Definitions & Basic Principles

Drug : is a natural or synthetic substance used in the treatment , cure , prevention , or diagnosis of disease or used to otherwise enhance physical or mental well being . Drugs may be prescribed for a limited duration , or on a regular basis for chronic disorders. The drug should be included in the official pharmacopoeia .

Crude Drugs : Are drugs originated from plant , animal kingdom , minerals they contain more amount of active constituent . They do not have any side effects .

Extract : Is a substance made by extracting a part of a raw material , often by using a solvent such as **Ethanol** or **Water** . Extracts may be solid as a tinctures or in powder form . (The aromatic principles of many spices , nuts , herbs , fruits , etc . , and some flowers , are marketed as extracts , among the best known of true extracts being almond , cinnamon , cloves , ginger , lemon , nutmeg , peppermint , pistachio , rose , spearmint , vanilla , violet , and wintergreen .

Extractives (derivatives) : This term deals with the principle constituents that found in natural substances by many methods like (Extraction , distillation …….etc .) this methods are responsible for the medicinal importance of natural substances and crude with notified these extractives are found whether a. single or mixture constituents .

Ex:

The plant Mint is a (Natural substance) , the leaf of this plant (also natural substance) , after drying , dried leaf (also natural substance) , dried leaf is considered crude when expressed to drying process is stilled as found in nature (There are no changes have been made to their molecular structure) . Dried leaves are considered as crude drug when they used to treatment the disease (like stomach inflation pain).

Dried leaf when exposed to extraction process , extractives like **Menthone** (this is one of the principle constituents in the dried leaf) . And also this extractive is used to treat the above disease or disorder .

Natural product : is a chemical compound or substance produced by a living organism found in nature that usually has a pharmacological or biological activity for use in pharmaceutical drug discovery & drug design .

A challenge

Q1: Why we study plant extracts?

Q2: What are the differences between: Phytotherapy, Phytopharmacology, Phytochemistry, Phytopharmacy?

Q3: what are the difference between Fixed oil, Essential oils, fats and waxes?

Q4: give an example of each compound which found in this lecture?

Introduction to Herbalism

Herbalism, or simply, **Medical plants** or **herbology**, is “the study of herbs and their medicinal uses”. This definition can be extended to include the cultivation, collection, or dispensing of aromatic plants, especially those considered to have medicinal properties.

Advantages and Disadvantages of Herbalism:

Advantages

- Reduced risk of side effects:
- Effectives with chronic conditions:
- Lower cost:
- Widespread availability:

Disadvantages

- Inappropriate for many conditions:
- Lack of dosage instructions:
- Poison risk associated with wild herbs:
- Medication interactions:
- Lack of regulation:

Herbalism include : higher plants, lower plant and, these includes:

1. Lichens
2. Algae
3. Thalophytes
4. Bryophytes
5. Pteridophytes
6. Gymnospermae
7. Angiospermae:
   a) Monocotyledones
   b) Dicotyledones

Taxonomy of medical and aromatic plants

To study the medical and aromatic plants, Those Plants should be classified to know the Morphological characters in addition to their general and species to avoid the interference Between their primary and secondary productivity, their medicinal importance and economical use. There are different kinds of these plants taxonomy and all of these could help in each respect:

1. Plants Taxonomy: which depended on the plant kingdom, classes, order, and families.
2. Organic Taxonomy: which depended on the active constituents in medicine and their Presence in the plants parts.
3. Chemical Taxonomy: which depended on the active and non-active groups of compounds which have different chemical structures. Carbohydrate, Fixed oils, Essential oil, Resins, Glycoside, Glyo-Alkaloid, Alkaloid, Bitter substance.
4. Industrial Taxonomy: which depended on the types of active chemical constituents and their industrial uses which produced by certain groups of plants.Aromatic plants , Medical Plants, Condiments, Insecticides, Coloring Agent.
5. Life seasonal Taxonomy: which depended on quality and quantity of the plant product during certain season of certain year of agriculture. Winter Plant, Summer plant, Neutral Plant. Based on habitat.
6. Remedy Taxonomy (therapeutic value): which depended on certain plant group which used to threat or for different particular remedy diseases.

Ex : CNS Active Plants, Plants modulating autonomic and autacoid activity, cardiovascular system Plants, Plants acting on respiratory system, Anti-allergic plants, Hypoglycemic plants, Anti- and pro-fertiliy plants, Plants promoting skin and bone healing, Plants acting on genito-urinary system, Gastro-intestinal pro- and anti-kinetic plants, Cytoprotective plants, Plants protecting against oxidative stress,

Chemotherapeutic plant products including antimicrobial, Anti-mutagenic plants Anti-cancer plants, Immune active plants, Adaptogens, Nutraceutics,

Phytochemistry and Classification of Natural Products

Metabolites are involved in the growth of organisms through the process of metabolism. The metabolism is referred to as the sum of the all the biochemical reactions carried out by an organism. Depending on the origin and function, metabolites can be divided into two major categories; namely, Primary and Secondary metabolites.

Primary Metabolites

Primary metabolites are essential to the growth of the cell. They are produced continuously during the growth phase and are involved in primary metabolic processes such as respiration and photosynthesis. Primary metabolites, which are identical in most organisms, include: **carbohydrates, sugars, amino acids, tricarboxylic acids**, the universal building blocks, and energy sources. Other than the above compounds, **proteins, nucleic acids, and polysaccharides** are also considered as primary metabolites.

Secondary Metabolites

Secondary metabolites are the compounds which are derived by pathways from primary metabolic routs, and are not essential to sustain the life of cells. These compounds do not have a continuous production. Very often secondary metabolites are produced during non-growth phase of cells. Secondary metabolites are the end products of primary metabolites such as: **Alkaloids**, **Glycosides**, **Essential oils**, **Resins and resin combination**, **Tannins…** etc.

1. Alkaloids

Alkaloids are natural, organic substances that are predominantly found in plants and normally contain at least one nitrogen atom in their chemical structure. Their basic (alkaline) nature has led to the term *alkaloids.* Since the identification of the first alkaloid, morphine, from the opium poppy (*Papaver somniferum*) in 1806, more than ten thousand alkaloids have been isolated from plants. Alkaloids are the active components of numerous medicinal plants or plant-derived drugs and poisons, and their structural diversityand different physiological activities are unmatched by any other group of natural products.

Classification of Alkaloids	
Alkaloidal amine	Ephedrin pseudoephedrine colchicine Capsaicin cathine
Pyridin and piperidine	Trigonelline Conhdrine, conicene, conine, pseudo conhydrine Ricinine, ricin
Quinoline alkaloids	Quinine , quinidine , cinchonine, and cinchonidine
Purine alkaloids	Caffeine, Theophylline, Theobromine Theobromine
Steroidal alkaloids	Veratrum Protovertrines

	Germidine, germitrine, neogermitrine, neoprotovertrine Solanium alkaloids Solasonine solanine
Indol alkaloids	Vinblasine, vincristine Reserpine Ergot ergomtrine and ergotamine
Isoquinoline alkaloids	Opium 1-Morphine, 2-noscapine (narcotine), 3-Thebaine 4-Codeine 5-Papaverine, Psychotrine, Cephalidne, Emefine.
Tropane alkaloid	Hyoscyamin, hyoseine Cocaine, hygrine, cinnamlcocaine

2. Glycosides

Glycosides: are compounds containing a carbohydrate and a non carbohydrate residue in the same molecule. The carbohydrate residue is attached by an acetal linkage at carbon atom 1 to a non carbohydrate residue or **AGLYCONE**.

The non sugar component is known as the **AGLYCONE**. The sugar component is called the GLYCONE. the glycone may comprise a solitary sugar group called monosaccharide or a number of sugar groups known as oligosaccharide. If the carbohydrate portion is glucose, the resulting compound is a **GLUCOSIDE**.

Classification of Glycosides

Glycosides may be categorized by different methods or according to different headings. For instance, glycosides may be classified according to the glycone, the nature of glycosidic bond as well as the aglycone.

1- According to glycone
2- According to the sort of glycosidic bond
3- According to aglycone

- Alcoholic glycosides:
- Anthraquinone glycosides:
- Coumarin glycosides:
- Cyanogenic glycosides:
- Flavonoid glycosides:
- Phenolic glycosides (Simple):
- Saponins:
- K- Steroidal glycosides or cardiac glycosides:
- Steriol glycosides: Steviol , stevioside and rebaudioside A
- M- Thioglycosides: Sinigrin, sinalbin,

3. Resins and resin combination

Resins : are amorphous products with a complex chemical nature, they are end products of metabolism , usually formed in ducts or cavities in plant tissues .

Classification of Resins

1. Resin acids :
2. Resino tannols
3. Rosin :
4. Eriodictyon
5. Mastic
6. Kava
7. Cannabis

Resin combination

1. Oleoresins : Resins
2. gum – resins:
3. Oleo – gum – resins : Oleoresins
4. Glyco-resins:
5. Balsams

4. Tannins

A yellowish or brownish bitter-tasting organic substance present in some galls, barks, and other plant tissues, consisting of derivatives of gallic acid.

Tannins are astringent, bitter plant polyphenols that either bind and precipitate or shrink proteins. The astringency from the tannins is what causes the dry and puckery feeling in the mouth following the consumption of unripened fruit or red wine. Likewise, the destruction or modification of tannins with time plays an important role in the ripening of fruit

Commercial tannins, as used in the leather industry, are obtained from quebracho, wattle, chestnut and myrobalans trees. Pharmaceutical tannin is prepared from oak galls and yields glucose and gallic acid on hydrolysis; many commercial samples contain some free gallic acid.

Classification of tannins

Two main groups of tannins are usually recognized; these are:

1. the hydrolysable tannins
2. the condensed tannins (proanthocyanidins).

exampleof some medical plants containing tannins

Punica granatum L./ Family : *Punicaceae.*
Galls on oaks
Geranium maculatum, geranium, Geraniaceae, plants in flower, flower
Thea sinensis, tea, Theaceae, plants, flowers, fields

5. VOLATILE OILS

Essential oils are compounds made up of several organic volatile substances. These may be alcohols, acetones, cetones, ethers, aldehydes, and are produced and stored in the secretion canals of plants. **Essential oil** is a concentrated hydrophobic liquid containing volatile aroma compounds from plants. Essential oils are also known as **volatile oils**, **ethereal oils**, **aetherolea**, aromatic oils or simply as the **oil of the plant** from which they were extracted, such as oil of clove. Volatile oils are complex liquid mixtures of odoriferous principles of varying chemical composition, which easily evaporate when exposed to air at ordinary temperature, and which are used for either their specific therapeutic activity or their aroma.

They are found in different organs: roots, ryzomes (ginger), wood (camphor), leaf (eucalyptus), flowering parts (Labiatae family). Plants can produce volatile oil as secondary metabolisms and accumulate in :

1. Glandular hair ex: Mentha piprtia/ family labiate.
2. Oil glands, ex: Citrus lemon. / family Rutaceae
3. Oil ducts, ex: Pimpinella anisum/ family umbelliferaea.

According to their function group they can be:

1. Alcohols (menthol, bisabolol) and phenols (timol, carvacrol)
2. Aldehydes (geranial, citral) and cetones (camphor, thuyone)
3. Esthers (bornile acetate, linalile acetate, methyl salicilate, anti-inflammatory compound similar to aspirin)
4. Ethers (1.8 - cineol) and peroxides (ascaridol)
5. Hydrocarbons (limonene, pinene α and β)

6. Fixed oil, fats and waxes (lipids)

Wax, oil, fats etc. are lipids that are molecules made up of hydrocarbons. These molecules are not water soluble and play a very important role in the structure and functioning of cells of living beings. Both wax and oil are sticky products. However, despite both being viscous and water insoluble chemicals.

.Conn and Stumpf (1976) have traditionally classified lipids into following 6 classes :

1. Acyl glycerols
2. Waxes
3. Phospholipids
4. Sphingolipids
5. Glycolipids
6. Terpenoid lipids including carotenoids and steroids

Oils

They are liquid products obtained by different techniques from the fruit of some vegetables or some animal organs. They are principally constituted by triglycerides; they also containanother lypophilic substances in low proportions,such as fatty alcohols, hydrocarbures, fatty acids,vitamins, phytosterols, etc. These last componentsdetermine in many cases their cosmetical and pharmaceutical activity.

The principal constituents of vegetable oils are esters of glycerol and fatty acids along with partially glyceridic material such as lecithin and substances such as tocopherol. Their composition will vary according to the species and the use will depend especially upon the variety, type and proportion of fatty acids. Ex: ALMOND OIL:

Fats

Fats are solid at room temperature. They are usually derived from animals and plants and are complex mixtures. Fats have a higher percentage saturated fatty acids than do oils. **Ex :** COCOA OIL

Wax

is a semisolid substance at room temperature that melts to become a low viscosity liquid at around 45 degrees Celsius. It is a greasy substance that most of us see and use in the form of shoe polish or ear wax. Waxes are also available in the form of hair styling products. Honeybees convert honey into wax when they store it in honeycombs. While beeswax is a natural product, most of the wax available in the market is produced in the laboratories. As a

chemical compound, waxes are insoluble in water though they are soluble in many other solvents. Whether natural or made synthetically, waxes are organic in nature.

What is the difference between Wax and Oil?

• Both oils and waxes are lipids, but waxes are thicker than oils.
• Waxes are semisolid at room temperature whereas oils are thick liquids at room temperature.
• Beeswax is a natural product though most waxes are produced synthetically.
• Oils are produced naturally by plants and other organisms.
• Waxes are not esters of glycerol like oils.
• There is single ester group in a wax chain as against three ester groups in cases of oils.
• Oils are used for fuel as well as cooking purposes.