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PHARMACOGNOSY AND PHYTOCHEMISTRY – I

UNIT 1

TOPIC :

- **Introduction to Pharmacognosy :**
  (a) Definition, history, scope and development of Pharmacognosy
  (b) Sources of Drugs– Plants, Animals, Marine & Tissue culture
  (c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum-resins).

Pharmacognosy

- Pharmacognosy is the branch of pharmaceutical sciences that deals with the study of crude drugs obtained from natural sources such as plants, animals, minerals, and marine organisms.
- It includes the identification, cultivation, collection, preparation, preservation, and standardization of natural drugs along with their chemical, biological, and therapeutic properties.
- The term *Pharmacognosy* is derived from the Greek words:
  - "Pharmakon" = drug
  - "Gnosis" = knowledge
    → Meaning "knowledge of drugs".

History of Pharmacognosy

1. **Ancient Period**
   - Knowledge of medicinal plants was based on folk medicine and traditional systems.
   - Famous traditional medicine systems include Ayurveda (India), Traditional Chinese Medicine, Unani, and Egyptian medicine.
   - Early texts:
     - Charaka Samhita and Sushruta Samhita (India)
     - Pen Tsao (China, by Shen Nung, ~2700 B.C.)
     - Ebers Papyrus (Egypt, ~1500 B.C.)
2. **Middle Ages**
   - Development of Materia Medica (records of medicinal plants and drugs).
   - Famous herbalists: Dioscorides (wrote "De Materia Medica") and Galen (developed herbal preparations called *Galenicals*).
   - Islamic scholars preserved and expanded pharmacological knowledge.
3. **Modern Period**
   - 1815: The term *Pharmacognosy* was first introduced by C.A. Seydler in his book *"Analecta Pharmacognostica"*.
   - 1817: Term also used by J.A. Schmidt in *"Lehrbuch der Pharmacognosie"*.

- 19th Century: Discovery and isolation of active principles like morphine, quinine, atropine, cocaine, and digitoxin.
- 20th Century: Development of phytochemistry, chromatography, spectroscopy, and plant tissue culture for drug discovery.

Scope of Pharmacognosy

1. **Study of Natural Drugs** – Collection, identification, cultivation, and standardization of crude drugs.
2. **Phytochemistry** – Extraction, isolation, and characterization of bioactive constituents (alkaloids, glycosides, flavonoids, tannins, etc.).
3. **Pharmacological Research** – Studying biological activity, therapeutic uses, and toxicity of natural products.
4. **Nutraceuticals and Herbal Medicine** – Development of functional foods, dietary supplements, and herbal formulations.
5. **Modern Drug Discovery** – Screening natural compounds for potential drugs in cancer, microbial diseases, and CNS disorders.
6. **Quality Control** – Ensuring safety, efficacy, and purity of crude drugs using techniques like chromatography & spectroscopy.
7. **Biotechnology** – Plant tissue culture, genetic engineering, and fermentation for large-scale production of drugs.
8. **Global Market** – Increasing demand for herbal medicines, cosmetics, and dietary supplements expands its industrial importance.

Development of Pharmacognosy

1. **Traditional Stage** – Based on local knowledge and use of medicinal plants without scientific validation.
2. **Experimental Stage** – Systematic study, classification, and preparation of herbal drugs (Galenic pharmacy).
3. **Chemical Stage** – Isolation and structural elucidation of **active principles** (e.g., alkaloids, glycosides).
4. **Biological Stage** – Pharmacological evaluation of crude drugs for therapeutic action.
5. **Modern Stage** – Integration of **biotechnology, molecular biology, chromatography, spectroscopy, nanotechnology, and bioinformatics** in natural drug research.

Sources of Drugs in Pharmacognosy

Drugs used in medicine are obtained from various natural sources, primarily plants, animals, minerals, marine organisms, and microorganisms. These sources provide crude drugs that are later processed, standardized, and formulated into dosage forms.

1. Plant Sources

- Plants are the oldest and most important source of drugs.
- Almost all parts of plants (roots, stems, leaves, flowers, fruits, seeds, bark, latex, gums, resins, etc.) can be used.
- In ancient times, most drugs were derived from medicinal plants, and even today, nearly 25–30% of modern medicines are obtained directly or indirectly from plants.

Examples of Plant-Derived Drugs:

- **Alkaloids:**
  - *Morphine* – from *Papaver somniferum* (opium poppy)
  - *Quinine* – from *Cinchona bark*
- **Glycosides:**
  - *Digoxin, Digitoxin* – from *Digitalis purpurea* leaves
  - *Senna glycosides* – from *Cassia species*
- **Flavonoids:**
  - *Rutin, Quercetin* – from various plants
- **Essential Oils:**
  - *Peppermint oil* – from *Mentha piperita*
  - *Clove oil* – from *Syzygium aromaticum*

2. Animal Sources

- Animals provide many useful therapeutic substances such as hormones, enzymes, proteins, and other products.
- These drugs are important in replacement therapy, digestion, and as biological products.

Examples of Animal-Derived Drugs:

- **Hormones:**
  - *Insulin* – from pig/cattle pancreas
  - *Thyroxine* – from thyroid gland
- **Enzymes:**
  - *Pepsin, Trypsin, Pancreatin* – from digestive organs
- **Toxins & Antitoxins:**
  - *Snake venom* – used for preparing antivenoms
- **Carbohydrates:**
  - *Honey* – used as a sweetening agent and demulcent

3. Marine Sources

- About 70% of the earth's surface is covered by seas and oceans, which contain over 500,000 species of marine organisms.
- Marine sources include algae, sponges, tunicates, mollusks, and fishes, which produce novel bioactive compounds.
- Marine natural products are widely researched for their anticancer, antimicrobial, and anti-inflammatory activities.

Examples of Marine-Derived Drugs:

- *Bryostatin* – from marine bryozoans (anticancer activity)
- *Ecteinascidins* – from tunicates (anticancer drug, ET-743 = Trabectedin)
- *Omega-3 fatty acids* – from fish oils (used in hyperlipidemia, heart disease)
- *Agar, Carrageenan* – from red algae (used in pharmaceuticals as gelling agents)

4. Mineral Sources

- Minerals and inorganic substances are important in medicine for their physiological and therapeutic actions.
- They may be used directly or in processed form.

Examples of Mineral-Derived Drugs:

- *Iron salts* – used in the treatment of anemia
- *Zinc oxide* – used in wound healing and as a skin protective agent
- *Magnesium sulphate (Epsom salt)* – used as a laxative and anticonvulsant
- *Calcium carbonate* – used as an antacid and calcium supplement
- *Sulphur* – used as an antifungal and antiparasitic agent

5. Microbial Sources

- Microorganisms such as fungi, bacteria, and actinomycetes produce valuable metabolites including antibiotics, immunosuppressants, and enzymes.
- These are widely used in modern medicine and pharmaceutical industries.

Examples of Microbial-Derived Drugs:

- **Antibiotics:**
  - *Penicillin* – from *Penicillium notatum*
  - *Streptomycin* – from *Streptomyces griseus*
  - *Tetracyclines* – from *Streptomyces species*
- **Immunosuppressants:**
  - *Cyclosporine* – from *Trichoderma polysporum* (used in organ transplantation)
- **Enzymes:**
  - *Streptokinase* – from *Streptococcus* species (used in clot dissolution)

Organized and Unorganized Drugs

1. Organized Drugs

- Organized drugs are crude drugs that are obtained directly from plant or animal parts and possess a definite cellular structure.
- They can be easily identified by their morphological and microscopical characters.
- Mostly, they are solid in nature.

Characteristics

- Direct parts of plants or animals (e.g., leaves, fruits, roots, bark).
- Retain proper cellular arrangement.
- Evaluated by macroscopy and microscopy.
- Identification based on morphological features such as shape, size, color, taste, odor, and texture.

Examples

- Leaves: Senna (*Cassia angustifolia*), Tulsi (*Ocimum sanctum*), Digitalis (*Digitalis purpurea*)
- Fruits: Coriander (*Coriandrum sativum*), Amla (*Phyllanthus emblica*)
- Barks: Cinnamon (*Cinnamomum zeylanicum*)
- Roots/Rhizomes: Ginger (*Zingiber officinale*), Turmeric (*Curcuma longa*)
- Seeds: Nux Vomica (*Strychnos nux-vomica*)
- Flowers: Clove (*Syzygium aromaticum*)

2. Unorganized Drugs

- Unorganized drugs are substances obtained from plants, animals, or minerals, but not as a direct anatomical part of them.
- They are usually the result of processes like extraction, exudation, or distillation.
- They do not possess cellular structure.
- They may occur in solid, semi-solid, or liquid form.
- Identified by organoleptic properties (color, odor, taste, texture, solubility).

Classification of Unorganized Drugs

1. **Dried Latex**
   - Latex is a milky fluid obtained from certain plants, which solidifies upon drying.
   - Used in pharmaceuticals, adhesives, and medical products.
   - **Examples:**
     - *Opium* – from *Papaver somniferum* (source of morphine, codeine)
     - *Papain* – from *Carica papaya* (proteolytic enzyme)
2. **Dried Juices**
   - Obtained by drying the natural juice of fruits or plants after removal of water.
   - Used for medicinal, nutritional, and flavoring purposes.
   - **Examples:**
     - *Aloe* – from *Aloe barbadensis* leaves (used as purgative)
     - *Catechu* – from *Acacia catechu* wood
3. **Dried Extracts**
   - Concentrated preparations obtained by evaporation of plant or animal extracts until a solid or semi-solid mass is left.
   - Contain active constituents in concentrated form.
   - Examples:
     - *Extract of Liquorice* – from *Glycyrrhiza glabra*

        - *Belladonna extract* – from *Atropa belladonna*

4. **Gums**
    - Pathological products of plants, formed as exudates due to injury or disease.
    - They are polysaccharides that swell in water to form mucilaginous solutions or gels**.**
    - Widely used as suspending agents, binders, emulsifiers, and demulcents**.**
    - **Examples:**
        - *Gum acacia (Gum arabic)* – from *Acacia senegal*
        - *Tragacanth* – from *Astragalus* species
5. **Resins**
    - Non-volatile, amorphous, sticky exudates produced by plants, which harden on exposure to air.
    - Insoluble in water but soluble in organic solvents.
    - Used in adhesives, varnishes, incense, and medicine**.**
    - **Types:**
        - **Pure Resins:** e.g., *Colophony* (from *Pinus* species)
        - **Oleoresins (Resin + Volatile oils):** e.g., *Capsicum* (capsaicin), *Ginger* (gingerol)
        - **Oleo-gum-resins (Resins + Gums + Volatile oils):** e.g., *Myrrh*, *Asafoetida*