Pharmacognosy

Lec: 1 **2nd stage**

Introduction to Pharmacognosy

Pharmacognosy: is the study of those natural substances principally plants that find use in medicine. or define as an applied science that deals with the biologic , biochemical and economic features of natural drugs and their constituents.

It is a study of drugs that originate in the plant and animal kingdoms.

The word derived from '*pharmakon*' meaning drug and '*gnosis*' meaning knowledge (Greek word).

Although pharmacognosy is concerned mainly with naturally occurring substance that have a medicinal action it is complete limited to such substance . thus surgical dressing prepared from natural fibers , flavouring , suspending agent, disintegrants and supporting media are also include within the subject.

Other fields that have natural associations with the subject are poisons , hallucinogenic plant , raw materials for the production of allergens herbicides ,insecticides and molluscicides.

Pharmacognosy science concerned with studying the following subjects:

1- Taxonomy of plants and the natural sources of drugs.
2- Distribution of natural products in the world.
3- Description of plants such as tree (salix), shrub (catharanthus), perennial (peppermint).
4- The active constituents from natural sources (active groups) such as Glycosides, Alkaloids, Volatile oils, Tannins etc.

5- The biosynthesis and storage places of the active constituents in organisms (plants, animals etc.).
6- The part used from the natural sources in medicine and pharmacy as leaf (Mint, Digitalis), roots (Liquorice), seeds (Coffee bean).
7- Storage and collection of the used part.
8- Physical, chemical and biological properties of active constituent.
9- The correct prescription of natural drug in the treatment of the disease

Plant nomenclature:

In the 18th century, Latin was universal language of scientists. Carlos Linnaeus (1707-1778) was a botanist who the founder of the botanical nomenclature system. Nomenclature system may include plants place of origin, leaf, bud, branch of flower description, special characteristics or even named after a person.

In his nomenclature

1. **the first** Latin word spelled with **capital** letter indicated the genus.
2. **The second** name **not capitalized** pinpoints the species.
3. plant **family** with **capital letter**.
4. The genus and species should be written in **italics** or **underlined**

E.g. Belladonna ست الحسن

Botanical name: *Atropa belladonna* (family: Solanaceae)

Other example: Digitalis نبات الدفلة

Botanical name : Digitalis purpurea Scrophulaiaceae

So it can be written in two way

5. Botanical names are **followed by** the names of a **person or their accepted abbreviations**

Ex: Mentha piperita Linnaeus or L

This name (Linnaeus) refers to the **botanist** who first described the species or variety. This name is useful where there is different names for the same plant.

taxonomy:

is the science of classification of all living organism into a groups based on similarities of structure or origin .

the aim of taxonomy

1.To identify all kinds of plants. This aim requires us to make a complete inventory of all the plants on the face of the earth.

2-To arrange the kinds of plants into a scheme of classification that will show their true relation.

This aim will enable to understand the relationships among groups of plants (starting from the lower plants and lesser groups or taxa such as the species).

Chemical plant taxonomy:

focuses on the classification of plants based on their chemical composition. the modern techniques of isolation and characterization have led to the chemical screening of many of plants compare with morphological and chemical constituents are more precisely definable and can be of more fundamental significance for classification purpose. The presence chemical taxonomy need to be those of intermediate distribution in the plant of such compound as the essential amino acid and common sugar is of **little diagnostic value** and the occurrence of coniine in the single species *Conium maculatum* of the large family Umbelliferae is also of **little taxonomic significance**.

Characters most studied in this connection are **secondary metabolites** ex: alkaloids, flavonoids, characteristic glycosides etc…& more recently, **DNA characteristics**, **specific proteins** & **amino acids**

sequencing in proteins.

Some words that should be define

Primary metabolites : A metabolite excreted during the growth phase .they mainly contain carbon ,nitrogen & phosphorus ex. sugars , amino acids , and nucleotides .

Secondary metabolites : Are compounds belonging to extremely varied chemical groups , such as organic acids aromatic compounds terpenoides , alkaloids etc..their function in plants for growth regulation , lignifications , coloring of plant parts , protection.

Crude drug: natural products which are not pure compounds i.e. plants or parts of plants, extracts or exudes; or an un refined or raw drug that is in its natural form such as a drug which is taken directly from plant source.

Biological sources of drugs

An examination of the list of drugs derived from natural sources , reveals the followings:

1. **Plant :** The majority of plants are derived from Spermatophyte (the dominant seed bearing plants). Within the Spermatophyte the number of species & the number of useful medicinal plants are divided unevenly between the phyla Gymnosperm , which yields some useful oils, resins & the alkaloid ephedrine , & the Angiosperm , which is divided into monocotyledons & dicotyledons (both of these provide many useful drugs but especially the dicotyledons).
2. **Fungi :** The fungi provide a number of useful drugs especially antibiotics, & are important in pharmacy in a number of other drugs
3. **Algae :** These are source of limited number of drugs ex: agar & alginic acid.

4. **Lichens & mosses :** This group contribute little to medicine.
5. **Ferns & lycopodium**.
6. **Land animals :** It provides traditional pharmaceutical materials ex: gelatin , wool fat , beeswax & are a source of hormons , vitamins & sera.
7. **Bacteria :** is a source for the production of antibiotics , substrates & their employments in genetic engineering ex: in the production of human insulin.

Methods of using plants:

Plants may be used as

1. **isolated parts** e.g. dried leaves of plant as digitalis which contain glycosides as digoxin which is used for the treatment of heart diseases & congestive heart failure.
2. **Whole plant** e.g. Catharanthus roseus & its active constituents vincristine & vinblastine which are used as anticancer.
3. **Extract of active constituents** e.g. extract of unripe fruit of which contains morphine in *somniferum Papaver* plant as which is used as narcotic.

Importance or value of natural products drugs:

Natural drugs & their active constituents play many significant roles in modern medicine , as the followings:

1. **Some medicinal plants & their drugs have a high healing power for some diseases** specially cancer & heart diseases ,& till now these drugs are still in use in medicine e.g. digitalis & catharanthus (Vinca rosea).
2. **Natural products provide a good source for a number of useful drugs that are difficult in not possible to be produced commercially by chemical or micro biological** mean ; therefore ,

the only mean to produce these drugs is the plant e.g. digoxin ,vincristine , vinblastine, morphine etc….

3. **products supply basic compounds that can be modified structurally to render them more active** , less toxic , or change their activity e.g. production of codeine(cough suppressants) from morphine (narcotic & causes addiction).
4. **Natural compounds can be used as models for the synthesis of some drugs that have the similar pharmacological activities** e.g. salicin which is a glycoside having anti rheumatic activity was used as a model for the synthesis of salicylic acid.
5. **Some natural compounds which demonstrate little or no activity themselves can be modified structurally by chemical or biological methods** to produce potent drugs not easily obtained by other methods e.g. using saponin glycosides as a source for the production of cortisones & its derivatives & other hormones.

The drug according to pharmacopeia can be divided to

1. Official drug.
2. Non Official drug.

Official drug :mean natural or synthetic drug that organized and included in official pharmacopeia

Pharmacopoeia: is a book containing directions for the identification of samples and the preparation of compound medicines and published by the authority of a government or medical or pharmaceutical society

Which is:

1-British pharmacopeia

2-United state pharmacopeia

3-European pharmacopeia

Example:-

1) **Seed of the plant Vinca Rosa** and their active constituent (Vincristin and vinblastin) which is used in the treatment of cancer disease.
2) **Dried leaf of the plant digitalis** and their active constituent (Digitoxin or Digoxin) these drugs are used for the treatment of some heart disease.

Unofficial drug:- These drugs are natural or synthetic substances which are recognized and included in official pharmacopeia but after a period of time these drugs appear toxic effect ex:- Khat used as narcotic.

Non official drug:- these drugs are never appear in official pharmacopeia.

Plants can divided according to its origin into:

A. in digenous plant that growing in their native countries to those regions such as pinus palustris in the southern united states.

B. naturalized Plants when they grow in a foreign land or in a locality other their native homes such as Datura which was introduced into the united states from Europe.

Cultivated medicinal plants have been propagated for centuries in china, India, Europe and many other lands.

Evaluation of drugs:

To evaluate a drug means to **identify** it and to determine its **quality** and **purity**.

The identity of a drug can be established by its actual collection from a plant or animal that has been positively identified another method of identification is the comparison of a representative unknown sample to a published description of the drug and to authentic drug samples.

The Quality refers to the intrinsic value of the drug (i.e the amount of medicinal principles or active constituents present.

Methods of Drug Evaluation is done by studying its various properties.

1-Organoleptic property

2-Microscopic property

3-Biologic property

4-Chemical property

5-Physical property

1.Organoleptic refers to evaluation by means of the organs of sense and includes the macroscopic appearance of the drug, its odour , taste and colour. It includes the study of morphology and other sensory characters.

2.Microscopic is the study of specific characters Feature in powdered plant drugs since powdered plant drugs possess few microscopic features of identification such as Cell content, Characteristic of tissue structures.

3.Chemical methods include qualitative chemical and tests, quantitative chemical tests of the active constituents by chemical assays and instrumental evaluation .the chemical assay represents the best method of determining the official potency.

4.The Biologic mean the pharmacologic activity of certain drugs has been applied to their evaluation and standardization. Assays on living organisms as well as on it act organs indicate the strength of the drug and because living organisms are used, the assays are called biologic assays or bioassays. This method isless precise, more time consuming and more expensive.

5. **Physical property**: In crude drug evaluation physical methods are often used to determine the **solubility, melting point**, water content, degree of fiber, **specific gravity**, **optical rotation**, **viscosity**, **refractive index**, and other physical characteristics of the herb material.

Environmental and Geographical conditions that effect on medical plant:

Plant growth , development & sometimes the nature & quantity of secondary metabolites are affected by Environmental and Geographical conditions The main factors affecting on medical plant are .temperature , rainfall , length of day , quality of light, Soil& altitude . Such effects have been studied by growing particular plant in different climatic areas & observing variations.

i. **Temperature** : example the formation of volatile oils appear to be enhanced at higher temperature , although very hot days may lead to physical loss of oil.

ii. **Rainfall** : its distribution throughout the year , its effect on humidity & its effect coupled with the water-holding properties of the soil ex: Some time continuous rain can lead to loss of water soluble substances like glycoside from leaves & roots by leaching .so it effect on the yield of some active constituents .

iii. **Day-length & radiation characteristics** : example the trace amount of menthofuran peppermint leaves under long day conditions while is a major component of plant in short-day conditions.

iv. **Soil (land)** some medicinal plants which grow in **acid soils**. Ex: **Digitalis and gardenia** and other grow in **alkaline soils**. Ex: ***Atropa belladonna*** and cinchona

v. **–altitude**

vi. **-Atmospheric composition**

Preparation of Crude Drugs for the Commercial Market

The crude drug which reaches the pharmaceutical manufacturing line will have passed through various stages which is:

1. Collection
2. Drying and grinding
3. Storage

1.Collection :

Drugs may be collected from wild or cultivated plants & the task may be undertaken by unskilled or skilled workers depending on the plant to be collected. There are many points that should be taken in consideration during collection to have a good yield & quality of the plant , these are:

a-The season at which each drug is collected because the amount & the nature of the active constituents is not constant throughout the year.

b-The age of the plant because it effect on the total quantity of the active constituents produced and the relative proportions of the components of the active mixture.

c-The time of collection the composition of a number of secondary metabolites varies throughout the day & night.

d-The growth stage of the plant part :ex. The **leaves** of the following plants: tobacco, senna, and **digitalis**, are collected in the full maturity stage

2.Drying and grinding:

Drying is essential for the maintaining the quality of crude that was collected

Drying may be performed by the following ways:-

1. Open air drying
2. Artificial drying.

It is important for the following:-

1. It removes moisture which may cause decomposition of plants
2. prevents molding, the actions enzymes, the action of bacteria.
3. Converts the drug into a more convenient for commercial handling

1.Open air drying is done by:

a) **Under the Sun light :** used for crude drugs which are not affected by the light and high temperatures ex : Black pepper

b) **Under Shade:** for crude drugs which are affected by light & high temperature ex: fruits of Opium in (*Papaversomniferum*).

The duration of the drying process varies from a few hours to many weeks ,and in case of open air drying depend very largely on the weather.

2. Artificial drying : this type can be done by using oven heat to plant materials in certain conditions which not affect plant constituents. Ex: seeds of coffee bean this method is more rapid than open-air drying & is often necessary in tropical countries where the humidity is very high .

3. Storage: Most of the crude drugs are stored at temperature (20–25°C) in closed containers for a period of time depending on the type of these drugs.

Storage should be done in

1- Light proof.
2- Moisture proof.
3- Closed containers.

4- Should not be stored in wooden boxes or drawers and never in paper containers because the drug will deteriorate by moisture and also attacked by insects, rats and mice; so few drops of chloroform and carbon tetrachloride are very useful for preventing insect attack.

Deterioration : The primary factors which must be considered in relation to drug deterioration are moisture content , temperature , light & presence of oxygen, when these conditions are suitable , living organisms ex : bacteria , mould , insects will rapidly multiply using drug as a source of nutrient.

1- **Humidity** : humidity in 10-12 % moisture may be sufficient to activate enzymes present in the leaves & bring about decomposition of the glycosides. Other drugs which contain mucilage quickly absorb moisture & become a sticky mass .

2- **Temperature** : an increase in temperature in combination with moisture may accelerate enzyme activity or large temperature rise will lead to a loss of volatile constituents .

   In case of absorbent cotton wool cause a reorientation of the small amount of fatty material present leading to non or lower absorbency.

3- **Sun-light** : direct sunlight can cause :

   a- Produce bleaching of leaves & flowers.

   b- Decomposition of certain constituents ex: vitamins in cod-liver oil

Oxygen : this factor assists in the resinification of volatile oils & in the rancidification of fixed oils.