**Sources of secondary metabolites Lec 2**

The major sources of secondary metabolites are plants (80% of secondary metabolite), bacteria, fungi, and many marine organisms (sponges, tunicates, corals, and snails)

**Secondary metabolites of plants**

Plant secondary metabolites represent highly economically valuable products. These are used as high value chemicals such as drugs, flavors, fragrances, insecticides, dyes, etc. Plants are rich in a wide variety of secondary metabolites, such as

* tannins,
* terpenoids,
* alkaloids
* flavonoids,

Plants have an almost limitless ability to synthesize aromatic substances, most of which are phenols or their oxygen-substituted derivatives

Many alkaloids are used in medicine, usually in the form of salts. Some examples include vinblastine which has antitumor properties ; quinine which has antipyretics and antimalarial properties; and reserpine which can be used to treat high blood pressure.

Phenols have antimicrobial , antiviral , anti-inflammatory , and vasodilatory actions. It protects the plant against adverse factors which threaten its survival in an unfavorable environment, antioxidants protecting cells.

Terpenoids are commercially important fragrance and flavoring agents. due to fruity odor and sweet floral aroma, respectively. The roles of terpenoids as pharmaceutical agents with activities such as antibacterial and antineoplastic are still under investigation. Terpenes are vital for life in most organisms exerting metabolic control and mediating inter and intra species interactions, it has also been shown that flowers can emit terpenoids to attract pollinating insects.

 Chemical structure of plant's secondary metabolites

 alkaloid  Phenol



 **Trpanoid**

**Production of secondary metabolites from plants**

**Conventional**

* The conventional method of secondary metabolite production relies on extraction of metabolite, not production, from the tissues of plant by different phytochemical procedures
* like solvent,
* steam
* supercritical extraction.

The recent developments in biotechnological methods like plant tissue culture, enzyme and fermentation technology have facilitated in vitro synthesis and production of plant secondary metabolites. The major processes include:

 A. **Immobilization**

Cell or biocatalysts are restricted within a matrix by entrapment, adsorption or covalent linkage. On addition of suitable substrate and provision on optimum physico chemical parameters, the desired secondary metabolites are synthesized. Immobilization with suitable bioreactor system provides several advantages, such as continuous process operation, but for the development of an immobilized plant cell culture process, natural or artificially induced secretion of the accumulated product into the surrounding medium is necessary.

 **2. In vitro tissue, organ, and cell culture**

**tissue culture**, a method of biological research in which fragments of [tissue](https://www.britannica.com/science/tissue) from an animal or plant are transferred to an artificial [environment](https://www.merriam-webster.com/dictionary/environment) in which they can continue to survive and function. Plant cell and tissue cultures can be established routinely under sterile conditions from explants, such as plant leaves, stems, roots, meristems, etc., both for multiplication and extraction of secondary metabolites. Shoot, root, callus, cell suspension, and hairy root culture are used to synthesize metabolite of interest. Metabolites which are localized in multiple tissues can be synthesized through unorganized callus or suspension cultures. But when the metabolite of interest is restricted to specialized part or glands in host plant, differentiated microplant or organ culture is the method of choice.

**Secondary metabolites of microorganisms**

Microbial secondary metabolites are low molecular mass products with unusual structures. The structurally diverse metabolites show a variety of biological activities like antimicrobial agents, inhibitors of enzymes and antitumors, immune-suppressives and antiparasitic agents, plant growth stimulators, herbicides, insecticides, antihelmintics, etc. They are produced during the late growth phase of the microorganisms. The secondary metabolite production is controlled by special regulatory mechanisms in microorganisms, as their production is generally repressed in logarithmic phase and depressed in stationary growth phases. The microbial secondary metabolites have distinctive molecular skeleton which is not found in the chemical libraries and about 40% of the microbial metabolites cannot be chemically synthesized.

**Secondary metabolites of bacteria**

The structurally diverse metabolites show a variety of biological activities like antimicrobial agents, inhibitors of enzymes and antitumors, immune-suppressives and antiparasitic agents, plant growth stimulators, herbicides, insecticides, antihelmintics, etc. They are produced during the late growth phase of the microorganisms. The secondary metabolite production is controlled by special regulatory mechanisms in microorganisms, as their production is generally repressed in logarithmic phase and depressed in stationary growth phases. The microbial secondary metabolites have distinctive molecular skeleton which is not found in the chemical libraries and about 40% of the microbial metabolites cannot be chemically synthesized.

**Features of microbial secondary metabolites**

• The principle and process of natural fermentation product synthesis can be successfully scaled up and employed to maximize its application in the field of medicine, agriculture, food, and environment.

• The metabolite can serve as a starting material for deriving a product of interest, extended further through chemical or biological transformation.

• New analog or templates in which secondary metabolite serve as lead compounds will lead discovery and design of new drugs.

 Secondary metabolites Biological activity

 Pyrethrins Insecticidal

 Baccharine Antineoplastic

 Gsaline Antineoplastic

 Digoxin Cardiac tonic

 Diosgunin Antifertility

 Morphine Analgesic

 Thebaine Source of codeine

 Suolpolanine Antihypertension

 Alropine Muscle relaxant

 Codeine Analgesic

 Shikonin Dye, pharmaceutical

