcare for its multi-substance synergy effects.

Phyto-therapeutic agents consist of medicinal plants, their parts, or standardized extracts containing secondary metabolites like carbohydrates, flavonoids, alkaloids, essential oils, tannins, glycosides,



- It acts as an antioxidant and protects liver cells from damage. It also stabilizes cell membranes and helps in protein synthesis.

B. Other Uses

- Traditionally, it is used as a galactagogue, bitter tonic, and for treating jaundice and bronchitis.
- In clinical studies flavonolignans have shown anticancer properties.

❑ Kutaki

Synonyms: Indian gentian, Picrorrhiza

Biological source: Kutaki consists of dried rhizomes of the *Picrorrhiza kurroa*.

Family: Scrophulariaceae

It contains not less than 5.0 per cent of Kutkin on dried basis.

Geographical Source

- Picrorrhiza is a perennial herb mainly found in the upper Himalayan region Himalayas (3000–5000) and China.
- In India, it grows naturally in Kashmir and Sikkim.
- It is also found in Punjab, Uttar Pradesh, and Himachal Pradesh.

Cultivation and Collection

These can grow well at higher altitudes in temperate or tropical climate. Partial shady areas are good for the growth of crop.

It can be cultivated at;

- Altitude** - 1800 to 2700 metres, and also at higher altitude in Himalayas (2700–4500 metres).
- Temperature** - ranging from 25° to 35°C is suitable.
- Soil** - These can be grown on variety of soil, though sandy loam soil with rich organic content and high moisture content are suitable for its cultivation. But, soil should not be water-logging.

Cultivation

- Rhizomes and seeds can be used to spread it.
- Sowing takes place in November and December at lower elevations and in April and May at higher elevations.
- The crop lasts for a total of two years.
- In order to properly pulverize the soil for Kutki agriculture, the area must be harrowed and plowed. The field is leveled and supplied with farmyard manure.
- A mixture of soil, farmyard manure, and sand is used to raise nursery beds.
- Healthy seeds are gathered and sown in May at a higher altitude and in November and December at a lower altitude.
- The plantation is completed in the spring at higher altitudes, while the seedlings are moved over the winter at lower altitudes.

Macroscopic Characters:

CHARACTER	DESCRIPTION
Colour	Rhizomes are deep greyish-brown in colour, externally white, blackish internally with whitish wood.
Odour	Slight and unpleasant.
Taste	Bitter.



Chemical constituents:

It has been discovered that neem has a variety of compounds that could be used to control pests. A substantial portion of the compounds that were separated from the plant are diterpenes.

(a) Leaves

- Azadirachtin - Insect repellent
- Meliantriol, Salanin - Anti-feedant

(b) Seeds

- Nimbin, Nimbidin - Antiviral action
- Azadirachtin - Insect repellent

(c) Flowers: Nimbosterol, Myricitin, Kaempferol – Insecticidal

(d) Fruits: Deacetyl azadirachtinol - Paralyzes insects swallowing mechanisms

(e) Bark:

- Nimbin, Nimbinin, Nimbidin – Antiviral
- Margolone, Margolonone - Antibacterial

(f) Roots: Excellent for reforestation.

The neem oil contains bitters (2%), which are sulphur containing compounds (Nimbin, Nimbidin, Nimbinin and Nimbidol).

Uses:

Possesses antimicrobial properties.

- Used as a bitter tonic to stimulate appetite and digestion.
- Acts as an astringent.
- Exhibits anthelmintic activity against intestinal worms.
- Employed in the treatment of leprosy.
- Used as an insect repellent.
- Shows antifeedant activity against insects and pests.
- Possesses spermicidal activity.
- Beneficial in the management of malarial fever.

□ Andrographis

Synonyms: Andrographis, Kirayat, Bhui-nimb, Bengal Chirata

Biological source: Kalmegh consists of dried leaves and tender shoots of the plant known as *Andrographis paniculata*

Family: Acanthaceae

Geographical Source:

- Kalmegh is an annual herb found in Sri Lanka and throughout India, specifically in Maharashtra, Karnataka, Uttar Pradesh, Tamil Nadu, Andhra Pradesh and Madhya Pradesh.

Cultivation and Collection: It is cultivated to some extent in Assam and West Bengal. It flowers in the months of September to December and is collected from November to December

Morphological characteristics:

5.10 DERMATOLOGICAL AGENTS

Dermatological agents are substances used for the treatment and care of skin disorders such as burns, wounds, infections, dryness, and inflammation. Herbal dermatological agents are widely used because they promote healing naturally with fewer side effects.

Aloe is one of the most important herbal dermatological agents used in traditional and modern medicine.

□ Aloe

Synonyms – Ghritkumari, Musabbar

Biological source - Aloes is obtained from the dried juice of leaves of aloe species.

- *Aloe barbadensis* (Curacao aloe)
- *Aloe ferox*, *Aloe spicata* (Cape aloe)
- *Aloe perryi* (Socotrine aloe & Zanzibar aloe)
- *Aloe vera* (Indian aloe)



Fig 5.3 : Varieties of Aloe

Family - Liliaceae

Description -

VERITIES	FORM	COLOUR	FRACTURE
Curacao	Opaque masses	Yellow brown to chocolate brown	Waxy like
Cape	Transparent and glassy	Dark brown to greenish brown	Smooth and glassy
Socotrine	Opaque	Brownish yellow	Conchoidal
Zanzibar	Opaque	Liver brown colour	Smooth and even fracture

Microscopy -

Microscopic Characteristics of Aloe Leaf

- T.S. of leaf shows outermost cuticle followed by epidermis, palisade cells mucilaginous parenchyma
- Mesophyll encloses vascular bundles which are covered with pericyclic layer.
- Inside the pericycle few large elongated thin walled aloetic cells are located.
- Aloe juice present in Pericycle fibre.
- Aloe gel present in Mucilaginous cells.
- Calcium oxalate crystals are present in parenchyma.

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