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Plants Secondary Metabolites as Medicines: A Review

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Abstract: Medicinal plants are the most important source of life saving drugs for the majority of the world's population. Plants are an important source for the discovery of new products of medicinal value for drug development as they produce a wide variety of secondary metabolites which serve them as defense compounds against herbivores and microbes. Secondary metabolites produced by plants do not aid in the growth and development of plants but are required for the plants to survive in its environment. They have been described as antibiotic, antifungal, antiviral and they are able to protect plants from pathogens. Products isolated from them have been used to treat infections, health disorders or diseases. In modern medicine, they provided lead compounds for the production of medications for treating various diseases from migraine up to cancer. This review deals with the Pharmacological activity and important functions of secondary metabolites in valuable medicinal herbs as Antimalarial, Antidiabetic, Hepatoprotective, Antiulcer, Antiinflammatory, Antimicrobial.

Keywords: Secondary metabolites, Antibiotic, Antifungal, Antiviral, Antidiabetic, medicinal plants

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Introduction

Secondary metabolites are numerous chemical compounds produced by plants. The toxic and repellent activity of secondary metabolites help in defending against pathogens. When a plant is attacked by herbivores or pathogens, the production of secondary metabolites increased (Devika and Koilpillai, 2012). Many plants synthesize a number of organic compounds which are not involved in primary metabolism and have no function in growth and development of plants. Such compounds are called secondary metabolites

or secondary plant products. According to their chemical structure, the secondary metabolites are classified into several classes (Rehab and Amira, 2018). It includes—Phenolics, Alkaloids, Saponins, Terpenes, Lipids and Carbohydrates (Rehab and Amira, 2018).

Phenolics:

The Phenolic molecules are effective antioxidants and free radical scavengers e.g. Flavanoids. The largest group of Plant Secondary

metabolites constitute phenolics. They contribute significant color, taste and flavor of many herbs, food and drinks. It has antiinflammatory activities as quercetin, antihepatotoxic properties as Silybin, Phytoestrogenic activity as Genistein and diadzein and others are insecticidal or naringenin (Gowlaska *et al.*, 2014).

Phenolics can be classified according to the structure as Simple Phenolics, Tannins, Coumarins, Flavonoids, Chromones, Xanthonenes, Stilbenes, and Lignans.

Alkaloids:

Alkaloids are nitrogen containing organic compounds. According to their basic chemical structure, Alkaloids can be divided into-- Acridones, Aromatics, Carbolines, Ephedras, Ergots, Imidazoles, Indoles, Bisindoles, Indolizidines, Manzamines, Oxindoles, Quinolones, Quinoxalines, Phenylisoquinolines, Phenylethylamines, Piperidines, Purines, Pyrrolidines, Pyrrolizidines, Pyrrolindoles, Pyridines and simple Tetrahydroisoquinolines (Tadeusz *et al.*, 2015).

The pharmacological actions of Alkaloids are Analgesia, Local Anesthesia, Cardiac stimulation, Respiratory stimulation, Relaxation, Vasoconstriction, Muscle relaxation, Toxicity, Antineoplastic, Hypertensive and Hypotensive. Alkaloids are used as insecticides e.g. Nicotine and anabasine (Hoftmann, 2003).

Saponins:

Numerous pharmacological properties of Saponins have been demonstrated such as Antitumor, Piscicidal, Molluscicidal, Spermicidal, Sedative, Expectorant, Analgesic and Antiinflammatory. Glycyrrhizin is used as expectorant and antitussive agent. Saponins are also used to treat chronic hepatitis and cirrhosis (Guclu-ustundag and Mazza, 2007).

Terpenes:

The most diverse group of Plant Secondary metabolites are Terpenes. According to the number of isoprene units in the molecule, the

Terpenes are classified into Hemiterpenes, Monoterpenes, Sesquiterpenes, Diterpenes, Sesterterpenes and Triterpenes,

Terpenes are the important components of plant essential oils or Volatile oils, It has various Medicinal uses such as Camphor and Menthol are used as counterirritants analgesics and antitching agents. It also shows Antihelmintics, Antibacterial, Antifungal, Antiprotozoal Antiinflammatory, Antineoplastic and Analgesic properties. It is used in herbal medicines as diaphoretics and antirheumatics (Seigler, 1998).

Lipids:

Lipids consists of a group of naturally occurring molecules which includes Fixed oils, waxes, Essential oils, Sterols, Fat soluble vitamins (such as Vitamins A, D, E and K), Phospholipids etc. They have many Pharmacological activities such as Antiinflammatory, Antiseptic, Antimicrobial, Analgesic, Sedative, Spasmolytic, Antiaging and Wound healing. It is also used in skin care products and in food preservation (Pichersky *et al.*, 2006).

Carbohydrates:

According to the chemical structure, the Carbohydrates are classified into four chemical groups such as Monosaccharides, Disaccharides, Oligosaccharides and Polysaccharides. It shows Medicinal effects such as Mucilage. Mucilage is a viscous sticky material produced by plants. It is used as Demulcent and in the management of inflammatory digestive disorders (Anbalahan, 2017).

Important functions of Secondary metabolites

Table 1 shows the important functions of secondary metabolites and its plant species (Saurabh *et al.*, 2015).

Conclusion

According to the above data, there are several classes of secondary plant metabolites that are responsible for the biological activities of herbal medicines. Eventually, secondary plant

Table 1: Important functions of secondary metabolites of plants

Secondary metabolite	Plant species	Biological action
L-Ephedrine	<i>Ephedra</i> sp.	Sympathomimetic
Amarogentin	<i>Swertia japonica</i>	Bitter tonic and hepatoprotective
Anthocyanin	<i>Vitis vinifera</i>	Protects against myriad of human diseases
Anthraquinones	<i>Cassia acutifolia</i>	Purgative
Artemisinin	<i>Artemisia</i> spp.	Antimalarial
Asiaticoside	<i>Centella asiatica</i>	Wound healing
Azadirachtin	<i>Azadirachta indica</i>	Insecticidal
Berberine	<i>Coscinium fenestratum</i>	Antibacterial, anti-inflammatory
Betacyanin	<i>Phytolacca americana</i>	Antioxidant
Caffeine	<i>Coffea arabica</i>	CNS stimulant
Camptothecin	<i>Ophiorrhiza rugosa</i>	Anticancer
Capsaicin	<i>Capsicum annuum</i>	Cures rheumatic pain
Cardenolides	<i>Digitalis purpurea</i>	Cardioactive property
Catechin	<i>Rheum ribes</i>	Antioxidant
Catharanthine	<i>Catharanthus roseus</i>	Nicotinic receptor inhibitor, anticancer property
Cathin	<i>Brucea javanica</i>	Psychoactive drug
Codeine	<i>Papaver</i> spp.	Analgesic
Cryptosin	<i>Cryptolepis buchanani</i>	Cardioactive property
Diosgenin	<i>Dioscorea deltoidea</i>	Synthesis of medicinal steroids
Eleutherosides	<i>Eleutherococcus senticosus</i>	Antidiabetic effects
Forskolin	<i>Coleus forskohlii</i>	Anticancer, glaucoma
Glycyrrhizin	<i>Glycyrrhiza glabra</i>	Expectorant and treatment of peptic ulcer
Gymnemic acid	<i>Gymnema sylvestre</i>	Antidiabetic
Hyoscyamine	<i>Datura stramonium</i>	Anticholinergic, antispasmodic
Hypericins	<i>Hypericum perforatum</i>	Antidepressant
Indole alkaloid	<i>C. roseus</i>	Anticancer
Isoflavones	<i>Psoralea corylifolia</i>	Antioxidant
Lignan	<i>Linum flavum</i>	Anti-inflammatory and antioxidant effects
Lupeol, Rutin	<i>Hemidesmus indicus</i>	Antioxidant
Plumbagin	<i>Plumbago rosea</i>	Antimicrobial, anti-inflammatory
Quercetin	<i>Pluchea lanceolata</i>	Antioxidant
Quinine	<i>Cinchona ledgeriana</i>	Antimalarial
Reserpine	<i>Rauvolfia serpentina</i>	Hypotensive
Resveratrol	<i>Vitis vinifera</i>	Cardiac and anticancer effects
Rutin	<i>Fagopyrum esculentum</i>	Antioxidant Treatment of capillary bleeding
Shikonin	<i>Lithospermum erythrorhizon</i>	Anti-HIV therapeutic agents
Silymarin	<i>Silybum marianum</i>	Hepatoprotective
Umbelliferone	<i>Ammi majus</i>	Sunscreen agent
Valepotriates	<i>Centranthus ruber</i>	Putative anxiolytic effect
Vincristine	<i>Catharanthus roseus</i>	Anticarcinogenic
Withanolide A	<i>Withania somnifera</i>	Sedative and antirheumatic

metabolites exert their action on molecular targets that differ from one case to the other. The use of herbal medicines should be based on comprehensive phytochemical studies for the determination of the chemical constituents of the herbs involved. Hence, the knowledge of the resultant pharmacological and toxicological effects can be deduced, as well as the possible synergistic or antagonistic effects due to the use of multiple component herbal formulae. For this reason, the isolation and structural elucidation of secondary plant metabolites, though ancient, is still a huge and fast growing approach, and the techniques used for separation and analysis are advancing continuously.

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