

SECONDARY METABOLITES (UNIT-IV)

Secondary metabolites that can be created from primary ones are not directly involved in the normal growth, development, and reproduction of the organism. They are molecules which are primarily involved in the overall maintenance/homeostasis of the organism. Secondary metabolites specifically modulate health-maintaining processes, including excretion of waste and toxic products from the body. That means, sustaining the overall health and functional status of the cells within organ systems of the body, the principal function of secondary metabolites. As an illustration, one could cite the biotransformation of tryptophan, a primary metabolite, into Actinomycin, which is a secondary metabolite.

Though the production of metabolites is a natural chemical and bioenzymatic reaction that occurs during metabolism in the body of all organisms, metabolites may also be produced as by-products of the body's reaction to exogenous/external substances or stimuli, such as medications and/or antigens.

Secondary metabolites are found expressed in various combinations in different parts of the plant (leaves, roots, shoots, bark), at different stages of growth (seedling, seed, plantlet, mature tree), under different environmental pressures (invasive microbes, herbivores), in numerous combinations of ways by different classes of plants.

Types of Secondary Metabolites:

These secondary metabolites are highly numerous in number, chemically diverse in nature and belong to three groups.

1. Isoprenoids or Terpenes, e.g., rubber, steroids, essential oils, carotenoid pigments.
2. Nitrogen containing compounds, e.g., alkaloids, glucosinolates, glycosides, non-protein amino acids.
3. Phenolic compounds, e.g., lignin, tannins, coumarins, aflatoxins, flavonoids (anthocyanins).

Role of Secondary Metabolites:

- (1) Some of them attract animals for pollination and seed dispersal.
- (2) They are used by the plants in their defence against herbivores and pathogens.
- (3) They act as agents of plant-plant competition.
- (4) They are used in making drugs, insecticides, flavours, pigments, scents, rubber, spices and other industrial materials like gums, resins for human welfare.

FOR MORE REFERENCE:

Primary Metabolites

- ❖ primary metabolites are involved in maintaining normal physiological processes thus, it is often referred to as a **central metabolite**.
- ❖ Essential for proper growth, development, and reproduction.
- ❖ Examples include **alcohols such as ethanol, lactic acid**.

Secondary Metabolites

- ❖ Secondary metabolites is a term for pathways for small molecule and products of metabolism that are not absolutely required for the survival of the organism.
- ❖ A secondary metabolite has an important ecological function.
- ❖ Examples include antibiotics, mycotoxins etc.

They are classified on the basis of

1. chemical structure
2. chemical composition
3. solubility in various solvents
4. pathways by which they are synthesized

Difference between primary and secondary metabolites

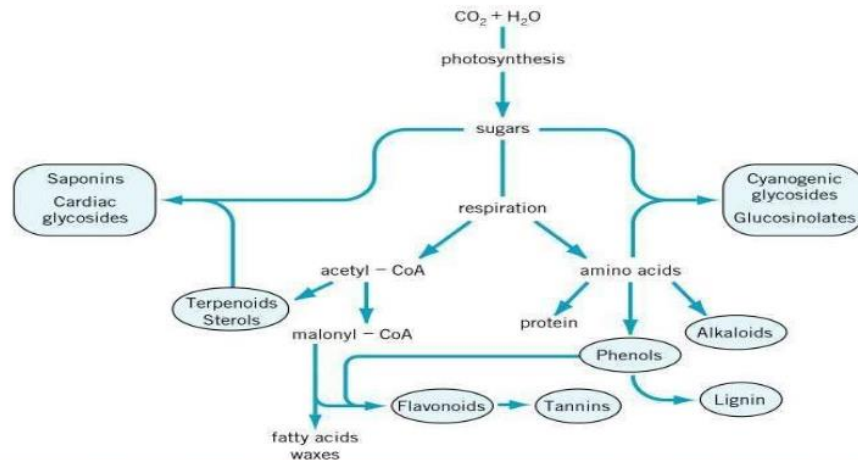
Primary metabolites	Secondary metabolites
They are involved in normal growth, development and reproduction.	They are not directly involved in the normal growth, development and reproduction.
Examples for primary metabolites are carbohydrates , fats and proteins.	Examples for secondary metabolites are alkaloids, tannis, resins, gums and latex etc.
They are not poisonous.	Some of these compounds are poisonous.

Categories of secondary metabolites

Major categories of secondary metabolites

- 1) Mycotoxins
- 2) Antibiotics
- 3) Alkaloids
- 4) Amino acids
- 5) Steroids
- 6) Vitamins

Secondary metabolites are derived from Primary metabolites



FUNCTIONS:

Secondary metabolites serve:

- (i) as competitive weapons used against other bacteria, fungi, amoebae, plants, insects, and large animals;
- (ii) as metal transporting agents;
- (iii) as agents of symbiosis between microbes and plants, nematodes, insects, and higher animals;
- (iv) as sexual hormones;
- (v) as differentiation effectors.

Economical importance of plant secondary metabolites

- Used in preparation of various dyes.
- Used in medicine industry.
- Used for making agrochemicals insecticides and raw material for industries.
- Used as perfume and cosmetics.
- Used as food colour and flavoring agent.

IDENTIFICATION TESTS FOR ALKALOIDS:

- Most **alkaloids** are precipitated from neutral or slightly acidic solution by
- Dragendorff's reagent (solution of potassium bismuth iodide) orange coloured precipitate.
- Wagner's reagent (iodine in potassium iodide) red-brown precipitate.
- Hager's reagent (picric acid) yellow precipitate.

IDENTIFICATION TESTS FOR GLYCOSIDE:

Keller killiani test:

Glycoside is dissolved in a mixture of 1 % ferric sulphate solution in (5%) glacial acetic acid. Add one or two drop of concentrated sulphuric acid. A blue colour develops due to the presence of deoxy sugar.

IDENTIFICATION TESTS FOR TANNIN:

Goldbeater's skin test:

A small piece of goldbeater skin (membrane prepared from the intestine of an ox) is soaked in 20% hydrochloric acid, rinsed with distilled water and placed in a solution of **tannin** for 5 minutes. ... A brown or black colour is produced on the skin due presence of **tannins**.

IDENTIFICATION TESTS FOR FLAVONOID:

1) Four pieces of magnesium filings are added to the ethanolic extract followed by few drops of concentrated hydrochloric acid. A pink or red colour indicates the presence of **flavonoid**.

2) To one milliliter of the crude stock extract, a few drops of dilute sodium hydroxide was added. An intense yellow colour appeared in the plant crude extract, which became colourless on the addition of a few drops of dilute acid which indicates the presence of **flavonoids**.

IDENTIFICATION TESTS FOR VOLATILE OIL:

To a thin section of drug add few drops of alcoholic solution of sudan-III, red color indicates presence of **volatile oil**.

IDENTIFICATION TESTS FOR RESIN:

Detection of resin: the pH of the extract of crude- drug with 90% ethanol (1+9) is acidic. Mix water to the solution and the transparent solution turns milkish. - Detection of free cinnamic acid (exclusion of Summatra Benzoin impurities).

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