The Bioscan
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
20(3): S.I(3). 1881-1894, 2025 www.thebioscan.com

PHYTOCHEMICAL SCREENING AND ANTIMICROBIAL PROPERTIES OF MEDICINAL PLANTS

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DOI: 10.63001/tbs.2025.v20.i03.S.I(3).pp1881-1894

KEYWORDS:
Medicinal plants, Phytochemical screening, Antimicrobial properties, Secondary, data analysis, Thematic synthesis, Traditional medicine, Bioactive compounds.

Received on:

18-09-2025

Accepted on:

23-10-2025

Published on:

28-11-2025

ABSTRACT

Medicinal plants have historically been considered as a very important source of therapeutics, especially because of the availability of bioactive phytochemicals. These are natural products that have been extensively researched due to their possible therapeutic pharmacology to humans because of their important defense roles in the plants. With the development of antimicrobial resistance, finding new sources of antimicrobial compounds synthesized by plants has taken serious consideration. Phytochemical screening is major tool in the assessment of occurrence of such compounds whereas antimicrobial testing also determines the therapeutic value of plant extracts against the pathogen microorganisms. This paper provides a secondary thematic approach to reviewing literature to analyze phytochemical composition and antimicrobial activity of medicine plants. The aim is to reveal the prevalent classes of phytochemicals in medicinal plants, investigate their antimicrobial activity and get the synthesis of thematic findings of different studies. Secondary data was systematically collected, coded, and thematically analyzed to identify recurring patterns and insights.

The analysis revealed four major themes: diversity and richness of phytochemicals, plant-specific antimicrobial efficacy, synergistic potential with conventional antibiotics, and ethnomedicinal significance. Alkaloids, flavonoids, tannins, saponins, and phenolic compounds emerged as the most commonly identified phytochemicals. Several plant species demonstrated significant antimicrobial activity, particularly against resistant strains of Staphylococcus aureus, Escherichia coli, and Candida albicans. This study underscores the therapeutic potential of phytochemical-rich medicinal plants and highlights the importance of integrating traditional knowledge with modern screening techniques. The findings support further research into plant-based antimicrobial agents as viable alternatives or complements to synthetic drugs.

I. INTRODUCTION

Phytochemicals are naturally occurring chemical compounds found in plants, primarily responsible for color, flavor, and resistance to pathogens. These compounds, although not essential nutrients for humans, have been widely acknowledged for their biological activities, including antioxidant, anti-inflammatory, anticancer, and antimicrobial effects. Common classes of phytochemicals include alkaloids, flavonoids, tannins, saponins, terpenoids, and phenolic compounds (Basson, Teffo & Risenga, 2023). Their significance lies in their capacity to serve as lead compounds for pharmaceutical development and as therapeutic agents in traditional medical systems.

The global rise in antimicrobial resistance presents a critical challenge to modern medicine. Bacterial and fungal strains resistant to conventional antibiotics and antifungals continue to emerge, rendering many standard treatments ineffective. This worrying tendency resulted to the necessity in alternative antimicrobial agents and their mechanism of action. The new interest in the use of medicinal plants in this context has led to using them as an orderly resource of the bioactive compounds, which could inhibit or kill resistant strains of microorganisms. The animal kingdom presents a wide range of different mechanisms, including the disruption of microbial membranes, prevention of biofilm formation, or quorum sensing inhibition; hence, plant-derived antimicrobial compounds are worth exploring into the pharmaceutical assessment. Traditional medicine has always had medicinal plants as core to its healing parts and modern drug discovery (Ali et al. 2022). The principles of ethnobotany have been used to treat and cure infections, wounds, and inflammatory diseases throughout the ages. Modern research continues to validate many of these applications, with phytochemical and antimicrobial screenings providing empirical evidence of efficacy. The integration of traditional wisdom with scientific investigation offers a comprehensive understanding of the therapeutic potential of medicinal flora.

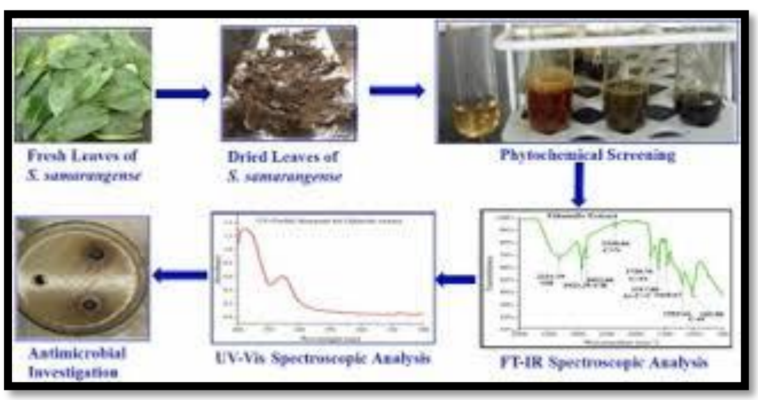

Figure 1: Phytochemical and Antimicrobial Analysis of Syzygium samarangense Leaf Extracts (Source: Ali et al. 2022)

This study aims to systematically review existing secondary literature to evaluate the phytochemical composition and antimicrobial properties of medicinal plants. The primary objectives are threefold: to identify and categorize the types of phytochemicals commonly reported in medicinal plant studies; to assess the documented antimicrobial efficacy of plant extracts against various pathogens; and to synthesize thematic findings from previous research through a structured secondary analysis.

Research objectives:

- To identify and categorize the predominant phytochemical compounds reported in medicinal plants across existing scientific literature.
- To assess the documented antimicrobial properties of medicinal plants against various pathogenic microorganisms.
- To synthesize recurring thematic patterns from secondary data to highlight trends, gaps, and implications for future phytochemical and antimicrobial research.

The study is guided by the following research questions:

1. What types of phytochemicals are most frequently identified in medicinal plants with reported antimicrobial activity?
2. Which plant species exhibit the highest levels of antimicrobial effectiveness across various studies?
3. What thematic patterns emerge from the existing body of research concerning the relationship between phytochemicals and antimicrobial properties?

By addressing these questions, this paper aims to contribute to the existing body of knowledge on plant-based antimicrobial agents, support evidence-based exploration of phytochemicals, and advocate for continued interdisciplinary research in the fields of ethnobotany, microbiology, and phytopharmacology.

II. LITERATURE REVIEW

Historical and Ethnobotanical Context of Medicinal Plants

The use of medicinal plants for therapeutic purposes has been documented since ancient times. Traditional healing systems in regions such as Asia, Africa, and the Middle East have long relied on the medicinal properties of local flora to treat infections, inflammatory conditions, and chronic illnesses. Ethnobotanical knowledge, often passed orally through generations, has guided the identification and preparation of plant-based remedies (Bawazeer et al. 2021). These practices have significantly influenced modern herbal pharmacopoeias and continue to provide a foundation for contemporary research in plant-based medicine.

Overview of Common Phytochemicals

Medicinal plants owe their biological activity to a wide variety of secondary metabolites, collectively referred to as phytochemicals. Among the most widely studied classes are alkaloids, flavonoids, tannins, saponins, terpenoids, and phenolic compounds.

- **Alkaloids** are nitrogenous compounds known for their diverse pharmacological effects, including antimicrobial, analgesic, and antimalarial activities.
- **Flavonoids**, a type of polyphenol, are recognized for their antioxidant and anti-inflammatory properties.
- **Tannins** exhibit astringent properties and are effective against several bacterial strains due to their protein-binding capabilities.
- **Saponins** are amphiphilic compounds that can disrupt microbial cell membranes.
- **Terpenoids** and **phenolic compounds** demonstrate significant antimicrobial and antioxidant effects, often

contributing to the plant's defense mechanisms.

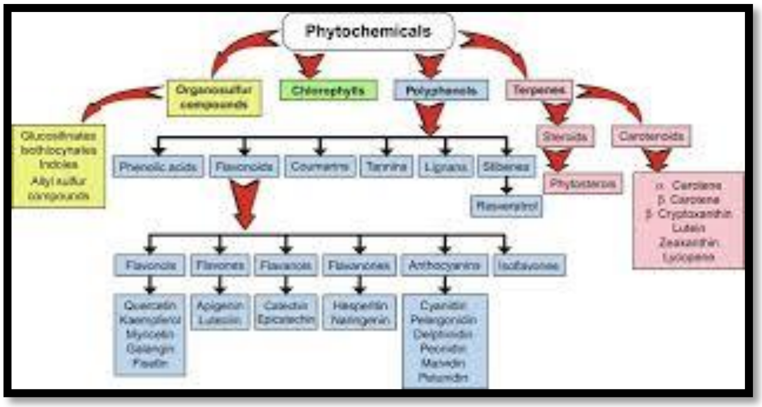

Figure 2: Overview of Common Phytochemicals (Source: Bawazeer et al. 2021)

These phytochemicals serve as potential lead compounds in the development of new antimicrobial agents, particularly in the context of increasing resistance to synthetic drugs.

Summary of In-vitro and In-vivo Antimicrobial Assays

The antimicrobial efficacy of medicinal plants has been investigated using both in-vitro and in-vivo experimental models. Agar diffusion, broth dilution, and microdilution are in-vitro methods, which determine the inhibitory or bactericidal effect of plant extracts on microbial strains. Such techniques have established strong antimicrobial activity in several plant species against microbes like *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Candida albicans*. Fourth, less frequently used in-vivo studies present meaningful data about the efficacy, toxicity, and pharmacokinetics of phytochemicals in a living organism (Bhandari et al. 2021). Such studies are commonly used animal models to evaluate therapeutic responses to plant extracts in induced microbial infections. Collectively, the in-vitro and in-vivo evidence indicates the potential of plant-based compounds in the creation of antimicrobial drugs.

Examples of Notable Medicinal Plants

Several medicinal plants have been consistently featured in the literature because of their broad-spectrum antimicrobial in nature. Bioactive antimicrobial compounds found in *Azadirachta indica* (neem) include flavonoids and nimbidin that have antibacterial, antifungal, and antiviral activities. *Ocimum sanctum* (holy basil) contains large amounts of eugenol and ursolic acid, which have added to its antimicrobial and immunomodulatory properties. The curcuminoids exhibited by *Curcuma longa* (turmeric), mainly curcumin, have shown membrane-disrupting and anti-inflammatory effects. Other examples noteworthy are *Allium sativum* (garlic), which contains organosulfur compounds, and *Zingiber officinale* (ginger), which contains gingerols and shogaols (Bhandari et al. 2021). Purified or unopened fractions, these species are commonly researched on account of their antimicrobial impacts. Their high rate of appearance in literature indicates a high level of pharmacological relevance and a solid starting point of future studies.

Global versus Regional Studies on Phytochemicals

A comparative perspective of global and regional studies shows uniformity as well as variation in results. The plants that should be studied globally are typically widespread or commercially significant and involve the use of powerful analysis techniques like high-performance liquid chromatography (HPLC) and gas chromatography-mass spectrometry (GC-MS). Such investigations are more inclined towards isolation of compounds, elucidation of mechanisms as well as the profiling of pharmacological parameters under controlled laboratory conditions. Regional work, in contrast, focuses on ethno-medicinal plants within local ecology, which can be guided by local traditional medicine and culture. Such studies are rich in context and often reveal species that have not been utilized pharmacologically, though they are often underrepresented in larger scientific databases and journals (Dubale et al. 2023). A regional study can tend to use more accessible processes of extraction and testing, which, though convenient, are not necessarily accurate like large scale internationalized steps. The phytochemical profiles of plants are affected in significant ways by environmental settings such as climate, altitude, and type of soil leading to further regional differences in the chemical actions of plants as antimicrobial agents. Chemical composition and bioactivity of plant extracts can also be affected by variation in local harvesting, drying, and preparation techniques. As a result, bridging global-standard analytical techniques with regional ethnopharmacological knowledge may enhance both the scope and depth of phytochemical investigations.

Thematic Observations from Previous Studies

Several recurring themes emerge from the reviewed literature. Firstly, a strong association exists between certain phytochemical classes—particularly alkaloids, flavonoids, and phenolics—and antimicrobial activity. Secondly, there is increasing evidence of synergistic interactions between plant extracts and conventional antibiotics, enhancing therapeutic efficacy and reducing resistance development (Ezez Mekonnen & Tefera, 2023). Thirdly, the convergence of ethnobotanical knowledge with scientific validation supports the therapeutic legitimacy of many traditional plant-based remedies. Despite these promising insights, challenges remain in translating laboratory findings into clinical applications. Limited toxicological profiling, lack of clinical trials, and the absence of standardized extract formulations hinder progress. Moreover, the lack of consistency in reporting practices between studies makes meta-analysis difficult. Thematic synthesis and integrated research frameworks on these issues may be a way of closing the gap between traditional knowledge and contemporary pharmacological practice.

Literature Gap

Several reviews have been conducted to evaluate the antimicrobial potential of medicinal plants, yet a significant number of them are constrained in their subjects. Available literature usually concentrates on certain individual families of plants, individual compounds or restricted geographical areas. This has created a dichotomy of knowledge that has limited comparative synthesis of larger datasets. Also, not all studies have extensive phytochemical characterization, and do not define any direct links between chemical components and anti-microbial effects. The heterogeneity of extraction methods, solvent systems, and methods of evaluating antimicrobials is another shared constraint to the comparability of results (Fatima et al. 2024). These methodological variations account for variation in reported efficacy and the establishment of standardized plant-based sources of antimicrobial agents. In addition, comparatively little includes toxicological testing or pharmacokinetics, and there is a huge gap between in-vitro findings and clinical application. There is also a limit to the knowledge of long-term effectiveness and possible aggravation to resistance using plant-based remedies due to the absence of longitudinal studies. The underrepresentation of regional and ethno-medicinal knowledge in peer-reviewed literature contributes to under-exploiting culturally relevant species with possible antimicrobial activity. The existing body of research on this matter thus requires a thematic synthesis to synthesize the work, isolate high-potential candidates, and fill the gaps in the knowledge.

III. METHODOLOGY

This research study has used a secondary research design, supported by thematic analysis to review phytochemical screening results and antimicrobial actions of medicinal plants. This methodological choice is explained by the existing volume and ever-wider potential of literature on this topic. Secondary analysis allows the collection and synthesising of past research to draw thematic interpretations that are more than a singular finding. It also provides a method to assess the overall research trends and gaps in knowledge, particularly within a multidisciplinary field, in an effective and academically responsible way (Gizaw et al. 2022).

A systematic search strategy was used to identify relevant literature from multiple databases, including SCOPUS and Google Scholar. Keywords such as "phytochemical screening," "antimicrobial activity," "medicinal plants," "plant extracts," and "bioactive compounds" were combined using Boolean operators. Studies were included if they met the following criteria: published in peer-reviewed journals; focused on phytochemical profiling or antimicrobial testing of plant species; and reported either qualitative or quantitative results relevant to antimicrobial efficacy. Exclusion criteria involved studies with insufficient methodological transparency, non-English publications, and papers unrelated to medicinal plant use.

From each selected study, data were extracted regarding phytochemical profiles, identified compounds, antimicrobial activity results, targeted microbial species, solvent types used for extraction, and sample sizes. Emphasis was placed on both the spectrum of bioactive compounds identified and the extent of antimicrobial activity against Gram-positive and Gram-negative bacteria, as well as fungal strains (Hamrita et al. 2022). Observations regarding regional plant use, ethnomedicinal contexts, and experimental variations were also recorded to support broader thematic development.

Thematic categorization involved multiple rounds of review, during which codes were grouped into broader conceptual categories. Initial codes were derived from frequently reported phytochemicals and plant species, types of antimicrobial assays, and observed efficacy. These codes were then refined and clustered to form overarching themes that captured the complexity and diversity of the secondary data (Tambe, Pedhekar & Harshali, 2021). In the process, one focused on the semantic similarity and relevance of concepts to maintain internal consistency of each theme. Specific focus was placed on the repeated patterns within various studies, such as connections within phytochemical classes and antimicrobial annotations, the geographical determinants of bioactivity, and differences in methodology. Manual coding was selected over automated methods to allow for greater interpretive depth and contextual sensitivity, particularly when synthesizing qualitative findings from heterogeneous sources (Kebede, Gadisa & Tufa, 2021). The reliability of coding was increased, by cross checking and revisiting source material to ascertain coherence with themes. Such repeated actions allowed reaching the level of general themes that not only generalised the available evidence but also revealed the underlying patterns and knowledge vacuums in the general scope of research. The themes thus formed became the analytical basis on how the findings were to be presented and have a structured discussion.

To maintain credibility, the sources used were peer-reviewed and published in legitimate scientific journals. An appropriate level of transferability was ensured through extensive backgrounds of each theme, which means that each can be applied to analogous lines of research (Tambe, Pedhekar & Harshali, 2021). Reliability was enhanced by adopting a standardized coding mechanism and recording all analysis steps. Despite the study having drawbacks caused by use of published data, methodological integrity and thematic style increase the validity and reliability of the findings.

IV. FINDINGS & DISCUSSION

Diversity and Richness of Phytochemicals

Another prominent trend of the literature reviewed is that a notable variety of phytochemical classes are found to occur in medicinal plants. The most frequently recognized compounds were alkaloids, flavonoids, tannins, saponins, terpenoids, and phenolics. It has been reported that these phytochemicals have extensive pharmacological features such as antimicrobial activity, antioxidant capability, and membrane-disrupting capacity. Various plant species were found to exhibit the

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existence of several phytochemical types, indicating a multi-mechanistic mechanism of action on microbial agents (Khanal, Sharma, Pokharel Kalauni, 2022). The frequency of definite phytochemicals is also linked with plant families. As an example, the constituents of the family Lamiaceae were often linked to high amounts of flavonoids and essential oils, but species of the family Fabaceae contained abundant concentrations of alkaloids and tannins. This botanical affinity suggests the role of taxonomic profiling in the phytochemical screening and increases the predictability of compound occurrence by plant classification.

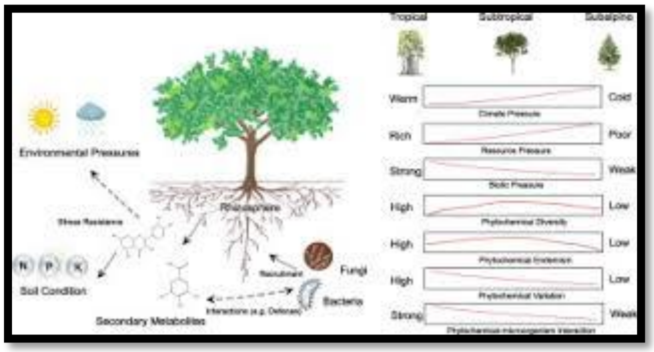

Figure 3: Diversity and Richness of Phytochemicals
(Source Khanal, Sharma, Pokharel Kalauni, 2022)

The phytochemical diversity also shows the ecological and defensive adjustments of plants to the environment. The compounds are not only useful as deterrents of herbivores and pathogen but also provide biochemical arsenals that can be utilized in therapeutic applications. The phytochemical concentrations variability between species, as well as within species produced in different regions, cue the role of environmental factors like soil, climate, and altitude. The biosynthesis and accumulation of secondary metabolites are further modified by seasonal changes, exposure to biotic and abiotics stresses, and variations in cultivation practices. In adverse conditions (severe climate or abounding in pathogens) phytochemical diversity in plants is relevant to their survival (M Auezov et al. 2024). Such plasticity of the ecology means that the same species collected in another area can have quite different pharmacology. Consequently, the geographic source of medicinal flora will be a pivotal factor in defining the quality, strength, and replicability of plant-derived formulations. Knowledge of these environmental factors is vital in standardizing phytochemical screening procedures and to optimize growing conditions to produce desired medicinal plants.

Antimicrobial Efficacy by Plant Species

These reviewed studies have shown through their findings that there was significant activity regarding antimicrobial activity on many species of medicinal plants. *Azadirachta indica*, *Curcuma longa*, *Ocimum sanctum*, *Allium sativum*, and *Zingiber officinale* extracts repeatedly exhibited inhibitory properties on a variety of microorganisms. These were Gram-positive strains like *Staphylococcus aureus* and *Bacillus subtilis*, Gram-negative strains like *Escherichia coli* and *Pseudomonas aeruginosa* and fungal pathogens such as *Candida albicans* and *Aspergillus niger*. Organic solvents like ethanol and methanol are used to prepare plant extracts that were usually more active than aqueous extracts in the tests of antimicrobial activity (Mohammed, Dekabo & Hailu, 2022). This trend is attributed to the solubility and extraction efficiency of non-polar solvents for certain phytochemicals, particularly alkaloids and terpenoids. Aqueous extracts, while more aligned with traditional usage, often displayed weaker inhibitory effects but still retained notable antimicrobial potential in some species.

The antimicrobial mechanisms were not always explicitly described but were often inferred from the bioactive profiles. Possible modes of action include disruption of microbial membranes, inhibition of protein synthesis, interference with nucleic acid replication, and the chelation of essential metal ions. Some phytochemicals may also inhibit enzymatic activity or impair microbial signaling pathways critical to pathogenicity and survival. These findings support the potential for plant-derived compounds to act as either standalone antimicrobial agents or as templates for synthetic drug development, particularly in the context of emerging resistance (Shendurse et al. 2021). Their structural diversity offers unique opportunities for discovering novel mechanisms beyond those targeted by existing antibiotics.

Synergistic Potential and Resistance Mechanisms

Another prominent theme involves the synergistic interaction between plant extracts and conventional antimicrobial drugs. Several studies reported enhanced antimicrobial efficacy when plant-derived compounds were used in combination with antibiotics. These synergistic effects were particularly evident in resistant bacterial strains, where plant compounds appeared to restore antibiotic sensitivity or potentiate drug action. Plant extracts have also shown the ability to disrupt microbial resistance mechanisms (Sharaf et al. 2022). In particular, inhibition of biofilm formation and interference with quorum sensing were recurrent observations. Biofilms, known for their resistance to antimicrobial agents, are a major factor in chronic infections. Certain flavonoids and phenolics were reported to disrupt biofilm architecture, thereby increasing microbial susceptibility to treatment (Nabi, Tabassum & Ganai, 2022). Additionally, compounds targeting quorum sensing pathways could prevent the regulation of virulence factors, thereby reducing pathogenicity without directly killing the microorganism. This thematic insight suggests a novel role for phytochemicals—not only as antimicrobial agents but also as resistance modulators. The potential for developing plant-based adjuvants to existing antibiotic therapies represents a promising avenue for addressing the global challenge of antimicrobial resistance.

Regional and Ethnomedicinal Patterns

Regional variations in phytochemical profiles and antimicrobial efficacy were also evident. Plants sourced from different geographic regions exhibited distinct phytochemical compositions, even within the same species. This diversity is influenced by environmental conditions, cultivation practices, and genetic variation. Consequently, the antimicrobial activity of plant extracts showed corresponding variability, reinforcing the need for region-specific studies and phytochemical mapping (Ndezo Bisso et al. 2022). Ethnomedicinal usage patterns frequently aligned with laboratory-confirmed antimicrobial properties. Plants traditionally used to treat infections and wounds were often found to possess strong antimicrobial activity in vitro. This correlation lends credibility to traditional knowledge systems and highlights their value in guiding scientific research. Moreover, some under-documented plants from indigenous traditions demonstrated significant activity, suggesting that many valuable species remain to be explored. The interplay between ethnobotanical knowledge and scientific validation presents an opportunity to broaden the pharmacological repertoire. However, the potential risks of overharvesting and habitat loss necessitate responsible sourcing and conservation strategies to ensure long-term sustainability.

Critical Discussion

The findings highlight the substantial promise of medicinal plants in the search for novel antimicrobial agents. However, notable variability exists across studies due to differences in extraction methods, plant part selection, solvent systems, microbial strains tested, and phytochemical quantification techniques. This inconsistency complicates direct comparisons and calls for methodological standardization in future research. Gaps were identified in the translation of in-vitro findings to clinical relevance (Sharaf et al. 2022). Few studies have progressed to toxicological assessments or clinical trials, limiting the applicability of promising results. Additionally, while synergistic effects with antibiotics have been observed, the molecular mechanisms remain poorly understood in many cases (Rahman, Khan, Liaqat & Zeb, 2022). Despite these limitations, the reviewed evidence supports the inclusion of medicinal plants in drug discovery pipelines, particularly in addressing antibiotic resistance. A multidisciplinary approach that integrates phytochemistry, microbiology, ethnobotany, and pharmacology is essential to unlock the full potential of plant-derived antimicrobials and to develop safe, effective, and sustainable treatments for infectious diseases.

V. CONCLUSION

A literature thematic program on phytochemical screening and antimicrobial properties of medicinal plants demonstrate a robust evidence on the therapeutic power of bioactive compounds found in plant-based products. Its important themes are abundance of phytochemicals, species-specific antimicrobial actions, regional ethno-medicinal application, and synergism with conventional antibiotics. Alkaloids, flavonoids, tannins, saponins, terpenoids, and phenolics are common compounds that have shown activity against Gram-positive, Gram-negative bacteria, and fungi.

Most phytochemicals are characterized by distinctive mechanisms of action, including biofilm disruption and quorum-sensing inhibition, which are broadly useful in combating antibiotic resistance. Others also synergise the action of current antibiotics providing new portfolios of combinations treatment. Nevertheless, translating in-vitro findings to the clinic is still challenging, as standardized extraction, testing, and assay methods are lacking, making it difficult to reproducibly validate them.

The validation of traditional remedies through the incorporation of ethnomedicinal and scientific methods has already occurred. The retention of this knowledge can even speed up the process of discovery and assistance towards culturally sensitive healthcare. To sum up, medicinal plants have a big potential of providing new antimicrobial agents. Further, interdisciplinary studies are needed to maximize their promise in addressing global health challenges such as antibiotic resistance.

Recommendations

Future studies must put more emphasis on primary studies using standardized phytochemical screening and antimicrobial screening protocol to enhance comparable results and reproducibility. Investigations in under-studied plant species, especially in plants of ethnomedicinal interest, could discover new bioactive compounds with therapeutic value. Plant-derived antimicrobial agent development: Interdisciplinary cooperation among botanists, microbiologists, chemists, and pharmacologists would be needed to extend the research work in this area.

VI. REFERENCE LIST

Ali, A. I. D. Y., Bahmani, M., Pirhadi, M., Kaviar, V., Karimi, E., & Abbasi, N. (2022). Phytochemical analysis and antimicrobial effect of essential oil and extract of Loranthus europaeus Jacq. on Acinetobacter baumannii, Staphylococcus aureus, and Pseudomonas aeruginosa. *Kafkas Üniversitesi Veteriner Fakültesi Dergisi*, *28*(2). DOI: 10.9775/kvfd.2021.26626

Basson, D. C., Teffo, T. K., & Risenga, I. M. (2023). A phytochemical screening, antioxidant and antibacterial activity analysis in the leaves, stems and roots of Portulacaria Afra. *J. Herbmed Pharmacol*, *12*, 109-117. doi: 10.34172/jhp.2023.10.

Bawazeer, S., Rauf, A., Shah, S. U. A., Shawky, A. M., Al-Awthan, Y. S., Bahattab, O. S., ... & El-Esawi, M. A. (2021). Green synthesis of silver nanoparticles using Tropaeolum majus: Phytochemical screening and antibacterial studies. *Green Processing and Synthesis*, *10*(1), 85-94. https://doi.org/10.1515/gps-2021-0003

Bhandari, S., Khadayat, K., Poudel, S., Shrestha, S., Shrestha, R., Devkota, P., ... & Marasini, B. P. (2021). Phytochemical analysis of medicinal plants of Nepal and their antibacterial and antibiofilm activities against uropathogenic Escherichia coli. *BMC Complementary Medicine and Therapies*, *21*(1), 116. https://doi.org/10.1186/s12906-021-03293-3

Dubale, S., Kebebe, D., Zeynudin, A., Abdissa, N., & Suleman, S. (2023). Phytochemical screening and antimicrobial activity evaluation of selected medicinal plants in Ethiopia. *Journal of experimental pharmacology*, 51-62. https://orcid.org/0000-0002-0552-1783

Ezez, D., Mekonnen, N., & Tefera, M. (2023). Phytochemical analysis of Withania somnifera leaf extracts by GC-MS and evaluating antioxidants and antibacterial activities. *International Journal of Food Properties*, *26*(1), 581-590. https://doi.org/10.1080/10942912.2023.2173229

Fatima, M., Zafar, I., Ain, Q. U., Anwar, M. M., Yousaf, W., Rather, M. A., ... & Sharma, R. (2024). Multifunctional analysis and antimicrobial activity of Adhatoda vasica: a traditional medicinal plant. *Drug Metabolism and Personalized Therapy*, *38*(4), 359-366. https://www.degruyterbrill.com/document/doi/10.1515/dmpt-2023-0012/html

Gizaw, A., Marami, L. M., Teshome, I., Sarba, E. J., Admasu, P., Babele, D. A., ... & Abdisa, K. (2022). Phytochemical screening and in vitro antifungal activity of selected medicinal plants against Candida albicans and Aspergillus niger in West Shewa Zone, Ethiopia. *Advances in Pharmacological and Pharmaceutical Sciences*, *2022*(1), 3299146. https://doi.org/10.1155/2022/3299146

Hamrita, B., Emira, N., Papetti, A., Badraoui, R., Bouslama, L., Ben Tekfa, M. I., ... & Snoussi, M. (2022). Phytochemical Analysis, Antioxidant, Antimicrobial, and Anti-Swarming Properties of Hibiscus sabdariffa L. Calyx Extracts: In Vitro and In Silico Modelling Approaches. *Evidence-Based Complementary and Alternative Medicine*, *2022*(1), 1252672. https://doi.org/10.1155/2022/1252672

Kebede, T., Gadisa, E., & Tufa, A. (2021). Antimicrobial activities evaluation and phytochemical screening of some selected medicinal plants: A possible alternative in the treatment of multidrug-resistant microbes. *PloS one*, *16*(3), e0249253. https://doi.org/10.1371/journal.pone.0249253

Khanal, L. N., Sharma, K. R., Pokharel, Y. R., & Kalauni, S. K. (2022). Phytochemical analysis and in vitro antioxidant and antibacterial activity of different solvent extracts of Beilschmiedia roxburghiana nees stem barks. *The scientific world journal*, *2022*(1), 6717012. https://onlinelibrary.wiley.com/doi/abs/10.1155/2022/6717012

M Auezov, G. A., Pernebekova, R., M Auezov, N. S., Uzakovich, Z. K., Rakhmonov, T., Azamatovna, T. K., ... & Inamovich, R. I. (2024). Comparative analysis of antimicrobial properties of medicinal plants used in veterinary medicine. *Caspian Journal of Environmental Sciences*, *22*(5), 1043-1053. DOI: 10.22124/cjes.2024.8071

Mohammed, S., Dekabo, A., & Hailu, T. (2022). Phytochemical analysis and anti-microbial activities of Artemisia spp. and rapid isolation methods of artemisinin. *AMB Express*, *12*(1), 17. https://doi.org/10.1186/s13568-022-01346-5

Nabi, M., Tabassum, N., & Ganai, B. A. (2022). Phytochemical screening and antibacterial activity of Skimmia anquetilia NP Taylor and Airy Shaw: A first study from Kashmir Himalaya. *Frontiers in plant science*, *13*, 937946. https://doi.org/10.3389/fpls.2022.937946

Ndezo Bisso, B., Njikang Epie Nkwelle, R., Tchuenguem Tchuenteu, R., & Dzoyem, J. P. (2022). Phytochemical screening, antioxidant, and antimicrobial activities of seven underinvestigated medicinal plants against microbial pathogens. *Advances in Pharmacological and Pharmaceutical Sciences*, *2022*(1), 1998808. https://doi.org/10.1155/2022/1998808

Rahman, T. U., Khan, H., Liaqat, W., & Zeb, M. A. (2022). Phytochemical screening, green synthesis of gold nanoparticles, and antibacterial activity using seeds extract of Ricinus communis L. *Microscopy Research and Technique*, *85*(1), 202-208. https://analyticalsciencejournals.onlinelibrary.wiley.com/doi/abs/10.1002/jemt.23896

Sharaf, M. H., Abdelaziz, A. M., Kalaba, M. H., Radwan, A. A., & Hashem, A. H. (2022). Antimicrobial, antioxidant, cytotoxic activities and phytochemical analysis of fungal endophytes isolated from Ocimum basilicum. *Applied biochemistry and biotechnology*, *194*(3), 1271-1289. https://link.springer.com/article/10.1007/s12010-021-03702-w

Shendurse, A. M., Sangwan, R. B., Kumar, A., Ramesh, V., Patel, A. C., Gopikrishna, G., & Roy, S. K. (2021). Phytochemical screening and antibacterial activity of lemongrass (Cymbopogon citratus) leaves essential oil. *Journal of Pharmacognosy and Phytochemistry*, *10*(2), 445-449.

https://www.researchgate.net/profile/Ashish-Shendurse/publication/351626620_

Tambe, B. D., Pedhekar, P., & Harshali, P. (2021). Phytochemical screening and antibacterial activity of Syzygium cumini (L.) (Myrtaceae) leaves extracts. *Asian Journal of Pharmaceutical Research and Development*, *9*(5), 50-54. https://doi.org/10.22270/ajprd.v9i5.1023