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# MEDICINAL HERBS OF GARO HILLS, MEGHALAYA: A COMPREHENSIVE OVERVIEW

**Waikhom Arunkumar Meetei* and Techi Yajo Tara**
Department of Rural Development and Agricultural Production, North Eastern Hill University, Tura Campus, Meghalaya, 795002, India
*Corresponding author E-mail: arunkumarw19@gmail.com
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**ABSTRACT**

Traditional medicine has been the backbone of the healthcare system of different communities of Garo Hills of Meghalaya. The abundance of medicinal herbs and priceless knowledge of traditional healers keep the flame burning. Due to exploration and scientific research in ethnobotanical fields, medicinal herbs and their association with healing techniques are documented and disclosed to the world. The traditional healers leverage different plant parts from a diverse array of herb species belonging to multiple plant families, inhabited in different environmental settings. However, the prospect is much larger and further measures in terms of conservation, cultivation, processing, marketing and other research aspects such as phytochemical analysis, clinical trials, genetic studies and tissue culture are necessary to tap the full potential. This study aims to contribute to the research domains and other stakeholders with a vivid understanding of the importance, diversity, applications, conservation and future scopes of medicinal herbs in the Garo Hills of Meghalaya.
***Keywords*:** Conservation, ethnobotany, Garo Hills, medicinal herbs, Meghalaya, traditional medicine.

## Introduction

The healthcare system of India has been deeply intertwined with traditional medicine since time immemorial. This is evidenced by the presence of age-old scripts, ayurvedic systems, and generational traditional medicinal practices that have been preserved and passed down in different parts of the country. Traditional medicine has played an important role in India's healthcare system, providing patients with an alternative approach to healing that is based on natural remedies and holistic treatments. The practice of traditional medicine has been widely accepted among the Indian population, and it continues to be an integral part of the country's healthcare system. In India, an estimated 80% of the population relies on herbal therapy (Hiren, Manisha, & Sheju, 2013).

The Garo Hills, located in the western part of Meghalaya, consists of five districts of Meghalaya viz. North Garo Hills, East Garo Hills, South Garo Hills, West Garo Hills, and South West Garo Hills. It is inhabited predominantly by Garos, followed by other tribes such as Koch, Hajong, Rabha etc. The overall climatic condition is characterized by tropical and subtropical climates. Garo Hills are renowned for their rich biodiversity, graced by the presence of two national parks (Nokrek National Park and Balpakram National Park), two sanctuaries (Siju Wildlife Sanctuary and Baghmara Pitcher Plant Sanctuary) along with Nokrek Biosphere Reserve and Elephant Reserve. Among the treasures hidden within this lush landscape are a plethora of medicinal herbs. The wealthy vegetation has been the backbone of traditional medicine and the healthcare of society. Ethnomedical studies through exploration and documentation in Garo Hills have been carried out by many authors (Rao, 1981; Sharma, Sharma, & Marak 2014; Singh, Mathew, & Mohan, 2016; Singh, Borthakur, & Phukan 2014; Marak & Lalnundanga, 2017; Sangma & Sahoo, 2017; Momin, Suresh, Momin, Singh, & Singh, 2016; Majumdar, Shyam, Chowdhury, Koch, & Roy, 2019; Marak & Mathew,

2020; Marak & Mathew, 2021; Marak & Mathew, 2022). As society shifts towards modern remedies and healthcare, the knowledge and potential of these medicinal plants are at stake. Moreover, the natural flora and traditional knowledge of medicinal plants in Garo Hills are rapidly declining due to various human activities, such as deforestation, shifting cultivation, urbanization, agriculture and lack of awareness about their importance (Marak & Mathew, 2021). This article explores the unique medicinal herbs of the region associated with traditional medicinal systems, as well as its future prospects and directions.

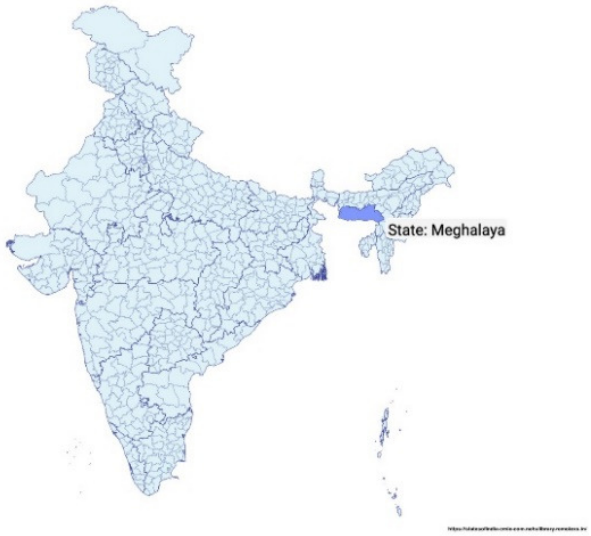


**Fig. 1 :** Map of India


**Fig. 2 :** Map of Meghalaya

## Traditional Medicinal System

According to WHO, Traditional Medicine is "*the sum of the knowledge, skills and practices based on the theories, beliefs and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health and the prevention, diagnosis, improvement or treatment of physical and mental illness*". India is famous for its traditional systems of medicine. Ayurveda, Siddha, Unani, Yoga, Naturopathy and Homeopathy are the well-recognised and renowned Indian systems of medicine. They are built and backed by strong foundations of philosophy and principles of treatment. Apart from these systems, there are a large number of healers following traditional medicine in different parts of the country.

The traditional medicinal system in the Garo Hills is deeply rooted in the cultural practices of the indigenous communities. The ethno-medicine of the Garos, practised by traditional healers known as Ojhas. Ojhas, often revered as custodians of ancient knowledge, play a pivotal role in using medicinal herbs to treat various ailments. The system is holistic, incorporating not only the physical aspects of health but also considering the spiritual and emotional well-being of individuals. The knowledge is usually passed down through generations orally, emphasizing the importance of preserving and documenting this traditional wisdom.

The reliance on herbal remedies indicates a strong belief in the healing properties of flora. The knowledge and practices associated with ethno-medicine have evolved through trial and error, with traditional healers accumulating valuable experience in treating a wide range of diseases. This accumulated wisdom is often based on a close observation of the local flora and its effects on health. The medicinal plants used in traditional ethno-medicine can be found at different altitudes and in various types of vegetation, indicating a rich biodiversity that contributes to the effectiveness of the treatments. The locals, guided by the Ojhas and traditional healers, utilize these plants to create herbal medicines that are believed to be particularly helpful in addressing multiple diseases and health issues.

The Ojhas, in addition to being traditional healers, also serve as priests and religious specialists in Garo society. They perform sacred rituals for the well-being of the Garo people on various occasions. This dual role highlights the intertwined nature of spirituality and healing within the Garo community, where ethnomedicine is not just a physical remedy but also a holistic approach that encompasses both the physical and spiritual dimensions of well-being. (Bain & Biswas, 2021). The strong reliance on ethnomedicine and the role of traditional healers in society underscore the importance of preserving and respecting traditional knowledge systems. These practices not only contribute to the health of the community but also reflect a deep cultural and ecological understanding that has sustained the indigenous people for generations.

## Herb and its Significance

Herb has its origin from the Latin word *herba,* meaning green plant. Emperor Charlemagne defined herb as "Friend of physician and pride of cooks" (Jones, 1996). Botanically, herbs or herbaceous plants can be defined as those plants whose stems do not become woody or persistent. Most herbaceous plants have flexible green stems, and during winter, many of them die back but persist with underground food-storage organs such as fleshy roots, rhizomes, bulbs, or corms. The flowering herbaceous plants (angiosperms) include almost all annual and biennial plants and a large number of perennial plants. Non-flowering herbaceous plants are limited to ferns and lycophytes, while all gymnosperms are woody plants. (Petruzzello, 2023)

In the ethnomedicinal field of study, medicinal herbs may encompass shrubs, trees and other plant forms that possess medicinal importance. However, in this review focus has been given particularly to the botanical herbs with medicinal potential to accentuate their significance, diversity and challenges in the region.

Herbaceous plants play diverse ecological roles across various habitats worldwide, from grasslands to aquatic settings, supporting biodiversity and serving as critical habitats even in forested landscapes. Essential for sustaining herbivores and facilitating nutrient cycling due to their shorter life cycles compared to woody plants, they constitute a significant portion of the world's food crops, including cereal grains, fruits, and vegetables. Additionally, culinary and medicinal herbs contribute significantly to the food and pharmaceutical industries, while in horticulture, they are cultivated for ornamental purposes, houseplants, and the floral industry, underscoring their economic relevance. Traditional medicine has long relied on herbs, and modern pharmaceutical industries explore their diversity for valuable phytochemical compounds, while other industries such as dyes, cosmetics, and perfumery also recognize their potential.

## Herbs in Traditional Medicine

Herbs are not only ecologically significant but also possess ethnobotanical uses and medicinal properties, with various species yielding different medicinally important compounds. Medicinal plants serve as reservoirs of novel chemical entities that exhibit beneficial pharmacological and therapeutic characteristics. The curative impact of these plants is attributed to the secondary plant substances they contain. Plant-derived bioactive compounds act as a defence mechanism against external stress and pathogens (Tepe, Daferera, Sokmen, Sokmen, & Polissou, 2005).

Phytochemicals, including alkaloids, tannins, flavonoids, phenolic compounds, terpenoids, etc., demonstrate diverse bioactivities such as antimutagenic, anticarcinogenic, antioxidant, antibacterial, and anti-inflammatory properties (Okarter & Liu, 2010). Antioxidants, a varied group of chemicals found in plants, play a crucial role in shielding the body from oxidative damage caused by free radicals and reactive oxygen species. They act by suppressing the formation of these harmful substances and functioning as scavengers for free radicals, thereby preventing numerous chronic diseases and mitigating side effects (Sawa *et al.*, 1999). Due to their reduced side effects, natural antioxidants are gaining increasing attention and undergoing intensive study (Ali *et al.*, 2001; Candan *et al.*, 2003). Herbal extracts, known sources of antimicrobial agents, are frequently utilized in treating various infectious diseases (Lee *et al.*, 2007; Newman & Cragg, 2007).

The herbs found in the Garo Hills are employed for a myriad of health conditions. From common ailments like cough and cold to more complex conditions like cancer, the traditional medicine of the region offers a diverse array of remedies. Local healers prepare concoctions, poultices, and infusions, individually or in combination of multiple herbs according to their effects. Understanding the specific uses of each herb is crucial for ensuring the preservation and sustainable use of these medicinal resources.

Studies reported numerous species of herbaceous habit belonging to families Acanthaceae, Adiantaceae, Amaranthaceae, Amaryllidaceae, Apiaceae, Apocynaceae, Araceae, Asteraceae, Basellaceae, Bignoniaceae, Blechnaceae, Bromeliaceae, Caryophyllaceae, Costaceae, Crassulaceae, Cucurbitaceae, Cyperaceae, Dryopteridaceae, Equisetaceae, Fabaceae, Gleicheniaceae, Lamiaceae, Liliaceae, Lindsaeceae, Lobeliaceae, Lycopodiaceae, Malvaceae, Melastomataceae, Musaceae, Nephrolepidaceae, Nyctaginaceae, Oxalidaceae, Plantaginaceae, Poaceae, Polypodiaceae, Polygonaceae, Pteridaceae, Orchidaceae, Rubiaceae, Saururaceae, Solanaceae, Taccaceae, Violaceae, Vitaceae, Zingiberaceae, etc. These plants are used in the treatment of various health conditions such as asthma, stomach ache, blood pressure, cancer, cough, flu, cold, cuts and wounds, diarrhoea, dysentery, bone fracture, jaundice, skin diseases, snake bite, insect bite, and many more.

The utilization of medicinal herbs is prevalent among the local traditional healers and collectors, with some of them being cultivated for trade. Medicinal plants have a significant impact on the livelihood of rural communities in Meghalaya, as they offer an opportunity for cash income. The collection, processing and marketing of these plants is a major economic activity for those dwelling near forests.

An enumeration of medicinal herbs used in the traditional health practices of different communities of Garo Hills is listed in the table no. 1:

**Table 1 :** Medicinal herbs used in traditional health practices in Garo Hills.

| Scientific Name | Vernacular Name | Family | Plant Parts | Uses | References |
|---|---|---|---|---|---|
| *Achyranthes aspera* L. | Kachipha pan (Koch) | Amaranthaceae | Stem | Hepatoprotective | Majumdar *et al.*, 2019 |
| | Minamkachi (Garo) | | Root | Leprosy | Rao, 1981 |
| *Acorus calamus* L. | Pachi (Garo) | Acoraceae | Leaves, root-stocks | Diarrhoea and dysentery | Marak & Lalnundanga, 2017 |
| | | | Stem | Bronchial asthma | Marak & Mathew, 2021 |
| *Adiantum lunulatum* | Dokongsibijak (Garo) | Pteridaceae | Whole plant | Bone fracture | Marak & Mathew, 2020 |
| *Adiantum philippense* L. | NA | Pteridaceae | Root, Frond | Dysentery, Rabies | Singh *et al.*, 2014 |
| *Ageratum conyzoides* L. | Namin-ing (Garo) | Asteraceae | Leaf | Typhoid | Singh *et al.*, 2014 |
| *Allium sativum* L. | Rasin gipok (Garo) | Amaryllidaceae | Bulb | Bronchial asthma | Marak & Mathew, 2021 |
| | Rosun (Koch) | Amaryllidaceae | Clove | Hepatoprotective | Majumdar *et al.,* 2019 |
| *Aloe vera* (L.) Burm F. | Aloe vera (Garo) | Asphodelaceae | Leaves | Urine infection | Sangma & Sahoo, 2017 |
| *Amaranthus spinosus* L. | Kotakhuriya pan (Koch) | Amaranthaceae | Roots | Hepatoprotective | Majumdar *et al.,* 2019 |
| *Ananas comosus* (L.) Merr. | Anaros (Koch) | Bromeliaceae | Tender leaves | Hepatoprotective | Majumdar *et al.,* 2019 |
| *Andrographis paniculata* | Haa neem (Koch) | Acanthaceae | Leaves and roots | Hepatoprotective | Majumdar *et al.,* 2019 |
| *Arisaema jacquernontii* Bl. | Jinjok (Garo) | Araceae | Tuber | Ringworm | Rao, 1981 |
| *Artemisia indica* Willd. | Phraphru khurbijak (Garo) | Asteraceae | Leaf | Asthma | Singh *et al.*, 2014 |
| *Asparagus officinalis* L | Me'mang ta'matchi (Garo) | Liliaceae | Roots | Dysentery | Marak & Lalnundanga, 2017 |
| | Sotmul (Koch) | | Roots | Hepatoprotective | Majumdar *et al.,* 2019 |
| *Basella alba* L. | Ganjek (Koch) | Basellaceae | Whole plant | Hepatoprotective | Majumdar *et al.,* 2019 |
| *Begonia roxburghii* (Miq.) A.DC. | Jajew jylwang (Jaintia) | Bignoniaceae | Whole plant part | Constipation | Singh *et al.*, 2014 |
| *Blechnum orientale* L. | Vobnam (Garo) | Blechnaceae | Rhizome, frond | Intestinal wounds, cuts and wounds | Singh *et al.*, 2014 |
| *Boerhavia diffusa* L. | Samdelrna (Garo) | Nyctaginaceae | Leaves | Rheumatism. | Rao, 1981 |
| | Aruwa pan (Koch) | Nyctaginaceae | Leaves | Hepatoprotective | Majumdar *et al.,* 2019 |
| *Bryophyllum pinnatum* (Lam) Oken. | Khodaimosto (Koch) | Crassulaceae | Leaves | Hepatoprotective | Majumdar *et al.,* 2019 |
| *Carum copticum* (L.) Benth.Hook.f | Dhania dakgipa (Garo) | Apiaceae | Seeds | Dysentery | Marak & Lalnundanga, 2017 |
| *Centella asiatica* (L.) Urb. | Manamuni/mesanachil (Garo) | | Roots and leaves | Dysentery | Marak & Lalnundanga, 2017 |
| | | Apiaceae | Leaf | Bronchial asthma | Marak & Mathew, 2021 |
| | | | Whole plant | Dysentery. | Singh *et al.*, 2014 |
| *Cheilocostus speciosus* (J.Koenig) C.D.Specht. | Kewa pan (Koch) | Costaceae | Rhizome | Hepatoprotective | Majumdar *et al.,* 2019 |

| | | | | | |
|---|---|---|---|---|---|
| *Chromolaena odorata* (L.) R.M. King and H. Rob | Sambangguri/ Amok (Garo) | Asteraceae | Leaves and shoots | Dysentery | Marak & Lalnundanga, 2017 |
| *Cissus quadrangularis* | Char shira (Garo) | Vitaceae | Stem | Bone fracture | Marak & Mathew, 2020 |
| *Cissus triangularis* | Tin shira (Garo) | Vitaceae | Stem | Bone fracture | Marak & Mathew, 2020 |
| *Colocasia affinis* Schott. | Kachhu (Garo) | Araceae | Flower | Tuberculosis | Singh *et al.*, 2014 |
| *Colocasia esculenta* | Matchitagong (Garo) | Araceae | Leaf | Bone fracture | Marak & Mathew, 2020 |
| *Costus speciosus* (Koenig.) Sm. | Jamlakhuti (Garo) | Zingiberaceae | Rhizome | Snake bite | Singh *et al.*, 2014 |
| *Crinum defixum* | Rajamuri (Garo) | Amaryllidaceae | Leaf | Bone fracture | Marak & Mathew, 2020 |
| *Cucumis melo* L. | Te.mit (Garo) | Cucurbitaceae | Pulp | Chronic eczema | Singh *et al.,* 2016 |
| *Curcuma elata* Roxb. | Nojor dikge (Garo) | Zingiberaceae | Rhizome | Bronchial asthma | Marak & Mathew, 2021 |
| *Curcuma longa* L. | Haldi (Garo) | Zingiberaceae | Rhizome | Oral ailments | Marak & Mathew, 2022 |
| *Cymbidium aloifolium* (L.) Sw. | Samguasi (Garo) | Orchidaceae | Leaf | Bronchial asthma | Marak & Mathew, 2021 |
| *Cynodon dactylon* (L.) Pers. | Dubla talay (koch) | Poaceae | Whole plant | Hepatoprotective | Majumdar *et al.,* 2019 |
| *Cyperus rotundus* L. | Midamdil/Samsi jaronte (Garo) | Cyperaceae | Tuber | Bronchial asthma | Marak & Mathew, 2021 |
| *Dendrocalamus hamiltonii* Gamble | Wa'nok (Garo) | Poaceae | Young leaves | Komjuri (weakness, fever and reluctance to eating). | Sangma & Sahoo, 2017 |
| *Dicranopteris linearis* (Burm, f.) Underw. | Leng bijak (Garo) | Gleicheniaceae | Frond | Bronchial asthma | Marak & Mathew, 2021 |
| *Dicranopteris linearis* (N. Burm) Underw. | NA | Gleicheniaceae | Frond | Asthma | Singh *et al.*, 2014 |
| *Drymaria cordata* (L.) Willd. ex Roem. & Schult. | Kynbat thalap (Jaintia) | Caryophyllaceae | Whole plant | Snake bite | Singh *et al.*, 2014 |
| *Drynaria quercifolia* (L.) J.Sm. | Gorpanka (Koch) | Polypodiaceae | Rhizome | Hepatoprotective | Majumdar *et al.,* 2019 |
| *Dryopteris cochleata* (Ham ex D.Don) C. Chr | NA | Dryopteridaceae | Rhizome | Rheumatism, leprosy | Singh *et al.*, 2014 |
| *Elephantopus scaber* L. | Dogrik dasu (Garo) | Asteraceae | Root | Urinary trouble | Singh *et al.*, 2014 |
| *Equisetum ramosissimum* Desf. | Sarawak (Garo) | Equisetaceae | Stem | Stomach pain | Singh *et al.*, 2014 |
| *Eryngium foetidum* L. | Samskal (Garo) | Apiaceae | Leaves | Diarrhoea and dysentery | Marak & Lalnundanga, 2017 |
| *Eucharis grandiflora* Planch and Linden | Bidil (golbera) (Garo) | Liliaceae | Tuber | Bronchial asthma | Marak & Mathew, 2021 |
| *Eupatorium canabimum* L. | Samsimari, Sambangguri (Garo) | Asteraceae | Leaves | Bleeding and stomachache | Sangma & Sahoo, 2017 |
| *Hedychium villosum* Wall. | NA | Zingiberaceae | Rhizome | Cough, flu and cold | Singh *et al.*, 2014 |
| *Houttuynia cordata* Thunb. | Matchaduri (Garo) | Saururaceae | Shoot | Antiviral, antibacterial and anti-leukemic activities | Momin *et al.,* (2016) |
| *Justicia gendarussa* | Dojagripe (Garo) | Acanthaceae | Leaf | Bone fracture | Marak & Mathew, 2020 |
| *Leucas lavandulifolia* Sm. | Domklos/dimuku gansisa (Garo) | Lamiaceae | Root | Bronchial asthma | Marak & Mathew, 2021 |
| *Lycopodiella cernua* | NA | Lycopodiaceae | Whole plant | Beri-Beri Cough, flu | Singh *et al.*, 2014 |

| | | | | | |
|---|---|---|---|---|---|
| (L.) | | | | and cold | |
| *Macrotyloma uniflorum* Lam. | Mendu (Garo) | Fabaceae | Leaf | Bronchial asthma | Marak & Mathew, 2021 |
| *Mimosa pudica* L. | Samichip (Garo) | Fabaceae | Root | Oral ailments | Marak & Mathew, 2022 |
| *Musa acuminata* Colla. | Aanaji likthai (Koch) | Musaceae | Raw fruit | Hepatoprotective | Majumdar *et al.,* 2019 |
| *Musa sapientum* L. | Te'rik atigola (Garo) | Musaceae | Fruits | Diarrhoea and dysentery | Marak & Lalnundanga, 2017 |
| *Nephrolepis cordifolia* (L.) Pr. | NA | Nephrolepidaceae | Rhizome | Cough, flu and cold | Singh *et al.*, 2014 |
| *Ocimum basilicum* L. | NA | Lamiaceae | Leaves | Diarrhoea and dysentery | Marak & Lalnundanga, 2017 |
| *Odontosoria chinensis* (L.) J.Sm. | NA | Lindsaeceae | Frond | Diarrhoea | Singh *et al.*, 2014 |
| *Onychium siliculosum* (Desv.) C.Chr. | Kiring (Garo) | Bignoniaceae | Frond | Dysentery | Singh *et al.*, 2014 |
| *Ornithogalum umbellatum* | Bethlehem | Asparagaceae | Whole plant | Bone fracture | Marak & Mathew, 2020 |
| *Oxalis corniculata* L. | Me'kampret chongipa (Garo) | Oxalidaceae | Fruits | Diarrhoea and dysentery | Marak & Lalnundanga, 2017 |
| | Sambrat (Garo) | | Whole plant | Cough, flu and cold | Singh *et al.*, 2014 |
| | Ambuluri (Koch) | | Whole plant | Hepatoprotective | Majumdar *et al.,* 2019 |
| *Paederia foetida* L. | Pasim (Garo) | Rubiaceae | Leaves | An'dime (a female disease after delivery) | Sangma & Sahoo, 2017 |
| *Plantago erosa* Wall | Chhakur-blang (Garo) | Plantaginaceae | Whole plant | Constipation | Singh *et al.*, 2014 |
| *Polygonum capitatum* D.Don | Sambodom-bong (Garo) | Polygonaceae | Whole plant | Insect bite | Singh *et al.*, 2014 |
| *Pratia nummularia* (Lam.) A.Br. & Aschers | NA | Lobeliaceae | Whole plant | Cancer | Singh *et al.*, 2014 |
| *Pteris ensiformis* Burm.f. | NA | Pteridaceae | Frond, rhizome | Dysentery, malaria | Singh *et al.*, 2014 |
| *Pteris vittata* L. | NA | Pteridaceae | Frond | Dysentery | Singh *et al.*, 2014 |
| *Rauwolfia tetraphylla* L. | Sarpagandh (Garo) | Apocynaceae | Young shoot, rhizom, roots | Stimulate mammary gland, snake bite, kill worm in cattle | Singh *et al.,* 2016 |
| *Sida acuta* Burm | Chirotha (Garo) | Malvaceae | Bark, leaves | Malaria | Sharma *et al.,* 2014 |
| *Sida rhombifolia* L. | NA | Malvaceae | Root | Tonic, blood pressure | Singh *et al.*, 2014 |
| *Solanum torvum* Sw. | Dieng-sohnang (Khasi) | Solanaceae | Root | Kidney stones | Singh *et al.*, 2014 |
| *Solena heterophylla* Lour. | Leng budu (Garo) | Cucurbitaceae | Whole plant | Bronchial asthma | Marak & Mathew, 2021 |
| *Sonerila maculata* Roxb. | NA | Melastomataceae | Root | Stomach pain | Singh *et al.*, 2014 |
| *Spilanthes acmella* L. | Wagamsam (Garo) | Asteraceae | Flower | Oral ailments | Marak & Mathew, 2022 |
| *Spilanthus paniculata* DC. | Santustem (Garo) | Asteraceae | Flower | Toothache | Singh *et al.*, 2014 |
| *Tacca integrifolia* Ker-Gawl. | NA | Taccaceae | Rhizome | Cuts and wounds | Singh *et al.*, 2014 |
| *Urena lobata* L. | Gamthai (Garo) | Malvaceae | Leaf | Jaundice | Singh *et al.*, 2014 |
| *Viola betonicifolia* J.Sm | NA | Violaceae | Whole plant | Vomiting, Cough, flu and cold | Singh *et al.*, 2014 |
| *Zingiber officinale* L. | E.ching (Garo) | Zingiberaceae | Rhizome | Bone fracture | Marak & Mathew, 2020 |
| | | | Rhizome | Bronchial asthma | Marak & Mathew, 2021 |

### Challenges associated with medicinal herbs

The use of medicinal herbs and traditional medicine systems faces several challenges, including:

- **Deforestation:** The loss of habitat due to deforestation leads to the depletion of medicinal plant populations and the destruction of biodiversity hotspots, which impacts the availability of diverse medicinal herbs. Unregulated logging and land conversion further exacerbate the issue.
- **Jhum Cultivation:** Traditional slash-and-burn agriculture practised in some regions results in the loss of natural habitats and disruption of ecological balance, often leading to soil degradation and reduced availability of medicinal plants.
- **Reckless Exploitation:** Overharvesting of medicinal plants for commercial purposes and the lack of sustainable harvesting practices threaten the long-term viability of traditional medicine systems.
- **Modern Medicine:** The dominance of pharmaceuticals often undermines the use of traditional medicine, and the perception of modern medicine as more effective reduces reliance on traditional remedies. Traditional knowledge and practices may be marginalized or lost.
- **Grazing:** Overgrazing by livestock can damage medicinal plant populations, leading to direct destruction of plants and competition for resources, reducing the availability of medicinal herbs.
- **Lack of Awareness:** Communities may lack awareness of the importance of preserving medicinal plants, traditional knowledge transmission may be declining among younger generations, and there may be limited understanding of sustainable harvesting and conservation practices.
- **Pollution:** Contamination of soil, water, and air from industrial activities affects medicinal plants, with chemical pollutants accumulating in plant tissues, rendering them unsafe for use. Urbanization and industrialization also encroach upon natural habitats, further degrading ecosystems.
- **Irrational Use of Herbal Medicines:** Assuming herbal medicines have no side effects or interactions can lead to delays in marketing and pose risks to consumers.
- **Infrastructure-related Issues:** The absence of well-trained personnel and advanced equipment poses challenges in the quality control of herbal drugs.
- **Climate Change:** Changing temperature, extreme weather conditions, disruptions of commensal relationships, increased pests and pathogens, and habitat fragmentation threaten many species of medicinal plants with extinction.
- **Biopiracy:** Traditional knowledge is exploited without consent, which is a major concern in the herbal medicine industry. People are not aware of intellectual property rights and other patenting measures.

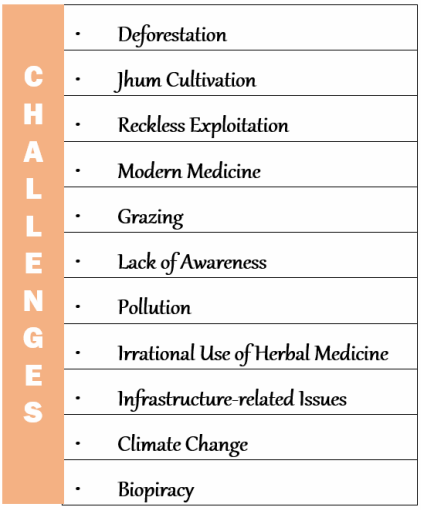


**Fig. 3 :** Challenges associated with the use of medicinal herbs and traditional medicine systems.

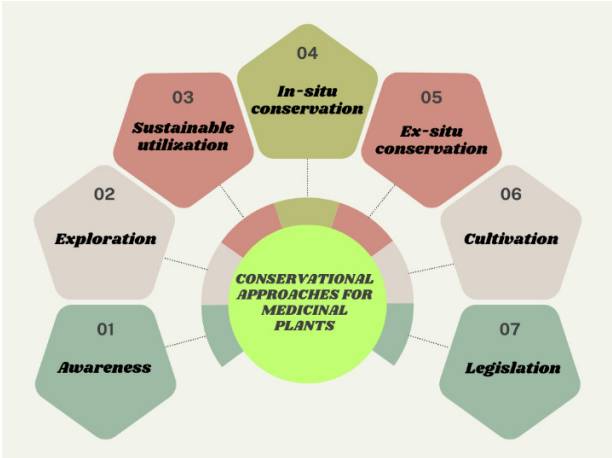


**Fig. 4 :** Conservational approaches for medicinal plants.

### Conservation of Medicinal Herbs

Despite their immense importance, the germplasm of medicinal herbs is facing a decline due to various anthropogenic activities such as exploitation, ignorance, developmental projects, shifting cultivation, pollution, etc. People often collect these plants in an

unplanned and non-scientific manner. It is crucial to take up suitable initiatives to conserve the medicinal plants in Meghalaya. Some measures for the conservation of medicinal herbs are discussed below:

1. **Awareness:** The first leap towards the conservation of medicinal herbs will be awareness of these valuable resources and their potential in the medicinal realm. This can be achieved through various methods such as conservation education, field research, involving local communities, and other outreach approaches.
2. **Exploration:** The study of medicinal plants requires an exploration of the areas where commercially valuable species of medicinal plants thrive the most, as well as the potential of these species to be utilized for commercial purposes in a particular location. Additionally, it is important to consider the conservation of endemic species that require protection, as well as the utilization of medicinally significant species in local health practices or alternative uses such as food, ornamentation, or timber. Finally, the identification of land suitable for the cultivation of medicinal plants is pivotal. (Sankar, Tripathi, & Kumar, 2014)
3. **Sustainable utilization:** Traditional healers have been practising this medicinal profession with a sustainable approach. With systemic collection methods and a growing awareness of the importance of these practices, we can expect to see a significant increase in the number of new plants and a more comprehensive approach to holistic healing. Concepts like 'Local Traditional Medicinal Practitioners Association' can take lead in this direction.
4. **In-situ conservation:** It means the conservation of the plants in their natural habitat. For this purpose, conservation sites with a high diversity of medicinal plants, a high coverage of endemic species in an accessible and manageable area can be selected and established. Protection, transplantation and replantation in their habitat is a very practical approach. It includes national parks, biosphere reserves, sacred grooves, protected areas etc. It is an 'ecocentric' approach where the species along with its surrounding ecosystem is conserved. On-farm and home garden conservation can also be practised.
5. **Ex-situ conservation:** It refers to the cultivation and maintenance of plants in an area outside of their natural habitat in a botanical garden or other suitable places. Botanical gardens can play a significant part in the conservation of medicinal plants through the development of propagation and cultivation protocols, as well as undertaking programs of domestication and variety breeding (Maunder, Higgens & Culham, 2001). Moreover, long-term preservation of plant propagules can be done through gene banks (seed bank, pollen bank, DNA libraries, etc.) in plant tissue culture repositories and by cryopreservation.
6. **Cultivation:** Through systematic research, the package of practices for many medicinal plants has been published. This aspect is difficult for some species with niche-specific growth habits. Production of quality planting materials through propagation, acclimatization, cultural practices and protected cultivation must be taken into consideration. Shankar *et al.* (2014) asserted that cultivation of *Amorphophalus campanulatus, Oroxylum indicum, Holarrhena antidysenterica* can be done in the Garo Hills which can be utilized to produce drugs for the pharmaceutical industry in India (Shankar *et al.*, 2014).
7. **Legislation:** While there are no specific policies or regulations for the conservation of medicinal plants, the purpose is served directly or indirectly by laws like Forest Act, 1927, Wildlife (Protection) Act, 1972 and Wildlife (Protection) Amendment Act 1991, Forest (Conservation) Act, 1980, Environment Protection Act, 1986, National Forest policy, 1988, National Biodiversity Act, 2002 and The Scheduled Tribes and Other Traditional Forest Dwellers Act, 2006.

**Prospects and Future Directions**

1. **Further research**: There is immense potential for further research to uncover resources and knowledge in the horizons of ethnobotany in Garo Hills. Exploration, documentation, phytochemical analyses, clinical trials, value addition, synergistic effects of herb combinations, and genetic studies are some of the trending areas of research. Laboratory to field approach will benefit the medicinal system of the community. Academic and scientific studies in the ethnobotany of this region will pave the way for further improvements.
2. **Scientific validation experiments:** Scientific validation is essential to bridge the gap between traditional knowledge and modern medicine. Conducting clinical trials, pharmacological studies, and toxicity assessments is necessary for understanding their medicinal value. Understanding the biological effects such as antimicrobial, antioxidant, anti-tussive, anti-diabetic, anti-cancer, etc. is also important to tap

the full potential. Scientific justifications will raise the standard of herbal medicine.

3. **Government schemes:** The Meghalaya government adopted the National AYUSH Mission Scheme which supports various activities such as nursery development, cultivation of medicinal plants, exhibitions, training/ awareness programs, etc. National Medicinal Plants Board (NMPB) facilitates several research and development activities in medicinal plants and they also provide Centrally Sponsored Sector Scheme on Conservation, Development and Management of Medicinal Plants which includes Home Herbal Gardens, School Herbal Gardens, Institution/Public Herbal Gardens etc.
4. **Funding Opportunities:** Securing funding for research projects, conservation efforts, and community-based initiatives is critical for the sustainable development of medicinal herb resources in the Garo Hills. DST, DBT, SERB NEC, ICSSR and NABARD are some prominent organisations sponsoring funding for projects. Governmental bodies, non-profit organizations, incubation centres and international agencies are to pave ways for financial support.
5. **Conservation and cultivation:** As discussed above, conservation approaches including cultivation are very important to keep the priceless knowledge and medicinal plants available to the world. There must be innovative and integrated approaches to the conservation of medicinal plants.
6. **Organic farming of medicinal plants:** Organic farming of medicinal plants has received increasing attention. It has the potential to increase the quality and productivity of the plants while maintaining a healthy environment. It is economically, environmentally, socially and technologically feasible. It is also important for the long-term development and sustainability of medicinal plants.
7. **Marketing of medicinal herbs:** The market for herbal medicine is expanding at a very fast rate. Herbal-based pharmaceutical companies are also processing. It is undeniable that there has been a rise in the global demand for products derived from plants. The Indigenous people must grab the market opportunity in the national as well as international platforms. However, to reach this stage there must be a strategic approach to the market linkage and commercial practices.
8. **Mass Production and Micropropagation:** Scaling up production to meet the increasing demand for medicinal herbs requires innovative approaches. Micropropagation offers a sustainable method for mass production while preserving the genetic integrity of the plants. Protocols have been developed for in vitro propagation of medicinal plants. It also helps to understand the secondary metabolite pathways of these plants. Recent advances in plant cell cultures offer cost-effective means for the commercial production of even rare or exotic plants and the valuable chemicals they produce, opening new possibilities for the scalable manufacturing of plant-derived medicines. Exploring these methods can contribute to the conservation of rare and endangered species.
9. **Community Responsibility:** There is a huge responsibility for the community to uplift this traditional medicine and to conserve the medicinal plants. Their participation in scientific research, understanding of the values of medicinal plants, awareness of schemes, funding, etc. are very important. Most importantly, the people must get the fruit of their own accomplishment in terms of health as well as income from these medicinal plants, while at the same time sharing the knowledge with the world.

## Conclusion

The medicinal herbs of Garo Hills represent a unique repository of traditional knowledge and biodiversity. Medicinal herbs serve as a valuable asset for healthcare as well as the livelihood of the community residing in the region. So, it is our responsibility not only to preserve the medical plants but also the traditional knowledge. Preserving this wealth requires a collaborative effort of traditional wisdom and modern scientific advancements. With the help of community participation, government initiatives, further research and sustainable practices, the Garo Hills provide a conducive environment for further advancement in the fields of ethnobotany, ethnomedicine and pharmacognosy as well as for high-end research in this dimension. The current study opens up the scope for further research and the exchange of knowledge across boundaries.

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