

Pharmacognosy



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Course Objective

- By the end of this course the students will be able to:
 - Describe general aspects of crude drugs, extraction and isolation methods
 - Extract, identify and evaluate compounds from natural sources.
 - Give services related to extraction, isolation and evaluation of natural products
 - Advising the patient about drug-herb interactions.

Introduction

1.1. Origin and History of Pharmacognosy

- ❖ Despite the variation in philosophical premise
- ❖ The **universal role of plants** in the treatment of disease was recognized by different systems of medicine like
 - ❖ Egyptians medicine, Unani medicines, Allopathic medicines.

Introduction ...

- ❖ By trial and error a primitive man:
 - ❖ Identify NP with food, medicinal value, & poisonous/ unpleasant nature.
 - ❖ This observations were handed from generation to generation.
- ❖ The healing power of plant roots, fruits, and juices were **discovered by accident** and **learned**.
- ❖ Individuals like **Hippocrates** (460-370 B.C), Galen, Aristotle and others contribute to medicine.

Introduction ...

1.2. Definition and description

- The word "**Pharmacognosy**" has its debut in the early 19th C.
 - ✓ To designate the discipline related to *medicinal plants*.
- It is derived from two Greek words
 - ✓ *Pharmakon* (drug), and
 - ✓ *gnosis* (to acquire knowledge of)
 - Literally to mean "**the entire knowledge of drugs**".
- **Pharmacognosy**, which is the study of medicines derived from *natural sources*.

Introduction ...

Scope of Pharmacognosy

- Concerned with:
 - ✓ The **identification** of drugs, both in the whole state and in powder form.
 - ✓ **Isolation techniques** and **pharmacological testing procedure (evaluation)** of new plant drugs (In **restricted sense**).
 - ✓ Their history, **distribution, cultivation, collection, preparation, storage, preservation**, commerce and use of plant drugs (In **broad sense**).

Scope ...

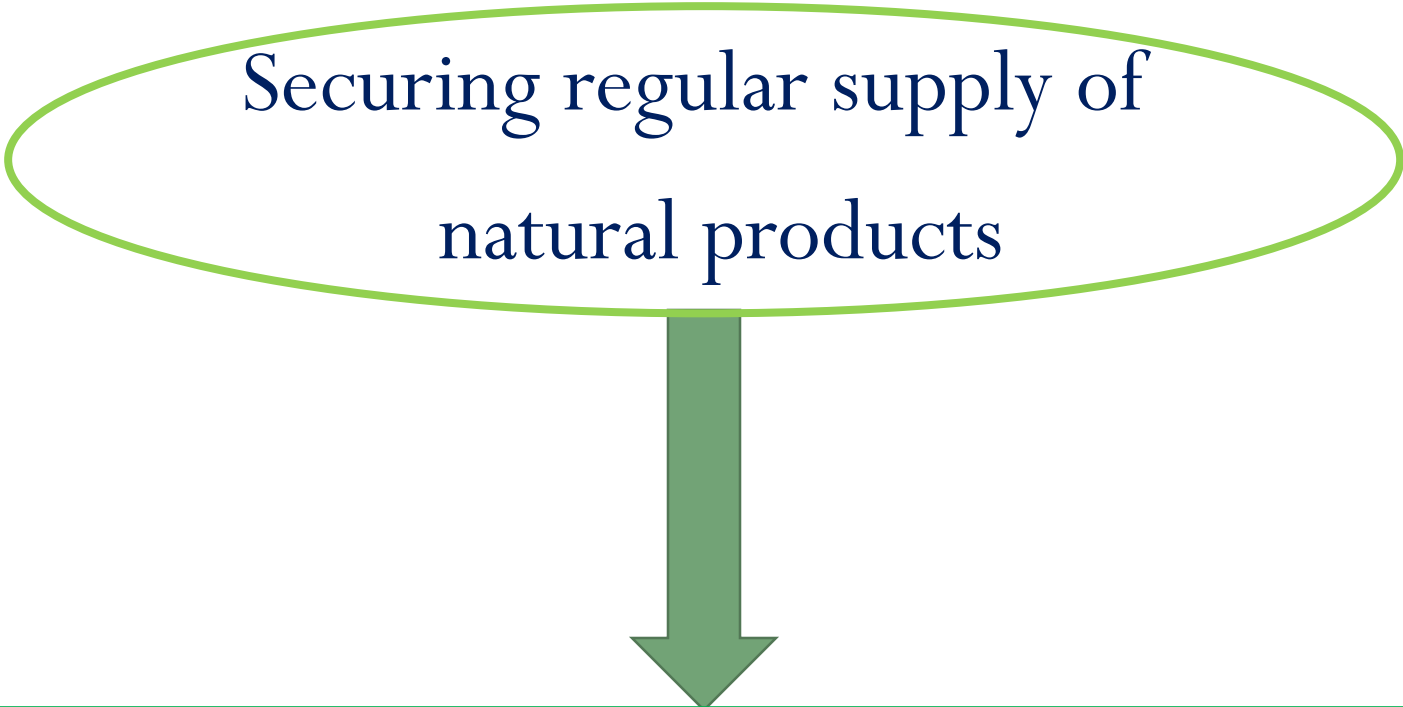
- Although pharmacognosy is principally concerned with plant materials,
 - ✓ There are also **animal** and **mineral** products which are traditionally encompassed within the subject.
- Examples of animal products
 - ✓ beeswax, gelatin, woolfat, vitamins, etc
- Other natural products such as antibiotics, and hormones may also be included within the subject.
- Marine organisms are receiving increased attention recently.

Scope ...

- Materials having no pharmacological action which are of interest to pharmacognosists are:
 - ✓ Natural fibers
 - ✓ Natural excipients (flavouring agents, suspending agents, colourants, disintegrants etc.)
- Other areas that have natural associations with the subject are
 - ✓ poisonous and hallucinogenic plants
 - ✓ allergens
 - ✓ Herbicides and insecticides

Scope ...

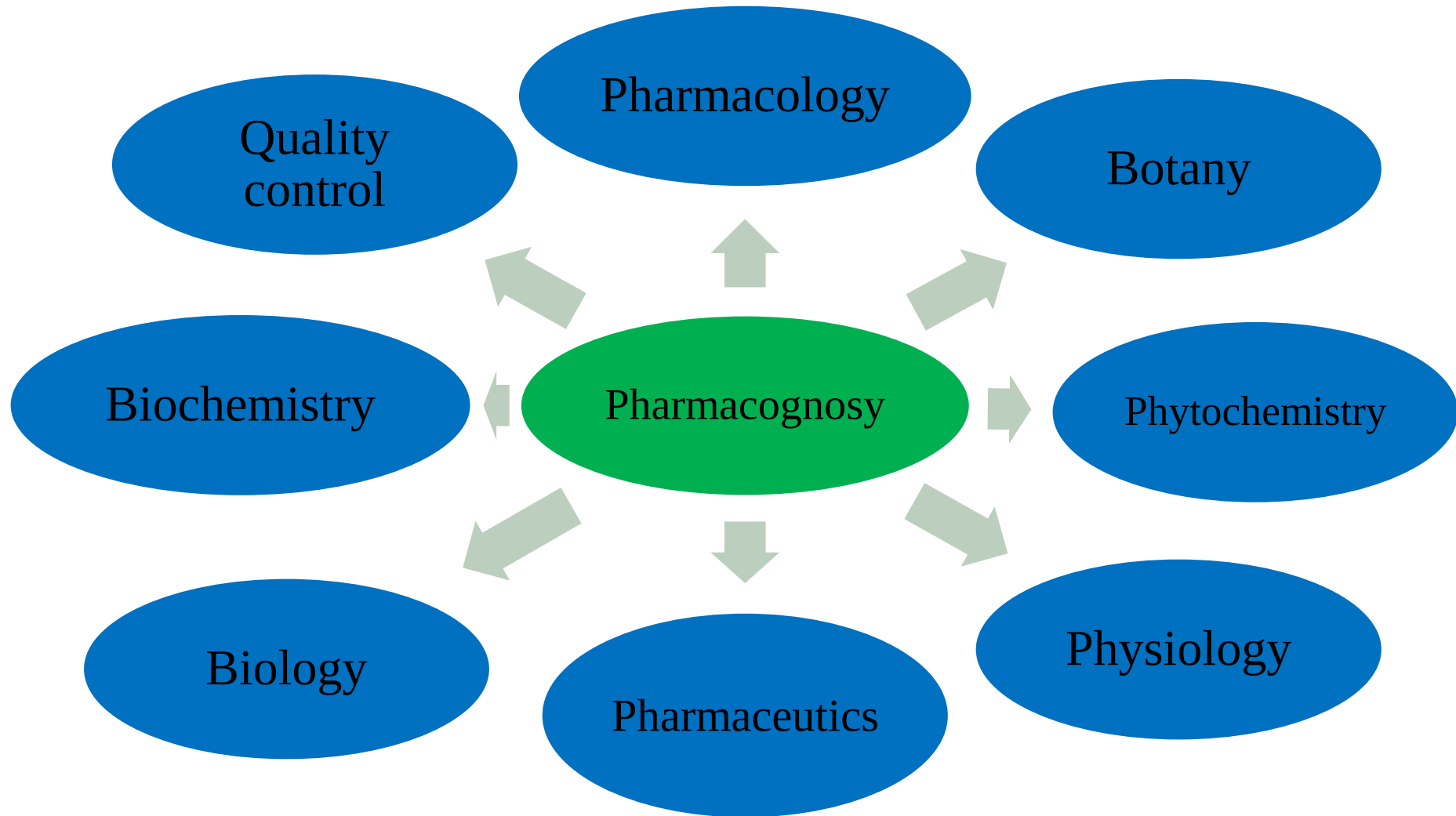
Scope of Pharmacognosy



Securing regular supply of
natural products

Incorporation of a natural products in the system of
modern medicine

R/ship with other fields



Why do we study pharmacognosy?

- Herbs offer a very good *alternative source of drugs* (provide useful drugs that are difficult, to produce commercially by synthetic means).
 - ✓ The share of natural products in modern medicine is as high as 45%
 - ✓ About 80% of the population (in developing countries)
- The process is environmentally friendly.
- Natural products are **more tolerated** by the body (negligible extent of side effects in the case of herbal drugs).
- Plants are considered as big laboratories and mankind is said to have used less than 3-5% of what nature can potentially provide (herbal drugs can treat any diseases).

Crude Drugs

Definition

Drug???

Drug means any substances:

- Recognized in the pharmacopeia
- Used for diagnosis, mitigation, treatment, or prevention of disease in human or animal.

Crude Drugs

Definition

A "crude drug" means

- ✓ a dried unprepared (raw form of) natural material of plant, animal or mineral origin, which is used for medicine.



Crude Drugs...

- Consist of natural substances that have undergone no other processes than transverse or longitudinal **cutting** after **collection** and **drying**.

❖ Crude drugs can thus be defined as:

- NPs that has not been advanced in value or improved in condition
 - By any process or treatment
 - Other than essential for Proper packing & prevention from deterioration.”

Crude Drugs...

Natural products:

❖ They can be

- ✓ Entire organism (plant, animal, microorganism)
- ✓ Part of an organism (a leaf or flower of a plant, an isolated gland or other organ of an animal)
- ✓ An extract or an exudate of an organism
- ✓ Isolated pure compounds

❖ Obtained from plants, animals, microorganism, and minerals.

Crude Drugs...

Role of natural products in modern medicine:

- Provide a number of extremely useful drugs that are difficult to produce commercially by synthetic means.
- Supply basic compounds that may be modified slightly to render them more effective or less toxic.
- Serve as prototypes or models for synthetic drugs possessing physiologic activities similar to the originals.

Crude drugs-Nomenclature

- A plant needs a name that applies to it and *only* to it. It can have

1. Common name

- Local language names (**vernacular names**).
- May vary from one country to an other, one state to an other.
- Thus, it is unreliable.

2. Botanical name

- Makes use of Carl Linnaeus (1707-1778) binomial system in which:
 - ✓ The 1st name denotes the **genus**
 - ✓ The 2nd (specific) name denotes the **species**.
 - Eg. *Lepidium sativum*, *Aloe weloensis*, *Lobelia gibberoa*.

The specific name may indicate

1. Some striking characteristics of the plant:

❖ *Conium maculatum* (maculate = spotted)

➤ stem with reddish, spotted patches.

❖ *Glycyrrhiza glabra* (glabrous = smooth).

➤ Refers to its smooth fruit

❖ *Hyoscyamus muticus* (muticus = short).

➤ The plant is being short.

❖ *Atropa belladonna* (bella = beautiful, donna = lady)

➤ the juice of the berry placed in the eyes causes dilatation of the pupils, thus giving a striking appearance).

The specific name may indicate...

2. A characteristic colour:

- *Piper nigrum* (= black)
- *Veratrum viride* (= green)
- *Citrus aurantium* (= golden yellow)
- *Digitalis purpurea* (= purple)
- *Digitalis lutea* (= yellow)

3- An aromatic plant or certain aroma:

- ✓ *Myritaceae fragrans* (having a fragrant, nice aroma)
- ✓ *Caryophyllus aromaticus* (refers to the aroma)

The specific name may indicate...

4- A geographical source or history of a drug:

- *Cannabis indica* (growing in India)
- *Tamarinds indica* (India)

5- A Pharmaceutical activity of an active constituents:

- ❖ *Papaver somniferum* (sleep inducing)
- ❖ *Strychnos nux vomica* (causing vomiting)
- ❖ *Ipomoea purga* (laxative).

6- A general meaning or a special indication

- ✓ *Allium sativum* (= cultivated)
- ✓ *Triticum vulgaire* (= wild)

Crude drugs- Classification

- A method of classification should be
 - ✓ Simple
 - ✓ Easy to use
 - ✓ Free from confusion and ambiguities.
 - In pharmacognosy, crude drugs are studied by classifying them according to:
 - ✓ Alphabets
 - ✓ Morphology
 - ✓ Taxonomy
 - ✓ Chemical constituent
 - ✓ Pharmacological activity
- **Note: each classification system has its own merits and demerits**

Crude drugs- Classification

I. Alphabetical Classifications

- The simplest way of classification of any disconnected items.
- The crude drugs are arranged according to their alphabetical order.
- This arrangement is employed for dictionaries, reference books, pharmacopeias, etc
- **Latin** and **English** (common names) or sometimes **local language** names (vernacular names) are used.

Merits:

- It is easy and quick to use.
- There is no repetition of entries and is devoid of confusion.
- Tracing, addition, and location of drug entries is easy.

Crude drugs- Classification...

Demerits: no relationship b/n successive drug entries.

Examples: Acacia, Benzoin, Cinchona, Dill, Ergot, Fennel, Gentian, Hyoscyamus,

II. Morphological classification :

- The crude drugs are grouped according to the external characters (parts) of the plant used .
 - ✓ E.g. Bark drugs (Cinchona bark, Cinnamon bark)

Crude drugs- Classification...

- ❖ **Organized drugs:** obtained from the direct parts of the plants and contain cellular tissues.
 - e.g Rhizomes, barks, leaves, fruits, entire plants, hairs and fibers.
- **Unorganized drugs:** prepared by some processes such as incision, drying or extraction with a solvent and don't have any cellular tissues.
 - e.g Aloe juice, opium latex, agar, gelatin, benzoin, honey, beeswax, lemon grass oil etc.

Crude drugs- Classification...

Organized Drugs	Unorganized Drugs
These may be of plant or animal origin.	These may be of plant, animal or mineral origin.
These are direct part of plant or animal.	These are the product of plant or animals.
These have cellular structure.	These do not have well defined cellular structure.
Generally identified by morphological character.	Generally identified by organoleptic properties.
Examples: Digitalis leaf, cinchona bark and ephedra stem.	Examples: Agar, gelatin, honey.

Crude drugs Classification...

➤ Merits:

- Helpful to identify and detect adulteration.
- Convenient for practical study of drug with unknown chemical nature.

➤ Demerits:

- No co-relation of chemical constituents with the therapeutic actions.
- Repetition of drugs or plants occurs.

Crude drugs- Classification...

III. Taxonomical (botanical) Classification:

- **Botanical classification** is based on
 - **natural relationship** and **evolutionary developments**.
- Arranged according to the plants from which they are obtained
 - **Kingdom, Phylum, class, order, family, genus, and species.**
- It allows a precise and ordered arrangement and accommodates any drug without ambiguity.

Crude drugs- Classification...

Merits

- Helpful for studying evolutionary developments.

Drawback

- Does not co-relate chemical constituents with biological activity of the drugs.

Crude drugs- Classification...

IV. Chemical /Biogenetic Classification:

❖ The crude drugs are grouped in based on their

➤ **Constituents** or **biosynthetic pathways**

Carbohydrates are polyhydroxy aldehydes or ketones containing an unbroken chain of carbon atoms.

✓ **Gums** Acacia, Tragacanth, Guar gum

✓ **Mucilages** Plantago seed

✓ **Others** Starch, Honey, Agar, Pectin, Cotton

Crude drugs- Classification...

Glycosides –upon hydrolysis give rise to one or more sugars (glycone) & non-sugar (aglycone).

- ✓ Anthraquinone Glycosides Aloe, Cascara, Rhubarb, Senna
- ✓ Saponins Glycosides Quillaia, Arjuna, Glycyrrhiza
- ✓ Cyanophore Glycosides Wild cherry bark
- ✓ Isothiocyanate Glycosides Mustard
- ✓ Cardiac Glycosides Digitalis, Strophanthus
- ✓ Bitter Glycosides Gentian, Calumba, Quassia, Chirata, Kalmegh

Crude drugs- Classification...

Tannins—non-nitrogenous polyhydroxy benzoic acid derivatives. Examples-

Pale catechu, Black catechu, Ashoka bark, Galls, Amla

Volatile oils— plant derived monoterpene and sesquiterpenes. Examples-

Cinnamon, Fennel, Coriander, Cardamom, Orange peel, Mint, Clove, **Lipids** - Fixed oils –

Castor, Olive, Almond, Shark liver oil

- Fats – Theobroma, Lanolin

- Waxes – Beeswax, Spermaceti

- **Resins**— Complex mixture of compounds like resinols, resin acids, resinotannols, resenes.
- Examples: Cannabis, Jalap, Capsicum, Turmeric, Balsam of Tolu and Peru, Myrrh, Ginger

Crude drugs- Classification...

Alkaloids – Nitrogenous substance of plant origin

- **Pyridine and Piperidine** – Lobelia, Nicotiana
- **Tropane** - Coca, Belladonna, Datura, Stramonium, Hyoscyamus, Henbane
- **Quinoline** – Cinchona
- **Isoquinoline** – Opium, Ipecac, Calumba
- **Indole** – Ergot, Rauwolfia
- **Amines** – Ephedra
- **Purina** – Tea, coffee

Protein – Gelatin, Ficin, Papain

Vitamins - Yeast

Triterpenes – Rasna, Colocynth

Crude drugs- Classification...

Merits

- It is a popular approach for phytochemical studies.

Demerits

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

Crude drugs- Classification...

V. Pharmacological (therapeutic) Classification:

- Based on pharmacological action/therapeutic use of most important constituents.
- ❖ More relevant and is the mostly followed method.

Crude drugs- Classification...

Pharmacological Action	Drugs
Anticancer	Vinca, Podophyllum, Taxus
Anti-inflammatory	Colchicum, Turmeric
Antiamoebic	Ipecac root, Kurchi bark
Antiasthmatic	Ephedra, Lobelia
Anthelminthic	Male fern, Quassia wood
Antispasmodic	Datura, Hyoscyamus
Astringent	Catechu
Analgesic	Opium, poppy
Bitter tonic	Quassia wood, Nux-vomica, Gentian
Carminatives	Coriander, fennel, clove, peppermint
Purgatives	Senna, Rhubarb
Expectorant	Tulsi, Balsam of Tolu, Vasaka
Cardiotonic	Digitalis, Squill, Strophanthus
Tranquilizers	Rauwolfia Roots

Crude drugs- Classification...

Merits

- ✓ Used for suggesting substitutes of drugs

Demerits

- ✓ Ambiguity and confusion : as drugs having different action on the body gets classified separately in more than one group .
- ✓ Cinchona--- **antimalarial** due to **quinine**
-----**antiarrythmic** due to **quinidine**.

Evaluation of Crude Drugs

- ❖ To evaluate a drug means to identify it and determine its quality and purity.
- ❖ Medicinal plants are categorized according to their:
 - ✓ Sensory (organoleptic)
 - ✓ Microscopic
 - ✓ Biologic
 - ✓ Chemical
 - ✓ Physical

Evaluation ...

A. Organoleptic Evaluation

- Is evaluation by means of sense organs based on:
 - ✓ Macroscopic appearance of the drug
 - ✓ Sensory character of the drug: gross morphology, colour, odour, taste, size, shape, and special features, such as: touch, texture.
- The simplest, yet the most human form of analysis.

Evaluation ...

B. Microscopic Evaluation

- Evaluation and identification of powdered drugs,
- Detection of adulterants, and
- Identification of plants by characteristic tissue features
- Determine microscopic characters like stomata number, stomata index, palisade ratio, vein-islet number, vein termination number, etc.

Evaluation ...

C. Biologic Evaluation:-

- Evaluation of pharmacological activity, potency, and toxicity.
- Microbiological assays
- More time consuming, more expensive and less precise.
- It can be
 - *in vitro*: done in lab; test tubes/ dish
 - *ex-vivo*: done in isolated organs of organism
 - *in vivo*: in the body of experimental animal



Evaluation ...

D. Chemical evaluation:- determinations of their active principles.

- **Qualitative chemical tests:** presence of the intended class of Cpd.
 - **Mayer's test:** detection of alkaloids
 - **Benedict's test:** for carbohydrates....
- **Quantitative chemical tests :**
 - **Acid value:** number of **carboxylic acid** groups in a chemical cpd,
 - **Saponification value:** number of total free and combined acids.
- **Instrumental analyses:** to analyse the chemical groups of cpd.
 - chromatographic and spectroscopic methods

Evaluation ...

E. Physical evaluation

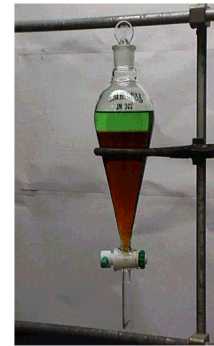
- Application of physical constants in crude drug evaluation.
- **Physical constants** : solubility, specific gravity (relative density), optical rotation, refractive index, melting point, water content, viscosity, ash values, and extractive values.
- Specific gravity. drugs that sink or not sink in water.
- Elasticity
- **Uv interaction:** Aconite--light blue, Berberine --yellow, Emetine---orange

Types of preparations from plants

- Fresh plant
- Crude drugs
- Crude extracts (extractives)
- Fractions (Solvent fractions)
- Isolated pure compound



**Peppermint
(fresh)**



Fractions



**Sandalwood (crude
drug)**



Isolated pure compound

Adulteration of crude drugs

- **Adulteration:** partial or full substitution of the original drug with other substance
 - Free from or inferior in therapeutic and chemical properties.
 - Introduction by human factors
 - May be accidental or deliberate
- Adulteration may occur as
 - ✓ **Admixture:** mixing of the drug with other material or
 - ✓ **Substitution:** complete substitution of the drug by another substance.

Types of adulteration and means of detecting them

❑ Accidental adulteration

- Occurs as a part of the normal process of collection of the drug and its preparation for the market.
- Tolerated as long as it is within the specified Pharmacopoeial limit (e.g. in BP usually 2% w/w).
- *It may comprise:*
 - **The Presence of inorganic matter** e.g. soil, sand.
 - ✓ Detected by high ash values, macroscopic and microscopic examination.

Types of adulteration and means of detecting them...

- Presence of parts of the plant other than the official part.
 - ✓ These other organs may contain a low amount of active constituents or none at all or may contain toxic compounds.
 - ✓ Detected by macro/ micro examinations
- Presence of other plants growing on or together with the drug plant and collected in the harvesting process.
 - ✓ Detected by macro/ micro examinations, chromatographic profile

Types of adulteration and means of detecting them...

➤ The wrong plant collected by mistake instead of the genuine one
by unskilled collectors

- ✓ Detected by macro/ micro examinations, chromatographic analysis, chemical tests

❑ Deliberate adulteration

- Usually takes place when
 - ✓ the drug in question is expensive
 - ✓ there is shortage of supply

Types of adulteration and means of detecting them...

- Admixture or substitution is carried out to sell the poorer quality drug at the regular price
- The adulterant is a readily available, cheaper, and often worthless material
- Common types of adulterants employed for deliberate adulteration:
 - ➡ **Completely different plant with superficial resemblance to the authentic drug**
 - ✓ Detected by macroscopical / microscopical examinations, and other identification tests like chemical tests

Types of adulteration and means of detecting them...

- ☛ A species closely related to the official drug but with slightly different constituents or lower amounts of the active compounds.
 - ✓ Detected by careful macro/ micro examinations, chromatographic profile, assay procedures
- ☛ The same species as the official drug but an inferior commercial variety with lower active compounds or slightly different constituents.
 - ✓ Detected by chromatographic profile, assay procedures

Types of adulteration and means of detecting them...

➡ Simulated worthless structures made to look like the authentic drug.

✓ Detected by macro/ micro examination

-
- ❖ When the plant material is powdered, adulteration is **more difficult** to detect by macroscopical/morphological examination.
 - ❖ Common adulterants of powders are sawdust, ground nutshells, starch, chalk, sand and other minerals.

Types of adulteration...

Generally, types of intentional adulterations can be :

- ✓ Adulteration with inferior commercial varieties.
- ✓ Adulteration by artificially manufactured substitutes.

Eg: Artificial invert Sugar for Honey

- ✓ Adulteration by Exhausted drugs (volatile oil).
- ✓ Adulteration by addition of Heavy Metals.
- ✓ Adulteration by Synthetic Principles.
 - E.g : Citral is added to lemon oil,
Benzyl benzoate is added to balsam of Peru.

Official and unofficial drugs

- **Pharmacopoeia:**

- ✓ Pharmacopoeia is a book recognized by the government as the legal authority for standardization of drugs.
- ✓ Drugs of outstanding therapeutic value are standardized in the national pharmacopoeias.

- **An official drug**

- ✓ one that is listed and described as being a definite therapeutic agent in the pharmacopoeia.
- ✓ Official herbal drugs are usually listed in Herbal Pharmacopoeias.

Official and unofficial drugs ...

- The monograph:
 - ✓ The descriptive material pertaining to any of the drugs in the Pharmacopoeia.
 - ✓ In the monograph of a crude drug the following information are generally covered:
 - Plant name, definition, and description
 - Special condition for collection or preparation for the market
 - Identity tests, tests for adulterant, method of assay
 - Special storage requirements
 - The usual dose and range of dosage if the drug is administered internally

Official and unofficial drugs ...

- ❑ A natural remedy that has not been characterized in such a manner or has failed to comply with the official monograph is referred to as:
 - ✓ an **"unofficial drug"**.

Thank You