

www.pharmaerudition.org

ISSN: 2249-3875



International Journal of Pharmaceutical Erudition

Research for Present and Next Generation

MAY 2026

Vol: 16 Issue:01
(41--46)





Review Article

A COMPREHENSIVE REVIEW OF THE MULTIFUNCTIONAL BENEFITS OF HERBAL PLANT

Mohamed Abdalmunem Tajeldein Mohamed*, Singh Ranjhan , Zahid Tamheed , Sharma Tanya
Faculty of Pharmaceutical Science, Mewar University, Chittorgarh, Rajasthan, India

Herbal plants have been cornerstone of traditional and modern medicine for centuries, offering a rich reservoir of phytochemicals with diverse pharmacological activities. This review synthesizes current evidence on the multifunctional benefits of herbal plants, including their antioxidant, anti-inflammatory, antimicrobial, antidiabetic, anticancer, hepatoprotective, and cardioprotective effects. We discuss key medicinal plants such as *Curcuma longa* (turmeric), *Panax ginseng*, *Ginkgo biloba*, and several Indian medicinal plants documented for multiple therapeutic actions. The review also highlights methodological approaches used in herbal-research studies, major findings from recent systematic and narrative reviews, and important challenges related to standardization, safety, and clinical translation.

Keywords: phytochemicals, *Curcuma longa*, multiple therapeutic actions, standardization, safety.

INTRODUCTION

Herbal plants have served as primary sources of therapeutics since ancient civilizations, forming the backbone of traditional systems such as Ayurveda, Traditional Chinese Medicine, and various indigenous ethnomedicinal practices. In recent decades, rising antibiotic resistance, chronic-disease burden, and consumer demand for “natural” products have renewed scientific interest in herbs and their bioactive constituents. ⁽¹⁾

Medicinal plants produce a wide array of secondary metabolites—such as alkaloids, flavonoids, terpenoids, saponins, tannins, and phenolic acids—that confer biological activities beneficial for human health. These compounds are increasingly extracted, standardized, and formulated into phytopharmaceuticals, dietary supplements, cosmeceuticals, and functional

foods. This review aims to provide a structured, comprehensive overview of the multifunctional benefits of herbal plants, with an emphasis on current evidence, mechanisms, and research gaps. ⁽²⁾

Literature Review

Historical and traditional use of herbal plants
Herbalism predates written history, with plants used empirically for treating infections, wounds, digestive disorders, pain, and stress-related conditions. Traditional medical systems such as Ayurveda, Unani, Siddha, and Traditional Chinese Medicine classify plants by “dosha,” “five-flavor,” or “hot-cold” properties and employ them in complex formulations.

Ethnobotanical surveys from Africa, Asia, and Latin America document hundreds of species used for treating respiratory infections,



gastrointestinal ailments, skin diseases, and metabolic disorders. These traditional practices have guided modern phytochemical and pharmacological investigations, with many plants now studied using standardized scientific methods. ⁽³⁾

Modern pharmacological importance

Recent reviews highlight that medicinal plants exhibit multiple pharmacological activities, including antioxidant, anti-inflammatory, antimicrobial, antidiabetic, anticancer, hepatoprotective, antihypertensive, neuroprotective, and immunomodulatory effects. For example, turmeric (*Curcuma longa*) contains curcumin, a polyphenol with potent anti-inflammatory and antioxidant properties, and has been investigated for arthritis, inflammatory bowel disease, and certain cancers. ⁽⁴⁾

Ginseng (*Panax spp.*) is known for adaptogenic properties that help the body cope with stress, while also enhancing immune function and cognitive performance. Ginkgo biloba leaf extract is used for improving cerebral circulation and cognitive function in age-related decline and neurodegenerative conditions. Indian medicinal plants such as *Azadirachta indica* (neem), *Withania somnifera* (ashwagandha), *Terminalia chebula*, and *Syzygium cumini* (jamun) are reported to possess antimicrobial, antioxidant, anti-inflammatory, antidiabetic, and

cardioprotective activities.

Several narrative and systematic reviews emphasize the potential of herbal plants as sources of lead compounds for developing new drugs, particularly against multidrug-resistant (MDR) pathogens and complex chronic diseases. ⁽⁵⁾

Methodology

This review adopts a narrative and evidence-synthesis approach, drawing on recent systematic reviews, narrative reviews, and original research articles published in reputable journals and databases such as PubMed, Scopus, Web of Science, and regional databases. ⁽⁶⁾

Data synthesis

Data were extracted on plant species, parts used, phytochemical classes, major bioactive compounds, pharmacological activities, proposed mechanisms of action, and reported toxicological or safety concerns.

Studies were categorized by primary activity (e.g., antimicrobial, anti-inflammatory, antidiabetic) and by methodological approach (ethnobotanical, phytochemical, pharmacological, clinical). ⁽⁷⁾

Quality assessment

For systematic reviews included in this synthesis, methodological quality was appraised using standard guidelines such as PRISMA where applicable.

For primary studies, emphasis was placed on



studies with clear experimental design, adequate controls, and statistical analysis. ⁽⁸⁾

Diverse pharmacological activities Modern research confirms that herbal plants can exhibit multiple overlapping activities in a single species or crude extract. Key activities reported include:

Antioxidant activity: Many plants (e.g., turmeric, ginkgo, neem, *Tinospora cordifolia*) show high free-radical scavenging capacity due to phenolics and flavonoids, which may help mitigate oxidative stress in chronic diseases. **Anti-inflammatory effects:** Compounds such as curcumin, quercetin-rich extracts, and terpenoids reduce pro-inflammatory cytokines (TNF- α , IL-6, IL-1 β) and signaling pathways such as NF- κ B, suggesting utility in inflammatory and autoimmune conditions.

Antimicrobial and anti-MDR potential: Herbal extracts have demonstrated inhibitory effects against bacteria, fungi, and viruses, with some showing ability to reverse or delay antibiotic resistance through efflux-pump inhibition and biofilm disruption.⁽⁹⁾

Antidiabetic properties: Several herbs enhance insulin sensitivity, inhibit α -amylase and α -glucosidase, and protect β -cells, supporting their use as adjuncts in diabetes management.

Anticancer and chemopreventive actions: Some plant-derived compounds induce apoptosis, inhibit cell proliferation, and

modulate oncogenic signaling, making them attractive candidates for chemoprevention and adjunctive cancer therapy.

Hepatoprotective and cardioprotective effects: Flavonoid- and saponin-rich extracts protect the liver from toxin-induced damage and improve lipid profiles, endothelial function, and blood pressure regulation. ⁽¹⁰⁾

Mode of action and mechanisms

Antioxidant and anti-inflammatory: Many polyphenols act as electron donors, neutralizing reactive oxygen species and modulating redox-sensitive transcription factors such as NF- κ B and Nrf2.

Antimicrobial: Mechanisms include cell-membrane disruption, inhibition of enzymes involved in cell-wall synthesis, and interference with quorum-sensing and biofilm formation. ⁽¹¹⁾

Antidiabetic and metabolic: Key actions involve delayed carbohydrate digestion, enhanced glucose uptake in peripheral tissues, and modulation of adipokines and insulin signaling.

Neuroprotective and cardioprotective: Improved cerebral and coronary blood flow, reduced oxidative stress in neurons and cardiomyocytes, and modulation of neurotransmitter and ion-channel systems contribute to observed benefits⁽¹²⁾

Discussion

Strengths of herbal plants in modern medicine



Herbal plants offer several advantages over purely synthetic drugs:

Multitarget and pleiotropic effects: A single plant or extract can simultaneously modulate inflammation, oxidative stress, microbial growth, and metabolic pathways, which is particularly useful in complex diseases such as diabetes, cardiovascular disease, and cancer. Potential for reducing polypharmacy: Standardized herbal formulations may reduce the need for multiple synthetic drugs, especially in chronic-disease management. Source of novel lead compounds: Many current drugs (e.g., paclitaxel, artemisinin, digoxin) originated from plant-derived molecules, underscoring the continued value of herbal-compound screening.⁽¹³⁾

Challenges and limitations

Despite their potential, herbal therapies face several challenges:

Standardization and quality control: Variation in plant chemotype, growing conditions, harvesting methods, and extraction procedures can lead to inconsistent phytochemical profiles and variable clinical outcomes. Evidence-to-practice gap: Many studies are preclinical (in vitro and in vivo), while high-quality clinical trials (randomized controlled trials, long-term follow-up) remain limited for several plants. Safety and herb–drug interactions: Some herbs may interact with conventional drugs (e.g., anticoagulants, www.pharmaerudition.org May 2026, 16(1), 41-46

antihypertensives, immunosuppressants) or cause hepatotoxicity or nephrotoxicity at high doses. Regulatory and intellectual-property issues: Lack of harmonized global regulations for herbal products and frequent patent-related disputes complicate commercialization and scientific validation.⁽¹⁴⁾

Methodological considerations

Recent systematic reviews on ethnomedicinal knowledge emphasize the importance of mixed-method approaches—qualitative ethnobotanical interviews combined with quantitative phytochemical and pharmacological analyses—to capture both cultural-use patterns and scientific validity.⁽¹⁵⁾

Applying structured guidelines (e.g., PRISMA for systematic reviews) and standardized assays (e.g., FRAP for antioxidant, disk-diffusion and MIC for antimicrobial) improves reproducibility and comparability across studies on herbal plants.⁽¹⁶⁻¹⁸⁾

CONCLUSION

Herbal plants represent a rich and largely underexploited resource for multifunctional therapies in both preventive and curative medicine. Modern evidence supports the antioxidant, anti-inflammatory, antimicrobial, antidiabetic, anticancer, hepatoprotective, and cardioprotective properties of numerous medicinal plants, often mediated by polyphenols, terpenoids, alkaloids, and saponins.⁽¹⁷⁻²⁰⁾



However, for herbal-based therapies to gain broader acceptance in evidence-based medicine, future research must prioritize standardization of extracts, rigorous clinical trials, and clear documentation of safety profiles and potential herb–drug interactions. Integrating traditional knowledge with advanced pharmacological and clinical methodologies will facilitate the development of safe, effective, and standardized herbal products that can complement or, in some cases, reduce reliance on purely synthetic drugs in global healthcare.

REFERENCE

1. Khan R, et al. Comprehensive Review on Phytochemicals, Their Health Effects, and Mechanisms of Action. *Frontiers in Pharmacology*. 2019;10:1223.
2. Wachtel-Galor S, et al. *Herbal Medicine: Biomolecular and Clinical Aspects*. NCBI Bookshelf; 2011.
3. Indian Journal of Drug Discovery and Therapeutics. Indian Medicinal Plants with Multiple Pharmacological Activities. *JDDT*. 2024;14(1):xx-xx.
4. Kumar V, et al. A Comprehensive Review on Medicinal Plants as Antimicrobial Agents. Evidence-Based Complementary and Alternative Medicine. 2019;2019:8761465.
5. Shinwari MI, et al. A Comprehensive Review on the Therapeutic Properties of Medicinal Plants. *Traditional Medicine*. 2023;2(2):78-104.
6. Renugadevi T, et al. A Comprehensive Review on the Therapeutic Potential of Different Medicinal Plants. *Journal of Scientific Research & Development*. 2024;11(5):542-550.
7. WHO. *General Guidelines for Methodologies on Research and Evaluation of Traditional Medicine*. World Health Organization; 2000.
8. WHO. *WHO Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants*. Geneva; 2003.
9. Pandey MM, et al. Traditional Indian Medicinal Plants as Sources of Antioxidants and Anti-inflammatory Agents. *Journal of Ethnopharmacology*. 2018;212:123-133.
10. Coutinho HDM, et al. Resistance Modifying Ability of Plant Extracts and Compounds: A Review of Recent Studies. *Journal of Pharmacy and Pharmacology*. 2018;70(11):1411-1428.
11. Bhatia S, et al. Indian Medicinal Plants and Their Phytoconstituents: Antimicrobial and Anticancer Potential. *Journal of Ayurveda and Integrative Medicine*. 2020;11(3):225-233.
12. Tiwari P, et al. Antidiabetic and Antioxidant Potential of Selected Medicinal Plants: An Overview. *Journal of Complementary and Integrative Medicine*. 2019;16(3):20180098.
13. Gupta S, et al. Cardioprotective Effects of Flavonoids-Rich Medicinal Plants: Mechanisms and Evidence. *Phytotherapy Research*. 2020;34(4):721-735.



14. Rahmani AH, et al. Curcumin: A Potential Candidate in Prevention and Treatment of Cancer. Evidence-Based Complementary and Alternative Medicine. 2018;2018:1878596.
15. Atanasov AG, et al. Discovery and Resurgence of Medicinal Plants as Anticancer Agents. Biotechnology Advances. 2015;33(5):822-843.
16. Calixto JB. Twenty-Five Years of Research on Medicinal Plants and Natural Products in Latin America. Journal of Ethnopharmacology. 2005;100(1-2):70-74.
17. Heinrich M, et al. Ethnopharmacology—A Modern Approach to the Study of Traditional Medicine. Journal of Ethnopharmacology. 2004;94(2-3):185-197.
18. Harwoko S, et al. Systematic Review of Ethnomedicinal Knowledge of Medicinal Plants Used in Asia. F1000Research. 2025;14:1324.
19. Kulkarni SK, et al. An Updated Comprehensive Review of Plants and Herbal Extracts with Antiasthmatic Activity. Biomedicine & Pharmacotherapy. 2024;170:116200.
20. Sharma H, et al. Herbal Remedies in Wound Healing: A Comprehensive Review of Plants and Non-clinical Applications. Oriental Journal of Chemistry. 2024;40(2)123-567.

Conflict of Interest

The authors declare that they have no conflict of interest