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Review Article

Medicinal Plants: Innovative Features, Nutritional Aspects, and Biological Technology for Exploration of Pharmaceutical Activities

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Abstract

New pharmaceuticals developed from the current medicinal plants can treat the ailment more successfully, potentially aiding the treatment, since a safer and more effective way may be discovered in the future. Nutritional value of medicinal plants and searching of novel compounds enhance the with therapeutic use in the different sectors. Secondary metabolites are created as byproducts or intermediates of secondary plant metabolism. Polymeric nanoparticles are colloidal structures that act to control the novel delivery of medications by guiding them to certain locations. Curcumin is one of the plant-based compounds with some medical potential. It a yellow polyphenol that typically targeted the cells of the viral particles. *Ganoderma lucidum* is a well-known treatment for hemiplegia and stroke. Nanoparticles are used in cancer diagnosis and therapy because of their ability to target tumours, deliver drugs, and boost the immune system. Among their advantages are their mucoadhesive, biocompatible, and biodegradable properties, as well as their multifunctional physicochemical properties that allow for site-specific targeting and allows the chemical modification. Nanoemulsions are currently appealing nanocarriers due to their ability to enhance the drug transport across bio-membranes, prolong the half-life in the body, and encapsulate medications with a high lipophilic aptitude. These days, nanoparticles provide a vast array of biological applications or an expanded the different fields.

Keywords: Pharmaceuticals, Medicinal Plant, Treatment, Novel Compounds, Therapeutics.

INTRODUCTION

One of the medicinal plants being used to develop a new drug for hypertension is *Marrubium vulgare*, a member of the Lamiaceae plant family. The hypotensive effect of the plant's crude oil is intensely examined. Additionally, diterpenoids, which relax arteries and reduce systolic blood pressure two factors that contribute to the hypertension may have cardiovascular activity [1, 2]. The second example is the Asteraceae plant family's artichoke, *Cynara cardunculus*. It is one of the oldest drugs due to its effects on the heart. It inhibits the high levels of cholesterol and decreases lipid levels. These drugs show that medicinal plants may be utilized as a treatment or made into pharmaceuticals. New pharmaceuticals developed from the current medicinal plant can treat the ailment more successfully, potentially aiding the patient, since a safer and more effective treatment may be discovered in the future. The novel drug and its conventional uses showed how plant families have a great deal of promise in treating heart problems. Consequently, a detailed examination of the mechanism and activity of the plant family in connection to cardiovascular illnesses is necessary [3, 4].

The rise of triglycerides and cholesterol in blood is referred to as hyperlipidemia. One of the CVDs caused by hyperlipidemia is atherosclerosis. It is the condition when lipids or fat molecules, often known as plagues, harden the arteries. The arteries will narrow as a result of these plagues building up in the arterial walls [4, 5]. It will lessen the artery's blood-carrying capacity, which is frequently connected to vascular diseases, heart disease, and stroke. High-density lipoprotein, or HDL, is the good cholesterol that reduces the risk of cardiovascular disease, and the substance with antihyperlipidemic qualities also aids in increasing the body's levels of this cholesterol [1-3].

Growing interest has been shown in organic farming's in the improvement of efficacy of medicinal plants for the better health. Organic farming aims to ensure the preservation while keeping the phytochemicals of the medicinal plants for biochemical activities. While producing more productive and high-quality materials. Organic farming is distinguished by the low or minimum requirements of using the different kinds of chemicals or sprayers affecting the health [6]. Organic farming, which relies on the farm-derived renewable resources and is ecologically benign, preserves the nutritional aspects of the bioactive compounds that responsible for the medicinal activities [6, 7].

Fig. 1: Shows the potential of different kinds of medicinal plants

The steady supply of nutrients and soil stability that organic fertilizers give has a significant influence on the development of medicinal plants and the synthesis of essential compounds. For example, using organic fertilizers increased the biomass and essential oil content of *Chrysanthemum balsamita* compared to not using them. Organic farming has become the diverse fields for the production of different kinds of medicinal plants. The discovery of genetic engineering has made it possible to biosynthesize natural compounds on a big scale. The genetic engineering makes the valuable efforts for screening the nutritional aspects of bioactive molecules [7, 8].

Nutritional Parameters, And Technologies in Exploring the Medicinal Plants

Nutritional value of medicinal plants and searching of novel compounds enhance the with therapeutic use in the different sectors. Micropropagation is the evolutionary one of the emerging techniques that can speed up regeneration and facilitate storage and transportation [9, 10]. When standard seed numbers for deciding the medicinal activities of the medical plants and is a feasible alternative for in vitro or ex vitro development. Moreover, using molecular marker-based methods used at the genetic level to implement breeding improvements may significantly cut down on the amount of time required for breeding [9, 10].

Beta-blockers, calcium channel blockers, analgesics, non-steroid anti-inflammatory drugs (NSAIDs), anticonvulsants, and tricyclic antidepressants are commonly used in orthodox conventional medicine (OCM) to treat headaches [11]. These drugs are associated with a wide range of negative side effects, which further motivates people to look for alternative therapeutic strategies from different sources, such as higher plants. The potential of medicinal plants to relieve headaches is demonstrated by the identification of different plants as traditional headache remedies [11, 12].

Studies have demonstrated the effectiveness of using the medicinal plants in alleviating headaches in a number of different plants. The treatment of headaches with medicinal plants such as *Griffonia simplicifolia*. It is effectively used to relieve the headaches. Given the strong reliance on traditional medicine, it's critical to identify the medicinal plants that frequently utilize to alleviate headaches. Consequently, it provides a critical

assessment of medicinal plants used to alleviate headaches [13, 14].

Medicinal compounds possess different the effective therapeutic potentials. Since the dawn of time, people have utilized medicinal plants to heal a wide range of ailments and fight disease. The medicinal plants provide the therapeutic potentials for the controlling the many diseases in the forms of diabetes, cancers and bacterial infections [15]. Headaches are among the many ailments that using medicinal plants. Headaches are common in both adults and children. Primary headaches have no known origin, but secondary headaches are caused by conditions such sinus infections, brain tumors, and neck traumas. The pain a person feels during a headache is influenced by their brain, blood vessels, and surrounding nerves [15, 16].

Both the activation of muscles in the head and specific neurons in a person's blood vessels send pain signals to the brain. Illness such as fever, cold, and infections, environmental noise, stress, pollution, strong perfume or household chemical odors, and genetics in those of children whose parents had a history of migraine headaches are more likely to experience them themselves are the common causes of headaches. Headaches account for 5% of the worldwide burden of the sickness in terms of disability [16, 17].

Traditional Medicine (TM) has exciting prospects to combat the MDR. Herbal remedies are utilized to cure ailments because of their wide spectrum of biological activity. A powerful tool for treating a range of diseases might be created by combining medicinal and nutritional methods. Secondary metabolites are created as byproducts or intermediates of secondary plant metabolism [18]. The architectures of secondary metabolites have evolved in microbes, plants, and animals to interfere with internal molecular targets and serve as defensive mechanisms. Moreover, a range of secondary metabolites may provide protection against oxidative or UV damage or affect cell signalling. Herbal antibiotics can have an impact on both gram-positive and gram-negative bacteria [19].

Some medicinal plants that have efficacy against most of infections for the treatment of viral as well as some bacteria. As a result, bacteria, fungi, and viruses cannot develop a resistance. Nature is thus the sole and most trustworthy source of these drugs. Plant chemical molecules will perform better than synthetic ones from the perspective of drug discovery since they will hit the therapeutic target at specific sites. Therefore, plant chemical components are one of the most promising areas for most significant innovative medicine discoveries [20].

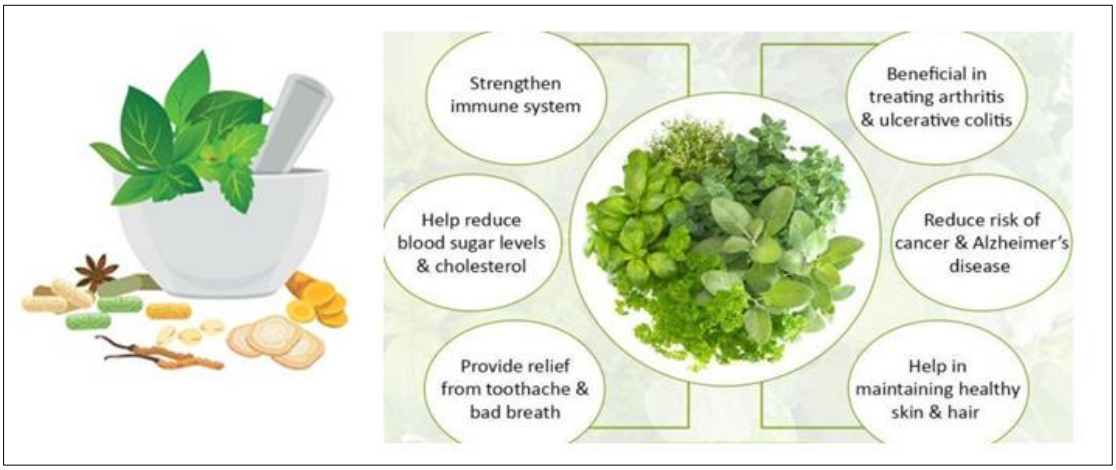

Fig. 2: Shows the nutritional components revealing the numerous bioactivities

Nowadays, understanding the basic chemical pathways involved in the screening of bioactive small molecule medications is a major challenge for drug development. The growing toxicity and decreasing efficacy of synthetic drugs are exacerbating the problem [21, 22]. This has led experts to look to herbal medicines for a cure as they are now understood to be crucial to the development of powerful remedies. The success of artemisinin is the best argument for encouraging ethnobotanists for discovering the compounds against the tuberculosis that is the caused in the respiratory tract and proliferation in some of the tumour cells. The most powerful tool is biotechnology, which will control and speed up the creation of new drugs made from plants [21, 22].

Polymeric nanoparticles are colloidal structures that act to control the delivery of medications by guiding them to certain locations. Some nano-based formulations acted for bacterial infections. They typically targeted the cells of the bacteria. As a result, some of the chemicals will releases that shows the efficacy of medicinal compounds. There are several techniques to make polymeric nanoparticles, depending on its payload and intended function. Both natural and manufactured biodegradable polymers make up these particles [23, 24].

Curcumin, is one of the plant compound with the some medical potential. It a yellow polyphenol that typically targeted the cells of the viral cells. The bioactive chemicals will releases that shows the efficacy of the polyphenols. It is a very potent and safe active component. The bioactive component of turmeric is used as an alternative medicine to treat a variety of ailments. However, its therapeutic applications are limited because of its low water solubility and bioavailability. It seems to have the ability to eradicate cancer cells and halt their proliferation. Curcumin is undergoing clinical trials, and some promising results have been observed [23-25].

Some diseases have been affected the health of the individuals. These are illnesses, such as neurodegenerative disorders, schizophrenia, concentration problems, and psychosis [26]. Studies have demonstrated that nicotine's ability to activate A7 nicotinic receptors is the source of its neuroprotective benefits. When A7 nicotinic receptors are activated, there is an increase in striatal dopamine release. As a result, the nigrostriatal circuit is protected and brain tissue is preserved. Because of its ability to reverse blood stasis and restore blood circulation. *Ganoderma lucidum* is a well-known treatment for hemiplegia and stroke. One of Ganoderma lucidum's primary active ingredients is triterpenes [27].

Drug modification has been used by scientists to get a medicine's release rate closer. For example, drug release rates. Alternatively, by injecting or implanting controlled drug carriers into the body, use a remote-control system to achieve precise and adjustable release rates in a "programmable on-demand" manner [28]. Researchers have investigated a variety of possible approaches to address these problems, which need for collaboration between other disciplines, including bioengineering and biomaterials. For example, microfluidic drug delivery systems that offer both stable release rates and variable reactivity to the environmental stimuli may enable the high precision and predictability in the administration of medications. Nowadays, one of the most used biomaterials for targeted therapeutic medication administration is alginate-based nanoparticles. Among their advantages are their mucoadhesive, biocompatible, and biodegradable properties, as well as their multifunctional physicochemical properties that allow for site-specific targeting and chemical modification [29, 30].

The porous, spongy surface of *Ramulus mori* based polysaccharide, primarily made up of the mannose, rhamnose, glucose, glucuronic acid, xylose, galactose, and arabinose. It is widely extracted for the inflammatory and infectious diseases due to its non-starch polysaccharide status. This problem might be addressed by creating a nano delivery system. Restore the intestinal barrier, stop weight loss, lower the DAI score, and promote colon length recovery in DSS-induced colitis mice. This can be achieved by correcting the metabolic disorder by increasing the amount of acetate, propionate, and butyrate and decreasing the diversity and richness of intestinal microbiota [31]. In mice with LPS-induced IBD, oral PLGA-RMP administration can also reduce intestinal inflammatory damage, increase the number of activated Treg in the intestine, decrease the DAI score, inhibit specific inflammatory cytokines including TNF-α, IL-6, IL-1β, and PGE2, inhibit macrophage polarization, and prevent CD3+CD8+T cell activation. PLGA-encapsulated RMP is more efficiently absorbed by macrophages than free RMP, and at 125 μg/mL, PLGA-RMP is demonstrated to be non-toxic to macrophages. Nanoparticles are used in cancer diagnosis and therapy because of their ability to target tumors, deliver drugs, and boost the immune system [31, 32].

The embelin also has anti-inflammatory, anti-tumor, and analgesic properties. In mice with DSS-induced colitis, embelin can significantly reduce the DAI score, inflammatory markers, and MPO accumulation while also improving weight loss, diarrhoea, significant bleeding, and immune cell infiltration. The targeting and effectiveness of embelin can be significantly improved by distributing it by nanoparticle loading. Enteric-coated microspheres loaded with embelin may significantly reduce the inflammatory response, glutathione level, oxidative stress level downregulating MPO, MDA, and LPO expression, and ulcer activity score in rats with produce continuous embelin release that is both pH-dependent and time-dependent [33, 34].

For controlled and targeted distribution, solid lipid nanoparticles (SLNs) are starting to show promise as an alternative to colloidal techniques [25]. SLNs offer outstanding biocompatibility since most lipids are biodegradable. SLNs offer controlled and targeted medication release and can be used to deliver hydrophilic and lipophilic drugs. Additionally, SLNs are less expensive than carriers based on polymers or surfactants [35]. A mixture of cholesterol and non-ionic surfactants is hydrated to form niosomes, which are non-ionic surfactant vesicles. It is possible to manipulate and modify the vesicle formulation's properties. Vesicles' composition, size, lamellarity, tapping volume, surface charge, and concentration may all be changed since they are non-ionic, which reduces the toxicity of medications [35, 36].

Medicinal Significance and Challenges

One major barrier to the development of drug delivery systems is the diversity and scarcity of the available material. Information from the literature is essential to the advancement of any study, including the nanomedicine treatment methods. The discrepancy between the published research and documented characterization of the reported experimental results is considered to be a major barrier to the progress of nanotechnology usage in medicine. The lack of consistent and scarce data that should guide industry

might hinder future advancements in nanomedicines and postpone the transfer from research and experimentation to clinical usage [37, 38]. Acceptability, or the ability to be absorbed by the body without stimulating the immune system, and biocompatibility, or the ability to function with the body under certain conditions, are two of the primary problems facing drug delivery systems. This is problematic because the body reacts quite differently to synthetic materials than it does to biological materials. Drugs that can also serve as carriers have been successfully developed by scientists. The complexity of the human system may also lead to intrinsic barriers to the capabilities of these delivery systems. For example, it is difficult to achieve therapeutic medication concentrations in the brain tissues due to the selective permeability of the blood-brain barrier, which prevents the entrance. Furthermore, because monoclonal antibodies attach to the surface of liposomes to produce the immunoliposomes, they are among the most common carriers in the body. However, due to their low levels of absorption, distribution, metabolism, and removal by the body, as well as their potential to trigger an immunological response. Moreover, these immunoliposomes have restricted activities. Because of this, liposomes are not a very good site-specific drug carrier. The primary barriers to the production of medicinal plants were found to be labor, lack of experience and training, marketing, funding, climate, and climate. The development of therapeutic plants will be encouraged by assistance [39, 40].

Plant-derived nanoparticles provide several significant advantages in the treatment of cancer, particularly in the fields of targeted drug delivery, gene therapy, and photothermal therapy. By delivering therapeutic genes, proteins, or chemotherapeutic medicines directly to cancer cells, these nanoparticles may be engineered to cause the least amount of damage to neighbouring healthy tissues [31, 32]. One of the key benefits of PDNPs is their capacity to effectively target tumor cells. By functionalizing cancer cell receptors with specific ligands, PDNPs can preferentially bind to them, increasing drug accumulation at the tumor site. Additionally, PDNPs enable combination treatments, which involve the administration of chemotherapeutic medications in conjunction with other treatment modalities like as gene therapy or photodynamic therapy (PDT) [31-33].

For example, it has been shown that doxorubicin-loaded Moringa oleifera-derived nanoparticles may precisely target and transport the drug to rat breast cancer cells, augmenting the therapeutic advantages against ovarian cancer. Since these nanoparticles have been shown in vitro to induce death in cancer cells while sparing healthy cells, they hold great promise for therapeutic uses. An additional indication of their potential was provided by a clinical experiment in which doxorubicin-loaded therapies for metastatic cancer showed an efficacy comparable to or superior to that of conventional doxorubicin treatments, with less adverse effects, such as nausea and hair loss [28-35].

Plant-derived nanoparticles have shown great promise in the fight against microbial diseases because of their strong antibacterial qualities. These nanoparticles can enhance the effectiveness of antimicrobial medications and lower the risk of resistance by serving as both antimicrobial agents and antimicrobial drug transporters [27-36]. By rupturing microbial cell membranes, preventing the development of biofilms, and interfering with microbial metabolism, PDNPs achieve their antimicrobial effects. Their broad-spectrum effectiveness against a variety of pathogens, including as bacteria, fungi, and viruses, as well as their capacity to lower antibiotic resistance by enhancing the targeted administration of medications, are two of PDNPs' main benefits in antimicrobial therapy. Silver nanoparticles produced from neem, for instance, have demonstrated potent antibacterial activity against a range of pathogens, including *Candida albicans*, *Staphylococcus aureus*, and *Escherichia coli*. The inhibition of cell wall production and oxidative damage to microbial cells are the reasons for their antibacterial qualities. Garlic-derived nanoparticles have also shown promise in antibacterial capabilities against *Pseudomonas aeruginosa*, a prominent source of hospital-acquired infections, as well as in wound healing and infection control. The potential of PDNPs has been further confirmed by clinical studies. For example, wound infections with silver nanoparticles produced from neem, patients who got the nanoparticles had a lower microbial burden and recovered faster than those who received traditional antibiotics [37, 38].

The nanomedicine has emerged as a viable anti-inflammatory treatment. It occurs at ambient temperature and requires a pH of neutral. When inflammation occurs, macrophages eat the like interleukin, LPS, and interferon, among others, they also encourage inflammation. Pro-inflammatory substances released by neutrophils at the site of inflammation draw macrophages to the area. Nanomedicine's improved ability to penetrate inflammatory and epithelial cells increases the treatment's efficacy and duration [29-31].

Among other nanoparticles, nanoemulsions are currently appealing nanocarriers due to their ability to enhance drug transport across bio-membranes, prolong the half-life in the body, and encapsulate medications with a high lipophilic aptitude. Recently, nanoemulsions have become more and more popular as a means of improving medication stability and solubility, protecting plant active ingredients from harsh environments, and increasing therapeutic efficacy. More drugs may be included in the encapsulation of herbal plant components, which is a more effective method of nanoemulsions distribution than traditional preparation [33-39].

CONCLUSION

Curcumin is a polyphenolic compound with several medical applications, including well-known antiviral qualities. It is poorly soluble in water and has a restricted oral bioavailability and the drug release properties have been reported in vitro. While all of the nanolipid formulations allowed for continuous curcumin release, only 80% of the drug released from the curcumin solution; the impact of the modified nanolipid carriers' sustained release was more pronounced than that of the unmodified nanolipids.

These days, nanoparticles provide a vast array of biological applications or a really alluring expanded field. The nanoparticulate systems have the ability to convert physiologically active substances that are labile, poorly soluble, and poorly absorbed into drugs that can be delivered effectively. Numerous active substances, enzymes, and genes may form the basis of this system. Its hydrophilic covering, which prevents the reticular-endothelial system from recognizing it, gives it a longer circulation duration. This drug delivery technique still has to be refined through particle engineering and a better understanding of the many biological interaction mechanisms.

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