

NEW DRUG DEVELOPMENT - A REVIEW ON NATURAL PRODUCTS OBTAINED FROM MEDICINAL PLANTS AS SOURCE

B. MALLESWARI,

Assistant professor,
St. Martin's Engineering College,
Survey No 563, Dulapally, Kompally. 500100.
mallikakanth12@gmail.com

RAMADEVI TRIPURA

Assistant professor,
St. Martin's Engineering College,
Survey No 563, Dulapally, Kompally. 500100
ramadevitripura@gmail.com

Abstract

Discovery of new drug using natural products that are obtained from plants is a thought-provoking task. From ancient times the natural products are being used as herbal medicine for illness or for treating many diseases. From the natural products the biological active secondary metabolites that have effective drug compounds helps in discovering of new drugs. Identification and the structural interpretation and chemical composition of molecules of natural products through IR, NMR, GCMS and HPLC helps to discover new drugs or to synthesize new drugs. Now this review emphasizes the precious role of natural products that have played and about to play in the discovery of new drug.

Key Words:

Natural products, medicinal plants, chemical composition of secondary metabolites, new drug development

Introduction

This review restricts itself to the more narrow definition of the natural product i.e. an organic compound that is synthesized from plants. Since olden days the natural products and their derivatives that obtained from plants are well known for their remedial sources and because of structural diversity they recognized as therapeutic agents. They have multidimensional chemical structures, helps to act as biological function modifiers. Moreover, the derivatives of natural products can be produced with more potentially and safely. Therefore the constituents of extracts of natural products motivated towards various drug discoveries that ultimately leads to approval as new drug by FDA. Plant metabolites are of two types, they are

A) Primary metabolites – these are directly involved in plant growth. These include carbohydrates, lipids, proteins, alcohols and nucleic acids.

B) Secondary metabolites: these are the compounds, which did not involve in growth of the plant. These are produce for the purpose of defense mechanism in the plant. The environmental factors don't show any effect on secondary metabolites production in plants unlike primary metabolites. These include phenols, alkaloids, Terpenes, essential oils and lignins. These secondary metabolites have complex chemical structures and shows medicinal

properties. The plant extracts acts as drugs because of these secondary metabolites. These play major role in development of new drugs based on natural products.

2. Classification:

The medicinal plants have secondary metabolites known as phytochemicals, which are effective constituents, possess medicinal properties acts as drug. These phytochemicals are classified into various categories basing on their chemical composition.

1. Poly Phenolic compounds
2. Terpenes
3. Alkaloids
4. Glycosides and
5. Saponins

1. Poly Phenolic Compounds:

These are Aromatic, aliphatic ring containing Phenols. These include Flavonoids, Phenolics Tannins.

Flavonoids are endorsed to their anti-oxidative, anti-inflamative, anti-carcinogenic and antimutagenic properties combine with their capability to modify key cellular enzyme functions. They have anticholinesterase activity.

Examples: Quercetin, reservaratrol, Kaempferol and quercitrin, caffeic acid, flavones rutin, naringin, hesperidin and chlorogenic, tannic acid, Gallic acid and ellagic acid

2. Terpenes: These are isoprene units. These include Carotenoids, steroids Terpenes acts as serotonin uptake inhibitors, receptors and neuro transmitters in the brain, antiseptic properties, stimulate secretion of mucous-example Eucalyptus oil, these act as basis of gastrointestinal drugs, pain relievers, antiseptics and anti oxidants.

Examples: Artemisinin, α -carotene, β -carotene, lycopene, lutein and zeaxanthi.

3. Alkaloids:

These are Nitrogen atom containing heterocyclic compounds.

These alkaloids act as anticancer drugs, used in heart failure-for example Digoxin.

These are used to treat blood pressure, used to relive from migraine headache, used as cough suppressant, Antiarrhythmic agent, Antispasmodic, anti-parkinson, cycloplegic drugs.

Example: Morphine, Caffeine, Berberin, and Codeine.

4. Glycosides:

These are derived from carbohydrates and non -carbohydrate molecules. Glycosidic residues act as antibiotic and antitumor agents. These also act as cardio active agents for example Digitalis; these are also used as anti-ulcer agent for example Liquorice, Example: Amygdalin, gentiopicrin, and rographolide, polygalin, Cinnamyl acetate

5. Saponins: These include glycosylated steroids, triterpenoids and steroid alkaloids. These acts as antibiotics, used in weight management, used to reduce cholesterol, used to inhibit tumor growth, these acts as anti-inflammatory agents. These are also used as flavour modifying agents

Example: Diosgenin and Hecogenin

3. Role of Natural Products in treatment of various

Diseases:

Natural medicines have been used for the treatment for years and prophylactic of Several diseases. Many of the natural products particularly secondary metabolites Which are biologically active, acts as multi target agents with chemical diversity and With more convincing in terms of their mechanisms. They help to find and synthesize Novel anti bacterial and anti-viral compounds and lead structures. Significant Advancements have been taken place for the development of new drugs. For example HIV infection. It was identified previously that flavonoids, coumarins and terpenoids Were capable of preventing and controlling many viral diseases. Recently tricyclic Coumarins have been identified which suppress nuclear –factor activation and inhibits The replication of HIV virus in vitro. During the past decade, the use of natural Products in the treatment and prevention of various diseases were increased. Multiple Sclerosis is considered as relapsing- remitting inflammatory and Autoimmune disease of central nervous system. It accompanying with destruction of The myelin sheaths of neurons. In this regard the use of natural products like Polyphenols, flavonoids, alkaloids, chalcones xanthenes, anthocyanin, isochlorogenic Acid, dehydrocheilanthifoline are evaluated for the therapeutic treatment and Prevention of this disease.

4. The role of Natural Products (Secondary metabolites) in plants as a source of new drugs and as Medicine:

The Natural Products that are present as secondary metabolites present in medicinal plants have excellent therapeutic properties are precious for then modern system of drug discovery and development. These are used as biologically active agents and can be used directly for therapeutic use. The biologically active components function as raw material for the development of new drug. These isolated structures can be used as bases for more complicated semi synthetic chemical compounds in development of new drug. For example Phenols - acts as anti- cancerous, Anti-oxidants, cytotoxicants, Anti-microbials and vasodilating. Terpenoids and Steroids - acts as Anti-microbials, detoxifying agents, anti-malarial, hepaticidal strengthners, anti-rheumatics, Alkaloids- acts as Neuropharmaceuticals, anti-cancerous, sedatives, and anti-microbials, insecticidal.

4.1.Natural product derived modern drugs:

A large number of present prescribed drugs are derived from natural products either directly or motivated by the structures of natural products. Analgesics are one of the oldest natural product based drugs. Willow tree bark has the propriety of pain relieving due to the presence of Salicin; a natural product, which was, hydrolyses to salicylic acid. Aspirin (acetyl salicylic acid) better used as pain reliever.

One best example for consideration is Opium. The most effective component of Opium is Morphine, an alkaloid, acts as opioid receptor agonist.

Another example is Zinconotide, N-type calcium channel blocker, analgesic based on cyclic peptide cone snail toxin.

Basing on natural products many number of anti infectives are discovered best example was Penicillin, isolated from pencillium. The drug Paclitaxel is based on natural product taxol, a terpinoid isolated from the pacific yew tree. One more example includes Captopril, an angiotensin-converting inhibitor used to treat hypertension and congestive heart failure.

5. Some Natural products as medicine which are available in market:

1.Tulsi: This medicinal plant found in every house in India The Tulasi leaves extract consists of essential oil have Terpenes and Flavonoids. The phytochemicals present in Tulsi are - Eugenol, Ursolic acid, Oleanolic acid, Carvacrol, β -caryophyllene (about 8%), Linalool, and rosmarinic acid. The essential oil present in Tulsi is eugenol (~70%), Germacrene (~2%) rosmarinic acid.

The therapeutic uses are – it is an antioxidant, it protects heart by reducing cholesterol levels, acts as anti aging agent, it has anti-bacterial, anti-viral, anti-fungal properties. It is mild diuretic and detoxifying agent, it has anti-inflammatory properties.

2. NEEM:

The main constituents of Neem are nimbn, nimbinin, nimbidin, nimbosterol; essential oil mainly contains sesquiterpene derivatives, tannins, margosine and 6-desacetyl nimbinene. It contains flavonoids – Kaempferol, Melicitrin. Quercetin and many more.

The therapeutic uses are - it acts as antifungal, anti-inflammatory, an antitumor properties. Anti-arthritic, antipyretic, hypoglycemic, antigastric ulcer, and antibacterial properties.

3. Ginger:

Ginger consists mainly Gingerol. It also consists of flavonoids and tannins along with volatile oil, which consists of zingiberene, Ciral, Borneol, Camphene and phellandrene. It also contains small amount of sugars, proteins and starch.

The therapeutic uses are - it cleans toxins from the body, it acts as anti-oxidant,

It relieves muscular pain, nausea; it has anti- viral and anti- bacterial properties. It is an anti inflammatory agent. It also inhibits diabetes.

4.Amla:

The phytochemicals present in amla are – it contains Gallic acid, quercetin, tannins, flavonoids, phyllaemblic acid compounds, vitamin –c, various polyphenols, terpenoids, and alkaloids. It also contains ellagic acid, chebulinic acid. The therapeutic uses of amla include: it consists of high amount of vitamin-C helps to control many infections. It removes toxins from the body and helps in brain functioning. it acts as blood purifier. It relieves gastric

disorders, it acts as antioxidant, it is antibacterial and acts as astringent. It acts as anti stress agent and controls cholesterol. It relieves from sleeping disorder.

5. Aswagandha:

This is also widely used medicinal plant. The chemical constituents of this are lactones, steroidal alkaloids, steroidal lactones with ergostane skeleton, alkaloids like withanine, pseudo-withanine, somniferine, etc.

The therapeutic uses are – it acts as sedative, it enhances memory, it is used in neurological diseases, it modulates immune system, it is an adaptogen, anti-inflammatory, anti-tumor, immunomodulator, nervine, Analgesic, anti-anemic properties

6. Cinchona:

The chemical composition of this plant consists of quinine and other alkaloids. The therapeutic use of this tree bark is – it acts as antimalarial agent.

6. Collaboration of Analytical methods and chemistry of Natural Products for new drug development:

The primary objective of this is to maintain balanced correlation between analytical tools followed by analysis of data. It is impossible to get exact chemical structure and percentage composition of natural products present in medicinal plants with analytical tools like HPLC, GC-MS, NMR, IR, U.V spectroscopies and column chromatography, etc. The knowledge of these techniques plays a vital role in development of new drug. These techniques help in analysis of micro compounds present in natural products. The main steps involved in development of new drug are extraction, isolation of components, Characterization of all active components from the medicinal plants. The primary and secondary metabolites present in the medicinal plant tissues are extracted by different methods or techniques because it is primary and most important step to analyze biologically active components. Conventional extraction methods and microwave extraction methods give idea about the yield obtained also. The recognition of biologically active components from the plants remains a very complicated task because of the compounds chemical diversity and complexity in their structures. Isolation of these active molecules will be done with the help of chromatography techniques like TLC, column chromatography, etc. Further the phytochemical screening assay gives idea about secondary metabolites, which help in curing of various diseases. The chemical structures of these will be identified and confirmed by spectroscopic methods like NMR, UV, IR and Mass spectroscopy. In case of crude extracts, NMR patterns can be seen and interpreted commonly combined with multivariate data, analyzed through comparative manner by discriminating the variance between moderately similar extracts, which can be linked with a specific biological activity, enables the construction of complex database of secondary metabolites.

7. Conclusion:

In the present context of global scenario of different diseases, an intensive research for different principal compound for the emergence of novel therapeutics are exceptionally important. It is highly difficult to determine clearly the chemical structure- activity and functionality relationship regarding the effect of secondary metabolites in biological system activity because of presence of huge number of secondary metabolites with complex chemical structures and their functional reactions. For the management of human diseases a new era of natural medicine may come with the aid of better screening methods from natural products obtained from the plants. A new approach emphasizing the significance of natural products as prime solution to unanswerable questions for example treatment for polycystic kidney disease, which is a silent killer. Advanced research should be done for the development of new drugs with very less side effects.

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