

Ministry of Higher Education
Salahaddin University-Erbil
Field Crops and Medicinal Plants Department



Main Classes of Plant Natural Products

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Lecture 5



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Main Classes of Plant Natural Products

Alkaloids

Terpenes and
Terpenoids
(Isoprenoids)

Phenolic
Compounds

Polyketides

Glycosides



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What are metabolites?

Metabolites are small molecules that are produced as intermediates or end products during the various chemical reactions that occur in the metabolic processes of living organisms.

These molecules play essential roles in maintaining life and sustaining the functions of cells and organisms as a whole.

Metabolites can be classified into two main categories:

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Major Classes of natural product

***1-Primary
metabolites***

***2- Secondary
metabolites***

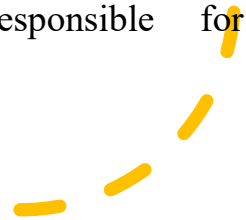
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1-Primary metabolites

Primary metabolites are organic molecules that have an intrinsic function that is essential to the survival of the organism that produces them (i.e. the organism would die without these metabolites).

Examples of primary metabolites include the core building block molecules (nucleic acids, amino acids, sugars, and fatty acids) required to make the major macromolecules (DNA, RNA, proteins, carbohydrates, and lipids) responsible for sustaining life.



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Primary metabolites



Primary metabolites are components of basic metabolic pathways that are required for life.

They are associated with essential cellular functions such as **nutrient assimilation, energy production, and growth/development.**

Primary metabolites include the building blocks required to make the four major macromolecules within the body: **carbohydrates, lipids, proteins, and nucleic acids (DNA and RNA).**

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Primary metabolites

These are large polymers of the body that are built up from repeating smaller monomer units.

The monomer units for building the nucleic acids, DNA and RNA, are the nucleotide bases, whereas the monomers for proteins are amino acids, for carbohydrates are sugar residues, and for lipids are fatty acids or acetyl groups.

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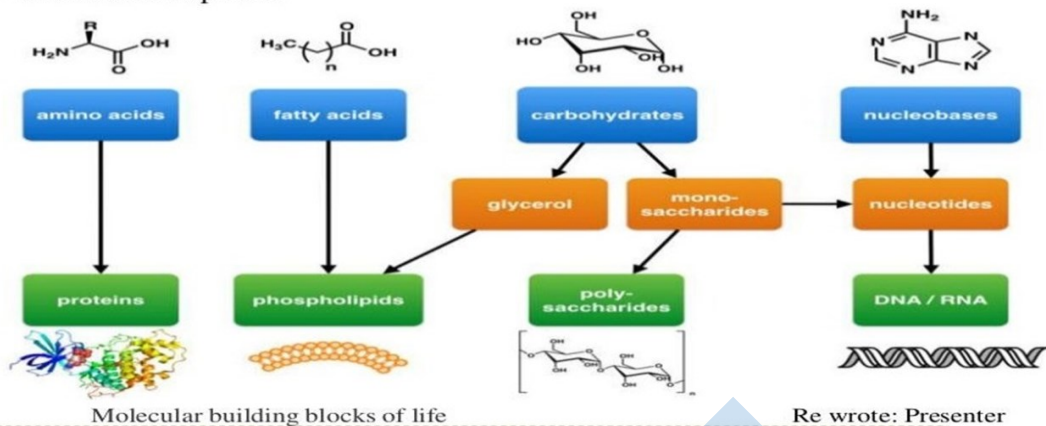
Primary Metabolites



P.M. Components of basic metabolic pathways that are required for life.

They are associated with essential cellular functions such as:

- ✓ Nutrient assimilation
- ✓ Energy production
- ✓ Growth/development.



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2. Secondary metabolites

These are metabolites that are not directly involved in essential metabolic pathways but often serve specialized functions.

Secondary metabolites can have various roles, including defense against predators, attracting pollinators, and acting as signaling molecules. They are typically more diverse among different species.



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Secondary metabolites



To date hundreds of thousands of secondary metabolites have been discovered!

The function of many other secondary metabolites is unknown. One hypothesis is that they **confer** a competitive advantage to the organism that produces them. An alternative view is that, in analogy to the immune system

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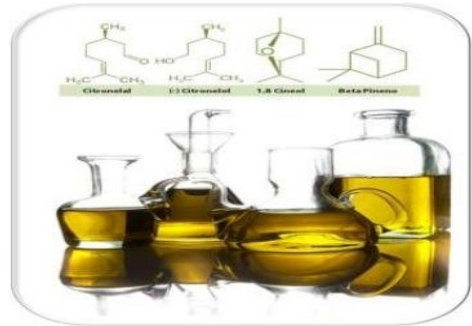
Secondary metabolites



S.M. Compounds that are not directly involved in the normal growth, development, or reproduction of an organism.

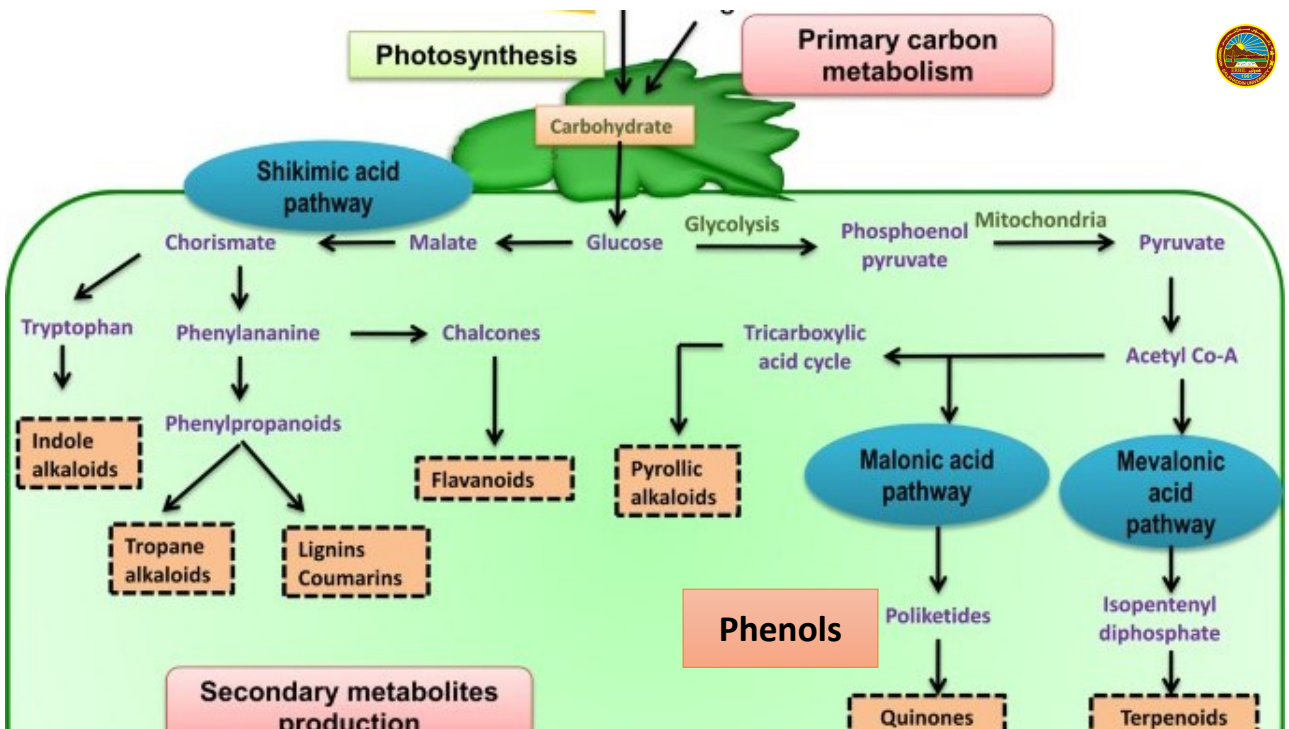
Unlike **P.M.** absence of **S.M.** don't result in immediate death, but rather the organism's survivability, fecundity or perhaps in no significant change at all.

Humans use secondary metabolites as medicines, flavorings, and recreational drugs.



<http://myeclinik.com/tag/marijuana/>

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Examples of secondary metabolites include:

1. **Phenolic Compounds:** Phenolic compounds include various aromatic compounds with antioxidant properties.

Resveratrol: Found in red wine, it has been studied for potential health benefits.

Curcumin: Present in turmeric, it has anti-inflammatory properties.

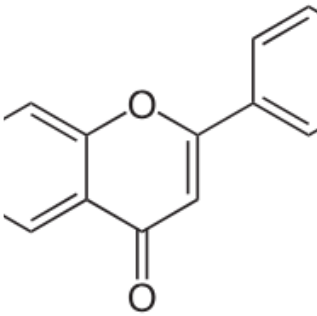
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2. **Terpenoids (Terpenes):** Terpenoids are hydrocarbons that contribute to the scent of many plants and have various functions:

Menthol: Gives mint its characteristic flavor and cooling sensation.

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3. Flavonoids: Flavonoids are a diverse group of polyphenolic compounds found in fruits, vegetables, and beverages like tea and red wine. They have antioxidant and other health-promoting properties.

Quercetin: Present in apples, onions, and red wine, it has antioxidant and anti-inflammatory effects.

Anthocyanins: Responsible for the red, purple, and blue colors in berries and grapes.

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4. Tannins: Tannins are polyphenolic compounds found in plants, often in leaves, bark, and fruits. They can have a bitter taste and are used by plants as a defense mechanism.



Catechins: Found in tea and red wine, they have antioxidant properties.

Gallotannins: Present in oak wood and responsible for the astringency in red wine.

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5. Saponins: Saponins are glycosides that can form soapy foams when agitated in water. They are found in various plant species and have roles in defense against herbivores.

Ginsenosides: Present in ginseng, they are believed to have adaptogenic properties.

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6. Lignans: Lignans are compounds found in plants that can have antioxidant and estrogenic effects.

Example: Flaxseed

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7. Glycosides: Glycosides are compounds in which a sugar molecule is bound to another molecule, often with medicinal properties.

Digitalis glycosides: Found in foxglove plants, they are used to treat heart conditions.

Amygdalin: Present in bitter almonds and apricot kernels, it produces hydrogen cyanide when metabolized.



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8. Alkaloids: Alkaloids are a large and diverse group of nitrogen-containing compounds with various pharmacological effects. Examples include:

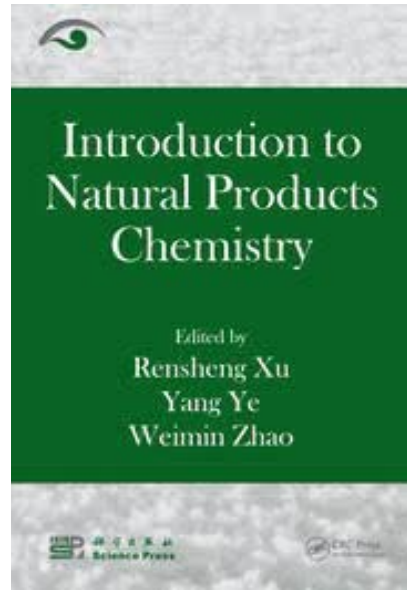
Caffeine: Found in coffee and tea, it acts as a natural stimulant.



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Reference



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