

## Pharmacognosy II

**Objectives:** This course is intended to study chemistry of natural product namely glycosides, volatile oils, fixed oils, tannins and resins. The course includes chemistry, pharmacology, uses of these constituents and plants containing these constituents.

**Pharmacognosy:** It is derived from two greek words, pharmakon (means drug or medicine) and gignosco (means knowledge of), as a result; the term of pharmacognosy means (knowledge of the drug).

### Pharmacognosy is concerned with:

1. **Taxonomy** of the natural sources
2. **Distribution** of natural sources
3. **Description** of these natural sources of drugs such as plants as natural source of medications (drugs)
4. **Active constituents** of natural sources (e.g. resins and alkaloids)
5. **Biosynthesis** pathways of active constituents,
6. **Storage** places of active constituents in plants (e.g. seeds, roots and leaves)
7. **Physical** and **chemical** properties of active constituents
8. **Collection** and **storage** of parts that used in treatment of specific diseases
9. **True prescription** of true drugs used in treatment of diseases.

### Important terms used in pharmacognosy

**Natural substances (natural products):** Those substances are found in nature and consist of a whole plant or whole animal with their active parts. They include:

1. All plants: such as fruits, seeds, leaves, roots and flowers.
2. Some parts of animals and their anatomic parts (e.g. glands and their secretions like adrenal glands and cortisone).

**Drugs:** are substances that have medicinal effects or activities and can be obtained naturally or synthetically.

**Crude drugs:** These are natural substances of plants or animals origin that are not synthetic and have not undergone any process except process of **collection** and **drying** where no changes in molecular structures have been made. They include any natural substances (natural products) that have **not** been advanced in value or improved in conditions when exposed to some forces like **crushing**, **extraction** or **grinding**.

**Extractives or derivatives substances:** These are the main constituents obtained from natural substances or crude drugs by different methods such as separation, extraction, distillation and sublimation. These found as single substances and/or mixture of substances and used as therapeutic agents.

Example: leaf of digitalis (Digoxin).

**Medicinal plants:** These are plants that contain the active constituents with pharmacologic and physiological properties.

**Indigenous (naturally occurring) plants:** These plants grow only in their native lands or homes.

**Habitat:** It is an area or region in which the plant or animal (that produce the drug or the active constituents) grow in.

**Naturalized plants:** These plants grow in foreign lands other than their native homes.

**Cultivated plants:** These plants grow under controlled conditions to improve their quality and/or quantity.

**Pharmacopeia:** It is a work book or dictionary that contains the true names of medicinal plants, e.g. British pharmacopeia (BP), European pharmacopeia (EP),

United States Pharmacopeia (USP) and National Formulary (NF).

**Official drugs:** These substances or preparations recognized and included in pharmacopeia books and approved to have different pharmacological and therapeutic properties.

**Unofficial drugs:** Those drugs are not listed any more in pharmacopeian books such as USP, BP, NF and EP. These drugs were used to be included and organized in pharmacopeia books but at the present time they no longer included either because they lost their therapeutic effect or due to appearance of fatal or dangerous side effects or both.

**Nonofficial drugs:** These drugs are never listed in pharmacopeia books because they do not have any medicinal or therapeutic effects.

### **Botanical (Plant) nomenclature:**

According to the rules of botanical nomenclature; the first name of the plant is written with capital letter and represent the **Genus**, while the second name is written starting with small letter and represent **species** and the two names are written under lines form.

For Example: *Atropa belladonna* (Genus) *belladonna* (species)

*Atropa belladonna* where:

*Atropa* is Latin word that means poisonous

*bella* is Italian word means beauty

*donna* means lady

## **General Biosynthesis Pathways of Secondary Metabolites**

**Metabolism:** Are all the chemical changes in living cells which involves the buildup and breakdown of chemical compounds.

### **Primary metabolism**

It refers to the biosynthesis, utilization and breakdown of the essential compounds and structural elements of the living organism, such as: sugars and polysaccharides, amino acids, peptides and proteins (including enzymes), fatty acids and nucleotides. The starting materials are  $\text{CO}_2$ ,  $\text{H}_2\text{O}$  and  $\text{NH}_3$ . All organisms possess similar primary metabolic pathways and use similar primary metabolites.

### **Primary metabolites**

These are such as glucose, fatty acids, DNA, RNA, amino acids and proteins.

#### **Those chemical compounds are characterized by:**

1. They are involved in growth and development
2. They are formed by photosynthesis
3. They are formed in high concentration inside plant cells
4. They represent the main source of energy
5. They are characterized by high molecular weight
6. They have structural (play a role in cell wall constitution) and functional (play a role in some plants' functions) roles in plants.

### **Secondary metabolism**

It refers to the biosynthesis, utilization and breakdown of smaller organic compounds found in the cell. These compounds, called secondary metabolites, arise from a set of intermediate building blocks: acetyl coenzyme A (acetyl-CoA),

mevalonic acid (MVA) and methyl erythritol phosphate (MEP), shikimic acid, and the amino acids phenylalanine/tyrosine, tryptophan, ornithine and lysine.

### **Secondary metabolites**

Those are chemical compounds that are not involved in growth, development or reproduction of organisms. They are not necessarily produced and their benefits are not yet known but may be produced for several reasons for example; as toxic materials that serve as a defense against predators, parasites and diseases, or to facilitate the reproductive processes or coloring agents such in roses.

#### **These compounds are characterized by:**

1. They are produced in small concentrations inside the cells
2. They do not serve as sources for energy
3. They have low molecular weight
4. They have no clear functions in plants but for human they are very useful for medicines production such as Digitalis or as coloring agents like Saffron and Crocin (chemical compounds found in crocus roses).

The processes and products of primary metabolism are similar in most organisms, while those of secondary metabolism are more specific. In plants, primary metabolism is made up of photosynthesis, respiration, etc., using CO<sub>2</sub>, H<sub>2</sub>O, and NH<sub>3</sub> as starting materials, and forming products such as glucose, amino acids, nucleic acids. These are similar among different species.

In secondary metabolism, the biosynthetic steps, substrates and products are characteristic of families and species. The origin of compounds starting from the set of intermediate building blocks, acetyl-CoA, MVA and MEP, shikimic acid, and the amino acids phenylalanine and tyrosine, tryptophan, ornithine and lysine.

### **Induction of secondary metabolism**

The induction of secondary metabolism is linked to particular environmental conditions or developmental stages. For example, when grown in a nutrient-rich

medium, most bacteria employ almost solely basic metabolism in order to grow and reproduce. However, when nutrients are depleted, they start producing an array of secondary metabolites in order to promote survival. Plants produce secondary metabolites as a response to adverse environmental conditions or in particular developmental stages. For example, exposure to UV radiation induces the biosynthesis of UV-absorbing compounds.

