

Medicinal Plants used for traditional healing practices among the tribal communities of Ri-Bhoi District, Meghalaya, India

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ABSTRACT

This study aimed to document and analyze the medicinal plants used by tribal communities in the Ri-Bhoi district of Meghalaya, India, and to evaluate their significance in traditional healing practices. Through the collection of ethnomedicinal knowledge using standard questionnaires and group interviews, the research identified 50 medicinal plant species across 35 families employed in treating 38 common ailments. The study assessed the use value (UV), informant consensus factor (ICF), and fidelity level (FL) of these plants to gauge their importance and effectiveness. The analysis revealed that *Euphorbia neriifolia* L. holds the highest use value (UV=0.36), indicating its frequent and significant use among local traditional healers. This plant, along with others identified, demonstrates a broad application in addressing various health conditions prevalent in the region. The study also noted a substantial degree of consensus among informants regarding the therapeutic uses of these plants, with ICF values ranging from 0.33 to 0.74. This suggests a strong agreement on the medicinal applications of specific plants for distinct disease categories. The fidelity levels (FL) of the medicinal plants varied between 33.33% and 100%, reflecting both the reliability and the degree of acceptance of these plants in traditional medicine. The high fidelity values for certain plants underscore their critical role in local health practices. Overall, this study underscores the rich ethno medicinal knowledge embedded within the Ri-Bhoi district's tribal communities and highlights the need for ongoing documentation and preservation of this traditional wisdom. The findings contribute valuable insights into the use and significance of local flora in traditional healing, which could inform future research and conservation efforts.

KEYWORDS: Meghalaya, Medicinal Plant, Ethnomedicine, Traditional healing practices, Ri- Bhoi district

Received: August 07, 2024
Revised: April 09, 2025
Accepted: April 19, 2025
Published: June 10, 2025

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INTRODUCTION

The term 'Ethnobotany' was coined by Harshberger in 1895 to indicate the use of plants by primitive and aboriginal people (Harshberger, 1896). According to the World Health Organization, about 80% of the world's population relies on herbal medicines for their primary healthcare need (WHO, 2002). Medicinal plants have traditionally been used as a source of health care system in rural India since ancient times including the North Eastern region, India (Choudhury *et al.*, 2015). Ethno medicine has been playing a very important role in the human health care system, which is mainly based on the belief and experience of the traditional people. Herbal medicines are cheap, more effective, and easily available and supposed to have no side effects and increasing the demand of herbal drugs in international trade (Kar & Barthakur, 2008). Tribal communities are mainly dependent on traditionally used medicinal plants

due to transportation and communication problems, their traditional medicinal plants are one of the most affordable to use as a source of medicinal treatment (Das, 2012). Around the world, about 75,000 plants are being used in different systems of medicine which more than 20,000 of the higher plants are used for the traditional treatment practices in indigenous culture (Kuddus *et al.*, 2016). Medicinal plants are used by the local and indigenous people of Assam, most of them lack knowledge about the phytochemicals present in the plant species used by them and phytochemicals of those plants are yet to be explored (Mao & Hynniewata, 2000). More than 200 forest plants are used by the indigenous people of Meghalaya for medicine and other purposes. Medicinal plants play a great role in their daily lives of tribal people and they cannot survive without herbal medicine which is used for specific ailments (Tynsong *et al.*, 2012). Meghalaya, a rich hotspot in northeastern India due to the presence of the Nokrek Biosphere Reserve, is home to

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a diverse range of plants including trees, herbs, shrubs, and non-flowering species like lichens and ferns, many of which are used for medicinal purposes. An ethno medico botanical survey titled “Ethnobotanical Studies of Khasi and Jaintia Hills in the State of Meghalaya” was conducted by Joseph and Kharkongor (1981). The current study was conducted to explore the extensive knowledge that local healers possess about medicinal plants in the region and how they use these plants to treat various ailments.

MATERIALS AND METHODS

Study Area

Meghalaya is a part of the north-eastern region of India which lies between 25°02' to 26°06' N latitude and 89°48' to 92°50' E longitude and covers an area of 22,429 sq. km. Ri-Bhoi is one of the districts of Meghalaya which lies between 90°15' E to 91°16' E longitude and 25°40' N to 25°21' N latitude and occupies an area of 2376 sq. km. It is bounded on the North by Kamrup district and on the East by Jaintia hills and Karbi Anglong district of Assam and on the West by West Khasi hills district and East Khasi hills district (Mao & Hynniewata, 2000). The study was undertaken in the different selected villages under the three Blocks of Ri-Bhoi district. The Ri-Bhoi district has three Blocks i.e., Umling CD Block, Jirang CD Block and Umsning CD Block (Figure 1).

Ethnomedicinal Survey

Ethnomedicinal study has been carried out from March 2022 to February 2023 in the selected villages of Ri-Bhoi district, Meghalaya. Information on ethnomedicinal practice and medicinal plants have been collected from the local healers (both men and women) using a structured questionnaire. In addition, the traditional healers were interviewed using semi-structured questionnaires and open-ended conversations. Along with an intensive household survey in selected villages on the use of traditional medicine practice using locally available plants of the area. The interviews were based on different parameters.

Collection and Identification

The whole process of collection, pressing and preparation of herbarium specimens have been done in accordance to the conventional herbarium techniques (Joseph & Kharkongor, 1981). All the plants have been identified with the help of Forest Flora of Meghalaya Vol 1&2, Flora of Nongpoh and vicinity Vol 1&2 (Friedman *et al.*, 1986; Haridasan & Rao, 1985-1987). Botanical Survey of India, Shillong and lastly with the help of online identification “The plant list” (<http://www.plantlist.org>) (Figure 2).

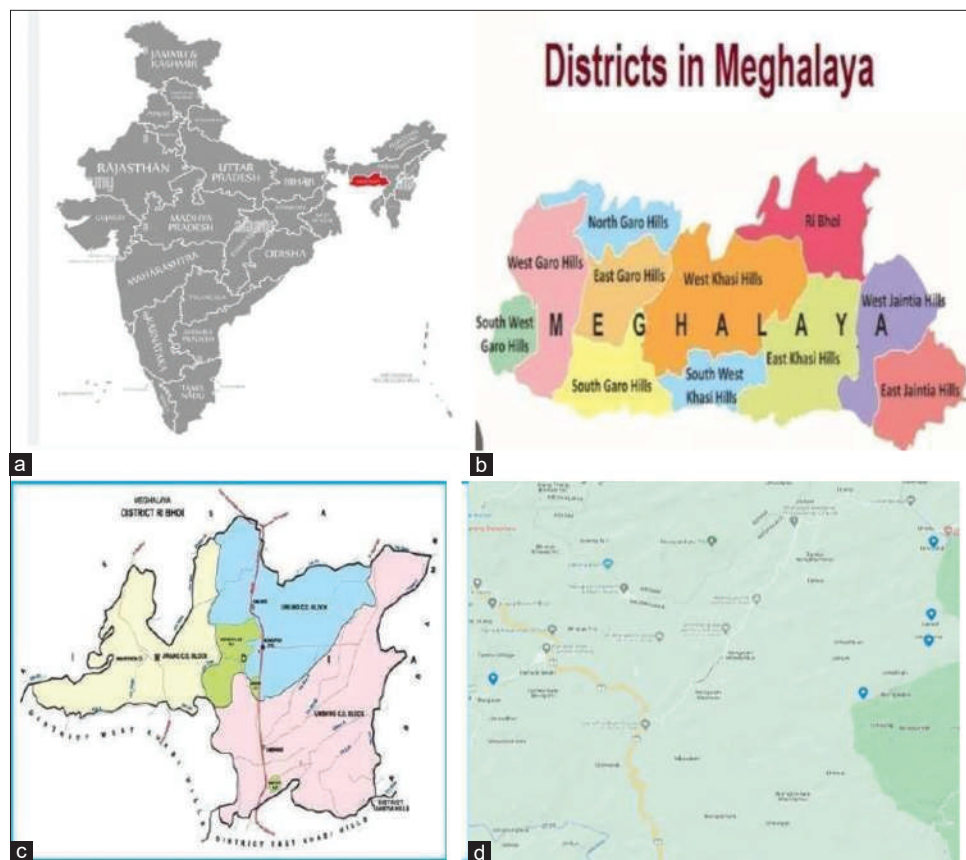


Figure 1: a) Meghalaya in the state map of India, b) District map of Meghalaya, c) Ri- bhoi district of Meghalaya and d) Visited sites of the study area

Table 1: List of species with their scientific name, local name, family, part of used diseases and mode of preparation

Scientific name	Habit	Local name	Family	Part used	Diseases	Mode of preparation
<i>Alternanthera brasiliana</i> (L.) Kuntze SP-108	Shrub	Samarang songappa (G)	Amarantaceae	Leaf	Menstrual pain	10-15 leaves of <i>A. brasiliana</i> mixed with 6-7 guava leaves, boiled it with 300ml of water to make 1/4 th juice extract. Take it 1-2 teaspoon two times for five days.
<i>Bauhinia variegata</i> L. SP-112	Tree	Megongful (G)	Fabaceae	Bark	Throat pain	Bark (50 gm) of this plant is crushed and soaked it 250 mL of water for 20-30 minutes. It is taken 2 teaspoon in the morning time (empty stomach) until it is cure.
<i>Callicarpa arborea</i> Roxb. SP-123	Tree	Machanche (G)	Lamiaceae	Bark	Menstrual problem	Bark of this plant is dried in sunlight to prepared powder. 25-30 gm powder are ground and mixed with water 250-300 mL, pour it overnight. It is taken 2 teaspoon in the morning time for few days to treat over bleeding in period.
<i>Camonea umbellata</i> (L.) A.R. Siomes & Staples SP-131	Climber	Samachengbudu (G)	Convolvaceae	Bark	Urine infection	Bark (30 gm) of this plant crushed and boiled with 300 mL of water to make 1/4 th extract. The extract is taken two times morning and evening after food for 3 days.
<i>Celosia cristata</i> L. SP-125	Shrub	Dongomat (G)	Amarantaceae	Leaf	Nose bleeding	6-7 leaves are crushed to make a paste and put it directly in nose as a nasal drop (2 drops) for one time in a day.
<i>Chromolaena odorata</i> (L.) R.M. King & H. Rob. SP-101	Herb	Sambanuggri (G)	Asteraceae	Leaf	Cut wounds and stomach-aches	Leaves (10-12) are pounded properly and juice is extracted. This juice can be taken one teaspoon daily after food to treat stomach-aches. Leaves can be applied on cut area for stop bleeding.
<i>Clitoria ternatea</i> L. SP-110	Climber	Nilikut (G)	Fabaceae	Root	Stomach problem, eye redness	Roots (10-20 gm) are ground, mixed with 150-250 mL of water and left it for 2 hours. It is taken two times after food for few days to treat stomach problem. Leaf (4-5) of this plant paste mixed with beetle leaf (1) and drooped it eyes for two times for few days to cure eye infection.
<i>Clerodendrum bungei</i> Steud. SP-114	Shrub	Chamskho (G)	Lamiaceae	Leaf	Nose bleeding	Leaves (1-2) are ground to make a juice and hold down it in nose hole until stop the nose bleeding.
<i>Cissus cactiformis</i> Gilg SP-107	Climber	Jormeh (G)	Vitaceae	Root	Bone fracture	Mode of preparation: Roots (50 gm) are ground to make a paste and bandaged over the fractured area of the body for 2-3 days. After that changed the paste and repeated the process again within 1 week for the treatment of bone fractured.
<i>Cordyline terminalis</i> (L.) Kunth SP-103	Shrub	Rawa (G)	Asparagaceae	Leaf and root	Children (1-5 years old) fever	The young leaf (4-5) of this plant, <i>K. pinnata</i> leaf (2-3) and <i>M. balbisiana</i> Colla tubers (10 gm) are crushed and make a smooth paste and apply it directly on forehead for 20-30 minutes
<i>Crinum americanum</i> L. SP-126	Herb	Rajamoni (G)	Amaryllidaceae	Leaf	Bone fracture, paralysis	Leaves (30-50 gm) of <i>C. americanum</i> , <i>C. quadrangularis</i> and <i>C. indicum</i> are ground to make a smooth paste and bandaged over the fractured area for 3 days until it dry. After that changed the bandaged and repeated the process again within 1 week for the treatment of bone fractured.

(Contd...)

Table 1: (Continued)

Scientific name	Habit	Local name	Family	Part used	Diseases	Mode of preparation
<i>Eleutherine bulbosa</i> (Mill.) Urb. SP-135	Herb	Bagasu (G)	Hypoxidaceae	Tuber	Bomiting	Tuber (10-20 gm) ground and boiled with 250 mL of water to make 1/4 th extract. The juice extract is taken 1-2 teaspoon, morning and evening for two times before food.
<i>Desmodium triquetrum</i> (L.) DC. SP-140	Herb	Samgange (G)	Fabaceae	Leaf	Menstrua problem (weakness)	7-8 leaves of this plant cooked with young chicken liver as a soup, taken it three times in a day for 1 week or more days until weakness to be overcome.
<i>Dieffenbachia amoena</i> Bull. SP-145	Herb	Malariro (G)	Araceae	Leaf	Spider bite	Leaf (2-3) of the plant crushed and directly applied on the spider bite area.
<i>Dillenia scabrella</i> Roxb. SP-138	Tree	Agatchi (G)	Dilleniaceae	Bark	Snake bite.	30-50 gm bark of this plant ground to make a paste and applied it on poisonous area.
<i>Discorea bulbifera</i> L. SP-121	Climber	Thajbudu (G)	Discoreaceae	Leaf	Snakebite	4-5 leaves are crushed and applied it on snakebite area.
<i>Euphorbia heterophylla</i> L. SP-133	Herb	Dudhigacchi (G)	Euphorbiaceae	Leaf	Skin infection, wound healing	Leaves (10-15) are crushed to make smooth paste and applied on infected area to cure skin infection and wound healing disorder.
<i>Euphorbia neriifolia</i> L. SP-147	Shrub	Suray (G)	Euphorbiaceae	Leaf, Root, stem	Eye infection, nail infection, fungal infection of skin, cold, cough, fever, asthma, snake bite	6-10 leaves of this plant ground to make a juice and taken it with honey, two times day and night after food to cure asthma. Leaves (10-15) are crushed and applied it on fungal area of skin for treatment of fungal infection. Leaf juice of this plant used to treat cold, cough, fever. Stem of this plant cut, hole it and put it in finger until dry it. Repeated it for 2-3 days to cure nail infection. Root (30 gm) of this plant crushed and apply immediately on snake bite area.
<i>Elephantopus scaber</i> L. SP-105	Shrub	Shamskhal (G)	Asteraceae	Leaf, root	Stomach pain (navel)	Root (10 gm) and leaf (5-7) of this plant pounded and applied it on navel area for half an hour for the treatment of stomach pain. Repeated the process for 2-3 days for better result.
<i>Eurya acuminata</i> DC. SP-122	Tree	Bormichi (G)	Pentaphyllaceae	Bark	Digestive problem	Barks are air dried to prepared powder, 50 gm powder (bark) boiled with 250 mL of water to make 1/4 th extract. It is taken 1-2 teaspoon morning and evening two times for a week.
<i>Flacourtia jangomas</i> (Lour.) Raeusch. SP-115	Tree	Bolchudabijak (G)	Salicaceae	Fruits	Haemoglobin increases	7-8 fruits ground with small amount of water to make a juice, taken it two times morning and evening after food for the treatment of anaemia.
<i>Flamingia stricta</i> Roxb. SP-149	Shrub	Samechakdolgappa (G)	Fabaceae	Leaves, bark	Bone fracture	<i>C. quadrangularis</i> leaf (15 gm), <i>J. grandalusa</i> (15 gm) leaf mixed with <i>F. stricta</i> (20 gm leaf and bark) Plant parts are grounded to make smooth paste and bandaged over the fractured area of the body for three days until it dry.
<i>Gardenia campanulata</i> Roxb. SP-150	Shrub	Darechik (G)	Rubiaceae	Root	Postpartum disorder	Roots are dried in sunlight to prepared smooth powdered form and stored it in a glass jar. 5-10 gm powder boiled with 100 mL of water to make a juice extract. It can be taken 10 mL, two times for few days or more until the postpartum problems are not cure.

(Contd...)

Table 1: (Continued)

Scientific name	Habit	Local name	Family	Part used	Diseases	Mode of preparation
<i>Hypoestes phyllostachya</i> Baker. SP-127	Herb	Sammechack (G)	Acanthaceae	Leaf	Swelling, itching	Leaf (10-20) pastes of this plant applied on swelling/itching area for the treatment of swelling and itching. diseases.
<i>Iresine herbstii</i> Hook. SP-109	Herb	Samarangdolla (G)	Amaranthaceae	Leaf	Menstrual over bleeding	10-20 leaves of this plant mixed with guava (4-6) and <i>K. pinnata</i> (2-3) leaf, crushed, boiled it to make ¼ th extract. It is taken two teaspoon 2 times after food for 4 days.
<i>Kalanchoe pinnata</i> (Lam.) Pers. SP-130	Herb	Walkhan (G)	Crassulaceae	Leaf	Cancer	10 gm leaves of this plant mixed with <i>M. indica</i> (10 gm), <i>P. guajava</i> (10 gm), <i>M. azedarach</i> (5 gm), <i>E. hitra</i> (3 gm), <i>A. marmelos</i> (10 gm) and <i>A. aspera</i> (2 gm) leaf. All plants are paste, add with honey and taken it two teaspoon, three times after food for 2 months.
<i>Jatropha curcas</i> L. SP-134	Shrub	Makgachhi (G)	Euphorbiaceae	Bark	Gastritis	Bark of this plant is dried in sunlight to prepared powder and 25-30 gm powder are ground and mixed with water 250-300 mL, pour it overnight. It is taken in the morning empty stomach for few days.
<i>Kaempferia rotunda</i> L. SP-106	Herb	Bhumichampa (G)	Zingiberaceae	Rhizome	Cough, cold, stomach problem	Tubers are dried to make powder, 5-10 gm powder mixed with water. It can be consumed at a rate of 1-2 teaspoon per day after meals.
<i>Maranta arundinacea</i> L. SP-129	Herb	Golbera (G)	Marantaceae	Tuber	Cough	Tuber of this plant dried in sunlight; 10 gm powder mixed with 100ml of water. The mixture is taken three times after food in a day for 1 week or more until is cure.
<i>Macropanax undulatus</i> (Wall. Ex G. Don) SP-117	Tree	Sambrong (G)	Araliaceae	Leaf	Headache	Leaves (6-10) crushed to make a smooth paste applied it on forehead for 20-30 minute until dry to cure headache.
<i>Melia azadirachta</i> L. SP-124	Tree	Neemburang (G)	Meliaceae	Leaf	Fever, stomach pain, skin diseases, fungal infection, toothache, dandruff, headache	(20-30 gm) leaf paste dried to prepared small sized round shaped tablet. One tablet is taken every morning in empty stomach for 15 days or more to cure stomach problem. <i>M. azedarach</i> leaf and <i>N. arbor-tristis</i> root mixed and grounded to make a juice, it is taken two teaspoons with honey (morning and evening) used for the treatment of fever. Leaf pastes of this plant used to treat skin, fungal infection, dandruff and headache problem.
<i>Milletia pinnata</i> (L.) Pierre. SP-128	Tree	Karengi (G)	Fabaceae	Bark	Stomach pain	Bark (10-20 gm) of this plant ground to make a powder and poured it overnight. It is taken 2 teaspoon empty stomach in the morning time for a week to treat stomach pain.
<i>Morinda angustifolia</i> Roxb. SP-144	Tree	Chengrong (G)	Rubiaceae	Root	Jaundice, cold, insect bite, fever, urinary diseases, indigestion	30 gm of <i>M. angustifolia</i> root barks, 7 gm <i>S. robusta</i> stem barks and 10 gm <i>O. indicum</i> root barks are dried to prepared powder, added with 3 gm turmeric powder. 50gm mixture of the powder boiled with 400-500 mL water to make ¼ th extract and stored it for further used. It is taken 30-40 mL (half tea cup), two times after food for one week or more until jaundice is not cured.

(Contd...)

Table 1: (Continued)

Scientific name	Habit	Local name	Family	Part used	Diseases	Mode of preparation
<i>Nyctanthes arbor-tristis</i> L. SP-111	Shrub	Athamphring (G)	Oliaceae	Leaf	Fever, Malaria	Leaf (10 gm) of this plant add with neem leaf (10 gm), crushed to make a juice. It is taken one teaspoon with honey, three times per day after food.
<i>Peperomia pellucida</i> (L.) Kunth SP-141	Herb	Samol-h-pang (G)	Piperaceae	Whole plant	Snakebite, ear pain	Whole plant (10 gm) crushed to make a smooth paste and directly applied on snakebite area for 24 hours, it is help to relief from poisonous pain. Leave (6-7) juice of this plant use for the treatment of ear pain. Two drops leaf juice given drop by drop in ear in a day at night time.
<i>Phyllanthus urinaria</i> L. SP-142	Herb	Memangambare (G)	Phyllanthaceae	Leaf	Eye infection	10 gm leaves of this plant mixed with 5 gm onion and 5 gm manimuni leaves, all plants leaves are ground to make a juice stored in a glass bottle. Two drops juice is put in to eyes daily in bed time to cure eye infection.
<i>Pterocarpus santalinus</i> L. f SP-104	Herb	Red Chandan (G)	Fabaceae	Leaf, bark, root	Headache, child (fits, seizure)	Leaf and bark (10 gm) of this plant paste with small amount of water and applied it on forehead for 1-2 hours to treat headache problem. <i>P. santalinus</i> bark mixed with the root of <i>C. decatylon</i> plant. A small amount of mixture is taken to make a tabiz to treat child's fits and seizure diseases.
<i>Rotheca serrata</i> (L.) Steane & Mabb. SP-137	Shrub	Dieingbharangi (G)	Lamiaceae	Leaf	Skin diseases, fever	The pounded leaves are applied for the skin diseases. 5-8 leaves are boiled with 200 mL of water and the juice extracts is taken two times after food to relief from fever.
<i>Saraca asoca</i> (Roxb.) Willd. SP-139	Tree	Asoca (G)	Fabaceae	Bark	Menstrual problem	Bark (10-20 gm) are boiled with (250-300 mL) water for 15-20 minutes in low flame to make concentrated extract and stored it in a glass container for future used. 10 mL extract can be taken two times in a day for one week or more.
<i>Sansevieria trifasciata</i> Pra in SP-148	Herb	Wakhum (G)	Liliaceae	Root	Insect bite	Root (10 gm) part of this plant is crushed and applied on spider bite area for half an hour to relief from it.
<i>Schefflera wallichiana</i> (Wight & Arn.) Harms SP-102	Tree	Dorengmi (G)	Arilicaceae	Leaf	Neck pain	7-8 Leaves with twigs warm around the neck to relive from pain.
<i>Sellaginella ornata</i> Spring SP-113	Herb	Aroma (G)	Sellaginaceae	Whole plant	Skin problems of animals	Whole plant (50 gm) crushed with banana leaf to make a smooth paste and applied it on the skin of animal for 2-3 days to cure skin infections.
<i>Scoparia dulcis</i> L. SP-132	Herb	Chinibunsamphal (G)	Plantaginaceae	Leaf	Mouth Cancer, tonsil	Leaves (20 gm) are paste and wrapped it with a cotton bandaged around the neck for an hour to cure tonsil. 30-50 gm leaves are boiled with water (250-500 mL) to make ¼ th juice extract. It is taken 10 mL two times (morning and evening) for one month or until cure mouth cancer.
<i>Solanum kurzii</i> L. SP-146	Shrub	Kimka (G)	Solanaceae	Fruit	Daibetes	50-100 gm fruits cooked with vegetables, taken it as a traditional dish by local healers to cure diabetes disorder.
<i>Shorea robusta</i> Gaertn. SP-136	Tree	Boldak (G)	Dipterocarpaceae	Leaf	Eye infection	4-5 pounded leaf of this plant applied as a drop in infected area of eyes to cure eye infection of cow.

(Contd...)

Table 1: (Continued)

Scientific name	Habit	Local name	Family	Part used	Diseases	Mode of preparation
<i>Stephania japonica</i> (Thunb.) Miers SP-116	Climber	Samkuchak (G)	Menispermaceae	Rhizome	Asthma	50 gm rhizome of this plant dried in sunlight, ground it to prepared powder. Small amount of powder (5 gm) mixed with warm water and taken it two times morning and bed time for few days to treat asthma.
<i>Sterculia villosa</i> SP-119	Tree	Olmak (G)	Sterculiaceae	Stem bark	Throat pain	Stem and barks (50 gm) are boiled with 500 mL water for 10 minutes in low flame. The juice (50-70 mL) is taken for gargle three times for few days to cure throat pain.
<i>Triumfetta rhomboidea</i> Jacq. SP-120	Herb	Samthre (G)	Malvaceae	Leaf, Root	Vomiting, dysentery, diarrhoea, skin problem, burns, fever.	20 gm roots boiled with 250 mL of water. Take it two times for one week to cure dysentery and diarrhoea. 10-20 gm of root is decoction to make juice extract, it can be taken 1 teaspoon in empty stomach for two days to treat vomiting. Leaves, stem, roots and <i>A. marmelos</i> barks are dried after that all of the parts of plants are wrapped by banana leaf and burn it on fire wood for few minutes. The mixtures are ground to make a fine powder and applied on it infected skin and burn area. Leaf (50 mL) juice is taken two teaspoon two times for 4-5 days to relief from fever.
<i>Zingiber zerumbet</i> L. SP-143	Herb	Ahutta (G)	Zingiberaceae	Rhizome	Joint pain, bone fracture	Rhizome of <i>Z. zerumbet</i> (15 gm), <i>P. nigrum</i> fruit (3 gm) and <i>C. gigantea</i> leaves (12 gm) are fried with mustered oil. Massage this oil extract properly in joint pain area two times in a day for one month or more until it is not cure.
<i>Ziziphus mauritiana</i> Lam. SP-118	Tree	Khangelwabok (G)	Rhamnaceae	Bark	Mouth ulcer	10-15 gm Stem bark is dried properly in sunlight, ground to make a fine powder and applied it with a mustard oil on infected area of mouth.

G – Garo tribes

Table 2: Use-Values (UV) and Fidelity % of medicinal plants in the selected study site

Scientific name	Family	Reported Diseases	FL (%)	UV
<i>Alternanthera brasiliana</i> (L.) Kuntze.	Amaranthaceae	Menstrual pain	42.85%	0.04
<i>Bauhinia variegata</i> L.	Fabaceae	Throat pain,	50%	0.04
<i>Callicarpa arborea</i> Roxb.	Lamiaceae	Menstrual problem	66.66%	0.04
<i>Camonea umbellata</i> (L.) A.R. Siomes & Staples	Convolvaceae	Urine infection	50%	0.04
<i>Celosia cristata</i> L.	Amaranthaceae	Nose bleeding, bleeding haemorrhoids	75%	0.09
<i>Chromolaena odorata</i> (L.) R. M. King & H. Rob.	Asteraceae	Cut wounds and stomach-aches	57%	0.09
<i>Clitoria ternatea</i> L.	Fabaceae	Stomach problem, eye redness	71.42%	0.09
<i>Clerodendrum bungei</i> Steud.	Lamiaceae	Nose bleeding, gastric, stomach pain	50%	0.13
<i>Cissus cactiformis</i> Gilg	Vitaceae	Bone fracture	100%	0.04
<i>Cordyline terminalis</i> (L.) Kunth	Asparagaceae	Children (1-5 years old) fever	50%	0.04
<i>Crinum americanum</i> L.	Amaryllidaceae	Bone fracture, paralysis	100%	0.09
<i>Eleutherine bulbosa</i> (Mill.) Urb.	Hypoxidaceae	Vomiting	42.85%	0.04
<i>Desmodium triquetrum</i> (L.) DC.	Fabaceae	Menstrual problem, weakness	33.33%	0.09
<i>Dieffenbechia amonea</i> Bull.	Araceae	Spider bite	57%	0.04
<i>Dillenia scabrella</i> Roxb.	Dilleniaceae	Snake bite.	66.66%	0.04

(Contd...)

Table 2: (Continued)

Scientific name	Family	Reported Diseases	FL (%)	UV
<i>Discorea bulbifera</i> L.	Discoreaceae	Snakebite	50%	0.04
<i>Euphorbia Heterophylla</i> L.	Euphorbiaceae	Skin infection, cut wounds	25%	0.09
<i>Euphorbia neriifolia</i> L.	Euphorbiaceae	Eye infection, nail infection, fungal infection of skin, cold, cough, fever, asthma, snake bite.	100%	0.36
<i>Elephantopus scaber</i> L.	Asteraceae	Stomach pain (navel)	33.33%	0.04
<i>Eurya acuminata</i> DC.	Pentaphylaceae	Digestive problem	50%	0.04
<i>Flacourtia jangomas</i> (Lour.) Raeusch	Salicaceae	Haemoglobin increases (Anemia)	66.66%	0.04
<i>Flamingia stricta</i> Roxb.	Fabaceae	Bone fracture	50%	0.04
<i>Gardenia campanulate</i> Roxb.	Rubiaceae	Postpartum disorder	50%	0.04
<i>Hypoestes phyllostachya</i> Baker.	Acanthaceae	Swelling, itching	40%	0.09
<i>Iresine herbstii</i> Hook.	Amaranthaceae	Menstrual over bleeding	33.33%	0.04
<i>Kalanchoe pinnata</i> (Lam.) Pers.	Crassulaceae	Cancer, kidney stone, digestive problem, fungal infection, skin infection	100%	0.22
<i>Jatropha curcas</i> L.	Euphorbiaceae	Gastritis	71.42%	0.04
<i>Kampheria rotunda</i> L.	Zingiberaceae	Cough, cold, stomach problem	40%	0.13
<i>Maranta aurundinacea</i> L.	Marantaceae	Cough	50%	0.04
<i>Macropanax undulatus</i> (Wall. Ex G.Don)	Araliaceae	Headache	25%	0.04
<i>Melia azedarach</i> L.	Meliaceae	Fever, stomach pain, skin diseases, fungal infection, toothache, dandruff, headache.	100%	0.31
<i>Millettia pinnata</i> (L.) Pierre	Fabaceae	Stomach pain	42.85%	0.04
<i>Morinda angustifolia</i> Roxb.	Rubiaceae	Jaundice, cold, insect bite, fever, urinary diseases, indigestion	100%	0.27
<i>Nyctanthes arbor-tristis</i> L.	Oliaceae	Fever, Malaria	100%	0.09
<i>Peperomia pellucida</i> (L.) Kunth	Piperaceae	Snakebite, ear pain	100%	0.09
<i>Phyllanthus urinaria</i> L.	Phyllanthaceae	Eye infection	60%	0.04
<i>Pterocarpus santalius</i> L.f	Fabaceae	Headache, child (fits, seizure), skin problem	57.14%	0.13
<i>Rotheca serrata</i> (L.) Steane & Mabb.	Lamiaceae	Skin diseases, fever	50%	0.09
<i>Saraca asoca</i> (Roxb.) Willd.	Fabaceae	Menstrual problem, uterine problem (painful urination), stomach pain gynaecological disorder (hormonal imbalance, irregular period)	100%	0.18
<i>Sansevieria trifasciata</i> Prain	Liliaceae	Insect bite	50%	0.04
<i>Schefflera venulose</i> (Wight & Arn.) Harms	Ariliaceae	Neck pain	50%	0.04
<i>Sellaginella ornate</i> Spring	Sellaginaceae	Skin problems of animals	71.42%	0.04
<i>Scoparia dulcis</i> L.	Plantaginaceae	Mouth Cancer, tonsil	100%	0.09
<i>Solanum kurzii</i> L.	Solanaceae	Diabetes	80%	0.04
<i>Shorea robusta</i> Gaertn.	Dipterocarpaceae	Eye infection	75%	0.04
<i>Stephania japonica</i> (Thunb.) Miers	Menispermaceae	Asthma	75%	0.04
<i>Sterculia villosa</i>	Sterculiaceae	Throat pain	80%	0.04
<i>Triumfetta rhomboidea</i> Jacq.	Malvaceae	Vomiting, dysentery, diarrhoea, skin problem, burns, fever	100%	0.09
<i>Zingiber zerumbet</i> L.	Zingiberaceae	Joint Pain, bone fracture	66.66%	0.09
<i>Zizyphus mauritiana</i> Lam.	Rhamnaceae	Mouth ulcer	50%	0.04

Use-Value (UV)

Determination of use value (UV) The relative importance of each prescribed medicinal plant was calculated by determining the use value (Phillips *et al.*, 1994; Zenderland *et al.*, 2019), in order to measure the relative importance of plants used by local healers on a quantitative basis: $UV = \sum U_i/n$

Where U_i is the number of use-reports cited by each informant for a given species and n refers to the total number of informants. When there are many use reports for a plant, the

UV will be high, and when there are few reports for a plant, the UV will approach zero (0).

Informants' Consensus Factor

Determination of Informants' consensus factor (ICF), i.e., ICF is usually calculated using a formula. This is done in order to find out the homogeneity in the information given by the informants of the study area. The ICF was calculated by the following formula (Trotter & Logan, 2019; Singh *et al.*, 2012; Bhat *et al.*, 2013).



Figure 2: a) *Desmodium triquetrum* (L.) DC., b) *Eurya acuminata* DC., c) *Triumfetta rhomboidea* Jacq., d) *Callicarpa arborea* Roxb., e) *Euphorbia heterophylla* L., f) *Camonea umbellata* (L.) A.R. Siomes & Staples, g) *Bauhinia variegata* L., h) *Kaempferia rotunda* L., i) *Morinda angustifolia* Roxb., j) *Crinum americanum* L., k) *Schefflera venulosa* (Wight & Arn.) Harms, l) *Jatropha curcas* L., m) *Rothea serrata* (L.) Steane & Mabb., n) *Millettia pinnata* (L.) Pierre, o) *Euphorbia neriifolia* L., p) *Alternanthera brasiliana* (L.) Kuntze, q) *Peperomia pellucida* (L.) Kunth and r) *Clerodendrum bungei* Steud

$$FIC = (Nur - Nt) / Nur - 1$$

Here Nur is the member of the use report in a particular category of illness by informants and Nt is the number of species of taxa that are used for the treatment of a particular disease category by informants of the study. The ICF values range from 0 to 1. When it is higher or close to 1, it indicates higher reports about a plant species used by the informants in a particular ailment. When the value is low or near 0, it indicates disagreement by the informants about a plant used for a certain ailment.

Fidelity Level Percentage (FL %)

For each species the Fidelity Level Percentage (FL%) was calculated by using the following formula (Friedman *et al.*, 1986).

$$FL (\%) = (lp/lu) \times 100$$

Where, lp=Number of informants who independently claimed the use of a particular plant species for a major ailment lu=Total

number of informants who mentioned the plant species for any ailment.

RESULT

The present study identified 50 medicinal plants from 35 families used to treat 38 common ailments (Tables 1 & 2). The study provides updated information on botanical names, families, local names, village names, parts used, diseases treated, and methods of preparation. Herbs were found to be the most commonly used, constituting 40% of the plants studied, followed by shrubs at 20%, trees at 30%, and climbers at 10% (Figure 3). Leaves, used predominantly in paste form, were the most frequently utilized part (46%) in herbal therapy. Various preparation methods include paste, powder, boiling, raw use, juice, and decoction. The local informants, mainly indigenous tribal people such as the Garo tribes who have long resided in the area, practice traditional medicinal plant use for treating a range of ailments. The Fabaceae family was particularly prevalent among the local healers. Common conditions treated include bone fractures, stomach pain, fever,

colds, and digestive disorders, while serious illnesses like oral cancer, paralysis, and snake bites are also addressed by these traditional healers.

Use Value of Medicinal Plants

The local tribes rely heavily on medicinal plants for their primary health care needs, and these plants also serve various other purposes such as food, animal fodder, firewood, and construction. Through semi-structured questionnaires distributed to the local communities in five villages within the study area, approximately 50 useful plant species have been identified. Among these, *Euphorbia neriifolia* L., *Melia azedarach* L., *Morinda angustifolia* Roxb., and *Triumfetta rhomboidea* Jacq. are noted for their highest total use value. Conversely, 27 species have the lowest total use value according to the local people. The Euphorbiaceae family stands out with the highest use value, indicating that its members are frequently utilized by the local tribes for treating various ailments. *E. neriifolia* is the most commonly used species, with a use value of 0.50, followed by *M. azedarach* with a use value of 0.43, *M. angustifolia* with 0.38, and *T. rhomboidea* also with a use value of 0.38.

Fidelity Value (FL)

The Fidelity Level (FL) value suggests that nearly all reported uses of these plants are for similar purposes and reflect the presence of phytochemical compounds within the medicinal plants. This study found that the fidelity of plant species for treating different ailments ranged from 33.33% to 100%, as detailed in Table 3. Plants with the highest FL of 100% include *Cissus cactiformis* Gilg, *Crinum americanum* L., *E. neriifolia* L., *Kalanchoe pinnata* (Lam.) Pers., *M. azedarach* L., *Peperomia pellucida* (L.) Kunth., *Saraca asoca* (Roxb.) Wild., *Scoparia dulcis* L., *M. angustifolia* Roxb., and *Nyctanthes arbor-tristis* L., indicating they are preferred by plant practitioners for disease treatment. Conversely, *Elephantopus scaber* L., *Iresine herbstii* Hook., and *Desmodium triquetrum* (L.) DC. show the lowest fidelity for treating a variety of diseases.

Informants’ Consensus Factor (IFC)

In this present investigation, the medicinal plants used to treat different ailments in the district of Meghalaya were classified

and the IFC value of every disease category was calculated (Table 3). In the study, the Gastroenteritis diseases category showed the greatest agreement with an IFC of 0.74%. It was followed by Endocrinology, Nephrology and haemorrhoids diseases category (0.71%), Dermatological (0.70%), fever, cold and cough (0.69%), Gynecological (0.67%), Urinogenital and Pulmonary diseases (0.67%), External injuries (0.67%), Snakebite and Spider bite (0.60%), Otorhinolaryngology (0.57%), Hematology and Jaundice (0.50%). In this present investigation, the medicinal plants used to treat different ailments in the Ri-Bhoi district of Meghalaya were classified into 11 ICPC (International Classification of Primary Care) disease categories. In the study, the Gastroenteritis diseases category showed the greatest agreement with an FIC of 0.74% and the least agreement between the informants was recorded in the responses related to Neurological disorder representing 0.33%.

DISCUSSION

In Meghalaya, a large number of indigenous and immigrant ethnic and tribal peoples are inhabiting with bewildering physical and cultural features. Ethnic people have always delivered their traditional knowledge from one generation to another. The present study documented 50 numbers of medicinal plant species belonging to 35 families used in the treatment of 38 common ailments which are used for medicinal purposes by the local healers. Previously, a similar study recorded 105 ethnomedicinal plant species of 93 genera representing 62 families were found in Kameng district of Arunachal Pradesh, documented by Kar and Barthakur (2015). Borgohain *et al.* (2016) documented through semi-structured interviews conducted on 17 traditional healers from nine Phake villages of Dibrugarh and Tinsukia districts of Assam, 50 medicinal plants used in treatment of 36 ailments to cure a cancer patient. In Meghalaya, a preliminary Survey was undertaken by Joseph and Kharkongor (1981) in the Khasi and Jaintia hills, which contributed substantially to ethnobotanical studies. Previously various authors worked on ethnomedicinal plants of Meghalaya about the knowledge of traditional practices (Kumar *et al.*, 1987; Samati, 2006; Singh *et al.*, 2014).

The local tribes depend on the medicinal plants for primary health care and these plants are also used for different purposes like food, animal fodder, firewood, construction, etc. Kvist

Table 3: Informant consensus factor (Fic) of the diseases reported by the informants

Diseases category	Use reports	No. of Taxa	Fic
Gastroenteritis	36	11	0.74
Endocrinology, Nephropathy and hemorrhoids diseases	8	3	0.71
Dermatological	11	4	0.70
Fever, cold, cough	14	5	0.69
Gynecological disorder	8	3	0.67
Urinogenital and Pulmonary diseases	16	5	0.67
External injuries	4	2	0.67
Other (Snakebite/Spider bite)	8	5	0.60
Otorhinolaryngology	20	9	0.57
Hematology and Jaundice	3	2	0.50
Neurological disorder	4	3	0.33

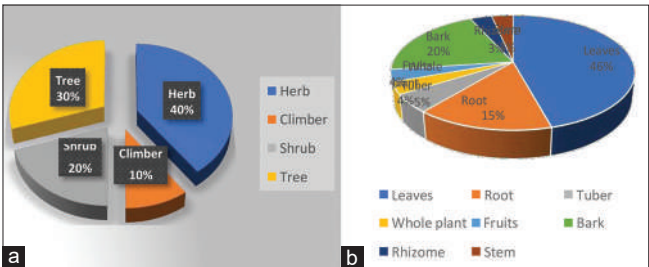


Figure 3: a) Percentage of plants in terms of its habits out of 60 plant species and b) Percentage of plant parts used for treating various diseases

(2001) suggested that the study of use value helps to identify some useful plant species that should be considered as priorities for conservation. In the present study, it was investigated that the Euphorbiaceae family has the highest use value, which is frequently used by the local tribes for the treatment of different diseases. The most commonly used species were *E. neriifolia* with 0.50 use value, which were followed by *M. azedarach* with (0.43) use value, *M. angustifolia* with 0.38 use value and *T. rhomboidea* with 0.38 use value. Previously, the highest use value of *Zingiber officinale* as the ethnomedicinal plant has also been reported by Gairola *et al.* (2014). Pala *et al.* (2019) recorded the highest use value for *Ocimum sanctum* (0.53) whereas the least use value of 0.013 was observed each for *Lennea coromandelica* and *Cinnamomum zeylanicum*. Navneet & Bhandari (2021) analysed the cross verification of indigenous people and recorded the highest use value of *Acacia catechu* (0.143) whereas other species *Ziziphus nummularia* has been observed for low use value (0.023). Mir *et al.* (2022) investigated that the highest use value was reported for *Capsella bursa-pastoris* (0.30) and the lowest use value of 0.08 was recorded for *Amaranthus caudatus*, *Cosmos bipinatus*, *Cuscuta europaea*, and *Impatiens glandulifera*. Ralte *et al.* (2024) documented the use value of the medicinal plants used by the indigenous community of the western region of Mizoram, India. The UV of *Oroxylum indicum* (L.) Kurz. (6.25) and *Curcuma longa* L. (4.31) were found to be the highest use value. While *Licuala peltate* Roxb. Ex Buch-Hum (0.09) received the lowest recognition for their therapeutic potential.

FL value indicates that almost all the use reports for these plants refer to the same purpose and the presence of phytochemical compounds in the medicinal plants. The present study revealed that the fidelity of a plant species disease was varied between 33.33% to 100% for treating different ailments. Sanglyne *et al.* (2019) investigated the fidelity value of 110 species which is belonging to 92 genera and 56 families and documented the fidelity value was maximum (77.77%) for the *Piper betle* group under the external injury. Similar to our finding that *E. neriifolia* has a higher FL % which may be due to its antimicrobial activities against different pathogens. According to Sultana *et al.* (2022), investigated that this species *E. neriifolia* may serve as a model for developing more potent drugs to combat COVID-19 and other newly emerging infectious diseases. Similar study was reported by various authors to investigate the number of informants who independently claimed the use of a particular plant species for a major ailment (Ezhil *et al.*, 2016; Caunca & Balinado, 2021; Reang *et al.*, 2023).

In this present investigation, the medicinal plants used to treat different ailments in the Ri-Bhoi district, Meghalaya were classified into 11 ICPC (International Classification of Primary Care) disease categories. In the study, the Gastroenteritis diseases category showed the greatest agreement with an FIC of 0.74% and the least agreement between the informants was recorded in the responses related to Neurological disorder representing 0.33%. Subba *et al.* (2023) recorded the highest Fic value was found in the case of digestive system disorder.

Asiimwe *et al.* (2021) studied that the highest ICF (0.71) which was recorded for respiratory disorders has been reported to be

the dominant disease category. The highest informant consensus factor with the highest number of species (93) being used for the digestive system (IFC = 0.76%), followed by oral and dentistry (IFC = 0.73%) category among the various communities of Assam, recorded by Gogoi and Nath (2021). Previously various authors followed this ICF value as a significant tool to carry out respective ethnobotanical work (Singh *et al.*, 2014; Hassan *et al.*, 2017; Arora & Lohar, 2019).

The diverse array of medicinal plants identified in Ri-Bhoi District reveals a sophisticated system of traditional medicine that has been honed over generations. These plants serve various purposes, from treating common ailments to managing chronic conditions, showcasing the adaptability and resilience of traditional healing systems. Moreover, the knowledge and practices surrounding these plants are threatened by modern challenges such as habitat loss, changing lifestyles, and the erosion of traditional knowledge. It is crucial to document and preserve this ethno medicinal knowledge, not only to safeguard cultural heritage but also to contribute to the broader field of ethno botany and pharmacology. Collaborative efforts between tribal communities, researchers, and policymakers are essential to ensure that this invaluable knowledge is not only preserved but also respected and integrated into broader health and conservation strategies. This survey also helped to comprehend the use value (UV), the informant consensus factor (ICF) and the fidelity level (FL) of these plants. Among 50 plant species documented, the local traditional practitioners often use *E. neriifolia* L., *Azedarach indica* L., *M. angustifolia* Roxb. and *T. rhomboidea* Jacq. having the highest total use value to the local community. The pharmacological screening activity and the isolation of pure lead compounds from each of the individual plants will give excellent information in regard with the true remedial activity to cure different health complications.

The traditional medicine practice is recommended strongly for selected medicinal plants as well as further work should be carried out to isolate, purify, and characterize the active constituents responsible for the activity of these plants. Further, the study will provide a platform for pharmaceutical industries to select the plants for various drugs in the ground of traditional medicine practices. The exploration of traditional healing practices among the tribal communities of Ri-Bhoi District, Meghalaya, underscores a profound and intricate relationship between these communities and their natural environment. The ethnomedicinal plant knowledge preserved and practiced by these tribes reflects a rich tapestry of cultural heritage and ancestral wisdom. These practices not only embody a deep understanding of local flora but also highlight the integral role of these plants in maintaining health and well-being within these communities. In conclusion, the study of ethno medicinal plant uses in Ri-Bhoi District provides valuable insights into the intricate relationship between humans and nature, and underscores the importance of preserving traditional healing practices. The continued recognition and respect for this knowledge can contribute to more sustainable and inclusive approaches to health and environmental conservation, benefiting both local communities and global health paradigms.

ACKNOWLEDGEMENT

The authors are grateful to University of Science and Technology Meghalaya, for providing the necessary experimental knowledge and facilities.

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