



## **Bioprospecting of Underutilized Medicinal Plants for Pharmacological Applications**

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**DOI : <https://doi.org/10.5281/zenodo.17607614>**

### **ARTICLE DETAILS**

**Research Paper**

**Accepted:** 20-10-2025

**Published:** 10-11-2025

#### **Keywords:**

*Bioprospecting, underutilized medicinal plants, phytochemicals, pharmacological activities, drug discovery, conservation.*

### **ABSTRACT**

Medicinal plants have been the cornerstone of traditional healthcare systems for centuries. However, only a fraction of the global plant diversity has been explored for their therapeutic potential. Underutilized medicinal plants represent an untapped reservoir of novel bioactive compounds with promising pharmacological applications. Bioprospecting an integrated approach combining ethnobotanical knowledge, phytochemical screening, and modern pharmacological tools offers a strategic pathway to discover and develop new drugs. This review highlights the importance of bioprospecting underutilized medicinal plants, their phytochemical richness, pharmacological potential, and the need for sustainable utilization and conservation strategies. Sustainable bioprospecting strategies, involving community participation, conservation of genetic resources, and equitable benefit-sharing, are essential to ensure the long-term availability and ethical utilization of these plant resources. By bridging traditional knowledge and modern science, the exploration of underutilized medicinal plants can lead to the development of new drugs, contribute to biodiversity conservation, and promote socio-economic growth in rural and tribal communities. Thus, the review



emphasizes that systematic research, validation, and conservation of these valuable yet overlooked plant species are vital for future pharmacological innovation and global health sustainability.

## INTRODUCTION

Medicinal plants have played a vital role in maintaining human health since ancient times. Globally, approximately 80% of the population depends on plant-based medicines for primary healthcare needs (WHO, 2020). Despite this dependence, a large number of medicinal plants remain underexplored, especially in biodiverse regions such as the Western Ghats, Himalayas, and tropical forests of Africa and South America.

Underutilized medicinal plants are species with known or suspected medicinal value but limited scientific validation or commercial use. Bioprospecting defined as the systematic search for bioactive compounds from natural sources offers opportunities to identify new lead molecules for pharmaceutical development. The present review focuses on the pharmacological potential of these underutilized plants, emphasizing recent advances in phytochemical and pharmacological research.

### Concept of Bioprospecting

Bioprospecting involves identifying and utilizing biological resources for their valuable compounds, genes, or derivatives. The process encompasses:

- **Ethnobotanical documentation** – Gathering traditional knowledge from indigenous communities.
- **Phytochemical screening** – Isolation and identification of secondary metabolites.
- **Pharmacological evaluation** – Assessing biological activities using in vitro and in vivo models.
- **Biotechnological tools** – Application of omics technologies for compound discovery.

Bioprospecting bridges traditional wisdom and modern science, ensuring that new drug leads are identified efficiently and ethically.

### Underutilized Medicinal plants: hidden potential

Many plants with ethnomedicinal importance are poorly studied or neglected due to limited awareness, lack of commercialization, or insufficient research funding. Examples include:

Plant species	Family	Traditional use	Reported phytochemicals
<i>Clerodendrum inerme</i>	Lamiaceae	Anti-inflammatory, antidiabetic	Flavonoids, terpenoids
<i>Leucas aspera</i>	Lamiaceae	Antimicrobial, wound healing	Alkaloids, phenolics
<i>Cissampelos pareira</i>	Menispermaceae	Antipyretic, antimalarial	Isoquinoline alkaloids
<i>Aerva lanata</i>	Amaranthaceae	Diuretic, hepatoprotective	Saponins, tannins
<i>Hemidesmus indicus</i>	Apocynaceae	Antioxidant, immunomodulatory	Steroids, coumarins

These plants represent a largely unexplored resource for novel pharmacologically active molecules.

### Phytochemical composition

Underutilized medicinal plants are rich in secondary metabolites such as alkaloids, flavonoids, tannins, terpenoids, glycosides, and phenolic acids.

- **Alkaloids** exhibit analgesic and antimalarial effects (*Cissampelos pareira*, *Tinospora cordifolia*).
- **Flavonoids** possess antioxidant, anti-inflammatory, and anticancer properties (*Leucas aspera*, *Ocimum gratissimum*).
- **Saponins and terpenoids** show antimicrobial and cytotoxic activities (*Aerva lanata*, *Clerodendrum inerme*).

Advanced chromatographic and spectroscopic techniques (HPLC, LC-MS, NMR) have accelerated the identification of these bioactive compounds.

### Pharmacological applications

Research on underutilized medicinal plants has demonstrated promising pharmacological activities, including:

#### Antimicrobial activity

Plant extracts of *Leucas aspera*, *Clerodendrum inerme*, and *Aerva lanata* exhibit broad-spectrum activity against bacteria such as *E. coli*, *S. aureus*, and *P. aeruginosa*. Secondary metabolites like flavonoids and alkaloids disrupt microbial cell walls and inhibit enzyme systems.



### **Antioxidant activity**

Underutilized plants are abundant in phenolic and flavonoid compounds that neutralize free radicals. *Hemidesmus indicus* and *Aerva lanata* have shown strong DPPH radical scavenging activity.

### **Anti-inflammatory and analgesic activity**

Methanolic extracts of *Clerodendrum inerme* and *Cissampelos pareira* reduce inflammation by inhibiting cyclooxygenase (COX) and lipoxygenase (LOX) pathways.

### **Anticancer and cytotoxic potential**

Phytochemicals from *Tinospora sinensis* and *Leucas aspera* demonstrate cytotoxic effects on cancer cell lines by inducing apoptosis and cell cycle arrest.

### **Antidiabetic and hepatoprotective effects**

Many underutilized plants exhibit enzyme inhibitory activities ( $\alpha$ -amylase and  $\alpha$ -glucosidase), lowering blood glucose levels. Extracts of *Aerva lanata* and *Hemidesmus indicus* have shown hepatoprotective effects against chemical-induced liver injury.

### **Challenges in bioprospecting**

Despite promising findings, several challenges hinder the sustainable utilization of underutilized medicinal plants:

- Inadequate documentation of traditional knowledge.
- Overharvesting leading to depletion of natural populations.
- Lack of standardization in extraction and testing methods.
- Ethical concerns and issues of benefit-sharing under the Convention on Biological Diversity (CBD) and Nagoya Protocol.

Addressing these challenges requires an interdisciplinary approach integrating ethnobotany, pharmacognosy, molecular biology, and conservation science.

### **Future prospects**

Modern biotechnological tools such as metabolomics, genome mining, and synthetic biology can revolutionize bioprospecting. Collaborative research between traditional healers and scientific institutions



can facilitate the discovery of new lead compounds. Additionally, sustainable harvesting and cultivation of underutilized medicinal plants should be promoted through community-based conservation programs.

## SUMMARY

The review on “*Bioprospecting of Underutilized Medicinal Plants for Pharmacological Applications*” highlights the immense potential of lesser known and neglected plant species as valuable sources of novel bioactive compounds. Despite their traditional use in indigenous healthcare systems, many underutilized medicinal plants remain scientifically unexplored. Bioprospecting efforts focus on identifying phytochemicals such as alkaloids, flavonoids, terpenoids, phenolics, and glycosides, which exhibit significant pharmacological activities including antimicrobial, antioxidant, anti-inflammatory, anticancer, and antidiabetic properties.

The paper emphasizes the importance of integrating ethnobotanical knowledge with modern pharmacological screening and biotechnological approaches to discover new lead compounds for drug development. It also underscores the need for sustainable utilization and conservation of these plant resources to prevent biodiversity loss. Advances in analytical chemistry, metabolomics, and molecular biology have further enhanced the ability to isolate, characterize, and validate bioactive constituents from these plants.

## CONCLUSION

Underutilized medicinal plants represent a rich but overlooked source of bioactive compounds with immense pharmacological potential. Systematic bioprospecting, supported by modern analytical and biotechnological methods, can lead to the discovery of novel therapeutic agents. Ethical utilization and conservation of these resources are crucial for ensuring their long-term availability and contribution to global healthcare and drug discovery.

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