Classification of Natural Products

Dr. Qays M. Issa

Natural product :

Is a chemical compounds or substances that usually has a pharmacological or biological activity for use in pharmaceuticals , food , cosmetics and industrial applications. Natural product produced by a living organisms found in nature , such as :

- plants : flavonoids , alkaloids , terpenes ….
- Animals : insulin , collagen , enzymes ….
- Microorganisms :

antibiotics , pharmaceutical agents , industrial enzymes , agricultural products.

- Marine organisms :

anticancer , antimicrobial , anti-inflammatory.

Natural Product Function

Natural products are often divided into **2** major classes:

1. Primary metabolites :

are organic molecules that is essential to the survival of the organism. Examples of primary metabolites include the core building block molecules (nucleic acids , amino acids , sugars , fatty acids) required to make the major macromolecules (DNA , RNA , proteins , carbohydrates , and lipids) .

2. Secondary metabolites :

are organic molecules that commonly have an external function that mainly **affects** other organisms . Secondary metabolites are not essential to survival but do increase the competitiveness of the organism within its environment..

- It is known that almost **80%** of the populations in developing countries are depend on the traditional medicine, mainly composing herbal prescriptions.
- In USA, about **25%** of the medications dispensed contain at least one active ingredient of plant origin.
- Over **50%** of modern drugs are derived or creative from natural products, serving as a cornerstone of pharmacology.
- Over **25%** of FDA-approved drugs have plant origins, with many others coming from microbial sources.

When the term **Natural Product** is mentioned, they can be:

A. The organism itself (plant , animal , microorganisms , marine organisms).

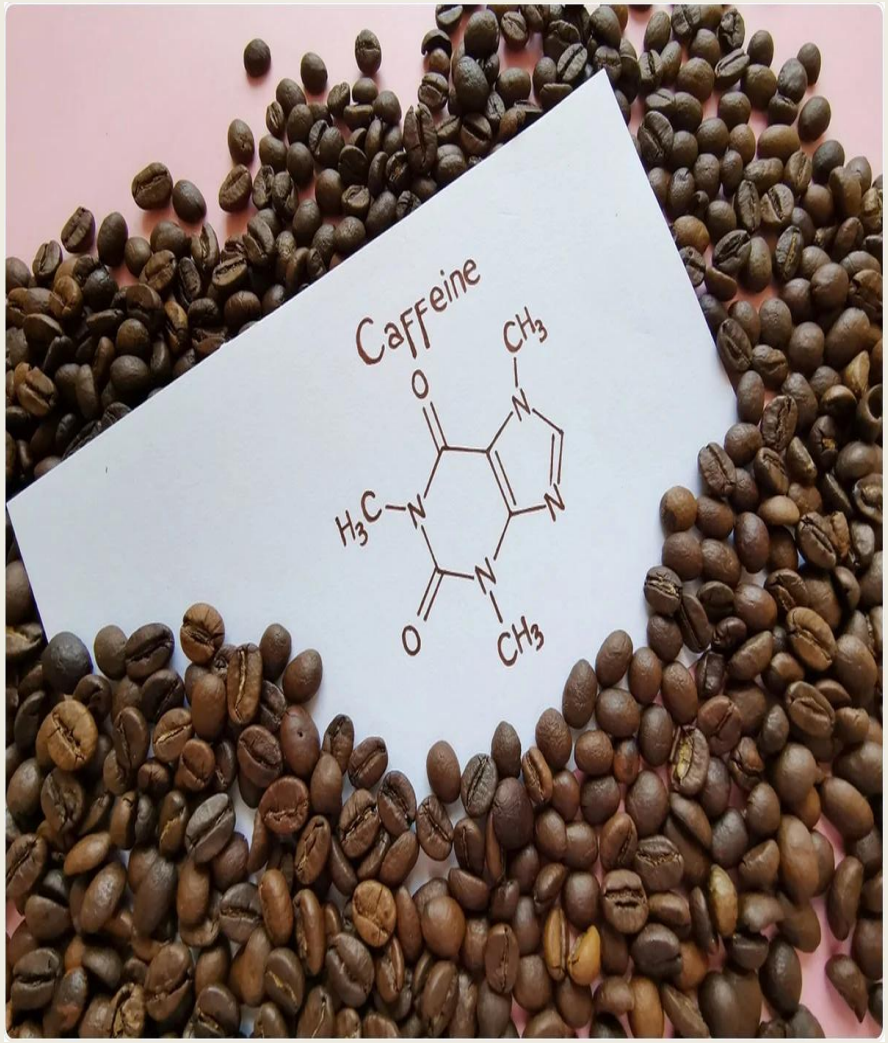
B. Any part of an organism (a leaf or flower of a plant, or other organ of an animal).

C. Extract .

D. Pure substances.

Plants are prolific sources of bioactive compounds such as:

Atropin , Ephedrine , Morphine , Caffeine , Salicylic acid , etc …..



Coffee



Atropa bella-donna



Papaver somniferum



Taxus brevifolia

Not only plants, but also other organisms including: marine animals, ants, frogs, worms, *etc*. as well as microorganisms produce very important drug molecules. For example, Apicidin isolated from the fungus *Fusarium pallidoroseum* has been reported as antiprotozoal against malaria factor *Plasmodium berghei*.

Human insulin is produced from *Escherichia coli* bacteria, which were genetically modified by Genentech (is a pioneering biotechnology company), which truly started producing the hormone in 1978 , this hormone was previously produced from cattle and pigs.

Why are Natural Products classified ?

1. Ease of study and organization.
2. Understanding biological activity.
3. Drug manufacturing and development.
4. Structural discrimination.
5. Identifying the source and environmental function.

Therefore, Classification is a Necessary Tool for Transforming Natural Products into Useful Resources in Medicine and Industry.

Why The Use of Natural Products Increased ?

Because of the great benefits of herbal medicine, such as

1. Low cost and widely available.
2. It has few side effects.
3. Sustainable and Eco-Friendly.
4. Boosted Immune System.

Classification of Natural Products :

A method of classification should be :

1. Simple
2. Easy to use
3. Free from confusion

Crude drugs are classified in the following different ways :

1. Alphabetical classification .
2. Morphological classification
3. Pharmacological classification
4. Chemical classification
5. Chemo-taxonomical classification

1. Alphabetical Classification

Is the simplest way of classification. Crude drugs are arranged in alphabetical order either in Latin or English names (common names) or sometimes local.

For example :

Acacia , Benzoin , Cinchona , Dill , Ergot , Fennel , Gentian , Hyoscyamus , Ipecacuanha , Jalap , Kurchi , Iiquorice , Myrrh , Nux-vomica , Opium , Podophyllum , Quassia , Rauwolfia , Senna , Uncaria gambier , Vasaka , Wool fat , Yellow bees wax , Zedoary.

2. Morphological classification

The crude drugs are arranged according to the part of the plant or animal , represented into :

A. Organised drugs (Cellular)

Derived directly from plant parts , maintaining cellular structure. For example :

Leaves : Senna , Digitalis

Roots : Liquorice

Rhizomes : Ginger, Turmeric

Barks : Cinchona , Pacific yew

Flowers : Clove

Seeds : Castor

Fruits : Cardamom

Hair and Fibers : Cotton , Cannabis

B. Unorganised drugs (Acellular) :

Products derived from plants, animals through physical processes (incision , drying , extraction) that do not contain cellular tissue. This method does not reflect chemical or pharmacological properties.

For examples :

Plant products : dried latex , dried juice , dried extracts , resins , fats, and volatile oil.

Animal products : Shark liver oil , Bee waxes , Gelatin.

3. Pharmacological classification

In this system, drugs are classified pharmacologically or therapeutically or according to their pharmacological action or therapeutic use. This classification is the most widely used among the rest of the classifications.

For example :

- Cardiac depressant - Cinchona
- Cardiotonics - Digitalis
- Expectorant - Liqourice
- Antiexpectorant - Stramonium leaves
- Brochodilators - Tea (Theophylline)
- Central analgesics - Opium (morphine)
- CNS Stimulants - Coffee (caffeine)

4. Chemical classification

Crude drugs are divided into different groups according to the chemical nature of their most important constituent present in the drug to which the pharmacological / therapeutic activity of drug is attributed.

Advantage of this classification is the ease of studying the chemical components of the drug.

Chemical constituents of Drugs :

A. Glycosides: are compounds which upon hydrolysis give rise to one or more sugar part (glycone) and non-sugar part (aglycone).

For example :

- Anthraquinone Glycosides – Aloe , Senna
- Saponins Glycosides – Glycyrrhiza
- Cyanophore Glycosides – Wild cherry bark
- Isothiocyanate Glycosides – Mustard
- Cardiac Glycosides – Oleander
- Bitter Glycosides – Gentian

B. Tannins: are water-soluble polyphenols that are present in many woody flowering plant. They occur normally in the roots , bark , the bark of oak , sumac and galls.

C. Volatile Oils :are Monoterpines and Sesquiterpenes obtained from plants. Ex: Cinnamon , Dill , Caraway , Coriander , Cardamom , Orange peel , Clove.

D. Lipids : such as : Castor, Olive, Almond, Shark liver oil.

E. Resins : Complex mixture of compounds like resinols , resin acids , resenes . Ex : Cannabis , Capsicum, Turmeric, and Ginger .

F. Alkaloids :

Alkaloids have diverse and important physiological effects on humans and other animals. Well-known alkaloids include:

morphine , quinine , ephedrine , nicotine.

Alkaloids are found primarily in flowering plants and a few alkaloids have been found in animal species. Both the **opium poppy** and the **ergot fungus** each contain about **30** different types.

5. Chemo-taxonomical classification

It is the classification of plants based on chemical composition, where equal importance is given to botanical classification and chemical components, as there are chemical compounds that distinguish specific groups of plants.

Therefore, plant metabolites can serve as the basis of classification of crude drugs.

It is latest system of classification and gives more scope for understanding the relationship between chemical constituents, their biosynthesis and their possible action.

Thanks for your listening

