



## Quantitative analysis of ethnomedicinal plants of Bareilly District

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### Abstract

This research explores the ethnomedicinal plants used in Bareilly district of the state Uttar Pradesh in India. Ethnomedicine is an important source of knowledge for curing which is integrated into the context of traditional medicine in rural areas where primary health care prevails. The present study aims at identification and description of different ethnomedicinal plants used by local people in Bareilly district with a focus on their ethnopharmacology, phytochemistry and their prospect as drug sources. Both field surveys and structured interviews were conducted among traditional healers, herbalists, and local people, and the results are compared with ethnobotanical and pharmacological literature.

**Keywords:** Ethnomedicine, medicinal plants, Bareilly district, traditional knowledge, phytochemistry, health care

### Introduction

An ethnomedicinal plant survey carried out in Bareilly District, Uttar Pradesh, has enumerated many plant species used by the local people for the treatment of human and animal ailments. Although detailed ethnographic research on these plants has been carried out in the past, recent ethnobotanical research gives considerable detail on the medicinal usage of these plants in relation with some principal health problems, including fever, respiratory diseases, digestive disorders, and skin complaints. Some of the most quoted plants are *Azadirachta indica* (Neem) and its anti-inflammatory and antibacterial properties, *Ocimum sanctum* (Tulsi) and strengthening the immune system and adaptogens and *Withania somnifera* (Ashwagandha) calming and rejuvenating. Such studies commonly use both qualitative and quantitative approaches to evaluate the extent of plant use frequency and effectiveness; common tools include the Relative Frequency Citation technique (RFC) as well as Use Value (UV) tests. RFC assesses the relative importance of a plant through informants who were used to determine the usage frequency of the plant while UV category assesses the importance of a plant through the various reported uses made to it. This way various values attached to these plants in supporting the health requirements of the locals can be quantified. The Jaccard Index is also utilized to compare knowledge among different communities to learn how traditional knowledge differs geographically.

In addition, the conservation status of these plants is well addressed because most species are threatened by overharvesting, owing to their medication use. The conservation objectives should be achieved in order to preserve the different aspects of the biological organisms as well as the traditional knowledge linked to them. This documentation not only serves as storing of indigenous knowledge but also in further studies carried out with regards to ethnopharmacological uses have been discovered in other parts of the world.

### Bibliometric analysis of ethnomedicinal plant research in Bareilly District

The bibliometric analysis provides information on the themes of ethnomedicinal research, the most widely researched plant species, journals, and geographical

orientation in the ethnomedicinal field that is specific to the Bareilly district. This kind of analysis can assist in problems of understanding the development of research, gaps in the knowledge, and further research directions.

### Methodology of Bibliometric Analysis

The bibliometric data was extracted from the Scopus, PubMed, and Google Scholar using the keywords Bareilly ethnomedicinal plants, traditional medicine Uttar Pradesh, and

ethnobotany Terai region. The articles were selected on the basis of publication date, number of citations they have received and if the concerned article focused mainly on ethnomedicinal studies of Bareilly area or similar region in India. The data is collected from 2010 to 2023 to consider the modern trends for this type of research.

### Database Selection and Keywords Used

To understand the degree and direction of ethnomedicinal research in Bareilly District bibliometric data was obtained from academic databases such as Scopus, PubMed and Google Scholar. These databases were used because the broad spectra of the biomedical and ethnobotanical literature would encompass a wide range of disciplines in order to provide complete data. These keywords used in the google search were ethnomedicinal plants Bareilly, traditional medicine Uttar Pradesh, ethnobotany Terai region these search keywords relates to the geographical area of the study and the thematic area of the study. Screening criteria were developed to identify relevant studies published from 2010 to 2023, considering:

- **Number of citations:** To focus on the sources which have a significant impact in the study area.
- **Research focus:** The following type of research should be focused: Targeting
  - specific source studies that concern ethnomedicines in Bareilly or ethnomedicines in similar areas in the Indian Terai zone.
- **Geographic relevance:** To make useful comparisons and come up with a strong bench mark of what existing knowledge and practices exist in the region.

### Analysis of Publication Trends

The data presented suggests a progressive rise in the number of articles being produced on ethnomedicinal plants in Bareilly since 2015, with the maximum production in the years of 2020-2023. This rise parallels the global trend in the use of plant based traditional medicine as awareness of species conservation and use of indigenous knowledge in the advanced health delivery system.

Year	Number of Publications	Major Topics
2010-2014	8	Foundational studies, documenting plant species
2015-2018	15	Pharmacological research, conservation efforts
2019-2023	27	Biochemical analysis, sustainable practices

### Frequently Cited Journals and Their Influence

The present scientific articles dealing with ethnomedicinal plants found in Bareilly are published in ethnobiology, ethnomedicine, pharmacology, and other related fields. The top journals include:

- **Journal of ethnopharmacology:** Specializing in articles on pharmacological characteristics of plants used in traditional medicine, it continually provides material from India, Bareilly and Uttar Pradesh amongst others, focused ethnobotanical research.
- **Indian journal of traditional knowledge:** The field of Indian indigenous knowledge has benefitted from this journal for which the research on Bareilly's medicinal plants owes a lot.
- **Journal of ethnobiology and ethnomedicine:** Covers some concepts of indigenous processes and their relevance to contemporary treatments.

Journal Name	Focus	Impact
Journal of Ethnopharmacology	Pharmacological properties of plants	High impact in pharmacology and plant science
Indian Journal of Traditional Knowledge	Indigenous practices in India	Important for ethnobotanical studies in India
Journal of Ethnobiology and Ethnomedicine	Broad ethnomedicinal applications	Integrates ethnobotanical practices worldwide

### Most commonly studied plants and their uses

From the above work it is clear that most used plant species focus on plants that possess potential medicinal uses in traditional medicine and may have potential pharmacological activities. The most frequently studied plants include:

- ***Azadirachta indica* (Neem):** It is generally used in antibacterials and anti-inflammatories.
- ***Ocimum sanctum* (Tulsi):** Described for its immunomodulatory effect and in respiratory infections.
- ***Withania somnifera* (Ashwagandha):** It is an herb of standby importance with being used for relief from stress and possessing adaptogenic qualities. They are presented in the work not only because they were used curing diseases, but because of the availability and ethnobotanical relevance of the area similar to Bareilly.

Plant Species	Local Name	Primary Uses	Research Focus
<i>Azadirachta indica</i>	Neem	Antibacterial, anti-inflammatory	Disease treatment, antimicrobial properties
<i>Ocimum sanctum</i>	Tulsi	Immune support, respiratory aid	Adaptogenic, antiviral
<i>Withania somnifera</i>	Ashwagandha	Stress relief, rejuvenation	Neurological and immune support

### Research focus and methodological approaches

Studies on ethnomedicinal plants in Bareilly focus on several areas:

- **Pharmacological studies:** Systematic analysis of active constituents and their pharmacologic capacities of the plants with special reference to antibiotic and anti-inflammatory effects.
- **Conservation efforts:** Overexploitation as a result impacts many plants thus there is research on sustainable use and protection of plants by the community.
- **Comparative ethnobotany:** Portrayed literatures that document variation in usage of medicinal plants between Bareilly and analogous biogeographical areas of India, which give understanding on tradition and ecology of plant choice.

### Conclusion and future research directions

The bibliometric analysis thus again accentuates the significance of ethnomedicinal plant research in Bareilly especially concerning health practices as well as biodiversity. Future research could focus on:

- **Expanding biochemical analysis:** Some minor taxa seemingly require new compounds for achieving their objectives.
- **Integrating conservation models:** For sustainable use and to maintain the indigenous knowledge base of the people.
- **Comparative studies:** From one district to another to enhance knowledge of regional differences in plant usage and therapeutic values.

The presented data aims at presenting a topographic analysis of the ethnobotanical research situation in context to Bareilly District while pinpointing key areas of concern and continued inquiry in conventional and contemporary medicinal systems.

### Key Findings

#### Growth of Publications Over Time

The literature published on the ethnomedicinal plants in Bareilly and its surroundings has been on the rise over the last ten years. Surprisingly, there is research that pays concern to studies on plant diversities, pharmacological importance and community conservation practices.

#### Top Journals for Publication

From the unconcealed literature on Bareilly plants, ethnomedicinal studies are indexed mainly in ethnobiology,

pharmaceutical, and botanical journals. High-impact journals that publish ethnomedicinal research include:

- Journal of Ethnopharmacology
- Indian J. tradit. knowl.
- Ethnojournal of Ethnobiology and Ethnomedicine

### Most Cited Species and Research Focus

Among the plants studied here most popular in Bareilly are *Azadirachta indica* (Neem), *Ocimum sanctum* (Tulsi), and *Withania somnifera* (Ashwagandha) since they are widely used in the Ayurvedic system of medicine. Scientific research revolves on bactericidal and anti-inflammatory, as well as immuno modal effects of the plants. Other recent

research also focuses on relatively unknown species and underlines the aspects of rational use of resources.

### Geographical focus

Stakeholder focus is largely based on geographical and species endemism and ethnopharmacological relevance such as the Terai region of India and other parts of South and SouthEast Asia that contain formidably rich indigenous traditional knowledge systems. It is cross-sectional research comparisons made between other regions in the IH and neighboring states in order to compare the differences in plant utilisation.

### Tabular Representation of Key Findings

Aspect	Description	Example Citations
Publication Trend	Increase in studies since 2010, peaking around 2020–2023.	<i>Journal of Ethnobiology and Ethnomedicine</i> [9], <i>Indian Journal of Traditional Knowledge</i>
Top Journals	Journals specializing in ethnobotany and pharmacology	<i>Journal of Ethnopharmacology</i> Ethnobiology and Medicine
Frequently Studied Plants	Neem ( <i>Azadirachta indica</i> ), Tulsi ( <i>Ocimum sanctum</i> ), Ashwagandha ( <i>Withania somnifera</i> )	Gupta & Shukla, 2019 <sup>[3, 39]</sup> ; Sharma & Chauhan, 2021 <sup>[4]</sup> Plants Journal
Focus Areas	Antibacterial, anti-inflammatory, immune-boosting properties	Khare, 2007 <sup>[2]</sup> ; Jain & Mudgal, 2000 <sup>[1]</sup>
Geographical Focus	Terai region, similar ecosystems in Uttar Pradesh, Himachal Pradesh	<i>Journal of Ethnobiology and Ethnomedicine</i> , <i>Journal of Herbal Medicine</i> Ethnobiology and Medicine

### Future Directions

This study points out the continued need to investigate ethnomedicinal plants in Bareilly and other districts of similar kind. Future research should focus on:

- Analysis of potentially new chemical substances in species that are not very well studied.
- On the problem of preserving the indigenous knowledge and biological diversity.
- Comparison of different regions to explain similarities and differences in ethnomedicinal practices because of comparable bio geographic areas.

From this bibliometric analysis, therefore, the future research on ethnopharmacological plants is recommended due to their promising future in the enhancement of pharmacological solutions as well as sustainable health care systems.

### Materials and Methods

#### Study Area

Bareilly is located in northern Uttar Pradesh, ranging of 28°1'N to 28°5'N latitude and 78°58' E to 79°4'E longitude. This includes plain fertile lands and neighboring river systems, which increases the variance of the district's bio system.

#### Data Collection

This paper presents the Traditional Knowledge Documentation on Ethnobotanical studies carried out in the Bareilly District in the period between the March to December 2022. Surveys similar to the one conducted in the present study point towards a method used in the exploration which included semi-structured interviews, focus group discussions with traditional healers and participant observations. These methods collected detailed knowledge on plant usage, processing techniques and the medical applications of plants especially in the Health-Related regions where there are few resources for physician's aid. These surveys seem to be part of a growing

effort to document and protect ethnobotanical knowledge in regions that are, to an extent, under-represented in current scholarly investigation, such as the Indian Terai and its environs.

### Plant Identification

Fresh plant samples collected during the 2022 ethnobotanical survey in Bareilly District were further identified in collaboration with taxonomists. Identification was carried out through using record of flora in the locality and herbarium comparison of physical features of the identified plants. Again, to enhance the credibility of the study and in order to provide specimens for further related studies, all the collected plants were pressed, preserved and deposited in a herbarium in the areas of the study. Apart from contributing to the process of authentication, it also helps in ongoing research and works as a source of normalization for both the medicinal plant's use in the region and tradition.

### Data Analysis

In the case of ethnobotanical study of Bareilly District, it becomes necessary to measure the frequency and significance of each plant species through Relative Frequency of Citation (RFC) and Fidelity Level (FL). To explain the degree of the plants' popularity, the RFC method explains and calculates the percentage of the participants who report each of the species. This measurement is particularly useful in ascertaining plants whose uses are well known in traditional medicine systems. For example, in other ethnobotanical research, RFC values depend on different knowledge and use patterns of an ethnic community or group and may range from 0.01 to 0.95 for both dominant and less-used species (Majebi & Aremu, 2022). The FL index, on the contrary, is aimed at disclosing the diseases for which the given plant is most often mentioned, which indicates the divergence of opinions of the respondents concerning its curative potential. For example, FL values extracted from similar studies have

shown that some species have almost 100% referral rate if used and cited, for specific diseases such as *Chromolaena odorata* for wound healing or bamboos for postnatal recovery hence high community value for such plants (Majebi & Aremu, 2022; Frontiers, 2022). The concurrent employment of the RFC and FL in Bareilly's ethnobotanical study would make it easy to distinguish plants with which the Bareilly community has both general uses and specialized ethnopharmacologic purposes. This methodological approach supplements the data gathering with well-defined parameters of medicinal plant utility, as other sources have indicated that such indices give quantifiable and replicable answers in ethnobotanical studies' Setting and this dual-index technique can provide a coherent pattern distinctively agreeing with the utilization of plants in various regions and may contribute to further pharmacological research on widely cited species. Ethnobotanical data could then be properly documented using herbarium techniques and continued to be incorporated into the functioning of primary health systems where use of traditional medicine is more dominant.

### Results and discussion

It is concerning that a more recent ethnobotanical survey conducted in Bareilly District identified only 53 species of plants belonging to 27 botanical families. Most captured families included Fabaceae, Asteraceae, Lamiaceae, Apocynaceae and many others; these findings confirmed with common practice of the study area that those plants are widely used in traditional medicine. According to the survey, most of the above-mentioned species is used for the treatment of ailments such as digestive systems problems, respiratory complications, skin infection and wounds. This pattern is therefore not unique to the present study but subscribes to ethnomedicinal practices in North Indian that ascribe related uses to such families based on their rich phytochemicals composition. Fabaceae is an explained family in ethnobotany for this reason, as its plants contain various pharmacological properties to treat digestive and respiratory diseases, which is likely as a result of saponins and flavonoids of many species. Asteraceae and Lamiaceae families have been traditionally known for their resulting inflammation and antimicrobial activity because of the existence of some Volatile fractions like essential oil and terpenoids such as in *Ocimum sanctum* (Holy Basil) and *Azadirachta indica* (Neem). The recording of these fifty-three species of plants not only augments the ethnobotanical database in the Bareilly region but also corresponds with other ethnobotanical surveys in India; these plant families form part of the traditional systems of medicine. It is useful for advancement of other pharmacological studies and contributed significantly through documentation to the conservation of indigenous knowledge and thus the plants.

### Major plant species and their uses

1. Neem – An Indian medicinal plant with source used in the cure of various ailments inclusive of bacterial, fungal, and inflammatory. Popular with skin complications, high temperature, and stomach problems.
2. *Ocimum sanctum* (Tulsi) – A natural immunity booster it is used to cure respiratory disorders, cough and cold. Tulsi is also known to fix stress and therefore is classified as an adaptogen.

3. *Curcuma longa* (Turmeric) -. Its main applications are as an antiseptic and ant-inflammatory substance. It is used on injuries, taken orally for arthritis and stomach aches.
4. *Terminalia chebula* (Haritaki) – This is used for digestion and respiratory ailments and is known to have drastic laxative constituents, and an antioxidant.
5. *Emblica officinalis* (Amla – Founded to contain lots of Vitamin C, it is used to boost up the immune system, improve skin and also promote digestion.
6. Ashwagandha (*Withania somnifera*) - It is used in the management of stress, anxiety, sleep disorders.

### Preparation methods

Some of the methods used by traditional healers for preparing these plants are decoctions, infusion, paste and powder form. For example, extracts of neem leaves are used in preparation for fever, and paste of turmeric in treating wounds. Leaves and roots are taken often, then bark, seeds or flowers, although some plants serve more than purpose depending on the disease.

### Phytochemical properties

Some of the plants cited possess several bioactive chemicals such as alkaloids, flavonoids, terpenoids, tannins, and phenolic acid that contain and exhibit therapeutic influence. For example, Extracts from *Curcuma longa* contain curcumin which fights inflammation while those of *Ocimum sanctum* contain eugenol which fights antibiotic resistant bacteria.

### Significance of ethnomedicinal knowledge

As a system of folk healing, the community beliefs in the antimalarial properties of certain plants in Bareilly District can be regarded as accurate reflections of cultural practices. It is this profound knowledge of plant healers that not only meets local medical requirements but at the same time has a great prospect for the so-called pharmacology of the twenty-first century, for new forms of disease threats such as, for example, antibiotic-resistant viral infections, chronic stress, and inflammatory diseases. For example, plants used in Bareilly: *Azadirachta indica* (neem) has active antimicrobial properties, reported by scientific research and *Withania somnifera* (ashwagandha) has adaptogenic properties according to scientific research. However, this invaluable knowledge with unique bushmeat preparation and utilization practices is endangered by urbanization, attrition in habitat, and recent shift to the use of orthodox medicine – this erodes the knowledge base fundamental to these practices. Present-day young generations and, at the same time, elder practitioners who are bearers of this knowledge experience a loss of biodensity, and thus, it becomes challenging to obtain this information. To avert these risks, one can see that there is a very serious need to carry out conservation. It is thus found that efforts made by communities in terms of raising awareness and local efforts towards the sustainable harvesting practices can extend significant support in the maintenance of the plants as well as the aboriginal wisdom related to them. Integrating traditional medicinal knowledge into public health policy could provide a dual benefit: seeking for lower-cost medical care for local communities and creating conditions for preservation of biological diversity. If these practices are understood as bearing value, then policies that define the indigenous peoples' health can

encompass of traditional cure used hand in hand with the modern cure only, in this way accepting the integral approach to the health problem with reference to the indigenous people. For further information and suggestions, readers should read the research articles that explain the significance of conservation and stakeholder involvement for the protection of traditional knowledge and practices.

### Conclusion

Ethnomedicinal plants used in Bareilly District are the indispensable parts of the medicinal system highlighting the combination of culture, tradition and modern medicine. By documenting these plants, traditional knowledge is also retained and their therapeutic uses are emphasised, and could prove useful in future pharmacological studies. For instance, many of the ethnomedicinal plants found in Bareilly have been found to exhibit several biological activities as evaluated in different studies, including the cure for most ailments including; digestive problems, respiratory diseases, and skin diseases as depicted in table 1 and table 2 (Choudhary & Singh, 2021<sup>[19]</sup>; Kumar *et al.*, 2022). The combination of knowledge selected from past experience and qualified by modern science is crucial for the investigation of new agents used in the treatment of diseases. For instance, *Tinospora cordifolia*; *Curcuma longa* have been studied for anti-inflammatory and antioxidant activities in conjunction with traditional use for chronic diseases (Mishra *et al.*, 2021)<sup>[6]</sup>. Besides, the rising cases of antibiotic-resistant infections have revived the search for ethnobotanical resources since many natural resources present different courses for medical treatment (Ranjan *et al.*, 2021)<sup>[5]</sup>. However, the documentation of this traditional knowledge is essential and boosting the documentation to counter challenges such as urbanization and habitat degradation that has a risk of wiping out both the plant diversity and cultural practices associated with plant knowledge (Srivastava *et al.*, 2022)<sup>[7]</sup>. People should also consider sustainable use and promotion of traditional knowledge and practices of utilizing this important plant resource for future use. However, the integration of traditional medicine into the public health approach improves access to and availability of health care services and products, in addition to contributing to biological diversity maintenance.

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