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Lecturer

What are Metabolites?

Metabolites are the intermediate products of metabolic reactions catalyzed by various enzymes that naturally occur within cells. This term is usually used to describe small molecules, or

Metabolites are compounds synthesized by plants for both essential functions, such as growth and development.

A plant cell produces two types of metabolites:-

1. Primary metabolites

Primary metabolites are synthesized by the cell because they are indispensable for their growth. Primary metabolites involved directly in growth and metabolism (carbohydrates, lipids and proteins).

Primary metabolites comprise many different types of organic compounds, including, but not limited to, carbohydrates, lipids, proteins and nucleic acids. They are found universally in the plant kingdom because they are the components or products of fundamental metabolic pathways or cycles such as the Krebs cycle, and the Calvin cycle.

Because of the importance of these and other primary pathways in enabling a plant to synthesize, assimilate, and degrade organic compounds, primary metabolites are essential.

Examples of primary metabolites include energy rich fuel molecules, such as sucrose and starch, structural components such as cellulose, informational molecules such as DNA (deoxyribonucleic acid) and RNA (ribonucleic acid), and pigments, such as chlorophyll. In addition to having fundamental roles in plant growth and development, some primary metabolites are precursors (starting materials) for the synthesis of secondary metabolites. Specific functions, such as pollinator attraction or defence against herbivore.

2. Secondary metabolites

Secondary metabolites are compounds produced by an organism that are not required for primary metabolic processes, although they can have important ecologic and other functions.

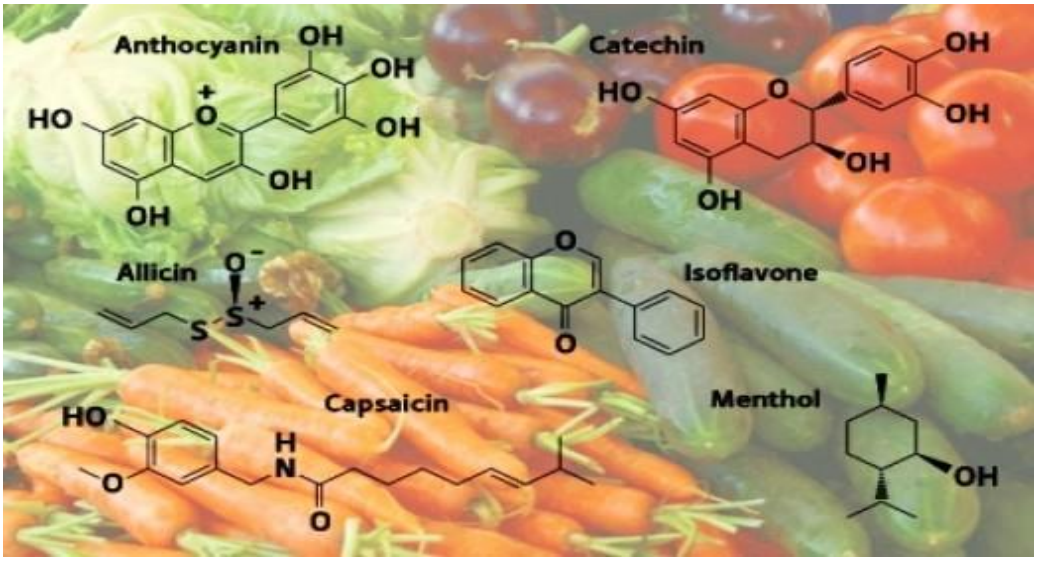
Secondary metabolites considered as end product of primary metabolism and not involved in metabolic activity (alkaloid, phenolics, sterols, steroids, essential oils, lignins and taninsetc).

Secondary metabolites largely fall into three classes of compounds: alkaloids, terpenoids, and phenolics. However, these classes of compounds also include primary metabolites, so whether a compound is a primary or secondary metabolite is a distinction based not only on its chemical structure but also on its function and distribution within the plant kingdom.

They include drugs, fragrances, flavor, dye, pigments, pesticides and food additives with applications in agriculture, industry and pharmaceuticals.

They act as defence chemicals. Their absence does not cause bad effects in the plants.

Many thousands of secondary metabolites have been isolated from plants, and many of them have powerful physiological effects in humans and are used as medicines.



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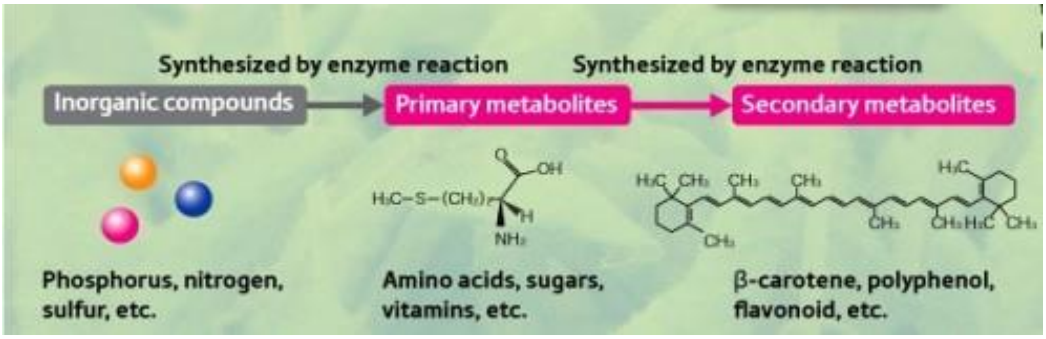
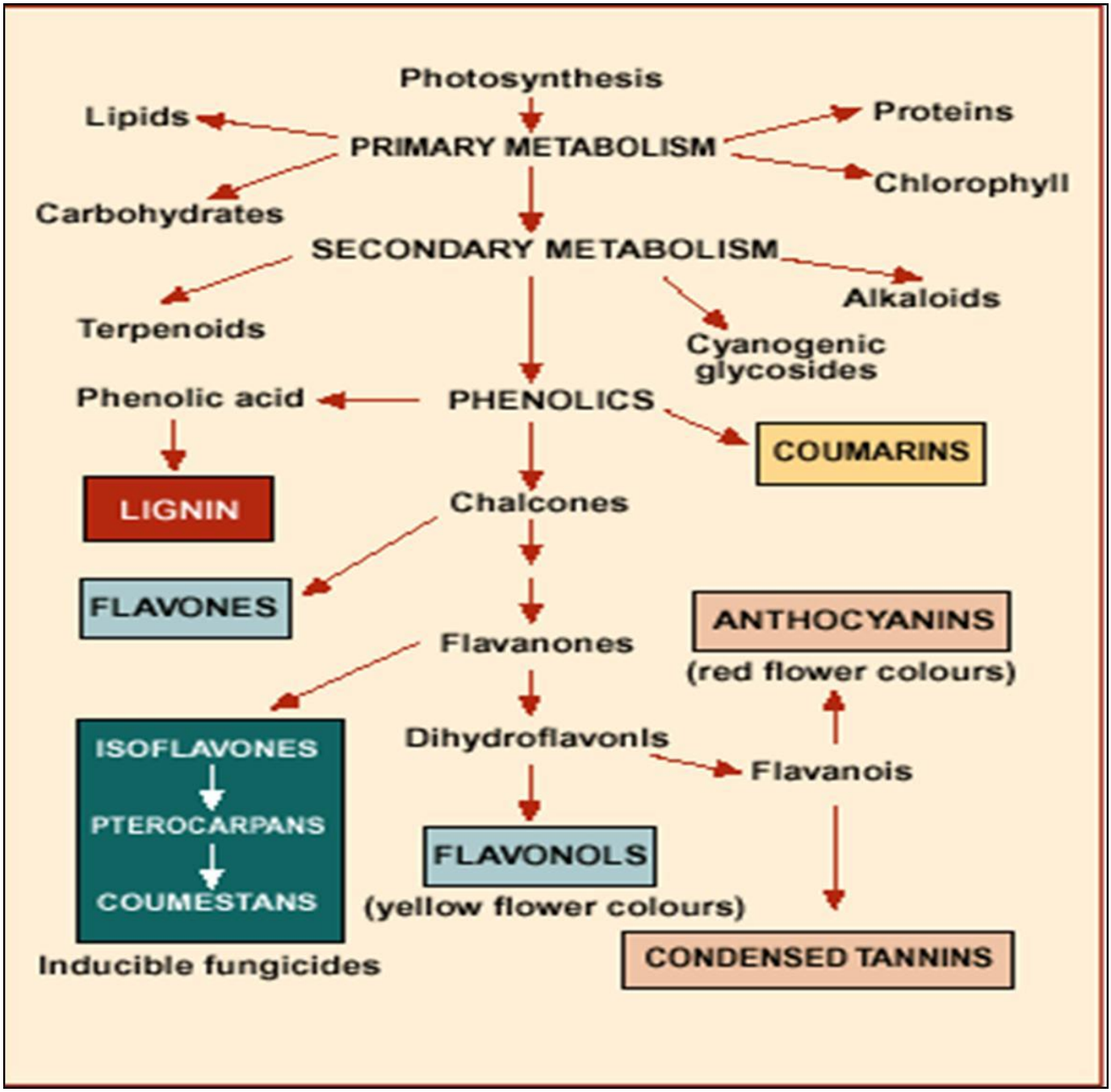


What is the difference between Primary Metabolites and Secondary Metabolites?

1. Unlike secondary metabolites, Primary metabolites are essential to cell growth, and they are involved directly in metabolic reactions such as respiration and photosynthesis.
2. Most primary metabolites are identical among most organisms, whereas secondary metabolites are numerous and wide spread, unlike the primary metabolites.
3. Secondary metabolites are derived by pathways in which primary metabolites involve. Therefore, secondary metabolites are considered as the end products of primary metabolites.
4. Primary metabolites are produced during the growth phase of cell while secondary metabolites are produced during the non- growth phase of the cell.
5. Secondary metabolites are accumulated by plant cells in very small quantities than primary metabolites.
6. The growth phase where primary metabolites are produced is sometimes called ‘trophophase’, whereas the phase during which secondary metabolites are made is called ‘idiophase.’
7. Most of the secondary metabolites are involved in defense reactions, unlike the primary metabolites.
8. Proteins, carbohydrates, and lipids are the main primary metabolites, whereas secondary metabolites are alkaloids, phenolic, terpenoid, sterols, steroids, essential oils and lignin's etc.



Secondary metabolites:- may be produced in the plant as:

1- Defence against predators.

2- Detoxifying agents.

3- They include most of the pharmacologically active natural plant products. They are usually produced in small quantity in the plant.

Factors influencing the production of plant secondary metabolites

1. Heredity or genetic composition that induces both qualitative and quantitative changes.
2. Stage of development.
3. Environmental changes that result mainly in quantitative variations.

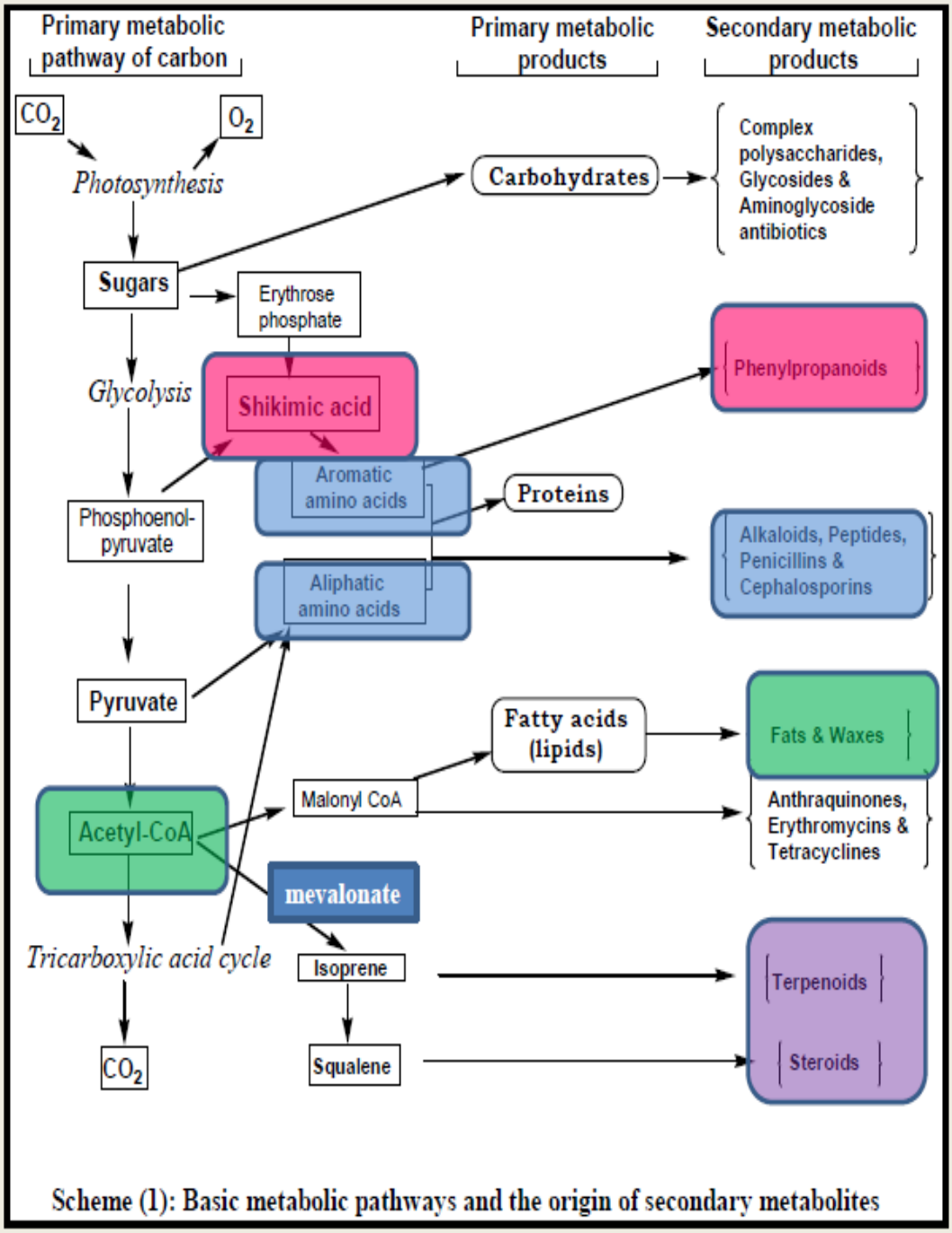
Functions of Secondary Compounds

1. The most common roles for secondary compounds in plants are ecological roles that govern interactions between plants and other organisms.
2. Many secondary compounds are brightly coloured pigments like anthocyanin that colour flowers red and blue. These attract pollinators and fruit and seed dispersers.
3. Nicotine and other toxic compounds may protect the plant from herbivores and microbes.

Biogenesis of secondary plant metabolites

Biogenetic pathways

- The pathways involved in the biosynthesis or biogenesis of the different types of the secondary plant constituents are dependent on the fundamental metabolic cycles of the living tissue.
- These are summarized in Scheme (1).



Scheme (1): Basic metabolic pathways and the origin of secondary metabolites