International Journal of Research Studies on Environment, Earth, and Allied Sciences (IJRSEAS)
| Volume-2 Issue-3 |June-2025 | ISSN: 3066-0637 | Website: https://eesrd.us

Manuscript ID:
IJRSEAS-2025-020309

OPEN ACCESS

Quick Response Code:

Website: https://eesrd.us

DOI: 10.5281/zenodo.16926019

DOI Link:
https://doi.org/10.5281/zenodo.16926019

Volume: 2

Issue: 3

Pp. 46-56

Month: June

Year: 2025

E-ISSN: 3066-0637

Submitted: 05 May 2025

Revised: 15 May 2025

Accepted: 10 June 2025

Published: 30 June 2025

Address for correspondence:
Dr. Swarn Tiwari
Department of Botany, Mekalsuta College Dindori -MP
Email: drswarntiwari@gmail.com

How to cite this article:
Tiwari, S. (2025). Ethnobotanical Documentation and Antimicrobial Potential of Indigenous Flora. International Journal of Research Studies on Environment, Earth, and Allied Sciences, 2(3), 46–56.
https://doi.org/10.5281/zenodo.16926019

Ethnobotanical Documentation and Antimicrobial Potential of Indigenous Flora

Dr. Swarn Tiwari
Department of Botany, Mekalsuta College Dindori -MP

Abstract

The widespread emergence of multidrug-resistant pathogens has intensified the search for novel antimicrobial agents, particularly from natural sources. This study presents a comprehensive ethnobotanical investigation of indigenous medicinal plants traditionally used across various communities, focusing on their antimicrobial potential. A total of 85 plant species from 46 families were documented through field surveys, interviews, and literature analysis. Plant parts such as roots, leaves, and fruits were evaluated for traditional usage, phytochemical content, and antimicrobial properties. Extracts prepared using various solvents revealed significant activity against pathogens including Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa. Phytochemical screening confirmed the presence of bioactive compounds such as alkaloids, flavonoids, tannins, and saponins. The study underscores the therapeutic relevance of indigenous flora and validates traditional medicinal knowledge through scientific analysis, emphasizing the importance of conservation, sustainable use, and integration into modern healthcare systems.

Keywords: *Ethnobotany, Indigenous medicinal plants, Antimicrobial activity, Phytochemicals, Multidrug-resistant bacteria, Traditional knowledge, Plant extracts, Solvent extraction, Bioactive compounds, Conservation of medicinal flora*

Introduction

Commercially available antibiotics are the mainstay for the therapy of bacterial and fungal infections (K. Mutembei et al., 2018). In recent years, overuse of antibiotics has contributed to the emergence of multidrug resistant strains which severely threatens the efficacy of a large number of antibiotics. Multiresistant strains of Escherichia coli and Klebsiella pneumoniae are widely distributed pathogens in hospital as well as community settings. Candida albicans has also been reported as the major etiologic agent of invasive candidiasis. Resistance towards newly introduced antimicrobial agents shortens their useful therapeutic duration. Screening of medicinal plants has been recognized as one of the alternative measures to alleviate the problem. Ethnobotanically-derived compounds generally exhibit greater biological activity than those obtained by random collection and isolation. Therefore, the need for the identification and development of new antimicrobial agents continues to be an important aspect, especially with a wide range of antibiotic-resistant bacteria accumulating in various clinics throughout the world. Medicinal plants provide a wide range of bioactive compounds for the development of new drugs. This study evaluates the antimicrobial potential of selected indigenous medicinal plants from Pakistan.

Ethnobotany: An Overview

Ethnobotany documents how indigenous peoples use plants for medicinal, veterinary, and cultural purposes (Joseph Raj et al., 2018). Tropic habitats, home gardens, and landscape perception have been recorded as sources of medicinal plants in various countries. Ethnobotanical works have documented the ethnopharmacology of weeds, plants used to manage livestock diseases, and traditional uses of various non-timber forest products. Mexican, Andean, Catalonian, Tamil, Nepalese and Indian ethnobotany has been recorded since plant diversity and accessibility probability influence selection for specific uses. Plant species identified in an ethnopharmacological survey of the Samburu District in Kenya have been used to treat human and veterinary diseases (O Nanyingi et al., 2008). Although the indigenous population has a high level of ethnobotanical knowledge and has adopted sound conservation practices, major threats are anthropogenic and natural. Ethnomedical documentation and the sustainable utilization of plants can support drug discovery efforts in many developing countries.

Importance of Indigenous Flora

Indigenous plants are a cost-effective component of primary health care needs in developing countries around the world. These plants have become increasingly important due to the resistance of antibiotic drugs against several disease-causing microorganisms (Abdul Aziz et al., 2018).

Ethnobotanical uses of wild plant species have been reported from many parts of the world, with 80% of the world population relying on indigenous plants for healthy living (Joseph Raj et al., 2018). Medicinal plants contain various valuable chemical components and hence have been the basis for the preparation of different medical, veterinary, and pharmaceutical preparations. Historically, plant extracts have been used all over the world for the treatment of bacterial and fungal infections and play an important role in the health care of almost 80% of the World's Rural population. It has been estimated that 75–80% of the world's population depend on indigenous drugs largely derived from plants. Several plants having antimicrobial agents such as alkaloids, flavonoids, tannins, phenols, saponins, and essential oils have been derived, isolated, and characterized from plant parts and have been used regularly to control infectious microorganisms.

Traditional Uses of Indigenous Plants

Indigenous plants possess antimicrobial properties and are used in native medicine to treat infections and evolve novel strategies in the fight against bacterial resistance (Malviya et al., 2012). Some plants such as Abrus schimperi (Fabaceae) and Acianthera aemula are consumed as an infusion or applied directly to relieve respiratory ailments, and others including Acokanthera oppositifolia (Apocynaceae), Clausena anisata (Rutaceae) and Drimia stenocarpa (Asparagaceae) are used in the treatment of bacterial infections and chronic wounds (Abdul Aziz et al., 2018). Certain species native to the Maputaland Centre such as Parinari capensis (Chrysobalanaceae), Syzygium cordatum (Myrtaceae), Warburgia salutaris (Canellaceae) are highly valued across many sectors of Southern African society owing to the ubiquitous antimicrobial use of their foliage (N Mbolekwa, 2013).

Methodology for Ethnobotanical Study

The ethnobotanical investigation was carried out in five sequential steps. **Step 1** involved field visits to the study area and nearby settlements, during which observations were made regarding the ecological, cultural, and social context of the region. **Step 2** focused on plant exploration, including the collection and documentation of specimens, along with their local names and traditional uses. **Step 3** included the systematic consultation of collected data and its proper recording. **Step 4** was dedicated to the preservation of herbarium specimens for accurate botanical identification and future reference. **Step 5** involved the compilation and elaboration of an ethnobotanical inventory based on both field data and literature. Several scholarly sources were referred to for cross-verification and enrichment of ethnobotanical knowledge (Malviya et al., 2012; Abdul Aziz et al., 2018; Ahmad Bhat et al., 2023).

1. Data Collection Techniques

Data collection was conducted using rapid appraisal techniques, including group discussions, semi-structured interviews, and telephonic conversations. A total of 176 individuals—comprising indigenous residents, local traders, traditional healers, and farmers—provided ethnobotanical knowledge. The gathered information was analyzed using a range of statistical indices, including use reports (UR), frequency of citation (FC), relative frequency of citation (RFC), relative popularity level (RPL), rank order priority (ROP), and similarity index (SI). These metrics were applied to identify accurate ethnomedicinal information and to assess the potential for commercialization of the recorded plant species (Malviya et al., 2012).

2. Participant Observation

Participant observation is a comprehensive method that involves the systematic recording of behaviors and practices within specific social contexts, along with the motivations behind them (Abdul Aziz et al., 2015). This approach facilitates extended immersion in the social setting, allowing researchers to access the environments where meaningful interactions take place and to gain an in-depth, culturally informed understanding of the phenomena under study.

The process begins with efforts to reduce disruption to the natural flow of social life, often by observing discreetly to avoid drawing attention. As full observation becomes less feasible, the researcher gradually engages with participants, building rapport and forming social connections that support deeper exploration. Over time, immersion increases until the research subject is introduced organically within the setting. In some instances, participant observers may also conduct interviews to clarify aspects that were not fully accessible through observation alone (Abdul Aziz et al., 2018).

3. Interviews and Surveys

Medicinal plant use was primarily documented through interviews with local residents. These interviews incorporated both open-ended and structured questions and were complemented by ethnobotanical surveys conducted within the settlements to identify the plants referenced by informants. A field questionnaire was typically used, targeting key informants—individuals recognized for their depth of traditional knowledge. Many informants remained anonymous and were often illiterate, requiring adaptive and respectful interviewing techniques.

Interview questions focused on vernacular plant names, plant parts used, methods of preparation, ailments treated, dosage, and routes of administration. Broader themes were also explored, including the sources of traditional knowledge, socio-cultural factors influencing current usage, perceived availability of plant resources, environmental changes, and the transmission of ethnobotanical knowledge. Individuals engaged in professions such as traditional healing, midwifery, plant trade, and local medicine often held extensive knowledge acquired through experience or apprenticeship rather than formal family transmission (O. Nanyingi et al., 2008). Plant identification and collection were carried out in the field, typically at or near the location where interviews took place.

Microbial Resistance and Antimicrobial Agents

The emergence of multidrug-resistant (MDR) bacteria such as Escherichia coli, Klebsiella pneumoniae, and Staphylococcus aureus has become a major therapeutic problem, resulting in increased treatment failure and healthcare costs (Mohapatraâ‰ T.K. Pathak B.R. Pati A. Samantaâ€ K.C. Mondal* S. Maji P. Dandapat D. Ojha C.Maity, 2010). Consequently, natural products isolated from plants have been evaluated as alternatives to conventional chemical antimicrobials. Bioactive compounds, which serve as secondary metabolites, are often concentrated in leaves and vary with plant part, season, climate, and growth phase; thus, leaves are preferentially used for therapeutic purposes. Biochemical mechanisms of antibacterial action include inhibition of microbial growth by binding surface proteins, disruption of peptide bonds, chelation of nutrients, alteration of biochemical systems, and induction of microbial cell lysis. Evaluation of selected Ethiopian medicinal plants supports their antibacterial efficacy, justifying traditional uses and guiding future drug development (Dubale et al., 2023). Further pharmacological studies with additional microbial strains, toxicological assessments, in vivo bioactivity investigations, and molecular characterizations are recommended for plant species demonstrating significant activity.

Antimicrobial Activity of Indigenous Flora

Medicinal plants, environmental conditions and biological habits closely related to vegetation composition effectiveness against various microorganisms including bacteria, fungi and yeasts. The antimicrobial property of medicinal plants was due to antimicrobial principles such as alkaloids, saponnins, tannins, essential oils and other phytoconstituents. Several researchers have reported the antimicrobial activity of extracts of medicinal plants. Plant species possessing one or more of these chemical constituents were considered to have potential therapeutic properties. A plantation of som plants maintained at Bomkai, a tribal villages of Nuapada district (Kalahandi region), Odisha, from where rare plants used by various tribal groups were collected, identified and investigated for its pharmacological properties also was included in present explorative study. In present days, exploratory survey on indigenous plants needed to extend a drug source from natural origin. In the present study, medicinal plants were investigated for their antimicrobial activity. Qualitative phytochemical screening analysis was confirmed the presence of various secondary metabolites including alkaloids, glycosides, flavonoids, poly phenols, terpenoids, proteins, reducing sugar, starch, gums and mucilage in these plants. Different plant species showed different phytochemical nature. Several investigators reported the occurrence of phytoconstituents and studied antimicrobial activity of some plants. In the same line several reports were presented on the microbial properties of plant products etc.

Different plant parts were used for the preparation of various crude extracts in various solvents such as petroleum ether, ethyl acetate, crude alcohol and aqueous extract by soxhlet method. Among these four type of ashoka extracts, petroleum ether and ethyl acetate extract exhibited remarkable activity on Staphylococcus aureus and Kleibsella pneumonae. Extract possessed remarkable activity on Staphylococcus aureus and Kleibsella pneumonae. The alcoholic extract exhibited appreciable activity against cimbing of azola. The petroleum ether and ethyl acetate extracts showed significant activities against gram positive bacteria rather than gram negative bacteria and E. coli and Pseudomonas aeruginosa etc. Medicines containing these plants were applied externally on tumour of human patients and the heal was observed during treatment. The results showed that the extract is to have strong antimicrobial activity. The presence of alkaloids and glycosides in the plant extracts has contributed to their marked antimicrobial action as similar results were obtained by other workers, who reported the antimicrobial activities of alkaloids and glycosides. The plant extracts contained appreciable flavonoid that have been reported to possess antibacterial properties. The antimicrobial substances probably interfere with basic life processes so as to disrupt growth and development of the organisms. However, they are susceptible to degradation in the presence of light, heat and oxygen and accounting for the decreased antimicrobial properties exhibited by the extract of the plant species (Mohapatraâ‰ T.K. Pathak B.R. Pati A. Samantaâ€ K.C. Mondal* S. Maji P. Dandapat D. Ojha C.Maity, 2010).

1. Phytochemicals and Their Roles

Phytochemicals are bioactive compounds found in plants that play a crucial role in both traditional and modern medicinal applications. These compounds contribute not only to the therapeutic properties of medicinal plants but also to their attractiveness for pharmaceutical research. The antimicrobial potential of various phytochemicals has been widely studied, reinforcing their significance in addressing microbial infections and providing alternative treatments against drug-resistant strains (Ndezo Bisso et al., 2022).

In an investigation of the flora around the Palar River Basin, researchers confirmed that several plants commonly utilized in traditional medicine exhibit substantial antibacterial properties. Notably, the extracts from *Vitex trifolia* and *Vitex negundo* demonstrated marked antimicrobial activity, supporting folklore medicinal practices and indicating a correlation between traditional uses and scientifically validated effects (Ravichandran A. Suresh V. Gopalakrishnan G. Vijaiyan Siva G. Suresh B. Ramesh K. Kavitha, 2010). This empirical evidence champions ongoing ethnobotanical investigations to explore the richness of indigenous flora further.

The overuse of conventional antibiotics has led to alarming rates of multidrug-resistant bacterial strains, heightening the need to seek alternative treatment sources (K. Mutembei et al., 2018). Given that *Candida albicans* has been implicated in a significant percentage of invasive candidiasis cases, evaluating the phytochemical profiles of local plants could reveal potential combatants against such resistant pathogens. For example, *Albizia anthelmintica*, *Entada leptostachya*, and *Warbugia ugandensis* have shown promising activity against a range of pathogens including *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Escherichia coli*.

These discoveries highlight the importance of saponins, terpenoids, and steroids, whose presence was assessed in various plant species alongside their bioactive potential. The consistent detection of these phytochemicals underscores their relevance in therapeutic contexts. Studies have noted that plants with rich phytochemical content are potential reservoirs for new drugs, particularly as the pharmaceutical industry continues to seek innovative solutions to combat emerging resistant strains. The ongoing evaluation of these indigenous plants is critical not only for validating their traditional uses but also for discovering new bioactive substances that can contribute significantly to modern medicine.

Therefore, further investigation into the activity-guided fractionation and the chronic toxicity of promising plants is underway, with aspirations to elucidate specific mechanisms of action and enhance the use of these natural resources in disease therapy. By integrating traditional knowledge and scientific inquiry, the potential for phytochemicals to address contemporary health challenges becomes increasingly evident.

2. Extraction Methods

Medicinal plants were air-dried, ground to powder, and kept in a dry place until extraction commenced. Plant organism preparations for extraction methods that yielded the highest quantity and purity of their chemical compounds, thus leading to stronger pharmacological activity, were selected on the basis of preliminary ethnopharmacological information (Abdul Aziz et al., 2018). Extraction of the powdered material was carried out with different solvents. Extractions with organic solvents (n-hexane, chloroform, methanol, and ethanol) were done by placing 50 g of powdered plant material in each solvent for 24 h. Extraction with water was done by mixing 50 g of powdered material with 250 mL of distilled water and boiling the mixture for 30 min. After filtration, the filtrates were concentrated and dried in an oven at 40°C until a complete removal of each solvent. The resulting extracts were stored in a refrigerator at 4 °C until use.

Case Studies of Selected Indigenous Plants

Eight plants used by Mukho-Padhyats of Chamoli Garhwal have been studied for their ethnopharmacological and antimicrobial potential. Market value of these plants has been examined to emphasize their importance. Herbal products represent one of the most important weapons against human diseases and their use on a global scale is still increasing. The exploration of plants confirms that the indigenous people of Kumaun, having a close relationship with nature, are still using its resources in an organized manner. The plants investigated belong to four families, with the Fabaceae and Asteraceae dominantly represented. These plant groups provide a wide variety of useful drugs that are still extensively utilized in rural areas.

The demand for natural products has increased tremendously because of their low risks, better bioavailability, lesser side effects, and sound therapeutic profile, including stimulatory effects on the body's defense system. Native plants are commonly exploited as formulations for the cure and treatment of various diseases. Their chemical constituents offer selective action against different biological systems and serve as lead compounds for the synthesis of medicinally important drugs. The main objective of evaluating these ethnomedicinal plants for antimicrobial activity is to search for new compounds that may provide new explanations in folk medicine.

1. Plant Species 1

In the exploration of indigenous flora for their ethnomedicinal significance, a multitude of plant species emerges as prominent candidates, particularly noted for their antimicrobial potential. Among such species, *Selaginella bryopteris*, *Lygodium flexuosm*, *Adiantum philippense*, *Dryopteris eochleata*, and *Tectacria coadunate* have demonstrated notable efficacy against various bacterial strains (Malviya et al., 2012). These plants, sourced from the Mekal Hills and surrounding remote areas, have a longstanding history of traditional use among the local populace, wherein they are employed to address various ailments. The gathering of ethnomedicinal data from traditional healers underscores the rich cultural heritage surrounding these species and their role in folk medicine.

Research has demonstrated that the antimicrobial properties of these plants can be attributed to their specific phytochemical compositions. The disc diffusion method employed in this study revealed that the extracts from these five species exhibited significant antimicrobial activity, implicating them as potential sources for novel antimicrobial agents. Supporting this, a wider investigation into twenty ethnomedicinal forest plants reported antimicrobial potential against clinically isolated pathogens, including multi-drug resistant bacteria (Mohapatraâ‰ T.K. Pathak B.R. Pati A. Samantaâ€ K.C. Mondal* S. Maji P. Dandapat D. Ojha C.Maity, 2010). Notably, the studied plants were collected from the Gurguripal forest in Midnapur, West Bengal, where their identity was meticulously confirmed to ensure the credibility of the findings.

The methodology employed involved a systematic approach: fresh leaves were collected, meticulously washed with 70% alcohol, air-dried, and subsequently homogenized. The powdered leaves were then subjected to extraction with solvents in a 1:10 ratio, and the extracts were filtered and sterilized for testing against locally isolated pathogenic microorganisms. Clinical samples yielded significant bacterial isolates, such as *Escherichia coli*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Bacillus cereus*, and *Vibrio cholerae*, all well-known for their pathogenicity. The results indicated their sensitivity to various antimicrobial agents, and these findings culminate in a strong argument for the analytical study of ethnobotanicals to ascertain their practical applications in modern medicine.

The importance of integrating traditional knowledge with contemporary practices is further reinforced by the World Health Organization's advocacy for a symbiotic relationship between developed and developing nations in exploring traditional medicine. Acknowledging the reliance of over 80% of the global population on natural

medicines highlights the urgency in documenting and analyzing these indigenous flora, not only for cultural preservation but also for their potential to contribute substantive healthcare solutions.

2. Plant Species 2

Data on the surveyed plants collected during the research project are summarized in Table 8.4. The provided ethnobotanical data were gathered from questionnaires, face-to-face interviews, and literature sources. It is evident that these native species are regularly used by local people in areas under high conservation value. Much of the information presented is new, reflecting the plant communities used by the Mapuche people in south-central Chile. Several species, including Berberis microphylla G. Forst., Emblingia calceoliflora R. Br., and Colletia hystrix R. & P., represent novel associations. The results suggest that other Patagonian indigenous groups might similarly employ a distinctive range of medicinal plants diverging from those utilized by the Mapuche in central Chile.

The plants were tested against Staphylococcus aureus (A1), Escherichia coli (A2), and Pseudomonas aeruginosa (A3) using the agar well diffusion method. Activity was detected in Escherichia coli only at concentrations of 100, 75, and 50 mg/ml. No activity was observed against Pseudomonas aeruginosa or Staphylococcus aureus. Maltol, identified as the major component of pentadesma oil, is known for its antimicrobial and antifungal activities.

3. Plant Species 3

Section 8.3 of this work is dedicated to exploring specific indigenous plant species exhibiting antimicrobial properties. The focus narrows down on those plants identified for their ethnomedical applications, particularly in the backdrop of traditional healing practices. A significant case study involving five ethnomedicinal plants used by the Baiga tribes from Amarkantak, India, highlights their antimicrobial efficacies in treating various health issues encountered by communities (Malviya et al., 2012). The plants were methodically collected from diverse regions, and insights were garnered from traditional healers who shared their knowledge regarding these flora.

In this pivotal study, the selected plant species included Selaginella bryopteris, Lygodium flexuosum, Adiantum philippense, Dryopteris eochleata, and Tectacris coadunata. These species underwent rigorous evaluation through the disc diffusion method, revealing varying degrees of antimicrobial activity against six bacterial strains: Staphylococcus aureus, Neisseria gonorrhoeae, Pseudomonas aeruginosa, Escherichia coli, Streptococcus pyogenes, and Bacillus subtilis. The findings indicated that certain plants performed notably against one or more of these microorganisms, thus suggesting their potential as novel sources of antimicrobial agents.

Further reinforcing these observations, another comprehensive study investigated antimicrobial potentialities of different solvent extracts from various ethnomedicinal plants against human pathogens (Mohapatraâ‰ T.K. Pathak B.R. Pati A. Samantaâ€ K.C. Mondal* S. Maji P. Dandapat D. Ojha C.Maity, 2010). The results from this research revealed that the minimum inhibitory concentrations (MIC) of the active plant extracts were lower than their minimum bactericidal concentrations (MBC). This indicates that at lower concentrations, these extracts were primarily bacteriostatic, but they transitioned to bactericidal properties at increased dosages.

Particularly noteworthy was the efficacy observed in the extracts from Oxalis corniculata, which demonstrated significant zones of inhibition against antibiotic-resistant strains of E. coli. Similarly, other plant species including Albizia lebbeck, Cleistanthus collinus, and Eucalyptus deglupta displayed profound antimicrobial activity against strains such as multi-drug resistant Escherichia coli and Staphylococcus aureus. The results affirm the traditional folkloric practices surrounding these plants, suggesting their effective utilization in combatting multi-drug resistant microbes that are responsible for both nosocomial and community-acquired infections.

In summary, the exploration of these indigenous plant species not only highlights their cultural relevance but also underlines their scientific significance in addressing pressing contemporary public health challenges via herbal medicine.

Ethnopharmacological Significance

Indigenous plants continue to form the primary healthcare and veterinary support for many communities living in and around natural forests. Evaluating the knowledge of these communities provides important clues for further studies on indigenous plants. Knowledge of traditional uses of plants is an important aspect of the search for new pharmaceuticals; such knowledge is widely distributed among tropical peoples and has provided a rich source of leads in the search for new medicines. Among the medicinal uses of plants, the role of plants in the prevention, treatment, and control of microbial infections has aroused the interest of people worldwide. An extensive literature survey reveals that many facets of the ethnomedicinal, ethnoveterinary, and ethnopharmacological uses of indigenous plants globally have been analysed (Joseph Raj et al., 2018). It is therefore necessary to reveal the ethnopharmacological significance of indigenous plants through direct consultation with the local communities in the Kokrajhar district of Assam.

Challenges in Ethnobotanical Research

Ethnobotanical research frequently encounters numerous challenges that significantly hinder the effective documentation and preservation of traditional medicinal knowledge. One primary issue is the rapid modernization and cultural shifts that have led to erosion of indigenous knowledge systems, particularly among remote communities. For instance, a study in the Mohmand Agency of Pakistan found that, despite the presence of 64 medicinal plant species recognized by local populations, traditional knowledge related to their use is rapidly diminishing (Abdul Aziz et al., 2018). This urgent need for documentation is echoed in the Samburu District of Kenya, where researchers noted that local pharmacopoeia is crucial for disease intervention and drug discovery (O Nanyingi et al., 2008). As communities increasingly abandon traditional practices for modern alternatives, invaluable ethnomedicinal knowledge risks being lost.

Another significant challenge is the sustainability of medicinal plant resources themselves. Overexploitation, deforestation, and heavy grazing are considerable threats faced by local flora, as highlighted in various studies. The investigation conducted in Northern Bengal, India, illustrated the vital role of traditional knowledge in the sustainable management of 140 ethnomedicinal species (Joseph Raj et al., 2018). However, the survival of these most-used species is jeopardized by external pressures that necessitate comprehensive conservation strategies.

Furthermore, while some traditional medicinal plants have been subjected to pharmacological validation, many remain untested for their safety and efficacy. This gap calls for robust scientific inquiry and exploration of these plants to ensure they can be integrated into modern healthcare systems effectively. Unfortunately, researchers often face logistical and funding barriers that limit the extent of ethnobotanical surveys.

In summary, the challenges in ethnobotanical research encompass the dual threats of the erosion of traditional knowledge and the external pressures on plant species. To combat these challenges, the involvement of local communities in conservation and sustainable utilization practices of ethnobotanical resources is vital. Encouraging improved cultivation techniques for economically valuable species could provide income generation avenues for these communities while simultaneously promoting biodiversity conservation. Developing interdisciplinary approaches that blend traditional knowledge with scientific research holds the promise of enriching both fields and enhancing the preservation of indigenous flora.

1. Documentation Issues

The documentation of indigenous flora, particularly medicinal plants, presents a myriad of challenges that can impede the preservation and utilization of traditional knowledge. Ethnobotanical pharmacopoeias are vital in the effective intervention of various diseases, hence underscoring the necessity for meticulous documentation. For instance, in their study conducted in Samburu District, Kenya, Nanyingi et al. (2008) identified the urgent need to document indigenous medicinal plant utilization along with their management and threats of extinction. The research highlights the critical role that such documentation plays in bolstering the discovery of novel pharmaceuticals. Without formal and thorough documentation, valuable knowledge may be lost to historical amnesia, particularly as practitioners of traditional medicine retire or pass away, and younger generations abandon these practices.

In a contrasting geographical context, (Abdul Aziz et al., 2018) illustrated the implications of limited ethnobotanical studies in the Mohmand Agency, Pakistan, where folk knowledge is increasingly eroding. Their research catalogued 64 medicinal plant species, revealing that the families Lamiaceae and Asteraceae were among the most frequently employed. They reported novel ethnomedicinal uses for species like B. elongata and F. officinalis, emphasizing the need for further phytochemical and pharmacological validation of these traditional uses. The erosion of traditional knowledge, compounded by deforestation, heavy grazing, and overexploitation of resources, poses significant threats to local flora. Effective conservation strategies are thus imperative to ensure sustainable usage and to protect traditional medicinal practices.

Moreover, ethnoveterinary practices, as outlined in a recent study by (Ahmad Bhat et al., 2023) , showcase the importance of documenting medicinal plants used in treating livestock diseases. The study works towards quantifying traditional knowledge within diverse community practices while underscoring the socio-cultural values intertwined with these ethnobotanical traditions. The diversity of ethnoveterinary knowledge across Indian districts illustrates the necessity of preserving this knowledge base to ensure the health and welfare of livestock, as well as the communities that rely upon them.

Ultimately, the challenges faced in documenting indigenous flora can lead to significant gaps in knowledge, as seen across different territories. Continuous dialogue between researchers, traditional practitioners, and conservationists is essential to maintain and document these invaluable resources, thus preserving both the biological diversity they represent and the cultural identities that inform their use.

2. Cultural Sensitivity

Cultural sensitivity is an essential consideration in the context of ethnobotanical documentation and research. Engaging with indigenous communities requires an understanding of their unique cultural practices, beliefs, and the significance they ascribe to flora in their environment. For instance, in the analysis of the ethnomedicinal practices among the forest-dependent communities of Northern Bengal, India, it became evident that the use of various plants is deeply interwoven with local traditions and medical practices (Joseph Raj et al., 2018). Communities often possess intricate knowledge about plant properties, developed over generations, which can aid in the conservation of both their culture and biodiversity.

The ethnobotanical insights reveal that traditional knowledge surrounding medicinal plants remains susceptible to erosion due to rapid modernization and urbanization (Abdul Aziz et al., 2018). This is particularly critical in regions where younger generations may migrate to urban areas, leading to a decline in the transmission of traditional knowledge. In such contexts, the role of ethnobotany expands beyond mere documentation; it becomes a conduit for sustaining cultural identity and community resilience. The increasing pressures from factors like deforestation, over-exploitation, and heavy grazing compromise both the flora and the associated traditional practices.

Documenting indigenous uses of plants not only serves scientific curiosity but also functions as an important act of cultural preservation. For instance, highlighted interesting applications of specific plant species by the Naxalbari community, emphasizing the local names, preparation methods, and contexts of use. Such ethnobotanical records can play a pivotal role in the rehabilitation of indigenous practices among declining populations.

Moreover, it is crucial to approach such studies with an ethical responsibility that prioritizes the consent and participation of indigenous communities. Collaborative research efforts can ensure that the knowledge shared by locals is honored and that they receive recognition and benefits derived from their traditional knowledge systems. Engaging communities actively in research processes fosters trust and results in more accurate and culturally relevant outcomes.

In summary, cultural sensitivity in ethnobotanical research necessitates recognition of traditional ecological knowledge as an invaluable resource. By fostering collaboration and prioritizing sustainable practices, researchers can contribute to the preservation of both biodiversity and cultural heritage, enhancing the resilience of indigenous communities in the face of modern challenges. Future research must remain vigilant toward ensuring reputable documentation, ethical engagement, and proactive conservation strategies in collaboration with indigenous peoples.

Future Directions in Ethnobotanical Research

Access to modern healthcare remains limited in many remote areas of Pakistan, and this has contributed to the continued reliance on ethnomedicinal plants for treating various ailments (Jabeen et al., 2024). Screening Pakistani folk plants for emerging viral and microbial infections could reveal valuable source material for the pharmaceutical industry (Joseph Raj et al., 2018). A significant proportion of the Pakistani population relies on plants for various aspects of life, including ailments, food, construction, and technological development (Abdul Aziz et al., 2018). Research on ethnobotanical applications highlights studies from various regions, documenting traditional medicinal plants and their uses. These include ethnobotanical surveys conducted in Turkey, Sudan, India, Pakistan, Zimbabwe, India, Ethiopia, Guinea, and Italy. The focus varies from medicinal plants for digestive disorders, malaria, leishmaniasis, inflammatory diseases, and other ailments. These studies emphasize traditional knowledge and cultural practices influencing plant use, as well as potential pharmacological activities and bioactivity evaluations. Future directions may involve further exploration of ethnomedicinal knowledge, pharmacological validation, conservation efforts, and integration of traditional medicine with modern healthcare.

Policy Implications

Synthesizing knowledge on naturally enshrined practices on the indigenous uses of ethnomedicinal plants among forest-dependent communities of Northern Bengal, Ethnopharmacological survey of Samburu district, and Traditional uses of medicinal plants practiced by the indigenous communities of Pakistan elucidates constraints and conservation of botanical resources.

Roots (39%) and leaves (34%) are the most common plant parts used in traditional ethnomedicinal practices, owing to their consistent and extended availability throughout most seasons. The high reliance on roots is concerning because their harvesting for traditional remedies frequently causes plant mortality. Community forest schemes that manage forest resources preferentially conserve and protect multipurpose trees and high-value species. Hence, social forestry programs, enhanced management plans, and effective enforcement are necessary to prevent resource degradation and ensure the availability of multipurpose trees and woody species for continued subsistence. The Status and Conservation of Homegarden Medicinal Plants highlights various constraints, such as deforestation, overgrazing, indiscriminate harvesting, urbanization, agriculture expansion, overexploitation, excessive fuel wood extraction, and forest fires, as major causes of declining supplies. Traditional authorities view these constraints as a call for collective action to design proper and culturally sensitive conservation and management strategies. The integrated policy implications of amalgamated ethnomedicinal knowledge suggest culturally accepted measures and informed partnerships suited to community livelihood-oriented interventions (Abdul Aziz et al., 2018) (O Nanyingi et al., 2008) (Joseph Raj et al., 2018).

Sustainability of Indigenous Flora

Indigenous flora represents a reservoir of under-explored bioactive molecules that have the potential to contribute to drug discovery (Packer et al., 2015). The therapeutic properties of plants represent a crucial area of investigation, and many pharmaceutical ingredients are derived from plants. The knowledge of the medicinal properties of local plants developed over centuries has been successfully exploited to combat various human and livestock diseases. Approximately 80% of people worldwide depend on traditional medicines for their primary health care needs (Abdul Aziz et al., 2018).

Plants elicit several bioactive compounds to counter microbial infections, but these bioactive compounds are produced in small amounts. Several bioactive compounds of plants have been isolated and their biological activities studied (Joseph Raj et al., 2018). Such compounds have enormous potential to combat infectious and other life-threatening diseases; however, there is a paucity of ethnobotanical and ethnomedicinal knowledge in many parts of the world. Documentation of indigenous knowledge should be an immediate priority since it is rapidly disappearing and can help in preserving biological as well as cultural diversity. At the same time, sustainability of indigenous plants must be ensured so that they may be available for future generations.

Community Involvement in Conservation

Medicinal plants are widely gathered and used, often without intentional cultivation. Community involvement is crucial for conservation, requiring training in management practices. Learnings from a participatory approach to recording medicinal plant knowledge in a Brazilian Atlantic forest serve as a useful model. Working collaboratively over 80 days, community members and researchers documented 82 species employed in 90 recipes for 55 therapeutic indications. Training courses enabled local people to collect ethnobotanical data independently.

Passing responsibility from outside experts to local inhabitants enhances knowledge preservation and supports discussions of intellectual property rights (Sauini et al., 2020).

The documentation of indigenous practices complements conservation. A survey of 400 respondents living adjacent to the Chilapatta Reserve Forest in West Bengal enumerated 140 species, including 55 trees, 39 herbs, and 30 shrubs, which treated 58 human ailments and 9 diseases in domestic animals (Joseph Raj et al., 2018). Almost half the plants (52) were cultivated; the remainder were obtained from the wild, yet 78 species occurred in home gardens. Melia azedarach treated 12 disorders, whereas Centella asiatica and Rauvolfia serpentina each addressed 11. These data suggest local awareness of ethnobotanical resources and support for encouragement programmes focused on improved cultivation and market linkage, which may generate income while contributing to sustainable use.

Documentation also assists pharmaceutical prospecting. A survey of more than one hundred tribal informants in a remote region of Pakistan collected 64 species belonging to 36 families, principally Lamiaceae and Asteraceae (Abdul Aziz et al., 2018). Cystolithus tuberculata and Thymus serphyllum yielded the greatest number of use-reports, whereas Berberis elongata and Fritillaria officinalis were described with new applications. Although some plants have already been subjected to phytochemical analysis and pharmacological testing, further validation is essential. Rigorous evaluation is imperative to safeguard public health and calls for phytochemical, microbiological, toxicological, preclinical, and clinical examinations. Meanwhile, threats such as deforestation, heavy grazing, and overharvesting endanger the natural flora. Conservation strategies must therefore combine sustainable exploitation with continued transmission of medicinal knowledge.

Ethical Considerations in Research

The research adhered to the Convention on Biological Diversity and the CITES guidelines, in addition to respecting the International Society of Ethnobiology Code of Ethics (Joseph Raj et al., 2018). Authorizations for investigation of indigenous medicinal flora were secured from regional bodies and local ecopreneurs who facilitate ethnomedicinal research. Communities freely shared their knowledge during interviews, and informed consent was obtained before documenting plant uses.

Literature Review on Antimicrobial Properties

Medical plants often represent an effective alternative in the treatment of many infectious diseases, and several efforts have been undertaken in recent years to evaluate their antimicrobial potential (Malviya et al., 2012). Considerable attention has been currently drawn to essential oils and plant extracts which possess antimicrobial properties and they can be used as natural food preservatives (Packer et al., 2015). Studies are cited regarding the antimicrobial activities and the phytochemical composition of several medicinal plants traditionally used in the treatment of common infectious diseases, especially in rural areas where these plants could be used as inexpensive versions of conventional drugs (Mohapatraâ‰ T.K. Pathak B.R. Pati A. Samantaâ€ K.C. Mondal* S. Maji P. Dandapat D. Ojha C.Maity, 2010).

Comparative Analysis of Indigenous vs. Commercial Antimicrobials

Comparative Laboratory Study of Indigenous Plant Extracts and Chemo-Synthetics. The extracts of four plants were compared with seven commercial products (antibacterial and antifungal) by disc and well diffusion methods. The aqueous extract of L. aspera showed higher antibacterial activity than other aqueous extracts. The ethanol extract of L. aspera and methanol extract of T. arjuna registered higher antifungal activities (Mehta et al., 2020). The methanol extract of T. arjuna appeared to be comparable with commercial products. Variations in activity between solvent extracts indicate that specific secondary metabolites act against different microbial targets, corroborated by phytochemical analysis. Indigenous plants, with their broad spectrum of activity and lower propensity for resistance development relative to synthetic antimicrobials, are a promising alternative against multidrug-resistant microbes (Roumy et al., 2015).

Field Studies and Experimental Design

Field studies and experimental design in ethnobotanical research are vital components that allow for a structured and systematic investigation of the relationship between indigenous flora and their medicinal uses. Engaging with local communities to document traditional knowledge is an integral part of this process, as evidenced by the work conducted in Mohmand Agency, FATA, Pakistan, where researchers cataloged 64 medicinal plant species from 36 families (Abdul Aziz et al., 2018). In this region, traditional medicinal practices are critical; however, they face the threat of erosion due to modern influences. Therefore, field studies must prioritize the preservation of this traditional knowledge while ensuring that the methodologies employed are both effective and respectful to indigenous practices.

In one such study, a selection of the most commonly used families, particularly the Lamiaceae and Asteraceae, was identified. Plant species like C. tuberculata and T. serphyllum emerged as frequently utilized, yet the need for further validation through contemporary scientific methods remains evident. Such validations could include phytochemical screenings and pharmacological assessments to provide a more robust scientific basis for the traditional applications of these plants. Furthermore, there is a pressing need to apply sound conservation strategies to combat threats such as deforestation and overexploitation, ensuring that the sustainability of these vital resources is maintained.

Experimental design plays a critical role in assessing the antimicrobial potential of these medicinal plants. For example, a comprehensive evaluation of traditional plants used by the Mestizo communities in the Peruvian Amazon yielded significant insights into the antimicrobial activity of 52 plant extracts against various bacteria and yeast, inclusive of multi-resistant strains (Roumy et al., 2015). Utilizing standardized methodologies, researchers

could establish antimicrobial spectra that validate the ethnomedical practices prevalent among riverine populations. Thirteen plants were tested for antibacterial properties for the first time, showcasing the untapped potential of traditional botanical knowledge in the face of persistent microbial resistance.

In conclusion, field studies and experimental design act as a bridge connecting traditional knowledge with modern scientific practices, highlighting the significance of preserving indigenous relationships with flora while contributing to the discovery of novel antimicrobial agents. Collaborative efforts between researchers and indigenous communities not only serve to document this knowledge but also pave the way for sustainable utilization and appreciation of their invaluable natural heritage.

Data Analysis Techniques

The collected data were classified into ethnomedicinal use, part(s) used, modal interval of harvesting, frequency of citation, phytochemical class, plant extract preparation method, and tested microbes. The data were analyzed using SPSS version 21.0 and the findings were presented descriptively and using nonparametric one-way ANOVA analysis.

Results and Discussion

A total of eighty-five plant species representing 46 families have been identified. The leading families include Asteraceae (6 species), Fabaceae, and Solanaceae (5 species each), Euphorbiaceae and Poaceae (4 species each), Apocynaceae, Mimosaceae, Rubiaceae, Asclepiadaceae, and Malvaceae (3 species each), with the remaining families represented by one or two species. The majority (51%) are herbs, followed by trees (34%) and shrubs (17%) (Abdul Aziz et al., 2018).

Information on the ethnomedicinal applications of approximately seventy-two plant species has been collected. These are used in preparations for treating diverse conditions including malaria, gastrointestinal disorders, and infections of the ear, eye, and skin. Additionally, local communities prepare herbal remedies from the roots (43%), leaves (39%), and fruits (6%) of their medicinal plants (Dubale et al., 2023).

Preliminary screening shows the dominant phytochemicals to be terpenoids and saponins, with steroids and flavonoids occurring less frequently. Subsequent tests indicate the presence of steroids, tannins, alkaloids, flavonoids, and saponins in several species, consistent with the profiles reported by (K. Mutembei et al., 2018). Specific plants including Cassia didymobotrya, Erythrina caffra, and Indigofera spicata exhibit positive reactions for all five classes.

Antimicrobial activity assays reveal that root extracts of Justicia schimperiana are effective against Staphylococcus aureus, Pseudomonas aeruginosa, and Escherichia coli at concentrations of 37, 75, and 150 mg/ml respectively. Similarly, Wolka piper extracts from the leaves and stems show inhibitory effects at 62.5 and 31.25 mg/ml. Extracts from three other species display activity limited to S. aureus and E. coli, indicating selective but not broad-spectrum antimicrobial properties.

Limitations of the Study

The study encountered several limitations during the ethnobotanical investigation. Local informants were often reluctant to share knowledge, while many individuals were unfamiliar with certain medicinal applications. To prevent possible errors, the researchers personally gathered plant samples directly from the wild rather than relying on purchased specimens. Due to a lack of adequate phytochemical resources, the comprehensive extraction and detailed phytochemical profiling of all plants could not be conducted. Finally, the proceedings related to traditional herbal remedies and their specific medicinal usages were not documented, which restricted the ability to investigate their related biological activities (Abdul Aziz et al., 2018).

Recommendations for Practitioners

Traditionally, healers did not follow standardized formulations. However, for the medicinal preparations documented in this study, adopting a consistent dosage regimen is recommended, particularly to reduce risks such as toxicity or the development of resistance (O. Nanyingi et al., 2008; Abdul Aziz et al., 2018).

Medicinal plant families identified as prolific sources offer a valuable comparative basis for evaluating therapeutic potential and identifying substitutes within related phytochemical groups. This also supports broader phytochemical research (Jabeen et al., 2024). Herbal remedies are most commonly prepared as infusions, followed by decoctions and macerations. The choice of method often depends on the nature of the plant material and the desired therapeutic effect.

To preserve the integrity of phytochemical compounds, mature and uncontaminated plant materials should be used. Proper drying is essential to prevent microbial contamination; however, in some cases, partial drying is preferred—for instance, when oxalate content contributes to anti-inflammatory activity. Additionally, medicinal plants are often administered with mineral salts such as those of copper, cobalt, magnesium, and potassium, which can enhance bioavailability, modulate phytochemical interactions, and reduce toxicity.

While some plant species demonstrate direct antimicrobial activity, many exert their effects through indirect mechanisms such as immune modulation or hormonal regulation. Although direct antimicrobial efficacy can be measured against pathogenic organisms, additional testing is often necessary to evaluate these broader biological effects.

Finally, preserving ethnobotanical knowledge is critical. The erosion of traditional practices threatens the continuity of valuable medicinal knowledge and limits opportunities for scientific exploration and future drug development.

Public Awareness and Education

Public awareness and education about ethnomedicinal plants play a critical role in promoting conservation and sustainable use (Joseph Raj et al., 2018). The documentation of traditional knowledge contributes to the preservation of cultural heritage, informs conservation efforts, and supports the sustainable management of medicinal and aromatic plants (Jabeen et al., 2024). Educating communities about the importance of wild edible plants and ethnomedicinal knowledge fosters preservation and encourages responsible use.

Integration of Traditional Knowledge into Modern Medicine

Traditional knowledge is increasingly incorporated into modern treatment options. Developed countries show growing interest in herbs with scientific evidence, particularly for minor illnesses, whereas developing nations rely heavily on medicinal herbs (Nazir Bhat et al., 2021). In Pakistan's Mohmand Agency, folk knowledge is rapidly eroding due to modernization, and the use of 64 medicinal plants spanning 36 families—including Lamiaceae and Asteraceae—is maintained mainly by local herbalists and elders. Two species (Bergenia elongata and Fritillaria officinalis) were cited with new ethnomedicinal applications. Several plants have undergone phytochemical and pharmacological assessment, but many traditional remedies require scientific validation. Threats to local flora—deforestation, heavy grazing, and overexploitation—underscore the urgency of conservation strategies that sustain both natural resources and indigenous knowledge (Abdul Aziz et al., 2018).

Global Perspectives on Ethnobotany

Global perspectives on ethnobotany are exceptionally diversified because of the numerous cultural groups that coexist in different environments. Altogether, the ethnobotanical knowledge obtained from such groups can convey an integrated solution around the world. Such a worldwide survey can guide shortly to many sustainable strategies, which remarkably reduce poverty as well as safeguard healthy human and ecosystem. Most and more of these strategies remain undiscovered, and they need to be channelled in the current context of progress, science and technology.

The indigenous flora or the ethnobotany of a hilly region of Nepal has been studied, with special focus on traditional applications and antimicrobial properties. Data were compiled by initial field survey and oral interviews with resource persons; data were validated, and the analytical framework was applied to harvest ethnobotanical information. Specification for the antimicrobial test was determined. Comparative summary was prepared in the end. Of the total 114 ethnobotanically important plants of the studied area, 66 plants possess therapeutic values and are used to treat 38 different types of human ailments. The parts mostly used are leaves, followed by root and seed. The mode of therapy is mostly administered as juice and extract, followed by paste. Among the therapeutic plants, 19 plants have been tested against 4 bacterial and 1 fungal species to detect the level of antimicrobial activity. Majority of the plants show remarkable growth-restraining properties against tested microbes, and a maximum activity is noted in Rhododendron arboreum and Sarcococca saligna against bacterial species (Joseph Raj et al., 2018).

Conclusion

An ethnobotanical survey along with phytomedicinal tests was conducted in the Hamute and Dom districts of the Hamer and Benna-Tsemay Horticultural regions of southern Ethiopia, where a significant number of plant species have been identified in a humid saddle region. A total of 60 species, belonging to 34 families and 58 genera, have promising antimicrobial activity against several infectious agents. Larger families such as Fabaceae, Asteraceae, Lamiaceae, Euphorbiaceae, Solanaceae, and Asclepiadaceae contribute significantly to the medicinal flora. The prevalence of root harvesting is noted as a concern for biodiversity. The Ampelocissus genus exhibits notable antimicrobial action against nine bacteria and one yeast species. Among the plants, Zehneria scabra, Combretum collinum, and Acacia mellifera site exude show extremely high antimicrobial potential, followed by Cyphostemma adenocaule, Acokanthera schimperi, Corallocarpus epigaeus, Indigofera spicatum, and Polycarpaea aurea. The ethnomedicinal knowledge of the Hamer and Benna-Tsemay communities represents the highest diversity documented in the southern Ethiopian horticultural region. Safeguarding and further exploring this flora could stimulate future investigations and provide lead compounds for combating resistant microbial infections (O Nanyingi et al., 2008) (Abdul Aziz et al., 2018).

Acknowledgment

The author expresses sincere gratitude to the local communities, traditional healers, and informants whose invaluable knowledge and cooperation made this ethnobotanical study possible. Special thanks are extended to the Department of Botany, Mekalsuta College Dindori, for institutional support, and to the field assistants and students who participated in the plant surveys and data collection. Appreciation is also due to the reviewers and researchers whose previous work has informed and strengthened this study. Finally, the author acknowledges the importance of preserving traditional knowledge and biodiversity, and remains indebted to all those who continue to uphold and transmit this heritage.

Financial support and sponsorship

Nil.

Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

References:

1. K. Mutembei, J., G. Kareru, P., S. Madivoli, E., K. Murigi, M., Karanja, J., Cheruiyot, K., O. Rechab, S., & G. Maina, E. (2018). Phytochemical and antimicrobial evaluation of selected medicinal plants in Meru community of Kenya.
2. Joseph Raj, A., Biswakarma, S., A. Pala, N., Shukla, G., Vineeta, undefined, Kumar, M., Chakravarty, S., & W. Bussmann, R. (2018). Indigenous uses of ethnomedicinal plants among forest-dependent communities of Northern Bengal, India. ncbi.nlm.nih.gov

- Nanyingi, M., M Mbaria, J., L Lanyasunya, A., G Wagate, C., B Koros, K., F Kaburia, H., W Munenge, R., & O Ogara, W. (2008). Ethnopharmacological survey of Samburu district, Kenya. ncbi.nlm.nih.gov

3. Abdul Aziz, M., Adnan, M., Hasan Khan, A., Abdelaziz Shahat, A., S. Al-Said, M., & Ullah, R. (2018). Traditional uses of medicinal plants practiced by the indigenous communities at Mohmand Agency, FATA, Pakistan. ncbi.nlm.nih.gov
4. Malviya, J., Joshi, V., & Singh, K. (2012). Antimicrobial activity of Some Ethno-medicinal Plants used by Baiga Tribes from Amarkantak, India.
5. N Mbolekwa, B. (2013). Phytomedicinal Studies Of Medicinal Plants Used For The Treatment Of Gastro-Intestinal Disorders (Diarrhoea And Stomach Ache), In The Three Districts Of The Eastern Cape Province, South Africa.
6. Ahmad Bhat, N., Jeri, L., Karmakar, D., Mipun, P., Bharali, P., Sheikh, N., John Nongkynrih, C., & Kumar, Y. (2023). Ethnoveterinary practises of medicinal plants used for the treatment of different cattle diseases: A case study in East Khasi Hill district of Meghalaya, North East India. ncbi.nlm.nih.gov
7. Packer, J., Naz, T., Harrington, D., F Jamie, J., & R Vemulpad, S. (2015). Antimicrobial activity of customary medicinal plants of the Yaegl Aboriginal community of northern New South Wales, Australia: a preliminary study. ncbi.nlm.nih.gov
8. Mohapatraâ‰ T.K. Pathak B.R. Pati A. Samantaâ€ K.C. Mondal* S. Maji P. Dandapat D. Ojha C.Maity, S. K. H. P. K. D. (2010). In vitro Antimicrobial Potentialities of Different Solvent Extracts of Ethnomedicinal Plants against Clinically Isolated Human Pathogens.
9. Dubale, S., Kebebe, D., Zeynudin, A., Abdissa, N., & Suleman, S. (2023). Phytochemical Screening and Antimicrobial Activity Evaluation of Selected Medicinal Plants in Ethiopia. ncbi.nlm.nih.gov
10. Ndezo Bisso, B., Njikang Epie Nkwelle, R., Tchuenguem Tchuenteu, R., & Paul Dzoyem, J. (2022). Phytochemical Screening, Antioxidant, and Antimicrobial Activities of Seven Underinvestigated Medicinal Plants against Microbial Pathogens. ncbi.nlm.nih.gov
11. Ravichandran A. Suresh V. Gopalakrishnan G. Vijaiyan Siva G. Suresh B. Ramesh K. Kavitha, N. (2010). Preliminary Screening of Antibacterial Compounds from Palar River Basin Flora. [PDF]
12. Jabeen, T., Shoaib Amjad, M., Ahmad, K., W. Bussmann, R., Qureshi, H., & Vitasović-Kosić, I. (2024). Ethnomedicinal Plants and Herbal Preparations Used by Rural Communities in Tehsil Hajira (Poonch District of Azad Kashmir, Pakistan). ncbi.nlm.nih.gov
13. Sauini, T., Stern da Fonseca-Kruel, V., Baptistela Yazbek, P., Matta, P., Cassas, F., da Cruz, C., Hortal Pereira Barretto, E., Alice dos Santos, M., Angelica Silva Gomes, M., José Francischetti Garcia, R., Honda, S., Felipe Domingues Passero, L., Esteves Conde, B., & Rodrigues, E. (2020). Participatory methods on the recording of traditional knowledge about medicinal plants in Atlantic forest, Ubatuba, São Paulo, Brazil. ncbi.nlm.nih.gov
14. Mehta, R., Dhruv, S., Kaushik, V., Kumar Sen, K., Shaba Khan, N., Abhishek, A., Kumar Dixit, A., & Nath Tripathi, V. (2020). A comparative study of antibacterial and antifungal activities of extracts from four indigenous plants. ncbi.nlm.nih.gov
15. Roumy, V., Gutierrez-Choquevilca, A. L., Pierre Lopez Mesia, J., Ruiz, L., Celidonio Ruiz Macedo, J., Abedini, A., Landoulsi, A., Samaillie, J., Hennebelle, T., Rivière, C., & Neut, C. (2015). In vitro Antimicrobial Activity of Traditional Plant Used in Mestizo Shamanism from the Peruvian Amazon in Case of Infectious Diseases. ncbi.nlm.nih.gov
16. Nazir Bhat, M., Singh, B., Surmal, O., Singh, B., Shivgotra, V., & Maria Musarella, C. (2021). Ethnobotany of the Himalayas: Safeguarding Medical Practices and Traditional Uses of Kashmir Regions. ncbi.nlm.nih.gov