

Pharmacognosy

Lecture Two

Objectives

By the end of this lecture, students will understand the following topics and terms.

- Drugs and Crude drugs
- Sources of Crude Drugs
- Organized and unorganized crude drug
- Official, unofficial, and non-official drugs.
- Current Use of Medicinal Plants
- Classification of natural products
- Plant Nomenclature and Taxonomy
- International Code of Botanical Nomenclature

References.

1. A.N.M Alamgir, "Therapeutic Use of Medicinal Plants and their Extracts" Vol 1, Progress in Drug Research 73, DOI 10.1007/978-3-319-63862-1-2, Springer International Publishing AG 2017.
2. W.C Evans, "Trease and Evans: Pharmacognosy" 16 Edition, 2009.
3. Biren N Shah, A.K Seth "Textbook of Pharmacognosy and Phytochemistry" First Edition 2010, ELSEVIER
4. Matthew Jebb "Plant Names" National Botanic Gardens, Glasnevin, Dublin; <http://www.plantnetwork.org/downloads/plantnames.pdf> Nov 2003.
5. Micheal Heinrich;Joanne Barnes;Simon Gibbons and Elizabeth M Williamson "Fundamentals of Pharmacognosy and Phytotherapy "2 Edition; Elsevier 2012.
6. Gurcharan Singh, "Plant Systematics: An Integrated Approach", Science Publishers, 2004

1. Drugs and Crude Drugs

➤ *Definitions:*

- **Drugs:** the term drug includes any substance, natural or synthetic, having therapeutic properties and used in the diagnosis, treatment, or prevention of diseases of man and animal.
- **Crude Drugs** are plants or animals, or their parts, which after collection are subjected only to drying, extraction with water, or making them into transverse or longitudinal slices or peeling them in some cases; or defined as drugs that have not been changed or modified in its chemical composition.

2. Sources of Crude Drugs.

The different sources of crude drugs can be summarized as follows.

➤ **Plant Origin**

Most crude drugs used in medicine are obtained from plants; these drugs may consist of the entire plants or parts of the plants. (examples of plant parts: senna leaves, nux vomica seeds, ginger rhizome, and cinchona bark).

Most of the plant-derived crude drugs are used in the dried form, and in a few cases, as in lemon and orange peels, are used in fresh conditions.

Plant exudates such as gums, resins and balsams, volatile oils, and fixed oils are also considered crude drugs.

Further drugs used by physicians and surgeons or pharmacists, directly or indirectly, like cotton, silk, and nylon in surgical dressing or kaolin; diatomite used in filtration of turbid liquid or gums; wax, gelatin, agar used as pharmaceutical

auxiliaries of flavoring or sweetening agents or drugs used as vehicles or insecticides are used in Pharmacognosy.

➤ **Animal Origin**

Drugs obtained from animals are entire animals, such as cantharides (a Spanish fly traditionally used for warts, veterinary diuretics, and as an abortifacient agent), glandular products, thyroid organs, or liver extracts. Similarly, fish liver oils, beeswax, certain hormones, enzymes, and antitoxins.

➤ **Mineral Origin:**

Drugs from mineral sources are kaolin, chalk, and diatomite.

3. Organized and Non-Organized Drugs

The crude drugs of natural origin can be divided into two main categories: organized and unorganized.

➤ **Organized Crude Drugs:**

These consist of the cellular organization in the form of anatomical features. These are mostly crude drugs from plant sources. Almost all morphological plant parts or the entire plant can be called organized drugs.

A long list can be made of such crude drugs, a few of them, like Cinchona bark, Senna leaves, Digitalis leaves, Nux vomica seeds, Rauwolfia roots, and many other examples of the above-mentioned groups or crude drugs exemplified by some other morphological organs can be quoted as examples of organized crude drugs.

Microscopical and anatomical studies are preeminent for such crude drugs. These can be used directly in medicine or by modifying or extracting the active ingredient from it.

The simple medicines prepared from these drugs are herbal teas, extracts, tinctures, etc., and they may be extensively processed for the isolation and purification of pure therapeutically active constituents, which are ultimately responsible for the drug's action.

➤ **Unorganized Drugs:**

These drugs do not have the morphological or anatomical organization as such. These products come directly into the market, but their ultimate source remains the plants, animals, or minerals.

Microscopical studies are not required for such crude drugs. These include products like plant exudates as gums, oleo gum, oleoresins, plant lattices like that of opium, aloetic juices like aloes or dried extracts of black and pale catechu, agar, alginic acid, etc., are products coming under this group.

Other products like essential oils, fixed oils, fats, and waxes obtained from vegetable or animal sources, although hydro-distilled or extracted from plants, become the direct commodity for use. Unorganized crude drugs may be miscellaneous mineral products like shilajit (a blackish-brownish resin from the rock layers in several mountains (Himalayan mountains) and has antioxidant properties and boosting energy). These products may be solid, semisolid, or liquid, and the physical, chemical, and analytical standards may be applied to test their quality and purity.

4. Official, unofficial, and non-official drugs

The above terms are explained as follows.

➤ **Official Drug:**

An official drug is any drug included in the current issue of the Pharmacopeia of a country and officially used for therapeutic purposes.

➤ **Unofficial Drug:**

An unofficial drug is a drug that was previously included in Pharmacopeia but not in the current issue of Pharmacopeia or any drug literature.

➤ **Non-official Drug:**

A non-official drug is any substance possessing some medicinal properties and used for therapeutic purposes but has never been included in pharmacopeia or any drug literature of any country.

5. Current Use of Medicinal Plants

The current medicinal plant use can be summarized as follows:

➤ **Natural form**

Powders for herbal teas by infusion, decoction, and digestion. The plants are delivered in bulk or teabag, are alone "simple" or in mixtures or even powders in capsules.

➤ **Galenic forms:**

Galenic formulations include herb infusions, decoctions, tinctures, extracts, and elixirs. Infusions and decoctions are liquid medicinal preparations representing aqueous extracts from medicinal plant raw materials and aqueous solutions of dried material or liquid extractions (concentrates).

➤ **Sources of bioactive molecules:**

Some bioactive chemicals are derived from natural sources as some may be either difficult or very expensive to synthesize,

➤ **Source of raw materials for semi-synthesis:**

Some molecules of interest can be semi-synthesized from natural sources, reducing the steps and the manipulation cost of production.

➤ **Other uses:**

Food and cosmetics industry (preservatives, antioxidants, thickening agents, etc...).

6. Classification of Natural Products

The most important natural sources of drugs are plants, microbes, animals, and marine organisms. Some useful products are obtained from minerals that are both organic and inorganic. To pursue (or to follow) the study of individual drugs, one must adopt some particular sequence of arrangement, which is referred to as a system of classification of drugs. A method of classification should be:

- ✓ Simple.
- ✓ Easy to use, and
- ✓ Free from confusion and ambiguities.

Because of their wide distribution, each classification arrangement has its own merits and demerits, but for study, the drugs are classified in the following ways.

6.1. 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). Examples of this System of Classification are Acacia, Benzoin, Chamomile, and Mint.

Some of the pharmacopeias, dictionaries, and reference books that classify crude drugs according to this system are as follows:

- Indian Pharmacopoeia
- British Pharmacopoeia
- British Herbal Pharmacopoeia

- United States Pharmacopoeia and National Formulary
- British Pharmaceutical Codex
- European Pharmacopoeia

➤ **Merits of the Alphabetical Classification**

- ✓ It is easy and quick to use.
- ✓ There is no repetition of entries, and it is devoid of confusion.
- ✓ In this system, location, tracing, and addition of drug entries is easy.

➤ **Demerits of the Alphabetical Classification**

There is no relationship between previous and successive drug entries.

6.2. Taxonomical Classifications

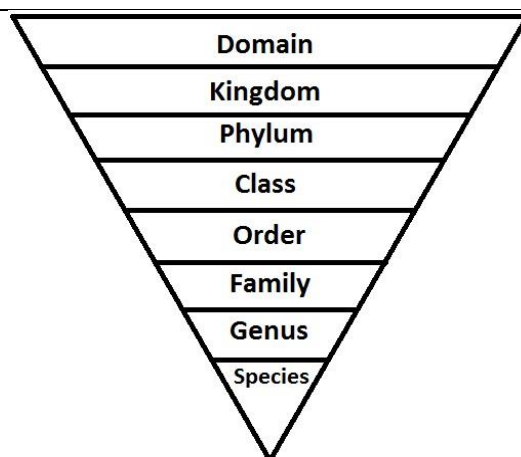
All plants possess different morphological, microscopical, chemical, embryological, serological, and genetic characteristics. The crude drugs are classified according to kingdom, subkingdom, division, class, order, family, genus, and species. It allows for a precise and ordered arrangement and accommodates any drug without uncertainty. As the basic botanical knowledge of pharmacy students decreases over the years, this system is becoming less popular for teaching purposes. Figure (1) demonstrates an example of this classification type.

➤ **Merits of the Taxonomical Classification**

Taxonomical classification helps study evolutionary developments.

➤ **Demerits of the Taxonomical Classification**

This system also does not correlate between the chemical constituents and biological activity of the drugs.



- Notes: Domain (the classification of the type of cell: (Bacteria, Archaea, and Eukaryotes) in plants, the domain is Eukaryotes
- Kingdom: Plantae
- Phylum/Division: which means vascular plant or non-vascular plant. In our example, it is a vascular plant (Tracheophyta), and the subdivision is Spermatophyta (produce seeds)
- Class: Angiosperma
- Order: Asteridae
- Family: Compositae
- Genus: Taraxacum
- Species: Officinale

Figure 1 “Dandelion classification ((الهندباء))”

6.3. Morphological Classification

In this system, the drugs are arranged according to the morphological or external characteristics of the plant parts or animal parts, i.e., 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 organized drugs, e.g., rhizomes, barks, leaves, fruits, entire plants, hairs, and fibers. The drugs prepared from plants by intermediate physical processes such as incision, drying, or extraction with a solvent and not containing any cellular plant tissues are called unorganized drugs. Aloe juice, opium latex, agar, gelatin, tragacanth, benzoin, honey, beeswax, lemon

grass oil, etc., are examples of unorganized drugs.

➤ **Merits of the Morphological Classification**

Morphological classification is more helpful in identifying and detecting adulteration. This classification system is more convenient for practical study, especially when the chemical nature of the drug is not clearly understood.

➤ **Demerits of the Morphological Classification**

- ✓ The main drawback of morphological classification is no correlation between chemical constituents and therapeutic actions.
- ✓ Repetition of drugs or plants occurs.

6.4. Pharmacological Classification

Grouping drugs according to their pharmacological action or of most important constituent or therapeutic use is termed pharmacological or therapeutic classification. This classification is more relevant and is mostly a followed method. Drugs like digitalis, squill, and strophanthus having cardiotonic action are grouped irrespective of their parts used phylogenetic relationship or the nature of phytoconstituents they contain.

➤ **Merits of the Pharmacological Classification**

This classification system can suggest substitutes for drugs if they are unavailable at a particular place or point in time.

➤ **Demerits of the Pharmacological Classification**

Drugs having different actions on the body get classified separately in more than one group, causing ambiguity and confusion. Cinchona is an antimalarial drug because of the presence of quinine. Still, it can be put under the group of drugs affecting the heart because of the antiarrhythmic action of quinidine.

6.5. Chemical Classification

Depending upon the active constituents, the crude drugs are classified. The plants contain various constituents like alkaloids, glycosides, tannins, carbohydrates, saponins, volatile oil, resin, Enzymes, and lipids. Irrespective of the morphological or taxonomical characters, the drugs with similar chemical constituents are grouped into the same group.

➤ Merits of the Chemical Classification

It is a popular approach for phytochemical studies.

➤ Demerits of the Chemical Classification

Ambiguities arise when particular drugs possess several compounds belonging to different groups of compounds.

7. Plant Nomenclature and Taxonomy

This section will discuss the scientific naming of plants related to their taxonomy

➤ **Scientific Names (Latin Names)**

All living things that biologists have named have a scientific name. This name adheres to a rigid formula comprising three parts. The first two parts are in Latin. The last part of the name (often omitted in nontechnical documents or books) is the author's name, literally the person who devised the name.

This nomenclature system, known as the Binomial system, was developed by a Swedish biologist “Carl Linnaeus.” The date of 1st May 1753 is when Linnaeus published his **Species Plantarum**. This book was revolutionary for two reasons. Firstly, it introduced the idea of binomial nomenclature (lit. two-name naming), and secondly, it was the first attempt to cross-reference all names used in botanical literature (4).

The species is the principal unit within the study of systematics. Biological diversity is subdivided into >500,000 discontinuous units (the botanical species) and >2 million zoological species. The species is thus the basic unit for studying relationships among living organisms. Systematicists study the relationships between species.

➤ **Taxonomy**

Taxonomy is the science of naming organisms and their correct integration into the existing nomenclature system. Each name is called a taxon (pl. taxa), thus representing any named taxonomic unit. To make this diversity easier to understand, it is structured into highly hierarchical categories, ideally representing the natural relationship between all the taxa (5).

The branches of the genealogical tree differ so much in size that it is not easy to decide which are of equal systematic importance and what one biologist may consider as a family another may regard as a subfamily. Similarly, the species of one botanist may be the subspecies or variety of another. The main hierarchical subdivisions of a division are arranged according to Engler's scheme.

➤ **Engler and Prantle system**

This system of classification of the entire plant kingdom was proposed jointly by two German botanists, Adolph Engler (1844-1930) and Karle Prantl (1849-1893). The classification was published in a monumental work, "Die Noturlichen Pflanzenfamilien," in a 23-volume work (1887-1915). The system provided classification and description down to the genus level, incorporating information on morphology, anatomy, and geography. The system is commonly known under Engler's name, who first published classification up to the family level under the title "Syllabus der Pflanzenfamilien"

Engler's scheme may be illustrated by the following example showing the systematic position of peppermint.

Kingdom: Plantae

Phylum/Division: Angiospermae

Class: Dicotyledoneae

Subclass: Sympetalae

Order: Tubiflorae

Suborder: Verbenineae

Family: Labiales (Lamiaceae)

Subfamily: Stachydoideae

Tribe: Satureieae

Genus *Mentha*

Species *Mentha piperita* Linnaeus (Peppermint)

Varieties *Mentha piperita* var. *officinalis* Sole (White Peppermint)

Mentha piperita var. *vulgaris* Sole (Black Peppermint)

It will be noted that in pharmacopeias and research publications, botanical names are followed by the names of persons or their accepted abbreviations (e.g., Linnaeus and Sole in the case of peppermint given above). These refer to the botanist describing the species or variety.

➤ Families

Closely related genera are grouped together into a family. Sometimes, families have a unique character that makes them easy to spot; for example, Leguminosae (Fabaceae), the pea family, is characterized by having a pea pod. Other families are difficult to identify easily, such as Rosaceae, the rose family, which has very variable fruits, including strawberries, blackberries, plums, apples, etc. No characteristic tells the taxonomist what a genus, family, order, or class is; it is merely a rational human point of view to divide and catalog the huge number of species. Today, all family names have the ending “aceae.”. The reason the conformity to -aceae was established is to ensure that firstly, a family name should be instantly recognizable, and secondly, to ensure that there is a nomenclatural type (see the section on Type Specimens)

However, there are eight traditional family names which it is still legitimate to use; they are represented in table (1) (FYI):

Traditional Name	Modern Name	Common Name
Compositae	Asteraceae	Daisy family
Cruciferae	Brassicaceae	Cabbage family
Gramineae	Poaceae	Grass family
Guttiferae	Clusiaceae	St.John.s wort family
Labiatae	Lamiaceae	Mint family
Leguminosae	Fabaceae	Pea family
Palmae	Arecaceae	Palm family
Umbelliferae	Apiaceae	Carrot family

Table 1” Traditional families and their modern and common names” (FYI)

➤ **Species, subspecies, varieties and forms.**

A **species** is a population or group of organisms that can interbreed with one another to produce fertile offspring that are, to all intents and purposes, similar to the parent population. Generally speaking, a subspecies (abbreviated to subsp. or ssp. But never spp.) represents some major change in appearance correlated with geographic position. For example, take Birch trees in the Himalayas. The white-barked species *Betula jacquemontii* grows in the Western Himalayas, whereas the darker-barked *Betula utilis* grows in the eastern end of the Himalayas. Therefore, *jacquemontii* was made a subspecies: *B. utilis* subsp. (or ssp.) *jacquemontii*. Automatically, the darker-barked specimens become *B. utilis* subsp. *utilis*.

Variety: Sometimes, such changes are neither as dramatic nor associated with geography but may be quirks (accidents or odd) of a particular population or habitat. In these cases, the variety category may be used; for example, many plants have populations with dwarf forms (var. *nana*), while others may have coastal forms (var. *maritima*).

Forms (or *Formas*) are not often used today but are generally applied to small differences in leaf or flower colors, i.e., *Cedrus atlantica* f. *glauca*. Often, forms and varieties are no more than genetic variations that do not get inherited by all descendants.

Cultivar: Trehane et al. (1995) defined a cultivated plant as One whose origin or selection is due to the activities of mankind. Such plants may arise by deliberate or chance hybridization or by further selection from existing cultivated stock. They may be selected from a wild population and maintained as an entity by continuous cultivation.

In summary, Var. is due to a natural mutation, whereas Cultivar is a mutation due to its effect on humans.

8. International Code of Botanical Nomenclature

When a plant taxonomist describes or compares previously described species

They follow particular rules in the International Code of Botanical Nomenclature (ICBN). With new taxa, these rules require that it is given a Latin (species) name that has never been used before, that it is described in Latin, and that a type specimen at a particular institution is nominated. Where species have been given more than one name in the past, decisions about which is the correct name and which are synonyms are governed by other rules, in this case, by the rule of priority. Six major principles summarize the ICBN rules.

The International Code of Botanical Nomenclature and the International Code of Nomenclature for Cultivated Plants (ICNCP) set the rules for plant nomenclature.

➤ Writing and Reading Plants Names Correctly

- The first letter of the genus name is always upper case, and the first letter of the specific epithet (and subsp. epithet, varietal epithet, etc.) is always lower case.
- Latin genus and species names should always be italicized when they appear in text that is in Roman type; if handwritten, they should be underlined.
- The variety name is written after var.
- Underline or italicize the variety name.

Example: *Sansevieria trifasciata* var. *laurentii* or Sansevieria trifasciata var. laurentii Example for subsp. *Grevillea victoriae* subsp. *navalis* .

- The abbreviation **f.** is used to signify that a mutation is a form; **forma (f.)** is placed after the specific epithet as mentioned in the following example:
Astrophytum myriostigma forma *quadricostata* or *Astrophytum myriostigma* f. *quadricostata*
- The last part of the scientific name is the author's name." Botanist who first described the species or variety" can be written as a full name or accepted abbreviations; the first letter is always in upper case, not italicized or underlined. Example *Mentha piperita* Linnaeus.
- Names of suprageneric taxa (above the genus level, e.g., families) are never italicized when they appear in Roman text. The first letter of these names is always upper case.
- When the genus name is used as a vernacular name (not Latin) within text or captions, it is not italicized. When in the singular, the first letter of the genus name can be either upper or lower case. When in the plural, the first letter of the genus name should always be in lower case, e.g. (many magnolias bloom in January). When it is the first word in a sentence, the first letter of the genus name should always be upper case, whether singular or plural.
- The cultivar name is designated by single quotation marks; it should never be designated by double quotation marks or the abbreviation "cv."
- The cultivar name is never italicized or underlined when it appears in Roman text.
- The first letter of each word is upper case, except for conjunctions and prepositions (of, de, no). example *Sansevieria trifasciata* 'Golden Hahnii'
- Common (vernacular) names: Common names should never be italicized when in Roman text. There are no rules governing the usage of common names, as there are for scientific names. The most important point is that

common name usage should be consistent throughout an article, a periodical, or a book. Normally, common names do not have their initial letter capitalized except when the word is a geographical or personal name. A common name can be combined with a cultivar name: potato 'Cara', rose 'Dublin Bay'.

➤ Questions & Answers Summarizing the text of nomenclature

✓ What is the difference between a species and a cultivar?

The former is found in the wild, whereas the latter has been brought into cultivation and maintained by people.

✓ What is a subspecies?

A geographical variation found within a species range but not different enough to make it into a species of its own.

✓ What is a variety?

An ecological variant found within the range of a species, maybe a mountain form or a coastal form

✓ What is forma?

A morphological variant found within a species' range, maybe with coloured leaves or different colored flowers (typically white flowered forms).

✓ What is a Genus?

A human idea for grouping similar species together usually on one or a few morphological characters. Genera (plural) don't exist in nature; only species do.

✓ What is a plant Family?

A broader category than a genus, but still a human idea, to cover all species,

which probably have a common origin and can be recognized on certain characteristics in common.

✓ Why are scientific names in Latin?

Latin was the language of scholarship until 200 years ago. All scientists could read and understand the language. Because Latin is a dead language (no country actually speaks it), it never changes, and a 17th-century dictionary, for example, is still up-to-date. Thus, Chinese, Russian, and English-speaking taxonomists can all communicate and understand one another's species descriptions. It is a very precise language with thousands of descriptive terms.

✓ What is the authority of a plant name, and why are they needed?

When a new species is first described and named, the person describing the species is referred to as the author. Sometimes, the same name has been used for different species or genera; in these cases, it is important to know which author's name is being referred to. i.e. *Erica hibernica* (Hook. & Arn.) Syme in 1866 and *Erica hibernica* Utinet in 1839.

The End of Lecture Two