UNIT-1

Introduction to Pharmacognosy

Pharmacognosy is a scientific discipline, which is primarily concerned with the study of crude drugs obtained from natural sources such as plants, animals or minerals.

The term 'pharmacognosy' was coined by Seydler.

History

The history of Pharmacognosy is as old as civilisation. Plants were used medicinally in:

- China
- India
- Egypt
- Greece before beginning of Christian Era.

In India, medicinal properties of plants is described in Rigveda and Atharvaveda (3500-1500 B.C.) from where Ayurveda has developed.

Scope

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 development of cultivation technology for medicinal and aromatic plants.

→ Plant Chemistry (Phytochemistry) allows extraction, isolation, purification and characterisation of phytochemicals from natural sources.

→ Development of pharmacognosy also leads to development of botany, taxonomy, plant biotechnology, plant genetics, plant pathology, pharmaceutics and other branches of science.

Sources of Drugs

Medications can be obtained from varied sources:

(i) Plant sources
(ii) Animal sources
(iii) Marine sources
(iv) Tissue culture

Plant Sources

Plants or plant parts have been used as medicines for centuries.

Almost every part of the plant is used as a medicine.

Leaves → Digitalis purpurea is the source of digitoxin and digoxin which are cardiac glycosides.

Flowers → vincristine, vinblastine (from Vinca rosea)

Fruits → Physostigmine

Seeds → Strychnine (CNS stimulant)

Roots → Emetine, Reserpine

Bark → Quinine (from Cinchona), Conessine (Holarrhena antidysenterica)

Stem → Tubocurarine (from Chondrodendron tomentosum), Ephedrine (Ephedra sinica and Ephedra equisetina)

Animal Sources

In most instances, the medicinal substances are derived from animal's body serections, fluid or glands.

Given below are some important animal products:

1) Hormones → These are mammalian products secreted directly into the animal blood by its endocrine glands. Some important hormones are Insulin, Thyroid, Oxytocin, Ephedrine, gonadotropin, vasopressin.

2) Ezymes → Enzymes act as catalysts in biological / biochemical reactions. Some enzymes are pancreatin, Trypsin, Pepsin.

3) Animal Extractives → This comprises of liver and stomach preparations and bile.

4) Other animal drugs → components like carmine (a colouring agent obtained from cochineal insects), cod liver oil, heparin, wool fat.

Marine Sources

Bioactive compounds from marine flora and fauna have been extensively used in the prevention, cure of many diseases.
Coral, sponges, fish and marine microorganisms produce biologically potent chemicals with interesting anti-inflammatory, antiviral and anti-cancer activity.
For example, curacin A from cyanobacterium Lyngbya majuscule, eleuthrobin from coral Eleutherobia.

Tissue Culture

Tissue culture is a technique of growing tissues or cells in an artificial medium separate from the parent organism. It is in-vitro cultivation of plant cell or tissue under aseptic and controlled environmental conditions.
Tissue culture is used to grow large number of medicinal plants in a small area.

Organised Drugs

These drugs are obtained from the direct parts of the plants and containing cellular tissues.
Directly plants parts are used as medicines.
e.g. rhizomes, bark, leaves, fruits, etc.

Woods of → Quassia, Sandalwood

Leaves of → Digitalis, Eucalyptus, Mint, Senna, Tulsi, Belladona, Tea.

Barks of → Arjuna, Ashoka, Cinchona

Seeds of → Isapghol, castor

Roots and Rhizomes → Ashwagandha, ginger, ginseng, Turmeric, Rauvolfia

Entire plant or Herb → Ergot, Ephedra, Bacopa, Andrographis

Unorganised Drugs

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 unorganised drugs.

These drugs are not the direct parts of plants but derived from them by the processes mentioned above.

Examples:

Dried latex → Opium, papain

Dried juices → Aloe-vera, Kino

Dried extracts → Agar, alginate

Waxes → Beeswax, Carnauba wax

Gums → Acacia, Tragacanth, Guar gum

Resins → Asafoetida, Benzoin, Tar

Volatile oils → Terpentine, coriander, peppermint, cinnamon, lemon, clove, camphor

Fixed oils & fats → Arachis, coconut, cotton seed, linseed, olive, sesame, almond

Classification of Drugs

In order to follow the study of individual drugs, one must adopt some particular sequence of arrangement which is classification system of drugs. So for the purpose of study, the drugs are classified in the following different ways:

(i) Alphabetical classification
(ii) Morphological ,,
(iii) Taxonomical ,,
(iv) Chemical ,,
(v) Pharmacological ,,
(vi) Chemo-taxonomical ,,
(vii) Sero-toxonomical ,,

Alphabetical Classification

In this classification system, the arrangement of crude drugs is done alphabetically of their Latin and English names (common names).

Some of the pharmacopoeias and reference books which classify crude drugs according to this system are as follows:

(i) Indian Pharmacopoeia.
(ii) British Pharmacopoeia
(iii) British Herbal Pharmacopoeia
(iv) United states Pharmacopoeia and National Formulary
(v) British Pharmaceutical Codex
(vi) European Pharmacopoeia (Latin titles)
(vii) Encyclopedia of Common Natural Ingredients used in Drugs and Cosmetics.

Example of alphabetical classification may be:
(A)cacia, (B)enzoin, (C)inchona, (D)ill, (E)rgot, (F)ennel

Merits

(i) easy system and quick to use
(ii) No entries appear repetitively
(iii) Location, tracing and adding drug entries can be done easily.

Demerits

This system lacks any relationship with the previous and successive drug entries.

Morphological Classification

In morphological classification system, the arrangement of crude drugs is done according to the plants parts used as drugs.

Drugs based on this classification are:

(i) Organised Drugs
(ii) Unorganised Drugs

} Discussed in previous section

Merits

(i) Easy identification and detection of adulteration
(ii) Practical study of by this classification system is more convenient in cases where chemical nature of the drug is unknown.

Demerits

(i) The chemical constituents have no corelation with therapeutic actions.
(ii) Repetition of drugs or plants may appear.

Taxonomical Classification or Biological

The crude drugs are classified according to their kingdom, division, class, order, family, genus, and species.

Class → Angiosperms and Gymnosperms

Order → names end with suffix - ales

Family → names end with suffix - aceae.

Genus → Papaver (Poppy), Aquilegia (Columbine)

Species → specifies an individual plant.

Merits

Evolutionary developments are understood under taxonomical classification.

Demerits

(i) It fails to recognise the organised and unorganised forms of crude drugs.

(ii) Chemical nature of active constituents and therapeutic significance of crude drugs also not included.

Chemical Classification

In chemical system of classification, the crudes drugs are classified as per the chemical nature of their chemical constituents.

Examples

Glycosides → digitalis, senna, cascara

Alkaloids → cinchona, datura

Tannins → Myrobalan, ashoka

Volatile oils → peppermint, clove, eukalyptus

Lipids → castor oil, beeswax, lanolin

Merits

Phytochemical studies are well performed through this system.

Demerit

Confusion occurs when a drug contains many compounds belonging to different groups.

Pharmacological Classification

Drugs are classified on the basis of pharmacological action of their active constituents.

Examples

1) Drugs acting on GI system
   (i) Bitters – Gentian, quassia, cinchona,
   (ii) Carminatives – mentha, cardamom
   (iii) Emetics – Ipecacuanha
   (iv) Anti-amoebics – Kurchi
   (v) laxative & purgatives – Ispaghula, senna
2) Drugs acting on Respiratory system
   (i) Expectorants – liquorice, vasaka
   (ii) Antitussives – Opium
   (iii) Bronchodilators – Ephedra
3) Drugs acting on CVS
   (i) Vasoconstrictors – ergot and ephedra
   (ii) Anti-hypertensives – Rauwolfia
4) Drugs acting on CNS
   (i) Central analgesics – opium
   (ii) CNS stimulants – coffee
   (iii) Analeptics – lobelia, camphor
   (iv) CNS depressants – belladona, opium
5) Anticancer
   vinca, podophyllum, camptotheca, taxus

Chemotaxonomical classification

This system of classification relies on the chemical similarity of a taxon, i.e., it is based on the existence of relationship between chemical constituents in various plants.

Merit

provides a better understanding of the relationship between chemical constituents, their biosynthesis and action,

Demerits

It is complex to recognise the chemicals in plant. Hence, it is a time-consuming process.

Serotaxonomical Classification

serotaxonomy uses serology in understanding and solving the taxonomical problems.
Serology is a science which deals with the nature and interactions of antigens antibodies.
The similarities and dissimilarities among different taxa are understood by serological reactions.

Quality Control of Drugs of Natural Origin

A crude drug's quality control includes botanical identification, solvent extraction, purification and characterisation of pharmaceutically active constituents.

A drug's quality is affected by adulteration as its pharmacological activity is reduced. Thus, in order to maintain a drug's efficacy, its quality control is performed.

Adulteration of Drugs

Adulteration can be defined as admixture or substitution of genuine drugs with spurious, inferior, defective, useless or harmful substances.

The substances which cause adulteration are called adulterants. Adulteration can be done by-

deterioration → Impairment in drug quality

admixture → Accidental addition of one object into another.

sophistication → intentional type of aduteration.

Inferiority → Any substandard drug

substitution → Addition of an entirely different substance instead of the original drug.

spoilage → occurs as a result of microbial attack.

Types of Adulteration

Aduteration is of two types:

(i) Direct or Intended Aduteration

(ii) Indirect or Unintended.

1) Unintended Aduteration

It may occur due to following reasons:

(i) By faulty collection of drug at wrong time, in wrong weather or other part is collected.
Example- collection of Senna stem in place of stem.

(ii) By imperfect preparation and processing of crude drugs. Example- cork part is not removed properly from ginger rhizome.

(iii) By improper storage. Example- if volatile oils are not stored properly in air tight amber coloured container.

(iv) Due to common vernacular names of different drugs. Example - Brahmi is common name for two plants - Bacopa monnieri and Hydracotyl asiatica.

2) Intended Adulteration

(i) Adulteration with artificially manufactured substance in crude drug.
Ex- parrafin wax in Beeswax.

(ii) with inferior quality material (sofistication).
Ex- Alexandrian senna is added in Indian Senna.

(iii) with harmful substances
Ex- brick powder is mixed with chilli powder

(iv) Adulteration with superficially similar but inferior drug. Ex- Saffron is mixed with flowers of Carthamus tinctorious.

(v) Addition of excessive material. Example- excessive addition of stem in Senna.

Evaluation

Aduteration can be checked by methods of evaluation. Evaluation is an elaborate process of establishing the correct identity of a drug and determining its quality and purity.

A drug can be evaluated by the following methods:

(i) Organoleptic evaluation
(ii) Microscopic evaluation
(iii) Physical ,,
(iv) Chemical ,,
(v) Biological ,,

1) Organoleptic Evaluation

It involves the use of sense organs and dipends on the appearance and sensory characters of drug, such as its gross morphology, shape and size, colour and external markings and odour and taste.

Eamples- Camphor (aromatic odour)
Ginger, capsicum (pungent odour)
Cardamom (green colour fruit)
lemon (sour taste)

2) Microscopic Evaluation

It is done with the aid of microscopes and utilises various microscopic characters of the drugs, such as trichomes, calcium oxalate crystals, starch grains, pollen grains, etc. and their histological features such as types and arrangement of various cells and tissues.

This method is very important in evaluation of powdered drugs.

Microscope is also essential for determining some important physical constants like stomata number, stomatal index, palisade ratio, vein-islet number of leaves.

3) Physical Evaluation

Physical evaluation involves the study of physical properties of crude drugs. The physical parameters remain constant in rare cases, but they help in evaluating the following:

(i) Moisture content of drug
(ii) Viscosity of drug
(iii) Melting point
(iv) Solubility
(v) Optical rotation – optically active substances can rotate the plane polarised light.
(vi) Refractive index
(vii) Ash content → It is the residue left behind after incineration (burning) of drug.

4) Chemical Evaluation

Chemical evaluation involves different chemical tests and assays. It involves both qualitative and quantitative determinations of their active constituents.

Examples–

For alkaloids – Dragendroff's Test, Mayer's test Wagner's test

For cardiac glycosides – Legal test, Baljet test, Killer Killiani test

For steroids – Liebermann-Burchard reaction

For carbohydrates – Molish test, Fehling solution test

5) Biological Evaluation

Biological evaluation of crude drugs is useful in determining the potency of drug sample. Living organisms or their isolated living tissues are used in this method for bioassay. Many drugs, particularly the antibiotics, toxins and toxoids and vitamins are assayed by this method.

Examples

(i) Analgesic activity is evaluated by Hot plate method, Tail Flick Method
(ii) Anti-pyretic activity is evaluated by Yeast induced pyrexia
(iii) Anti-inflammatory activity is evaluated by Carageenan induced rat paw edema.

Quantitative Microscopy

Leaf constants

(i) **stomatal number** → It is the average number of stomata present per square mm of leaf epidermis.

(ii) **stomatal Index** → It is the percentage of stomata in comparison to total number of epidermal cells, each stoma being counted as one cell.

$$\text{stomatal Index} = \frac{S}{E+S} \times 100$$

where, S = number of stomata per unit area
E = number of epidermal cells in the same unit area.

(iii) **Palisade Ratio** → It is the average number of palisade cells present below each epidermal cell.

(iv) **Vein-Islet Number** → It is the number of vein islets present in per square mm of leaf surface midway between the midrib and margin.

(v) **Vein-Termination number** → It is the number of veinlet terminations present per square mm. of the leaf surface midway between the midrib and margin.

Licopodium Spore Method

→ Lycopodium spore Method, is used for the estimation of foreign organic matter in powdered drug.

→ Licopodium spores are uniform in size (25 μ).

→ Licopodium spores are obtained from Lycopodium clavatum.

→ Examples of drugs to be estimated by this method: powdered clove and powdered ginger.

Procedure

(i) Dry the powdered drug at 105°C and determine its steady weight at room temperature.

(ii) Weigh accurately the powdered drug and lycopodium spores and mix them.

(iii) Suspend the mixture in a viscous liquid.

(iv) Examine it in a microscope.

(v) Count the characteristic particles of the organic matter as well as the Lycopodium spores in the field.

(vi) Make one more slide in the same way to get counts in 25 fields.

(vii) Prepare two more slides.

(viii) Determine the average of 4 sets of counts (4×25 = 100 fields in all) and also the percentage of moisture content.

Calculation of % purity

$$\% \text{ purity} = \frac{n \times w \times 94000 \times 100}{S \times m \times p}$$

where, n = number of foreign organic particles

S = number of lycopodium spores

w = wt. in mg of Lycopodium spores

p = standard value for number of particles per mg of the pure sample

94000 = number of spores per mg of Lycopodium spore powder.

Camera Lucida

Camera Lucida when attached with a compound microscope, helps in drawing microscope images of of objects on paper. It works on the principle of reflecting beam of light through a prism and a plane mirror. The microscopic image of the object is reflected by the prism onto the plane mirror and from there the image is reflected onto the plane mirror. The observer moves the pencil on the lines of the image and draws a correct image of the object on the paper.