CHAPTER II
CRUDE DRUGS



Introduction

Definition

Drug

Drug means any substances that is:

- ✓ Recognized in the pharmacopeia
- ✓ Used for diagnosis, mitigation, treatment, or prevention of disease in human or animal.
- ✓ Affect the structure or function of human or animal and also substances of natural or synthetic origin having therapeutic properties and chiefly used as medicines or ingredients in the medicine.

Crude drugs are any naturally occurring, unrefined substance derived from organic or inorganic sources such as plant and animal.

- It is used for those natural products such as plants or part of plants, extracts and exudates which are not pure compounds and used in medicine.
- The term crude drug generally applies to the products from plant and animal origin found in a raw form. However, the term is also applied to include pharmaceutical products from mineral kingdom in original form and not necessarily only of organic origin such as kaolin, bentonite etc.

❖ Crude drugs can thus be defined as:

- The term "**crude drug**" indicates any natural products which has not been advanced in value or improved in condition by:
  - Grinding
  - Chipping
  - Crushing
  - Distilling
  - Evaporating
  - Extracting
  - Artificial mixing with other substances.

- The term “**advanced**” means the natural products that has been improved or advanced in value beyond what is essential by some mechanical or physical process.

Crude drugs:

- Dried plant parts used in medicinal preparations
- Complex mixtures of cells and chemicals
- Previously mainly used in the form of alcoholic extracts (tinctures)
- Pharmacist need basic knowledge of the ways in which how medicinal plants can be extracted and tested for presence of active principles

Sources of crude drugs

- Plant sources, e.g. Senna, Digitalis, Datura, Cascara, Cinchona, Clove, Opium, etc.
- Animal sources, e.g. cochineal, cantharidin, honey, cod liver oil, musk, thyroxin, etc.
- Marine sources, e.g. sponges, red algae, agar, etc.
- Mineral sources, e.g. talc, kaolin, kieselguhr, etc.

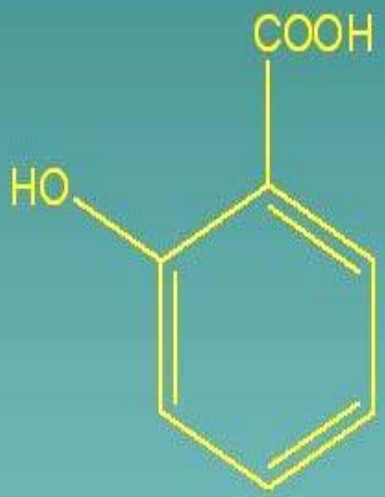
Natural products:

- They can be
  - ✓ Entire organism (plant, animal, organism)
  - ✓ 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

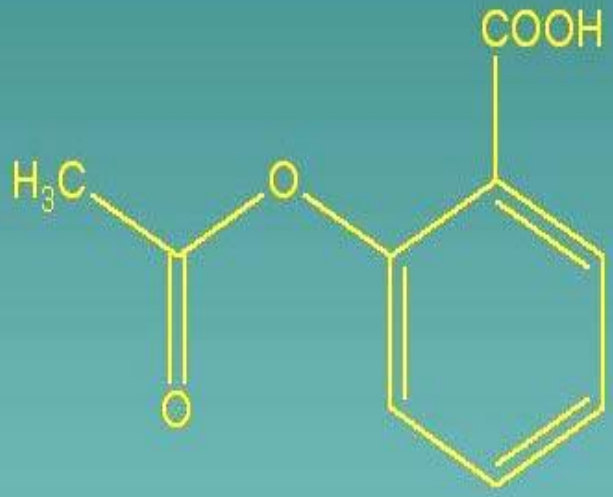
Value of natural products

- Compounds from natural sources play four significant roles in modern medicine:

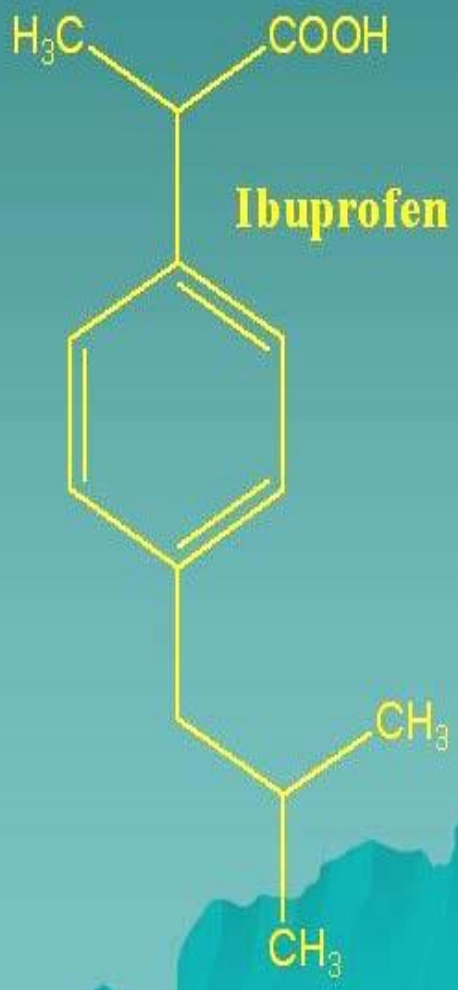
1. provide a number of extremely useful drugs that are difficult or impossible, to produce commercially by synthetic means.
2. Natural sources also supply basic compounds that may be modified slightly to render them more effective or less toxic
3. Their utility as prototypes or models for synthetic drugs possessing physiologic activities similar to the originals.
4. Some natural products contain compounds that demonstrate little or no activity themselves but which can be modified by chemical or biological methods to produce potent drugs not easily obtained by other methods



Salicylic Acid



Aspirin



Ibuprofen

- **Animal drugs**
  - Are collected from wild or domestic animals; mainly from domesticated animals like vegetable drugs from cultivated plants.
  - Drugs such as lard, lanolin, and milk products, as well as hormones, endocrine products, and some enzymes are obtained from domesticated hogs, sheep or cattle.
  - Processing and purification of animal drugs varies with the individual drugs.

1. **Entire animals**

- **Cantharides:** dried beatles of *Lytta vescatoria* and the active constituent cantharidine anhydride of dibasic acid cantheric acid:
- Used as irritant rubefacient (counter irritant)
- **Cochineal:** obtained from dried female insect of *Dactylopius coccus*.
- The active principle is carminic acid…coloring agent in tooth paste.

2. Animal products

- **Musk:** dried, distilled product of gland musk deer. Active constituent is volatile muskone used as fixative in class perfumes.
- **Thyroid:** dried cleaned powdered thyroid gland. Mainly from ox. used as treatment of goiter and obesity.
- **Pepsin:** obtained from glandular layer of fresh hog used as protein digestion.

Types of drugs derived from plants

1. Herbal drugs, derived from specific parts of a medicinal plant
2. Compounds isolated from nature
3. Nutraceuticals, or “functional foods”

- **Vegetable Drugs**
  - Plant drugs are collected from wild or cultivated plants; the plants could belong to higher or lower plants but the flowering plants taking the largest share, spermatophyta (seed producing plants).

Function of Pharmacognosist:

- Identification of the drug sources
- Determination of the morphological character
- Investigation of potency, purity, and admixture
- Planning and designing of the cultivation of medicinal plants
- Prescription of the detail processes of collection, drying and preservation
- Knowledge about active constituents, chemical nature and uses

Nomenclature of Crude Drugs(plant drugs)

- **Common naming**
  - **L**ocal language names (vernacular names)

- **Scientific naming/ Binomial naming**
  - more appropriate for exchange of information
  - they avoid ambiguity

- forms the basis of correct identification and authentication of the crude drug.

- Correctly identified drug will lead to phytopharmacological studies and development of novel drugs.

- A universal nomenclature for crude drugs, applicable all over the world, could consist of the scientific plant name together with the English name of the plant part.

- The reason why common names are not reliable is that they may lead to more than one Accepted botanical name.

The Binomial System

- In this system the first name, which is always spelt with Capital letter, denotes the **genus** whilst the second name denotes the **species**.
  - Swedish biologist **Carl Linnaus**, (1753).

- **The specific (Species) name is usually chosen to indicate:**

1- Some noticeable characteristics of the plant:

- *Conium maculatum* (maculate = spotted)
  - stem with reddish, spotted patches.
- *Glycyrrhiza glabra* (glabrous = smooth).
  - Refers to the fruit of this species which is a smooth pod.
- *Hyoscyamus muticus* (muticus = short).
  - The plant 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).

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)

4- A geographical source or history of a drug:

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

5- A Pharmaceutical activity or an active constituents:

- *Papaver somniferum* (sleep inducing)
- *Strychnos nux vomica* (from two latin words, nut causing vomiting)
- *Ipomoea purga* (laxative).

6- A general meaning or a special indication

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

The generic name may also allude to certain characters of the plant:

- *Atropa,* from Atrops, meaning flexile, the name of the Greek fate who cuts the thread of life, alluding to the poisonous characters of the drugs.

- *Glycyrrhiza* is from glucose= sweet, riza = root.

Origin (Sources) of Crude Drugs

1. Natural or Biological Origin
2. Geographical origin
3. Commercial Origin

1. The Natural or Biological Origin

- Is the plant or animal yielding it
  - if a plant, botanical origin or botanical source
  - if an animal, zoological origin or source

2. Geographical Sources of Drugs

- is the region in which the plant or animal yielding the drug grows
- Plants growing in their native countries are said to be **indigenous** to these regions

  e.g. *Hyoscyamus muticus* of Egypt
- Plants are said to be **naturalized** when they grow in a foreign land or in locality other than their native home

3. Commercial Origin

- The commercial origin of a drug refers to its production and its channels of trade

Classification of Crude Drugs

- The most important natural sources of drugs are **higher plant**, **microbes** , **animals** and **marine organisms**.
- Some useful products are obtained from minerals

Why classifying crude drugs?

- Aim: is to study the origin of drugs and their evolution from their source; a simpler to advanced form over a period of time
- In order to pursue 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
  - Simple
  - Easy to use
  - Free from confusion and ambiguities.
- Each arrangement of classification has its own merits and demerits.

- For the purpose of study, drugs are classified in the following different ways:
  - Alphabetical classification
  - Morphological classification
  - Taxonomic classification
  - Pharmacological classification
  - Chemical classification
  - Chemotaxonomical classification

A. Alphabetical Classification

- Alphabetical classification 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 classify crude drugs according to this system.
- These are:
  - Indian Pharmacopoeia
  - British Pharmacopoeia
  - British Herbal Pharmacopoeia
  - United States Pharmacopoeia and National Formulary
  - British Pharmaceutical Codex.
  - European Pharmacopoeia
- In European Pharmacopoeia- arranged in Latin names
- U.S.P. and B.P.C- these are arranged in English.

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, Nuxvomica, Opium, Podophyllum, Quassia, Rauwolfia, Senna, Vasaka, Wool fat, Yellow bees wax, Zeodary.

B. Morphological Classification

- arranged according to the morphological or external characters of the plant parts or animal parts .
  - which part of the plant is used as a drug
  - e. g. leaves, roots, stem etc.
- The drugs obtained from the direct parts of the plants and containing cellular tissues are called as *organized drugs*
  - *e. g.* Rhizomes, barks, leaves, fruits, entire plants, hairs and fibres.

- The drugs which are prepared from plants by some intermediate physical processes such as incision, drying or extraction with a solvent and not containing any cellular plant tissues are called as unorganized drugs.
  - Aloe juice, opium latex, tragacanth, benzoin, honey, beeswax, lemon grass oil etc. are examples of unorganized drugs.

Organised Drugs

- **Woods**– Quassia, Sandalwood, Red Sandalwood.
- **Leaves**– Digitalis, Eucalyptus, Gymnema, Mint, Senna, Spearmint, Squill, Tulsi, Vasaka, Coca, Buchu, Hamamelis, Hyoscyamus, Belladonna, Tea.
- **Barks**– Arjuna, Ashoka, Cascara, Cassia, Cinchona, Cinnamon, Kurchi, Quillia, Wild cherry.
- **Flowering parts**– Clove, Pyrethrum, Saffron, Santonica, Chamomile.
- **Fruits**– Amla, Anise, Bael, Bahera, Bitter Orange peel, Capsicum, Caraway, Cardamom, Colocynth, Coriander, Cumin, Dill, Fennel, Gokhru, Hirda, Lemon peel, Senna pod, Star anise, Tamarind, Vidang.

- **Seeds**– Bitter almond, Black Mustard, Cardamom, Colchicum, Ispaghula, Kaladana, Linseed, Nutmeg, Nux vomica, Physostigma, Psyllium, Strophanthus, White mustard.
- **Roots and Rhizomes**- Aconite, Ashwagandha, Calamus, Calumba, Colchicum corm, Dioscorea, Galanga, Garlic, Gention, Ginger, Ginseng, Glycyrrhiza, Podophyllum, Ipecac, Ipomoea, Jalap, Jatamansi, Rauwolfia, Rhubarb, Sassurea, Senega, Shatavari, Turmeric, Valerian, Squill.

- **Plants and Herbs**– Ergot, Ephedra, Bacopa, Andrographis, Kalmegh, Yeast, Vinca, Datura, Centella.
- **Hair and Fibres**– Cotton, Hemp, Jute, Silk, Flax.

Unorganised Drugs.

- **Dried latex**– Opium, Papain
- **Dried Juice**– Aloe, Kino
- **Dried extracts**– Agar, Alginate, Black catechu, Pale catechu, Pectin
- **Waxes** - Beeswax, Spermaceti, Carnauba wax
- **Gums** – Acacia, Guar Gum, Indian Gum, Sterculia, Tragacenth.
- **Resins**– Asafoetida, Benzoin, Colophony, copaiba Guaiacum, Guggul, Mastic, Coal tar, Tar, Tolu balsam, Storax, Sandarac.
- **Volatile oil–** Turpentine, Anise, Coriander, Peppermint, Rosemary, Sandalwood, Cinnamon, Lemon, Caraway, Dill, Clove, Eucalyptus, Nutmeg, Camphor.
- **Fixed oils and Fats**– Arachis, Castor, Chalmoogra, Coconut, Cotton seed, Linseed, Olive, Sesame, Almond, Theobroma, Cod-liver, Halibut liver, Kokum butter.
- **Animal Products** – Bees wax, Cantharides, Cod-liver oil, Gelatin, Halibut liver oil, Honey, Shark liver oil, shellac, Spermaceti wax, wool fat, musk, Lactose.
- **Fossil organism and Minerals**– Bentonite, Kaolin, Kiesslguhr, Talc.

Difference between organized and unorganized drugs

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.

Merits:

- More helpful to identify and detect adulteration.
- More convenient for practical study especially when the chemical nature of the drug is not clearly understood.

Demerits:

- there is no co-relation of chemical constituents with the therapeutic actions. (main drawback)
- Repetition of drugs or plants occurs.

C. Taxonomical Classification

- Taxonomical classification is purely a botanical classification
- based on principles of natural relationship and evolutionary developments.
- the drugs are arranged according to the plants from which they are obtained,

  Kingdom, phylum, classes, orders, families, genera and species

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

Merits

- Taxonomical classification is helpful for studying evolutionary developments (no ambiguity)

Drawback

- This system does not co-relate the chemical constituents and biological activity of the drugs.

D. Pharmacological Classification

- Grouping of drug according to their pharmacological action /of most important constituent /their therapeutic use
- more relevant and is mostly followed method.
- Table below gives an outline of pharmacological classification of drugs .

Classification of Drugs based on Pharmacological action.

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

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 gets 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 antiarrythymic action of quinidine.

E. Chemical/Biogenetic Classification

- The crude drugs are divided into different groups according to the chemical nature of their most important constituent or their biosynthetic pathways
  - Constituents or biosynthetic pathways
- Since the pharmacological activity and therapeutic significance of crude drugs are based on the nature of their chemical constituents, this classification is dependent upon the grouping of drugs with identical constituents.

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

- ✓ Gums Acacia, Tragacanth, Guargum
- ✓ Mucilages Plantago seed
- ✓ Others Starch, Honey, Agar, Pectin, Cotton

Glycosides – Glycosides are compounds which upon hydrolysis give rise to one or more sugars (glycone) and 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, Strophantus
- ✓ Bitter Glycosides Gentian, Calumba, Quassia, Chirata, Kalmegh

Tannins– Tannins are complex organic, non-nitrogenous derivatives of polyhydroxy benzoic acids.

Examples- Pale catechu, Black catechu, Ashoka bark, Galls, Myrobalan, Bahera, Amla

Volatile oils– Monoterpenes and sesquiterpenes obtained from plants

Examples- Cinnamon, Fennel, Dill, Caraway, Coriander, Cardamom, Orange peel, Mint, Clove, valerian

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 Colophony, Podophyllum, Cannabis, Jalap, Capsicum, Turmeric, Balsam of Tolu and Peru, Asafoetida, Myrrh, Ginger

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

Merits

- It is a popular approach for phytochemical studies

Demerits

- Ambiguities
  - Plants contain more than one group of active constituents each with different actions

F. Chemotaxonomic Classification

- This system of classification relies on the chemical similarity of a taxon.
- 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 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,
- It is the latest system of classification and gives more scope for understanding the relationship between chemical constituents, their biosynthesis and their possible action.

The Evaluation of crude drugs

- **Evaluation deals with:**
  - the correct identification of the plant
  - determination of the quality & purity
  - detection of nature of adulteration
- **Reasons for crude drug evaluation**
  - biochemical variation in the drug
  - deterioration due to treatment & storage
  - substitution and adulteration
- **Identification of the plant**
  - comparison with authentic or genuine sample
  - comparing the published description of the drug with unknown sample

METHODS

- ✓ Organoleptic
- ✓ Microscopic
- ✓ Biologic
- ✓ Chemical
- ✓ Physical

- 1. Organoleptic Evaluation
  - Is evaluation by means of sense organs and includes:
    - ✓ Macroscopic appearance of the drug
    - ✓ Its odor and taste
    - ✓ Its sound of fracture
    - ✓ The feel of the drug to the touch

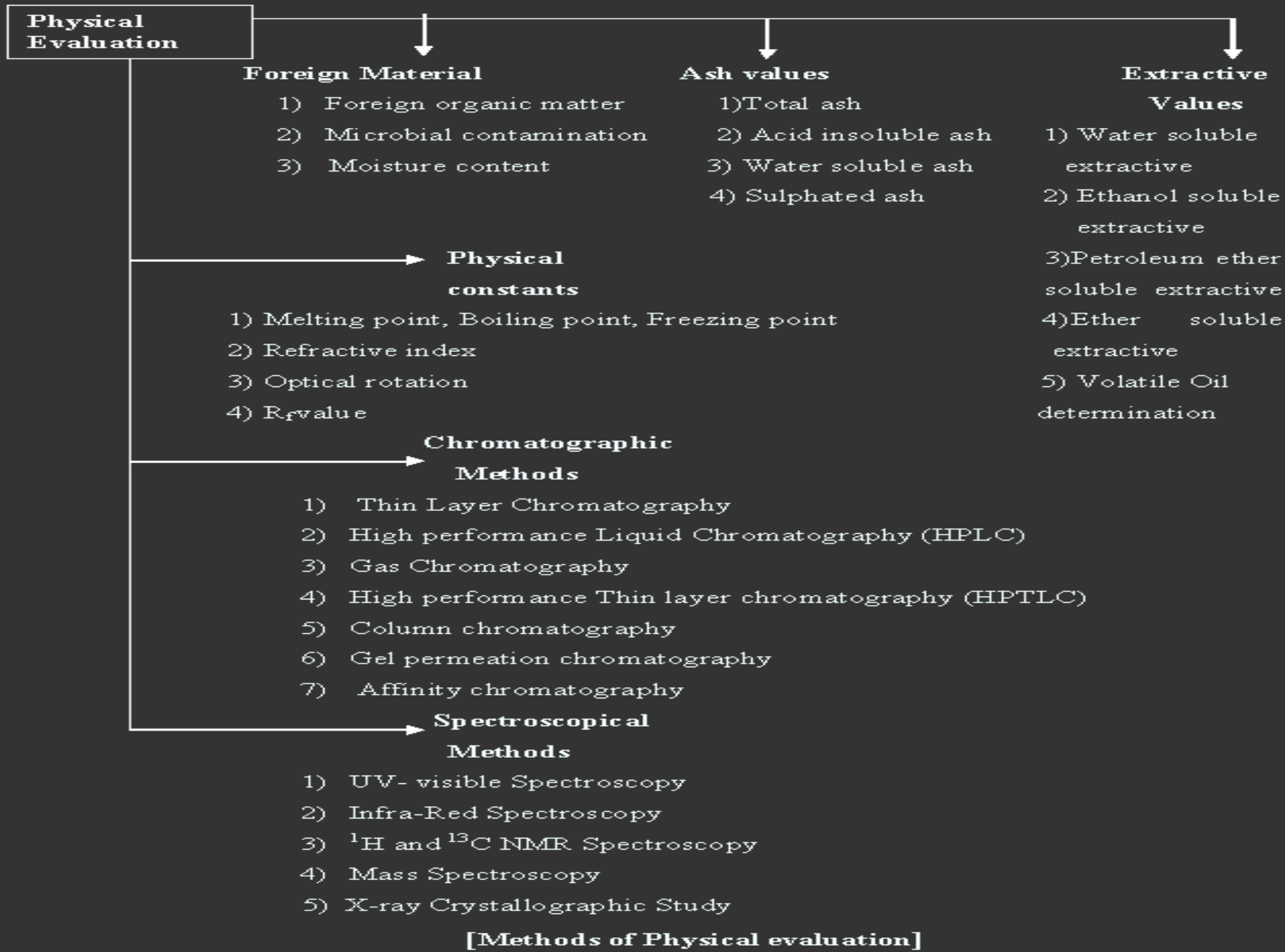
- 2. Microscopic Evaluation
  - ✓ Microscope has been used since 1847
  - ✓ It is used to study adultrated animal or plant drugs and identification or true powdered drug.
  - ✓ Exclusively used to study powder
  - ✓ Applies suitable stain, reagent, or mounting agents.

3. Chemical evaluation

- It comprises of different chemical test & chemical assays
  - Phytochemical screening
  - Employed :
    - ✓ For identification of crude drugs
    - ✓ To ascertain purity of drugs
    - ✓ Chemical assay- for both quantitative and qualitative

- 4. Physical evaluation
  - Application of physical constants in crude drug evaluation.
    - Specific gravity is used occassionally
    - e.g. drugs that sink or not sink in water.
    - Elasticity may also be used
    - Uv interacrtion of certain drugs is important quality.
    - Some alkaloids give distinct colors with uv –light.
      - Aconite-----light blue
      - Berberine ----yellow
      - Emetine-------orange
  - Physical constants applied generally are solubility, specific gravity, optical rotation, refractive index, melting point and water content.

4) Physical Evaluation: [1, 2, 3, 5, 6]



[Methods of Physical evaluation]

5. Biological (Bioassay) Evaluation

- includes the quantitative assay of the drugs using biological models of intact animals, animal preparations, isolated living tissues or microorganisms
- it is less precise, time consuming & more expensive to conduct
- Used to measures the actual biological activity of a given sample

In-vitro Bioassays

- are rapid
- less selective, but diagnostic
- less expensive
- suitable for minute amounts of materials
- suitable for screening large number of samples in dug discovery programs

In-vivo Bioassays

- more selective,
- expensive,
- mostly time consuming
- animal model
- require large amounts of material
- hardly could guide the fractionation of extracts or mixture of compounds

Adultration of crude drugs

Adultration is the substitution of the original crude drug partially or fully with other substances which is either free from or inferior in therapeutic and chemical properties.

Types of Adulteration

- ✓ Adulteration with inferior commercial varieties

  Eg: Eucalyptus globulus oil by other cheap volatile oils

- ✓ Adulteration by artificially manufactured substitutes.

  Eg: Artificial invert Sugar for Honey

- ✓ Adulteration by Exhausted drugs. Eg: Clove, Fennel.
- ✓ Adulteration by addition of Heavy Metals.

  Eg: Lead in pieces of Opium.

- ✓ Adulteration by Synthetic Principles. Eg: Adding Citral to Oil of Lime.

Official and unofficial drugs

- Drugs are either official or unofficial. An official drug is one which is listed and described in a book recognized by the government as the legal authority for standards "**Pharmacopoeia**"

- Unofficial drug are substances that have been recognized in either official pharmacopeias or National Formularry but are not presently found in the current issues.

- Nonofficial drugs are substances that have never been appeared in either books.

Official and Unofficial Drugs Cont…

•In the monograph of a crude drug the following information are generally covered:

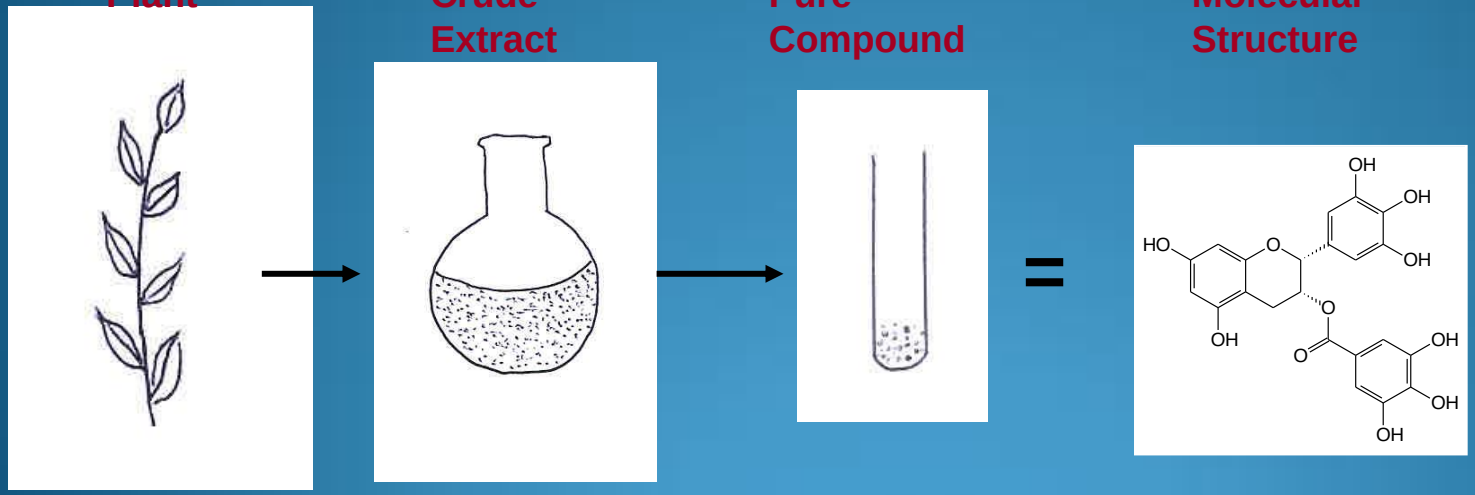
- English, Arabic, Latin & French names
- Definition
- Description special condition for collection
- Preparation for the market, identity tests, tests for adulterant
- Method of assay,
- Special storage requirements
- The usual dose and range of dosage if the drug is administered internally

Scheme for Pharmacognostic Studies of a Crude Drug

- **Official title, synonyms or vernacular names, if any.**
- **Biological source and family.**
- **Geographical source or habitat.**
- **History and introduction of crude drug.**
- **Cultivation collection, processing for market and commerce in crude drugs.**
- **Morphological or macroscopical character.**
- **Microscopic or histological studies.**
- **Chemical constituents and qualitative chemical tests**
- **Pharmacological actions, therapeutic and other Pharmaceutical uses and Pharmaceutical preparation or formulations.**
- **Commercial varieties, substitutes and adulterants**

4. Steps in the Scientific Analysis of Drugs from Natural Resources

Plant → **Crude Extract** → **Pure Compound** = **Molecular Structure**



4.1. Steps in the Scientific Analysis of Drugs from Natural Sources

1. Selection and collection of plant material



- Accidental experience
- Doctrine of signatures
- Random screening
- Traditional use
- Littérature Information Sélection Technique (L.I.S.T.)
- Selection based on chemotaxonomy

Steps Cont…

2.Taxonomic identification of the plant

- Pressing







Steps Cont…



3.Literature survey

- to get update on current knowledge about the plant
  - helps to avoid repetition
  - helps to design methods of extraction …..
- to check consistency of folkloric use

Steps Cont…

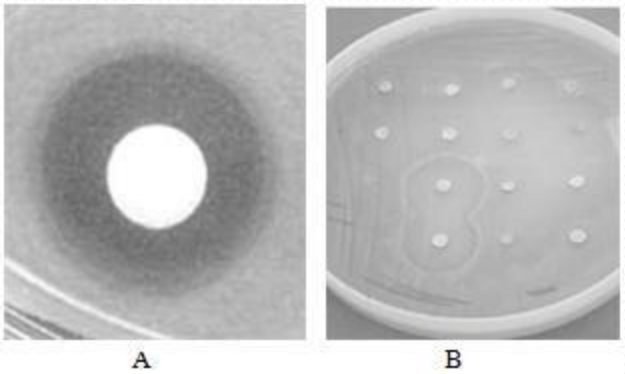
4. Design of appropriate extraction method



Steps Cont…

5. Checking extracts/ fractions for pharmacological activity

- *In-vitro* and *In-vivo*





Steps Cont…

6. Phytochemical screening

- **Chemical tests** and Chromatography





Steps Cont…

7. Isolation of active compounds

- Classical and modern methods



Steps Cont…

7. Structure Determination

- NMR
- MS
- UV-vis
- IR



4.2. Approaches to Screening Process

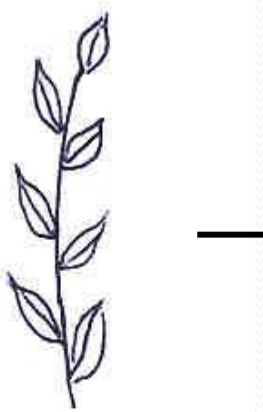
1. Phytochemical Approach

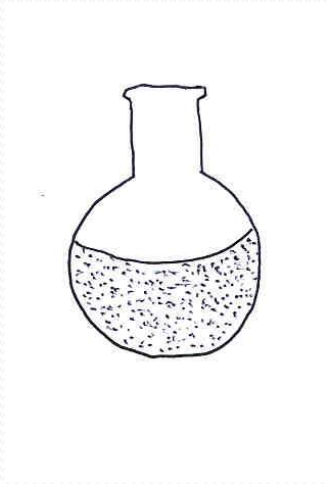
- Requires firstly the isolation of a pure compound from the plant, and then to determine its bioactivity (if any) by applying the classic pharmacological studies
- It involves:
  - Screening of extracts for specific chemical class
  - Using chemical reagents for detection
  - Chemically-guided fractionation
- Results:
  - Minute/Trace components are mostly missed (detection limits)
  - Unknown natural compounds are certainly missed
  - Mostly: No biological activity found

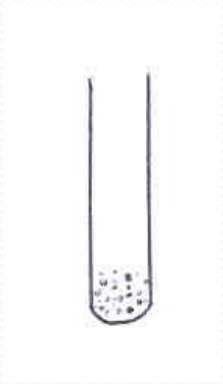
Approaches to Screening Cont…

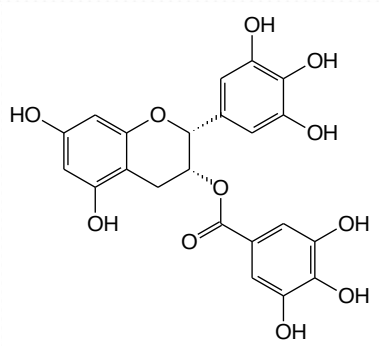
From Plant to Drug

Plant → **Crude Extract** → **Pure Compound** = **Molecular Structure**









Approaches to Screening Cont…

2. Bioactivity Approach

- Extracts are screened for a specific therapeutic activity using mostly *in-vitro* bioassay(s).
- Only those possessing a bioactivity are fractionated
- Active fractions are further fractionated to isolate the active compounds in pure form
- Followed by characterization of its structure
- Results: often leads to the finding of highly potent, minor, novel compounds

From Plant to Drug

Plant → **Crude Extract** → **Pure Compound** = **Molecular Structure**

