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INTRODUCTION TO PHARMACOGNOSY

(STRICTLY ACCORDING TO SYLLABUS APPROVED BY PCI FOR B.PHARM COURSE)

For B.PHARM
Ist Sem

SHREE SAI PRAKASHAN

UNIT I

Fundamentals of Pharmacognosy

Pharmacognosy-It is a branch of Science dealing with crude drugs obtained from natural sources. In a broad sense, Pharmacognosy deals with the history, distribution, cultivation, collection, preparation, identification, evaluation, preservation and uses of crude drugs and their derivatives obtained mainly from Plants and animals.

The word 'Pharmacognosy' derived from two Greek words- 'Pharmacon' means a drug and 'Gignosco' means to acquire knowledge.

The word 'Pharmacognosy' was first coined by a German scientist "C.A. Seydler" in 1815 in the title of his work "Analecta Pharmacognostica".

History of Pharmacognosy

Divided in four parts-

1. Primitive era- Pharmacognosy has been developed from ancient civilization who used parts of plants and animals for healing, eliminate pain, control suffering and to treat diseases. The primitive man tried to understand the rationale behind use of the crude drugs and transfer his knowledge by mouth and later on by carving on to stones and clays and then writing on parchment or paper.

2. Pre-Christian era- Chinese medicine is the oldest system of this era. Ayurveda also described uses of medicinal plants and Charak samhita & Susruta samhita were compiled during this phase. Papyrus ebers of Egypt described about 700 medicinal plants and Theophrastus is known for his work on plant kingdom of this era.

3. Era after Christ- Dioscoroides a Greek Physician, described a variety of medicinal plants in his manuscript "De Materia Medica" in 78 AD. Many scientists work like Galen, Parcelsus, Willium Turner, Le-Mary & Willium Withering is still known for their contribution in development of Pharmacognosy. Dersone isolated Narcotine and Serturner isolated Morphine from Opium.

4. Modern Pharmacognosy- Starting from 1815, there was rapid growth and development in subject of Pharmacognosy along with growth of other subjects and development of modern techniques for plant drugs. During this era Penicillin and Streptomycin antibiotic was isolated. A number of plant drugs were also identified

as potential curative agents for many serious diseases. For example- Vinca alkaloids Vincristine and Vinblastine as anticancer, Reserpine as antihypertensive, Digitoxan and Digoxin as cardiotonic and many more.

Scope of Pharmacognosy

1. Pharmacognosy is critical in development of different disciplines of science. The knowledge of plant taxonomy, plant breeding, plant pathology and plant genetics is helpful in the development of cultivation technology for medicinal and aromatic plants.

2. Pharmacognosy is important branch of pharmacy which is playing key role in new drug discovery and development by using natural products.

3. Pharmacognosy is an important link between pharmacology and medicinal chemistry.

4. By means of Pharmacognosy, natural products can be dispensed, formulated and manufactured in dosage forms acceptable to modern system of medicine.

5. Development of Pharmacognosy also leads to development of botany, taxonomy, plant biotechnology, plant genetics, plant Pathology, Pharmaceutics, Pharmacology, Phytochemistry and other branches of science.

Sources of Drugs

Plants- 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 etc. For example leaves of Digitalis purpurea are the source of Digitoxin and Digoxin, which are cardiac glycosides.

Animals-Pancreas is a source of Insulin, used in treatment of Diabetes. Sheep thyroid is a source of thyroxin, used in hypertension. Cod liver is used as a source of vitamin A and D. Blood of animals is used in preparation of vaccines. Cochineal (dried full grown female insects) consists of carminic acid used as colouring agent for foods, drugs and for cosmetic products.

Plant Tissue Culture-It is in-vitro cultivation of plant cell or tissue under aseptic and controlled environmental conditions, in liquid or on semisolid well-defined nutrient medium for the production of primary and secondary metabolites or to regenerate plant. This technique affords alternative solution to problems arising due to current rate of extinction and decimation of flora and ecosystem. Applications are Production of Phytopharmaceuticals, Biochemical Conversions

Clonal Propagation (Micro-propagation), Production of Immobilized Plant Cell and Sources of drugs of natural origin.

Sources of drugs continued..

Marine Sources-The greater part of the earth surface is covered by seas and ocean, which contains about 5,00,000 species of marine organisms. Many of these compounds have shown pronounced biological activity. In the western medicine agar, alginic acid, carrageenan, protamine sulphate, spermaceti & cod and halibut liver oils are the established marine medicinal products. Macroalgae or seaweeds have been used as crude drugs in the treatment of iodine deficiency states such as goiter, etc. Various examples are-

1. **Anticancer drug**-Bryostatins, Dolastatins, Ara-C
2. **Anti-inflammatory drugs**-Pseudoterosins, bi-indole, Manoalide
3. **Cardio-vascular drugs**-Anthopleurins, Laminine, Saxitoxin
4. **Anthelmintic drugs**-Kainic acid, Domoic acid
5. **Antimicrobial drugs**-Cephalosporin, Istamycin, Nitenin

Crude Drug and its Types

Crude drugs- It means the natural substances from vegetable and animal sources that have undergone no any processing other than collection and drying. These are also called as Simples or Simple drug. These are of two types-

Organized Drugs (Cellular drugs)	Unorganized Drugs (Acellular drug)
1. These are organs of plants or animals and are made up of cells or definite structure. Examples- Flower,fruit,seed, leaf, root, stem etc. 2. Solid in nature and studied and identified by structural features. 3. Examples- Leaf- Digitalis, Root- Ruwolfia, Stem- Ephedra, Fruit- Fennel, Flower- Clove	1. These are derived from parts of plant or animal by some process of extraction and followed by purification, if necessary. Examples- Extracts, juices, lattices, gums, mucilage, resin etc. 2. Solid/ Semi solid/ liquid in nature and can be studied oridentified by Chemical and physical parameters 3. Examples- Extracts- Agar, Juices- Aloe, Lattices- Opium, Gum- Acacia, Mucilage- Isabgol

(c) Historical milestones in drug discovery: Morphine, quinine, aspirin, warfarin, Penicillin, cephalosporin, taxol and artemisinin.

1. Morphine : Isolated in **1804** by German pharmacist's apprentice **Friedrich Serturner** from raw opium poppy juice (*Papaver somniferum*). He named it

morphium after Morpheus, the Greek god of dreams. This marked the absolute dawn of **alkaloid chemistry,** proving for the first time that specific crystalline organic chemicals—rather than vague vital forces—responsible for plant-based therapies.

Mechanism of Action : Morphine acts as a potent agonist primarily at the **opioid receptors** in the central nervous system (CNS). It mimics endogenous endorphins, binding to the G-protein coupled receptors (GPCRs). This inhibits adenylate cyclase, closes voltage-gated calcium channels, opens potassium channels, hyperpolarizes neurons, and ultimately blocks nociceptive (pain) transmission.

2. Quinine : While the indigenous Quechua people of Peru used the bark of the Cinchona tree for centuries, French chemists **Pierre Joseph Pelletier** and **Joseph Bienaime Caventou** successfully isolated the pure alkaloid in **1820.** It became the first pure chemical compound mass-administered to treat a global infectious disease (malaria).

Mechanism of Action : Quinine acts within the acidic food vacuole of intraerythrocytic *Plasmodium falciparum* parasites. The parasite degrades host hemoglobin, releasing toxic free heme. Quinine inhibits the enzyme **heme polymerase,** preventing the crystallization of toxic heme into inert **hemozoin** pellets. The parasite consequently dies of autointoxication.

3. Aspirin : Synthesized in **1897** by **Felix Hoffmann** at the Bayer company in Germany. Willow bark (*Salix*) had been utilized since antiquity to alleviate pain, but its active constituent (salicylic acid) caused horrific gastric mucosa irritation. Hoffmann bound an acetyl group to it, making it highly tolerable and giving the world its first mass-marketed synthetic blockbuster drug.

Mechanism of Action : Aspirin acts as a **suicide inhibitor** of Cyclooxygenase enzymes (**COX-1** and **COX-2**). It functions via covalent modification, physically transferring its acetyl group to a specific serine residue in inside the enzyme's catalytic channel. This permanently halts the transformation of arachidonic acid into pro-inflammatory prostaglandins and pro-thrombotic thromboxanes.

4. Penicillin (Benzylpenicillin / Penicillin G) : Discovered accidentally in **1928** by Scottish bacteriologist **Alexander Fleming** when a stray *Penicillium notatum* mold contaminated a petri dish, dissolving *Staphylococcus* bacteria colonies. It was later scaled up and purified in the early 1940s by **Howard Florey, Ernst Chain,** and their Oxford team to support Allied troops during WWII.

Mechanism of Action : Penicillin acts as a cell wall synthesis inhibitor. Because of its structural similarity to the terminus of bacterial peptidoglycan precursors, it acts as a structural mimic. It binds covalently to the active site of

Penicillin-Binding Proteins (PBPs), such as transpeptidase. This completely stops bacterial cell wall cross-linking, causing osmotic lysis and cell death.

5. Warfarin : Investigated by chemist **Karl Paul Link** at the University of Wisconsin in the 1930s-1940s following a mysterious veterinary emergency where cattle bled to death after consuming moldy sweet clover. Patented in **1948** as a highly potent rat poison (rodenticide), its clinical safety profile was later refined, allowing it to become a vital anticoagulant for human patients by 1954.

Mechanism of Action : Warfarin blocks the coagulation cascade by functioning as a competitive inhibitor of **Vitamin K Epoxide Reductase Complex 1 (VKORC1).** This blocks the reduction of Vitamin K epoxide back into its active form, hydroquinone. Without active vitamin K, gamma-glutamyl carboxylase cannot post-translationally modify clotting factors **II, VII, IX, and X,** halting blood clot formation.

6. Cephalosporin (Cephalosporin C) : Isolated in **1948** by Italian scientist **Giuseppe Brotzu** from a *Cephalosporium acremonium* fungus cultivation collected near a raw sewage outfall in Sardinia. It provided a vital pharmaceutical alternative to penicillin as bacterial strains began producing destructive penicillinase enzymes.

Mechanism of Action : Cephalosporins operate under an identical mechanism to penicillins, covalently binding bacterial **PBPs** and disrupting peptidoglycan polymer cross-linking. However, the presence of the six-membered dihydrothiazine ring makes the beta-lactam core considerably less accessible to and more resilient against degradation by bacterial beta-lactamases.

7. Taxol (Paclitaxel) : Discovered in **1962** during an extensive National Cancer Institute (NCI) mass screening program of botanical extracts. Samples gathered from the bark of the Pacific Yew tree (*Taxus brevifolia*) by botanist Arthur Barclay yielded the active cytotoxic agent, which was chemically defined in **1971** by chemists **Monroe Wall** and **Mansukh Wani.**

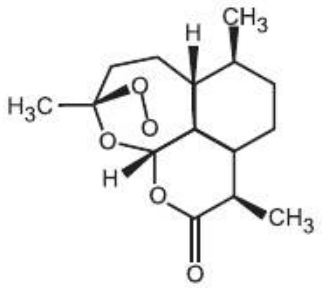
Mechanism of Action : Unlike traditional chemotherapeutic agents that cause DNA damage, Taxol is a **microtubule stabilizer.** It binds specifically to the β-subunit of the tubulin heterodimer. This shifts the thermodynamic equilibrium toward microtubule assembly, stabilizing the polymer and halting dynamic disassembly. The mitotic spindle becomes permanently "frozen," locking the dividing cancer cell in the G2/M phase of mitosis and inducing apoptosis.

8. Artemisinin : Discovered during **Project 523,** a secret military research project launched in the late 1960s by China to find antimalarial treatments during the Vietnam War. Scientist Tu Youyou analyzed over 2,000 traditional herbal preparations. Guided by a 400 AD text (*Handbook of Prescriptions for Emergencies*), she used a low-temperature ether extraction on sweet wormwood

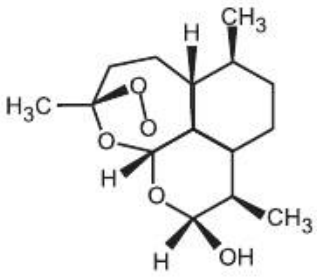
(*Artemisia annua*) to successfully isolate artemisinin in **1972,** earning the **2015 Nobel Prize.**

Mechanism of Action : Artemisinin acts as a prodrug activated by intra-parasitic iron. When the malaria parasite breaks down host hemoglobin inside human erythrocytes, it releases massive amounts of free iron. This iron chemically attacks the drug's **endoperoxide bridge,** cleaving the peroxide bond. This reaction produces highly reactive, toxic carbon-centered free radicals that alkylate and destroy crucial parasite proteins (such as PfATP6), destroying the parasite

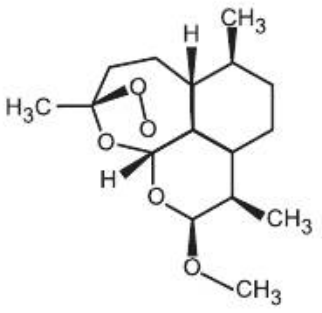
Antimalarials-1



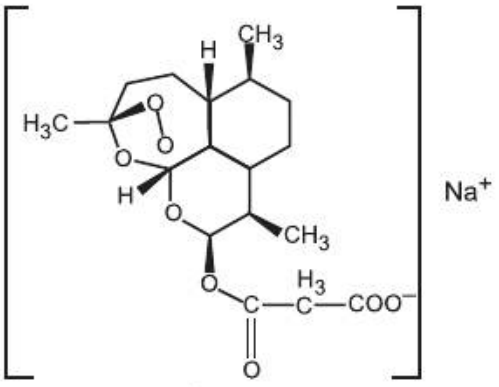
Artemisinin



Dihydroartemisinin



Artemether



Artesunate

Introduction to Different Herbal / Traditional Pharmacopoeias: A pharmacopoeia is an official, legally binding document published by a government or a recognized medical/pharmaceutical authority. It lays down the standards for the identification, purity, strength, and quality of drugs. With the global resurgence of traditional medicine, dedicated herbal pharmacopoeias have become essential to ensure the safety, efficacy, and standardization of botanical products.

1. Indian Pharmacopoeia (IP)

The Indian Pharmacopoeia is published by the Indian Pharmacopoeia Commission (IPC) on behalf of the Ministry of Health and Family Welfare, Government of India. It is the official book of standards for all drugs manufactured, sold, and distributed in India.

- **Evolution:** Early editions focused strictly on synthetic allopathic drugs. Recent editions (especially from IP 2007 onwards) feature a dedicated section for herbal drugs and formulations.
- **Herbal Scope:** It contains monographs for widely used indigenous medicinal plants, crude drugs, and prepared herbal extracts.
- **Quality Parameters:** Monograph standards include macroscopic and microscopic identification, total ash, acid-insoluble ash, water and alcohol-soluble extractive values, and heavy metal limits.
- **Modern Integration:** It utilizes advanced analytical techniques like High-Performance Thin-Layer Chromatography (HPTLC) and High-Performance Liquid Chromatography (HPLC) for quantitative estimation of active phytoconstituents.

2. British Herbal Pharmacopoeia (BHP)

The British Herbal Pharmacopoeia is published by the British Herbal Medicine Association (BHMA). First released in fascicles starting in 1976, it remains a highly respected international reference for Western herbal medicine.

Core Focus: It provides definitive qualitative and quantitative scientific standards exclusively for herbal substances used in medicine.

Monograph Design: Each monograph outlines the botanical source, precise part of the plant used (e.g., root, leaf, flower), and geographical sources.

Diagnostic Features: It places high emphasis on diagnostic macroscopical and microscopical structural characteristics to detect adulteration.

Therapeutic Application: Uniquely, it outlines the specific therapeutic actions (e.g., diuretic, sedative), documented traditional indications, and recommended dosage ranges.

3. United States Pharmacopeia 3 Herbal Medicines and Dietary Supplements (USP 3 HMDS)

The United States Pharmacopeia (USP) establishes official quality standards for medicines and supplements in the USA. The USP Herbal Medicines and Dietary Supplements compendium is a specialized reference tailored to the growing global market of botanicals.

- **Global Benchmarking:** It is widely regarded as one of the most stringent quality control manuals in the world.

- **Strict Standardization:** It relies heavily on instrumental fingerprinting methods (HPLC, GC, HPTLC) to verify the authentic identity and concentration of active markers.
- **Safety Thresholds:** It enforces precise, strict safety limits for agrochemical residues (pesticides), heavy metals (lead, arsenic, cadmium, mercury), microbial contamination, and fungal toxins (aflatoxins).
- **Scope:** It covers both domestic American botanicals and imported global herbs commercialized as dietary supplements.

4. Ayurvedic Pharmacopoeia of India (API)

The Ayurvedic Pharmacopoeia of India is a legal document issued by the Ministry of AYUSH, Government of India. It standardizes the quality of drugs originating from the ancient Ayurvedic system of medicine.

- **Two-Part Structure:** The compendium is systematically divided into two major sections:
  - **Part I:** Focuses entirely on single crude drugs (raw herbs, minerals, and animal products).
  - **Part II:** Focuses on compound formulations (traditional multi-herb preparations like *Choorna, Asava, Arishta, Vati, and Taila*).
- **Traditional Criteria:** It incorporates classical Ayurvedic profiles such as *Rasa* (taste), *Guna* (properties), *Virya* (potency), *Vipaka* (post-digestive effect), and Prabhava (special action).
- **Modern Verification:** Traditional parameters are paired with modern physico-chemical values, including thin-layer chromatography (TLC) profiles and loss on drying.

5. Unani Pharmacopoeia of India (UPI)

Published by the Ministry of AYUSH through the Unani Pharmacopoeia Committee, this official text serves to standardize the drugs used in the Unani system of medicine (based on the Greco-Arabic medical tradition).

- **Dual Classification:** Mirroring the API, it includes distinct volumes for single drugs (*Asl-ul-Advia*) and compound formulations (*Murakkabat*).
- **Physico-chemical Focus:** Monographs provide quantitative limits for total ash, water-soluble ash, alcohol-soluble extractives, moisture content, and volatile oil content.
- **Identity and Purity:** It establishes detailed macroscopic, microscopic, and chemical test parameters to ensure raw materials are authentic and free from adulteration or substitution.

6. American Herbal Pharmacopoeia (AHP)

The American Herbal Pharmacopoeia is developed by a non-profit organization dedicated to promoting the responsible use of herbal medicines. It is recognized for producing some of the most comprehensive monographs in existence.

- **Dual-Component Monographs:** AHP monographs are split into two deeply detailed sections:
  - **Quality Control Compendium:** Offers exhaustive botanical, chemical, and analytical guidelines to verify purity and identity.
  - **Therapeutic Compendium:** Provides an extensive peer-reviewed literature review covering historical use, modern clinical trials, pharmacology, toxicology, safety data, drug interactions, and contraindications.
- **Global Relevance:** While developed in the US, it covers prominent medicinal plants from Western, Ayurvedic, and Traditional Chinese Medicine (TCM) systems.

Comparative Summary Table

Pharmacopoeia	Publishing / Regulatory Authority	Primary Focus	Geographical Influence
IP (Indian)	Indian Pharmacopoeia Commission	Allopathic and Herbal Drugs	India (with global recognition)
BHP (British)	British Herbal Medicine Association	Western Botanical Drugs	United Kingdom and Europe
USP 3 HMDS	United States Pharmacopeia	Dietary Supplements & Botanicals	USA (globally accepted standards)
API (Ayurvedic)	Ministry of AYUSH, India	Traditional Ayurvedic Formulas	India and global Ayurvedic centers
UPI (Unani)	Ministry of AYUSH, India	Traditional Unani Formulations	India and the Middle East
AHP (American)	American Herbal Pharmacopoeia	Deep Analytical & Therapeutic Review	Global

Official and non-official; codified and non-codified drugs

Pharmacognosy is the branch of pharmaceutical science that deals with drugs obtained from natural sources such as plants, animals, minerals, and microorganisms. Crude drugs are natural substances that have undergone only simple processing such as drying, cleaning, or grinding and have not been chemically modified. For proper identification, study, and utilization, crude drugs are classified using different systems.

1. Official and Non-Official Drugs

Official Drugs

Official drugs are those drugs that are included and described in recognized pharmacopoeias or official compendia and comply with the standards specified therein.

Definition

A drug is considered official when it is listed in an authorized pharmacopoeia such as:

- Indian Pharmacopoeia (IP)
- British Pharmacopoeia (BP)
- United States Pharmacopeia (USP)
- European Pharmacopoeia (Ph. Eur.)

Characteristics

- Quality standards are established.
- Identity, purity, strength, and storage conditions are specified.
- Accepted for medicinal use by regulatory authorities.
- Subject to quality control testing.

Examples

- Senna
- Digitalis
- Clove
- Ginger
- Ispaghula

Advantages

- Standardized quality.
- Assured safety and efficacy.

- Legal recognition.

Non-Official Drugs

- Non-official drugs are drugs that are not included in any recognized pharmacopoeia or official compendium.

Characteristics

- Lack official standards.
- May be used in traditional or folk medicine.
- Quality specifications are not universally established.
- Limited regulatory recognition.

Examples

- Some regional medicinal plants used in Ayurveda and folk medicine.
- Newly discovered medicinal plants awaiting pharmacopoeial inclusion.

Advantages

- Source of new drug discoveries.
- Widely used in traditional healthcare systems.

Disadvantages

- Lack of standardization.
- Variable quality and efficacy.

2. Codified and Non-Codified Drugs

Codified Drugs

- Codified drugs are drugs whose therapeutic uses, dosage, preparation, and standards are documented in authoritative texts or pharmacopoeias.

Characteristics

- Scientifically documented.
- Standards and specifications available.
- Therapeutic indications established.

Examples

- Senna
- Belladonna
- Cinchona
- Digitalis

Merits

- Reliable information available.
- Easy standardization.
- Better quality assurance.

Non-Codified Drugs

- Non-codified drugs are drugs that are not documented in official pharmacopoeias or standard reference books.

Characteristics

- Knowledge mainly based on traditional use.
- Scientific validation may be inadequate.
- Standards often unavailable.

Examples

- Many folk medicines.
- Indigenous medicinal plants used by tribal communities.

Merits

- Potential source of novel therapeutic agents.

Limitations

- Lack of scientific evidence.
- Difficulty in quality control.

Classification of Drugs

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

(a) simple, (b) easy to use, (c) free from confusion and ambiguities.

Because of their wide distribution, each arrangement of classification has its own merits and demerits, but for the purpose of study the drugs are classified in the following different ways:

1. Alphabetical classification
2. Taxonomical classification
3. Morphological classification

4. Pharmacological classification
5. Chemical classification
6. Chemotaxonomical classification
7. Serotaxonomical classification

Alphabetical Classification

It is the simplest way of classification of any disconnected items. Crude drugs are arranged in alphabetical order of their Latin and English names (common names) or sometimes local language names (vernacular names). Some of the pharmacopoeias, dictionaries and reference books which classify crude drugs according to this system are as follows:

1. Indian Pharmacopoeia 2. British Pharmacopoeia 3. British Herbal Pharmacopoeia 4. European Pharmacopoeia 5. United States Pharmacopoeia and National Formulary

Merits

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

Demerits

There is no relationship between previous and successive drug entries.

Examples :

- Acacia,
- Benzoin,
- Cinchona,
- Dill,
- Ergot,
- Fennel,
- Gentian,
- Hyoscyamus,
- Ipecacuanha,
- Jalap,
- Kurchi,
- Liquorice,
- Mints,
- Nux vomica,
- Opium,
- Podophyllum,
- Quassia,
- Rauwolfia,
- Senna,
- Vasaka,
- Wool fat,
- Yellow bees wax.

Taxonomical (Biological) Classification

All the plants possess different characters of morphological, microscopical, chemical, embryological, serological and genetics. In this classification the crude drugs are classified according to kingdom, subkingdom, division, class, order, family, genus and species as follows.

Merits

Taxonomical classification is helpful for studying evolutionary developments.

Demerits

This system also does not correlate in between the chemical constituents and biological activity of the drugs.

Morphological Classification

In this, the drugs are arranged according to the morphological or external characters of the plant parts or animal parts, i.e. which part of the plant is used as a drug, e.g. leaves, roots, stem or any unorganized drug.

Organized Drugs

- **Woods:** Quassia, Sandalwood.
- **Leaves:** Digitalis, Eucalyptus.
- **Barks:** Arjuna, Ashoka, Wild cherry.
- **Flowering parts:** Clove, Pyrethrum, Saffron.
- **Fruits:** Amla,, Bael,, Capsicum, Caraway.
- **Seeds:** Black Mustard, Cardamom, Ispaghula.
- **Roots and Rhizomes:** Aconite, Ashwagandha, Ginger.
- **Plants and Herbs:** Bacopa, Andrographis.
- **Hair and Fibres:** Cotton, Hemp, Jute, Silk, Flax.

Unorganized Drugs

- **Dried Latex:** Opium, Papain.
- **Dried Juice:** Aloe, Kino
- **Dried extracts:** Agar, Alginate, Black catechu, Pale catechu.
- **Waxes:** Beeswax, Spermaceti.
- **Gums:** Acacia, Guar Gum, Indian Gum.
- **Resins:** Asafoetida, Benzoin, Colophony.

- **Volatile oil:** Peppermint, Sandalwood,, Lemon.
- **Fixed oils and Fats:** Arachis, Castor, Coconut, Linseed.

Merits

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

Demerits

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

Pharmacological Classification

Grouping of drug according to their pharmacological action or their therapeutic use is termed as pharmacological or therapeutic classification of drug. This classification is more relevant and is mostly a followed method. For example-

1. **Drugs acting on GIT**
   - **Bitter-** Gentian, Quassia, cinchona
   - **Carminative-**Dill, Mentha, Cadamon
   - **Emetics-** Ipecacuanha
   - **Anti-amoebics-** Kurchi, Ipecacaunha
   - **Bulk laxatives-** Agar, Ispaghuha, Banana
   - **Purgatives-** Senna, Castor oil
   - **Peptic ulcer treatment-** Derivative of Glycyrrhetinic acid , Raw banana
2. **Drugs acting on respiratory system**
   - **Expectorants-** Liqurice, Ipecacaunha, vasaka
   - **Antiexpectorant-** stramonium leaves (Atropine)
   - **Antitussives-** Opium Bronchodialators-Ephedra, Tea
3. **Drugs acting on the cardiovascular system**
   - **Cardiotoics-** Digitalis, Squill, Strophanthus
   - **Cardiac depressant-** Cinchona, Veratrum
   - **Vasco-constrictors-** Ergot, Ephedra
   - **Antihypertensives-** Rauwolfia
4. **Drugs acting on autonomic nervous system**
   - **Adrenergic-** Ephedra Cholinergic- Physostigma, Pilocarpus
   - **Anticholinergics-** Belladona, Datura

5. **Drugs acting on CNS**
   - **Central analgesics-** Opium
   - **CNS stimulants-** Coffee
   - **Analeptics-** Nux Vomica, Lobelia, Camphor
   - **CNS depressants-** Hyoscymus, Belladona, Opium Hallucinogenics-cannabis,Poppy Latex
6. **Anticancer-**Vinca, Podophyllum, Campotheca,
7. **Antispasmodics Smooth muscle relaxants-**Opium (Papavarine), Datura, Hyoscymus Skeletal muscle relaxants-Curare
8. **Antirheumatics-** Aconite, Colchicum, Guggul
9. **Anthelmintics-** Quassia, Male Fern, Vidang
10. **Immunomodulatory agents-** Ashwagandha, Tulsi, Ginseng, Asparagus, Picrorrhiza, Kurroa
11. **Drugs acting on skin and mucous membrane-** Olive oil, wool fat, Beeswax, Balsam of tolu.
12. **Astringents-** Myrobalan, Black catechu

Merits

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

Demerits

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

Chemical Classification

Depending upon the active constituents, the crude drugs are classified. The plants contain various constituents in them like alkaloids, glycosides, tannins, carbohydrates, saponins, etc. Irrespective of the morphological or taxonomical characters, the drugs with similar chemical constituents are grouped into the same group. It is preferred method for classification. For example-

- **Glycosides**- Digitalis, Senna, Cascara.
- **Alkaloids**- Cinchona, Datura, Nux-vomica
- **Tannins**- Pate catechu, Ashoka
- **Volatile oil**- Peppermint, Clove, Eucalyptus
- **Carbohydrates and derived products**- Acacia, Agar, Guar gum. Etc.

Merits

It is a popular approach for phyto-chemical studies.

Demerits

Ambiguities arise when particular drugs possess a number of compounds belonging to different groups of compounds.

Chemotaxonomic Classification

This system of classification relies on the chemical similarity of a taxon, i.e. it is based on the existence of relationship between constituents in various plants. There are certain types of chemical constituents that characterize certain classes of plants. This gives birth to entirely a new concept of chemotaxonomy that utilizes chemical facts/characters for understanding the taxonomical status, relationships and the evolution of the plants.

For example, tropane alkaloids generally occur among the members of Solanaceae, thereby, serving as a chemotaxonomic marker. Similarly, other secondary plant metabolites can serve as the basis of classification of crude drugs. The berberine alkaloid in Berberis and Argemone, Rutin in Rutaceae members, Ranunculaceae alkaloids among its members, etc., are other examples.

Merits

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

Serotaxonomic Classification

On the basis of antiserum properties or protein homogeneity between plants. Proteins most widely used as antigens in serotaxonomy are those, which carry useful taxonomic information and are easy to handle. Both structural and reserve proteins can be used in the field of systematics, as long as they belong to the same group and the same organs are always compared.

For example:

1. A close relationship among the Magnoliidae, Hamamelididae and Comiflorae of the angiosperms has been found, based on comparative serological studies of their major seed proteins. This has refuted the idea of their independent evolution.

2. The homogeneity of the iridoid-producing Comiflorae has been confirmed by serological studies, which has supported the inclusion of the Gentianaceae in it.
3. Based on phytoserological studies, Pickering and Fair brothers (1970) have proposed the classification of the family Umbelliferae into Hydrocotyloideae, Saniculoideae and Apioideae, and Apioideae was found to be more closely related to Saniculoideae than to Hydrocotyloideae.

Merits

It is latest technique for classification and most reliable.

EXERCISE

Short Answer Questions (2 Marks)

1. Define Pharmacognosy.
2. Explain the scope of Pharmacognosy.
3. Who coined the term Pharmacognosy?
4. Mention two objectives of Pharmacognosy.
5. Describe the present status of Pharmacognosy.
6. Write any two applications of Pharmacognosy.
7. Mention the importance of Pharmacognosy in the pharmaceutical industry.
8. Define crude drug.
9. Differentiate between Pharmacognosy and Pharmacology.
10. Mention two recent developments in Pharmacognosy.
11. Define natural drugs.
12. List the different sources of crude drugs.
13. Give two examples of plant drugs.
14. Mention two drugs obtained from animals.
15. What are microbial drugs?
16. Define marine drugs.
17. Mention two mineral drugs.
18. Define plant tissue culture.
19. What is callus culture?
20. Mention two advantages of plant tissue culture.
21. Who discovered morphine?
22. Name the source of quinine.

23. From which plant was aspirin originally derived?
24. What is the therapeutic use of warfarin?
25. Who discovered penicillin?
26. Name the microorganism producing penicillin.
27. From which fungus was cephalosporin first isolated?
28. Mention the source of Taxol.
29. Name the plant producing artemisinin.
30. Mention one therapeutic use each of Taxol and artemisinin.
31. Define Pharmacopoeia.
32. What is the Indian Pharmacopoeia?
33. What is the British Herbal Pharmacopoeia?
34. Define the United States Pharmacopeia (USP) Herbal Medicines and Dietary Supplements.
35. What is the Ayurvedic Pharmacopoeia of India?
36. Define the Unani Pharmacopoeia of India.
37. What is the American Herbal Pharmacopoeia?
38. Mention two objectives of Pharmacopoeias.
39. Why are Pharmacopoeias important?
40. Name any four herbal Pharmacopoeias.
41. Define official drug.
42. Define non-official drug.
43. What are codified drugs?
44. Define non-codified drugs.
45. What is alphabetical classification?
46. Define morphological classification.
47. What is taxonomical classification?
48. Define chemical classification.
49. What is pharmacological classification?
50. Define chemotaxonomical classification.

▼ Semi-Long Answer Questions (5 Marks)

1. Explain the definition, scope, and objectives of Pharmacognosy.
2. Describe the history and development of Pharmacognosy.
3. Discuss the present status of Pharmacognosy in modern healthcare.

4. Explain the importance of Pharmacognosy in drug discovery.
5. Describe the role of Pharmacognosy in quality control of herbal medicines.
6. Explain the various natural sources of drugs with suitable examples.
7. Discuss plant and animal sources of crude drugs.
8. Describe microbial and marine sources of drugs.
9. Explain mineral sources of drugs with suitable examples.
10. Discuss the importance and applications of plant tissue culture in Pharmacognosy.
11. Explain the discovery and medicinal importance of morphine.
12. Discuss the discovery and therapeutic uses of quinine.
13. Describe the history and importance of aspirin.
14. Explain the discovery and pharmaceutical importance of penicillin and cephalosporin.
15. Discuss the medicinal significance of Taxol and artemisinin.
16. Explain the role of Pharmacopoeias in herbal drug standardization.
17. Discuss the Indian Pharmacopoeia and Ayurvedic Pharmacopoeia of India.
18. Explain the British Herbal Pharmacopoeia and American Herbal Pharmacopoeia.
19. Describe the USP Herbal Medicines and Dietary Supplements.
20. Discuss the importance of traditional Pharmacopoeias in quality assurance.
21. Differentiate between official and non-official drugs.
22. Explain codified and non-codified drugs with examples.
23. Discuss alphabetical and morphological classification of crude drugs.
24. Explain taxonomical and chemical classification with suitable examples.
25. Discuss pharmacological and chemotaxonomical classification along with their advantages and limitations.

▼ Long Answer Questions (10 Marks)

1. Define Pharmacognosy and discuss its history, scope, development, and present status.
2. Explain the evolution of Pharmacognosy and its importance in modern pharmaceutical sciences.
3. Discuss the contribution of Pharmacognosy in herbal drug research and development.
4. Explain the different sources of drugs (plant, animal, microbial, marine, mineral, and plant tissue culture) with suitable examples.

5. Discuss the significance of natural sources in modern drug discovery.
6. Describe plant tissue culture, its techniques, advantages, and pharmaceutical applications.
7. Discuss the historical milestones in drug discovery with reference to Morphine, Quinine, Aspirin, Warfarin, Penicillin, Cephalosporin, Taxol, and Artemisinin.
8. Explain the source, discovery, and therapeutic importance of the major natural product-derived drugs.
9. Describe the contribution of natural products to modern drug discovery and healthcare.
10. Describe the various herbal and traditional Pharmacopoeias and discuss their significance in the standardization of herbal medicines.
11. Compare the Indian Pharmacopoeia, Ayurvedic Pharmacopoeia, Unani Pharmacopoeia, British Herbal Pharmacopoeia, USP Herbal Medicines and Dietary Supplements, and American Herbal Pharmacopoeia.
12. Explain the role of Pharmacopoeias in ensuring the quality, safety, and efficacy of herbal drugs.
13. Explain the various methods of classification of crude drugs-alphabetical, morphological, taxonomical, chemical, pharmacological, and chemotaxonomical-with suitable examples, merits, and limitations.
14. Discuss official and non-official drugs, codified and non-codified drugs, and explain the different systems of crude drug classification.
15. Compare the different methods of classification of crude drugs, highlighting their merits, limitations, and pharmaceutical applications.