

Natural Products

A natural product is a chemical compound or substance produced by a living organism. They may be extracted from tissues of (plant, animal, marine organism and micro-organism). These extracts are a rich source of lead compounds for pharmaceutical applications.

Natural Product Function

Natural products are often divided into two major classes: primary and secondary 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 ((carbohydrates (Sugar), nucleic acids (DNA/RNA), amino acids (Protein), and fatty acid (Lipids) responsible for sustaining life.

Secondary metabolites in contrast are organic molecules that typically have an extrinsic function that mainly affects other organisms outside of the producer. Secondary metabolites are not essential to survival but do increase the competitiveness of the organism within its environment.

Natural product sources

1. Natural products from microorganisms

Microorganisms as a source of potential drug candidates were not explored until the discovery of penicillin in 1929. Since then, a large number of terrestrial and marine microorganisms have been screened for drug discovery. Microorganisms have a wide variety of potentially active substances and have led to the discovery of antibacterial agents like cephalosporins, antidiabetic agents like acarbose, and anticancer agents like epirubicin.

2. Natural products from marine organisms

The first active compounds to be isolated from marine species were spongouridine and spongothymidine from the Caribbean sponge *Cryptothecacrypta* in the 1950s. These compounds are nucleotides and show great potential as anticancer and antiviral agents. Their discovery led to an extensive research to identify novel

drug candidates from marine sources. About 70% of the earth's surface is covered by the oceans, providing significant biodiversity for exploration for drug sources. Many marine organisms have a sedentary lifestyle, and thereby synthesize many complex and extremely potent chemicals as their means of defence from predators. These chemicals can serve as possible remedies for various ailments, especially cancer. One such example is discodermolide, isolated from the marine sponge, *Discodermia dissoluta*, which has a similar mode of action to that of Paclitaxel, and possesses a strong antitumor activity. It also exhibits better water solubility as compared to paclitaxol. A combination therapy of the two drugs has led to reduced tumor growth in certain cancers.

3. Natural products from animal sources

Animals have also been a source of some interesting compounds that can be used as drugs. Epibatidine obtained from the skin of an Ecuadorian poison frog, is ten times more potent than morphine. Venoms and toxins from animals have played a significant role in designing a multitude of cures for several diseases. Teprotide for example, extracted from a Brazilian viper, has led to the development of cilazapril and captopril, which are effective against hypertension.

4. Natural products from plant sources

The use of plants as medicines has a long history in the treatment of various diseases. The earliest known records for the use of plants as drugs are from Mesopotamia in 2600 B.C., and these still are a significant part of traditional medicine and herbal remedies. To date, 35,000-70,000 plant species have been screened for their medicinal use.¹³ Their Several important drugs such as Taxol, camptothecin, morphine and quinine have been isolated from plant sources. The first two are widely used as anticancer drugs, while the remaining are analgesic and antimalarial agents, respectively.

Soap:- is the sodium salt of a fatty acid. Have a party hydrophilic (dissolves in water) and other lipophilic (fat dissolves dirt).

Sugars:- are natural polyhydroxialdehydes or polyhydroxiketones with different functions: structure, energy storage components of the nucleic acids, etc. They

are formed by photosynthesis in plants and are classified into monosaccharides (glucose), disaccharides (sucrose) and polysaccharides (cellulose, starch, etc.).

Sweeteners:- are natural or synthetic substance that gives a sweet taste to food. We can find natural sweeteners such as sucrose (cane and beet), fructose (sugar simpler and sweet, honey), lactose and galactose (sugars from milk, less sweet), and synthetic as: saccharin (300 times sweeter than sucrose), aspartame (160 times sweeter), etc.

Saccharin:- is an artificial sweetener. The basic substance, benzoic sulfilimine, has effectively no food energy and is much sweeter than sucrose, but has a bitter or metallic aftertaste, especially at high concentrations.

Formula: $C_7H_5NO_3S$

Molar mass: 183.18 g/mol

Melting point: 228.8 °C

Density: 828.00 kg/m³

Soluble in: Water

Aspartame:- is an artificial, non-saccharide sweetener used as a sugar substitute in some foods and beverages. In the European Union, it is codified as E951. Aspartame is a methyl ester of the aspartic acid/phenylalanine dipeptide.

Formula: $C_{14}H_{18}N_2O_5$

Molar mass: 294.3 g/mol

Melting point: 246 °C

Density: 1.35 g/cm³

Flavours and perfumes:- Food Additives (flavours, colours, antioxidants, etc.).

An antioxidant:- is a molecule that inhibits the oxidation of other molecules.

Drugs:- Product to be administered for curative purposes. Although there are many natural source products that are used as drugs, the synthesis of drugs is well developed and provides a large amount of chemicals that are used as such.

For example: sedatives, antiinflammatories, diurethics, antiviral, hepatoprotectors, etc.

Regulators:- like dopamine, used for Parkinson's syndrome (only L-Dopa is active) Parkinson's disease is a degenerative disorder of the central nervous system. The motor symptoms of Parkinson's disease result from the death of dopamine-generating cells in the substantia nigra, a region of the midbrain; the cause of this cell death is unknown.

Antibiotics:- chemical products able to inhibit the growth of microorganisms and even destroy them.

Analgesics:- drug that relieves pain without causing loss of consciousness. Painkillers are a large group that ranges from the derivatives of opium (solid product obtained by drying the milky juice of the opium poppy "*Papaver somniferum*" with a 25% alkaloids), and morphine (potent analgesic, very toxic and produces dependence), codeine (anticoughing), heroin (synthetic derivative obtained by acetylation of morphine, good analgesic with less depression than morphine addiction but more addiction), methadone (synthetic substitute for heroin with analgesic properties but also cause addiction) to opiates, such as aspirin, which is derived from the Salicylic acid (glycoside from the bark of willow formerly used as an analgesic), Paracetamol and ibuprofen. The application of topical analgesics includes all anti-inflammatories, such as hydrocortisone and derivatives, and the general and local anesthetics at low doses.