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DRUG DISCOVERY: THE ROLE OF MEDICINAL PLANTS

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ABSTRACT

Medicinal plants have long been used since prehistoric as sources for drug design. Different standard techniques have been used in the area of drug discovery from medicinal plants. Phytochemicals which are chemical compounds produced from plant secondary metabolism are sources of many of the new drugs and active ingredients of medicines. Plants with medicinal potency have contributed greatly to the discoveries of novel drugs and these have continued to provide an important source of new drug against different diseases like cancer, HIV/AIDS, malaria. Several compounds have been isolated from medicinal plants which may act as chemo-preventive agents. This paper reviews the role of medicinal plants towards their application in drug discovery.

Keywords: Phytochemicals, medicinal plants, natural products; secondary-metabolism, chemo-preventive agents

INTRODUCTION

Drug discovery using natural products is a key role for designing new lead. Plants are the source of some of our most important drugs, including those so chemically complex (e.g., the anticancer drugs vincristine and vinblastine from the Madagascar periwinkle (*Catharanthus roseus*) (Howes, 2018) and those that may never have been discovered without natural product research. These medicinal herbs are effective because they contain phytochemical compounds that exhibit anti-bacterial, antiviral, immuno-modulatory, anti-cancer, and anti-inflammatory properties effective against a multitude of diseases (Sen and Chakraborty, 2017; Ren *et al*., 2020). The efficacy and effectiveness of herbal medicine have been further confirmed scientifically through several studies- for instance, the aqueous extract of dandelion has shown to inhibit influenza a virus infection.

Achillea millifolium (yarrow), *Caryophyllus aromaticus* (clove), *Melissa offficinalis* (lemon -balm), *Ocimun basilucum* (basil), *Psidium guajava* (guava), *Punica granatum* (pomegranate), *Rosmarinus officinalis* (rosemary), *Thymus vulgaris* (thyme) and phytochemicals such as benzoic acid, carvacrol, cinnamic acid, and eugenol were found to contain antimicrobial properties (Nascimento *et al*., 2000).

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Worldwide, over ten million new cases of cancer (all sites excluding non-melanoma skin), with over six million deaths, were estimated in the year 2000 (Parkin *et al*.,2001). Therefore, this review focuses on the role of medicinal plants in drug discovery.

1.1 Classification of herbal plants

1. Classification based on their physiologic activity: Approximately one half of the medicines used today are natural products, i.e. alkaloids, antibiotics or synthetic analogues. For that it is usually employed a classification that represents the physiologic activity, such as hormones, vitamins, antibiotics and mycotoxins. Even though the compounds belonging to each group have different structures and biogenetic origins, a narrow relationship is occasionally between those aspects and activity (Wright, 2009).

2. Classification based on their taxonomy: This classification is based on morphological studies of plants, or plant taxonomy. Many constituents of plants such as alkaloids and isoprenoids have been isolated from species, genera, families or specific plant. For example, the "opium" of Papaver somniferous contains twenty alkaloids such as morphine, thebaine, codeine, and narcotine. they are all biosynthesized from precursor 1-bencilisoquinolina by oxidative coupling (Shree, 2011).

3. Classification based on their biogenesis: The relatively recent advances in biochemistry have greatly clarified the interplay between enzymatically catalysed reactions of the primary metabolites and biopolymers. These metabolites lead to secondary metabolites, so called because it is obvious his role in the metabolism of many organisms (Sangmai 2010).

1.2. Mechanism of action of phytochemicals

1. Several phytoconstituents act as antioxidants. Antioxidants are compounds that protect cells against the damaging effects of reactive oxygen species which results in oxidative stress leading to cellular damage (Mattson and Cheng, 2006).
2. Phytochemicals act in synergy with chemo-therapeutic drugs (Liu, 2004).
3. They are used as chemotherapeutic or chemo preventive agents with chemoprevention referring to the use of agents to inhibit, reverse, or retard tumorigenesis.

1.3. Biological Activities of Phytochemicals

1. Reduce the risk of coronary heart disease by preventing the oxidation of low-density lipoprotein (LDL) cholesterol, reducing the synthesis or absorption of cholesterol, normalizing blood pressure and clotting, and improving arterial elasticity (Mathai, 2000).

2. Phytochemicals may detoxify substances that cause cancer (Meagher and Thomson, 1999).

1.4. Classification of phytochemicals

Phenolic compounds

Biological activities of phenolic acids include; increases bile secretion, reduces blood cholesterol and lipid levels and antimicrobial activity against some strains of bacteria such as *staphylococcus aureus* are some of biological activities of phenolic acids (Silva *et al*., 2007).

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Flavonoids

Flavonoids are ubiquitous among vascular plants and occur as glycones, glucosides and methylated derivatives. Activity of flavonoids: Flavonoids have been stated to possess many useful properties, containing anti-inflammatory activity, enzyme inhibition, antimicrobial activity, oestrogenic activity, anti-allergic activity, antioxidant activity, vascular activity and cytotoxic antitumor activity (Tapas *et al*.,2008).

Alkaloids

Alkaloids protect plant against micro-organisms, insects and herbivores (feeding deterrents). The antibacterial and antifungal activities of alkaloids have been reported (Molyneux *et al*.,1996).

Terpenoids

Medicinal properties of terpenoids such as anticarcinogenic (e.g. perilla alcohol), antimalarial (e.g. artemisinin), anti-ulcer, septicidal, antimicrobial or diuretic (e.g. glycyrrhizin) activity and the sesquiterpenoid antimalarial drug artemisinin and the diterpenoid anticancer drug taxol have been documented (Langenheim, 1994; Dudareva *et al*., 2004)

Saponins

The anti-microbial activities of saponins have been reported (Lacaille- Dubois and Wagner, 2000)

Tannins

The biological action of tannin-containing plant extracts containing tannins has been well reported (Mueller-Harvey, 1999). Tannins has been reported to cause decreased frequency of chronic diseases (Serrano *et al.,*2009).

1.5. Safety concerns for phytochemicals

Side effects caused by medicinal agents of plant origin are minimal compared to synthetic drugs (Fennel *et al*., 2004). Phytochemicals have been observed to be safe for humans. For example, daily oral doses of epigallocatechin-3-gallate (EGCG) for 4 weeks at 800 mg/day in 40 volunteers only caused minor adverse effects (Phillipson, 2007). For resveratrol, a single oral dose at 5g in 10 volunteers only causes minor adverse effects (Boocock *et al*., 2007).

1.6. Pharmacological roles of some medicinal plants

Plants have several pharmacological roles such as antioxidant, antiviral, anticancer, antimicrobial, antifungal, diuretic and antiparasitic.

1.6.1. Diuretic and antiatherosclerotic effects

Allium sativum

This is commonly known as garlic. Antidiuretic activities of *Allium sativum* have been reported **(**Tiwari *et al*., 2012). Garlic is also claim to help prevent heart diseases (including atherosclerosis, high cholesterol, and high blood pressure) (Brace,2002). Garlic is used as carminative, aprodisic, expectorant and disinfectant in the treatment of pulmonary conditions. It has reported that garlic lowered the blood pressure and level of cholesterol (Chan *et al*., 2013).

1.6.2. Anti -inflammatory activity

Curcuma longa

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It contains the active phytochemical such as alkaloid – curcumin which possesses a range of pharmacological properties- anti-inflammatory, antioxidant and antimicrobial activities (Zhang *et al.*, 2017; Ravindran, *et al*.,2010).

Morinda officinalis

Morinda officinalis, belongs to the family Rubiaceae. The ethanolic extract of *M. officinalis* showed antidepressant-action in rodent animal models of depression (Mondal, 2010)

1.6.3. Antimicrobial Activity

Mangifera indica

This is a species of mango in the Anacardiaceae family. Different pharmacological activities like antioxidants, radioprotective, antiallergic, antiviral, antidiabetic etc from different parts of *M. indica* are reported.

2. Solving Antibiotics Drug Resistance Through Herbal Medicine

Plants have been used as medicines for more than 5000 years (Brown and Wright, 2016), as a source of antibiotics, antineoplastic, analgesics, cardioprotective, among others (Chen *et al.,* 2016). We are running out of antibiotics and could not add any new group of antibiotics (WHO, 2017). The development of multi drug resistance (MDR) in microorganisms is increasing global health challenge for the treatment of infectious diseases (Brown and Wright, 2016). Most of the pathogenic bacteria have developed resistance to modern antibiotics as a result of which we are faced with multi drug resistance among bacteria. For example, Drug-resistant tuberculosis (XDRTB) has been identified in 92 countries and there were about 450,000 new cases of multidrug-resistant tuberculosis (MDR -TB) worldwide in the year 2012 (WHO, 2014). Drug-resistant TB is a threat to human health and the control of malarial have reduced over the years (WHO, 2018a). There were an estimated 450 000 incident cases of MDR/RR-TB in 2021 (WHO, 2022). Natural compounds have been extensively explored for new drug discoveries (Chandra *et al*., 2017). Therefore, drugs derived from plants and fungi are alternatives against these diseases (Dauncey and Howes, 2020).

Conclusion

Medicinal plants have been used and are still in use today in the production of drugs which include antiviral, antibiotics, anti-cancer, anti-parasitic and antifungal drugs. Extracts from medicinal plants are more effective, have good therapeutic properties and less side effects compare to orthodox drugs. This have been employed by new or novel drug discoveries to improve human health today.

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