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Pharmacologically active phytochemicals in common medicinal plants- A review

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ABSTRACT

Medicinal plants contain a diverse array of pharmacologically active phytochemicals, which are natural compounds that can have beneficial effects on human health. These phytochemicals often have therapeutic properties and can be used in traditional medicine, herbal remedies, and even modern pharmaceuticals. Pharmacologically active phytochemicals are natural compounds found in plants that can have significant effects on human health and well-being. These compounds are often associated with various medicinal properties and are extensively studied for their potential therapeutic benefits. It's important to note that while these phytochemicals show promise for various health benefits, more research is needed to fully understand their mechanisms of action and potential therapeutic applications. Additionally, the effectiveness and safety of using these compounds as supplements or treatments can vary, and consulting with a healthcare professional is recommended before making any significant changes in diet or health regimen. Plants contain various medications, including antispasmodics, emetics, antimicrobials, antipyretics, antidiarrheals, antioxidants, and antitumor agents. Research on their medicinal properties has focused on evaluating and characterization of plant constituents against various diseases. This review examines the significance of plants as sources of biologically active compounds while providing an overview of pharmacologically active common medicinal compounds.

Figure : 00 References : 35 Tables : 02
KEY WORDS : Pharmaceuticals, Phytochemicals, Therapeutics, Traditional medicine.

Introduction

Bioactive phytochemicals or bio nutrients are abundant in medicinal plants. Studies conducted over the last two to three decades have demonstrated the critical role that these phytochemicals play in the prevention of chronic diseases like cancer, diabetes, and coronary heart disease. Dietary fibre, antioxidants, anticancer, detoxifying agents, immunity-potentiating agents, and neuropharmacological agents are the main classes of phytochemicals with disease-preventing properties. Each of these functional agent classes is made up of a diverse group of chemicals with varying potencies. Some of these phytochemicals have more than one function[28]. Chemotherapy and radiotherapy, the conventional cancer treatment used nowadays, are expensive and cause many side effects, including such minor ones as vomiting, alopecia, diarrhoea, constipation, and major ones such as myelosuppression, neurological, cardiac, pulmonary and renal toxicity[2]. Coumarin (2H-1-benzopyran-2-one), a naturally occurring compound derived from plants, is well known for its pharmacological properties, which includes anti-inflammatory, anticoagulant, antibacterial, antifungal, antiviral, anticancer, antihypertensive, antitubercular, anticonvulsant, anti-adipogenic, anti-hyperglycaemic, antioxidant, and neuroprotective effects. Dietary exposure to benzopyrones is crucial due to their presence in a number of foods, including coffee, tea, wine, seeds, nuts, fruits, and vegetables[31]. Due to their potential health benefits, polyphenolic chemicals like flavonoids have been employed in numerous medications and food products since ancient times. They are still relevant and well-liked today. Due to their antioxidant function, several phenolic chemicals found in natural foods may lower the risk of major health issues. Plants are replete in flavonoids[29]. Because they are readily available and harmless, medicinal plants have been used historically for a long time to cure a variety of illnesses. Phytochemicals found in medicinal plants provide a number of health advantages. Healthcare professionals are looking into plant-based medicines as a potential supply of antidiabetic pharmaceuticals because of their high potency and lack of adverse effects as diabetes prevalence rises[4]. Cancer patients seek alternative remedies such as traditional medicinal plants for safe and effective treatment and

help overcome the side effects of conventional therapy[33]. A number of plant elements, including the leaf, stem, bark, and root, are used to prevent, relieve symptoms, or restore anomalies to normal. Herbal therapies are viewed as alternative medications by conventional medicines because their practices do not strictly follow the information accumulated through scientific approaches. However, the majority of pharmaceuticals currently prescribed by doctors and pharmacists were once used as herbal treatments, such as digitalis, quinine, opium, and aspirin[5,6].

Pharmacologically important common plants

Historically, medicinal plants were primarily used by specialized healers in rural communities. Commercialization has led to overharvesting, resulting in rare, endangered, and threatened species[18]. Natural resources-based drugs dominate the pharmaceutical industry, with drug development programs aiming to create efficient, secure, and side effect-free medications. However, new drugs have decreased in recent decades[12] .

Because it is a rich source of antioxidants, neem (*Azadirachta indica*), a plant in the Meliaceae family, is thought to have a health-promoting effect. It has been widely used in the treatment and prevention of various diseases in Chinese, Ayurvedic, and Unani medicines throughout the world, particularly in the Indian Subcontinent. Through increased antioxidant activity, bacterial growth inhibition, and genetic pathway modulation, plant products or natural products play a significant role in the prevention and treatment of diseases. Due to their low side effects and affordable properties, the therapeutic role of many plants in the management of diseases is still being enthusiastically researched[3] .

A ginger plant, is widely used in traditional medicine for treating various illnesses. Indian turmeric, *Curcuma longa*, also known as haldi, is popular due to its high curcumin content. Its rhizomes produce roots and shoots, and curcumin, a fat-soluble polyphenolic pigment, gives Indian curries their characteristic yellow colour. Turmeric is also known as “Indian saffron” and is a natural antiseptic[9].

Cajanus cajan Millsp. leaves and their medicinal product, Tongluo Shenggu capsules, contain phenolic compounds, which are pharmacologically active. Methanol, ethanol, ethyl acetate, and acetone exhibit higher antioxidant activities in *C. angustifolia* extracts[15].Methanol, ethanol, ethyl acetate, and acetone showed significantly higher scavenging percentages and are related to phenolic compounds, according to the antioxidative activities of *C. angustifolia* extracts[1,15].

Ceugenol, an active component in *Ocimum sanctum* L., is primarily responsible for the therapeutic properties of Tulsi, a plant widely used in traditional Indian medicine due to its widespread availability[27,22] . Tulsi, meaning “Matchless” in Sanskrit, is the herb kingdom’s queen and is known for its sanctity in religion, spirituality, and culture. Its leaves, seeds, and roots have medicinal uses and are used in pharmaceutical, perfumery, cosmetics, and indigenous medicine. Tulsi is a stimulant, aromatic, and antipyretic herb, reducing kaph and vat while escalating pitta, according to Ayurveda[22,27].

Ashwagandha, also known as *Withania somnifera*, is a shrub in the Solanaceae family, commonly used in Ayurveda, a Hindu medical system. It boosts physical stamina, endurance, and well-being, with over 50 chemical components, primarily withanolides, steroidal alkaloids and lactones. Ashwagandha is grown in arid regions of South Asia, Central Asia, and Africa[21].

Amla, known as *Phyllanthus emblica* Linn., is a significant medicinal plant in Indian traditional medical systems, used for various ailments, including diuretics, laxatives, liver tonics, and ulcer preventives. Research shows gallic acid, ellagic acid, emblicanin A and B, phyllembein, quercetin, and ascorbic acid have various biological properties, including analgesic, anti-tussive, antiatherogenic, adaptogenic, neuroprotective, chemo preventive, and anticancer[11,12]. A nootropic drug made from *Bacopa monnieri* extract, which supports antioxidant mechanisms, protects cells from AD-related damage, and chelates iron[10] .

India is rich in biodiversity and has a long history of using plants for their pharmacological properties. Many plants in India have been traditionally used in Ayurveda, Siddha, Unani, and other traditional systems of medicine, as well as in modern pharmacology.

Pharmacologically important chemical compounds in common plants and their role in the treatment of various diseases

Plant-derived substances are gaining attention due to their numerous uses, including traditional and modern medical systems, nutraceuticals, food supplements, and pharmaceutical intermediates. The medicinal properties of plants are specific to specific species or groups due to taxonomically distinct secondary product combinations. Secondary products from plants, which protect against microbial pathogens through cytotoxicity, could potentially serve as antimicrobial medicines in humans, influenced by their ecological function and the physiological processes involved in disease treatment[33-35].

Bael (*Aegle marmelos*), an Indian medicinal plant,

TABLE-1 : The status of common medicinal plants and their uses

S.No.	Herb Name	Scientific Name	Medicinal Properties and Uses
1.	Amla	*Emblica officinalis*	Rich in vitamin C, antioxidants; supports immune function, digestion, hair and skin health
2.	Ashwagandha	*Withania somnifera*	Adaptogenic; supports stress management, overall well-being, energy levels
3.	Brahmi	*Bacopa monnieri*	Cognitive-enhancing properties; used to improve memory, concentration, brain function
4.	Cinnamon	*Cinnamomum verum*	Studied for blood sugar management, insulin sensitivity
5.	Ginger	*Zingiber officinale*	Anti-nausea, anti-inflammatory, digestive properties; used for nausea, vomiting, gastrointestinal discomfort
6.	Guggul	*Commiphora wightii*	Potential cholesterol-lowering, anti-inflammatory effects
7.	Neem	*Azadirachta indica*	Antifungal, antibacterial, antiviral properties; used for skin conditions, dental health, insect repellent
8.	Pippali	*Piper longum*	Digestive, respiratory benefits; improves digestion, alleviates respiratory congestion
9.	Sarpagandha	*Rauvolfia serpentina*	Contains reserpine used to treat hypertension, mental health conditions
10.	Shatavari	*Asparagus racemosus*	Rejuvenating herb for women; supports female reproductive health, hormonal balance
11.	Tulsi	*Ocimum sanctum*	Adaptogenic, immunomodulatory, antimicrobial effects; used in Ayurveda for various health benefits
12.	Turmeric	*Curcuma longa*	Anti-inflammatory, antioxidant properties; used for arthritis, digestive disorders, wound healing

has numerous medicinal properties, including astringent, antidiarrheal, and anti-inflammatory effects. Its leaves, fruits, stems, and roots are used in ethnomedicine, with compounds showing potential for treating serious illnesses like cancer and diabetes[23,24,27]. Natural ingredients, especially plants and herbs, have long been a common source for medications, whether they are used as traditional preparations or as pure active ingredients. Even though traditional medicine has been practised for centuries in both developed and developing nations, 80% of people still use plant-based medications to treat their medical conditions[19].

Articum lappa, a medicinal edible plant in the Asteraceae family, has been used in Traditional Chinese Medicine for centuries due to its bioactive metabolites with significant therapeutic potential. These metabolites have shown various pharmacological effects, including antimicrobial, antioxidant, and neuroprotective properties, and have potential applications in nanomedicine[35]. The use of herbal medicines as a significant source for the development of novel pharmaceutical molecules to treat severe diseases has been well-documented. According to reports, many plant species contain phytoconstituents like glycosides,

TABLE-2 : The presence and impact of active phytochemicals from common medicinal plants

Phytochemical	Effects and Properties	Sources
Alkaloids	Potent physiological effects; pain relief, stimulation, *etc.*	Opium poppy, cinchona bark, *etc.*
Terpenes/Terpenoids	Aromatic, contribute to flavours/scents; potential medicinal properties	Essential oils, various plants
Flavonoids	Antioxidant, anti-inflammatory; support overall health	Fruits, vegetables, herbs
Polyphenols	Antioxidant, anti-inflammatory; support overall health	Grapes, turmeric, green tea
Glycosides	Medicinal properties; treatment of heart conditions	Foxglove and other plants
Saponins	Soap-like properties; potential antimicrobial effects	Various plant species
Anthocyanins	Antioxidant; contribute to health benefits	Fruits, flowers
Tannins	Astringent taste, antimicrobial, antioxidant properties	Fruits, nuts, tea, wine
Coumarins	Anticoagulant, anti-inflammatory, anticancer effects	Several plant species
Cannabinoids	Therapeutic effects; pain relief, *etc.*	Cannabis plant

saponins, flavonoids, steroids, tannins, alkaloids, terpenes, and others that have pharmacological effects. The traditional spice known as clove, or *Syzygium aromaticum*, has been used for food preservation and has a number of pharmacological properties. *S. aromaticum* is abundant in sesquiterpenes, monoterpenes, hydrocarbons, and phenolic compounds, among other phytochemicals. The three most important phytochemicals in clove oil are eugenyl acetate, eugenol, and -caryophyllene[7,13] .

Traditional medicines, spices, and other food ingredients have all been made from medicinal plants, which have been used for human healthcare since ancient times. The aromatic herbaceous plant known as garlic (*Allium sativum*) is used both as a food and a traditional treatment for a number of illnesses. In traditional medicines, it has been shown to have a number of biological properties, including anticarcinogenic, antioxidant, antidiabetic, Reno protective, anti-atherosclerotic, antibacterial, antifungal, and antihypertensive activities. The sulphur-containing phytoconstituents alliin, allicin, ajoenes, vinyl dithiins, and flavonoids like quercetin are abundant in *A. sativum*. Various biological activities, such as antibacterial, antiviral, antifungal, antiprotozoal, antioxidant, anti-inflammatory, and anticancer activities, have been assessed for extracts and isolated compounds of *A. sativum*[7,13,30] .

Curcumin is one chemical component discovered in Indian plants that is crucial to pharmacology. Turmeric (*Curcuma longa*), a popular spice in Indian cooking, contains the primary active element, curcumin, which is a naturally occurring chemical. It is well-known for its potential medical advantages and has undergone substantial research[9,17] .

Conclusion

Phytochemicals in plants have numerous pharmacological properties, including anti-metastatic, anti-diabetic, hypoglycaemic, antioxidant, hepatoprotective, anti-inflammation, anti-bacterial, anti-fungal, and anti-viral effects. Despite their high demand, only 10% of plants have been studied for their therapeutic potential. Some plants, having flavonoids, alkaloids, and tannins, have the potential to be turned into drugs like local anaesthetics, general anaesthetics, antinociceptives, analgesics, or sedatives. However, there are few well-controlled clinical trials with phytochemical drugs and their real-world human applications. Medicinal plants contain various

pharmacologically active phytochemicals, which can significantly impact human health. However, more research is needed to fully understand their mechanisms of action and potential therapeutic applications. Consultation with a healthcare professional is recommended before making significant changes to diet or health regimen.

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