# Ethnobotanical documentation of medicinal plants and traditional fermented foods of the Mishing community in Jorhat district of Assam, India

Preronaa Gogoi, Surajeet Konwar, Sujata Das, Dashami Das, Rituporna Doimari, Tinnu Sonar, Sita Doley

**Correspondence**

**Preronaa Gogoi[1], Surajeet Konwar[2*], Sujata Das[3], Dashami Das[4], Rituporna Doimari[5], Tinnu Sonar[4], Sita Doley[6]**

[1]Department of Botany, Digboi College (Autonomous), Digboi, Assam
[2]Department of Botany, Tangla College, Tangla, Udalguri, BTR, Assam
[3]MBBT, Tezpur University, Tezpur, Assam
[4]Department of Life Sciences, Dibrugarh University, Dibrugarh, Assam
[5]Department of Life Sciences, Debraj Roy College (Autonomous), Golaghat
[6]Department of Education, Gauhati University, Assam

*Corresponding Author: surajeetkonwar5456@gmail.com

**Ethnobotany Research and Applications 34:75 (2026)**- http://dx.doi.org/10.32859/era.34.75.1-31
Manuscript received: 06/12/2025 - Revised manuscript received: 20/06/2026 - Published: 21/06/2026

## Research

## Abstract

*Background*: The current study documents the traditional knowledge of ethnomedicinal plants, and ethnic fermented foods and beverages used by the Mishing community in the Jorhat district of Assam, aiming to understand their contribution to primary healthcare and cultural practices.

*Methods*: Ethnobotanical surveys were carried out in 10 villages of Jorhat district between March 2024 and 2025 through semi-structured questionnaires, individual interviews, and focused group discussions with 50 key informants, and the plants were collected, taxonomically identified using standard floras and online databases, and then analyzed quantitatively using indices such as Use Value (UV), Informant Consensus Factor (ICF), Relative Frequency Citation (RFC) and Fidelity Level (FL%).

*Results*: A total of 94 medicinal plant species belonging to 56 families were recorded, with Lamiaceae and Rutaceae being the most represented families, and leaves constituting the most frequently used plant part for treating ailments including diabetes, dysentery, jaundice, gastric disorders, infections, kidney stones, and allergies. *Ocimum sanctum* and *Paederia foetida* had the highest use value (UV) of 1. The highly cited or high RFC value containing plant species included *O. sanctum* and *Azadirachta indica* (0.96). *Acorus calamus*, *Aegle marmelos*, *O. sanctum* and *P. foetida* had the highest FL%. In addition, two ethnic fermented foods (Numsing and Iku) and two traditional rice-based fermented beverages (Po: ro apong and Noggin apong) were documented, prepared using diverse medicinal plant additives and household techniques that enhance preservation, palatability, and nutritional value.

*Conclusions*: The results reveal a rich repository of ethnomedicinal knowledge and fermentation practices that support community-based primary healthcare and nutrition among the Mishing people. Immediate scientific validation and conservation-oriented documentation are required to safeguard this rapidly declining indigenous knowledge system.

*Keywords*: Ethnomedicine; Mishing; Traditional knowledge; Ailment; Use Value; Informant Consensus Factor (ICF); Relative Frequency Citation (RFC) ; Fidelity Level (FL%); Treatment, Fermented food.

## Background

Traditional medicinal plants have long been essential in preventing and treating various diseases. According to the World Health Organization, approximately 88% of the world's population, particularly in rural regions, still uses traditional and herbal medicines for the prevention and treatment of various ailments (Ralte *et al.* 2024). The dependence of ethnic groups on their traditional medicine system is driven by its affordability and easy access, as well as the fact that these phyto-remedies are deeply rooted in their culture and everyday lives (Choudhury *et al.* 2015; Saikia *et al.* 2006; Rout *et al.* 2012; Daimari *et al.* 2019; Sikdar and Dutta, 2008; Namsa *et al.* 2011). Indigenous people have a long history of utilizing and conserving different medicinal plants for treating diseases like diarrhea, leprosy, asthma, scabies, constipation, diabetes, jaundice, dysentery, skin diseases, and reproductive-related disorders (Choudhury *et al.* 2015; Rout *et al.* 2012; Daimari *et al.* 2019; Das *et al.* 2008; Saikia *et al.* 2006; Charah, 2014; Bhandari, 1984). Historically, the medicinal uses of plants and their parts have been catalogued in Hindu scriptures such as the Rig Veda, Atharva Veda, and Charak Samhita (Daimari *et al.* 2019; Sharma *et al.* 2012; Kanneganti *et al.* 2023; Rasool *et al.* 2020). Consequently, many modern healthcare medicines directly or indirectly have roots in age-old traditional systems, where the phytomedicines knowledge derived from indigenous groups forms a fundamental base for modern drug derivation (Rout *et al.* 2012; Kanneganti *et al.* 2023). Traditional knowledge heavily drives the preservation of native plant resources significant to local populations (Cox, 2000; Leonti *et al.* 2002; Leonti, 2011; Kayani *et al.* 2015). Proper study, identification, and documentation can help identify new formulas and targets for discovering drugs to cure ailments.

North East India is a hub of biodiversity and a well-recognized part of the Indo-Burma hotspot (Rout *et al.* 2012; Adhikari *et al.* 2018; Barbhuiya *et al.* 2009). In this landscape, numerous economically critical medicinal plants flourish due to a well-suited humid climatic zone and favorable geography (Choudhary *et al.* 2015; Daimari *et al.* 2019; Sharma *et al.* 2012). Several tribes with vivid, unique cultures coexist within the different states of Northeast India. The rich ethnic diversity and abundance of bioresources across the eight states of the North Eastern Region, Assam, Arunachal Pradesh, Nagaland, Manipur, Meghalaya, Mizoram, Tripura, and Sikkim, have resulted in a vast supply of traditional fermented foods and unique drinks (Teramoto *et al.* 2002). Indigenous knowledge systems among the ethnic communities of North East India are closely linked with traditional food practices, particularly fermentation. Fermented foods and beverages have been integral to the social, cultural, and nutritional life of various tribes since ancient times. Different ethnic tribes here have highly distinctive, regionally specific methods for fermenting food and using different substrates (Das and Deka, 2012; Keishing and Banu, 2015; Tamang *et al.* 2012).Fermented foods are vital to human diets because of their affordability, particularly in underdeveloped nations, and indigenous fermented foods represent a major dietary component for several ethnic tribes in India. Fermentation is regarded as one of the earliest and most cost-effective techniques for developing unique tastes, scents, and textures. In addition to preserving food, the process enhances its flavour and nutritional content (Keith and Steinkraus, 1996). All fermented foods work in concert with a unique type of microbiota that raises the levels of vitamins, proteins, fatty acids, vital amino acids, and other nutrients (Sharma and Kapoor, 1996). Because they possess proper nutritional value, the preservation of these fermented food items along with standard preparation protocols is crucial.

The Mishing ethnic group, belonging to the Indo-Mongoloid group of the Indian population, is one of the well-known tribes of Assam. Their origin is traced back to the hilly areas of Arunachal Pradesh, from where they later migrated to different parts of Assam. The Mishing community has been utilizing many medicinal plants to cure various ailments since time immemorial through their indigenous knowledge system (Ralte *et al.* 2024) and these are also incorporated into fermented food products, enhancing both their nutritional and therapeutic value. This vital knowledge is mostly passed on from one generation to the next, usually through word of mouth and lacks proper documentation. Additionally, with the influence of modern lifestyles and innovations in medical science, the employment of traditional and herbal medicines is rapidly decreasing. Thus, proper documentation and assessment are crucial for the preservation of this indigenous knowledge.

Compared to other regions of Assam, the districts of upper Assam have been less focused on the study of medicinal herbs prepared and used by the different residing ethnic groups. The Jorhat district of Upper Assam, India, is well known for its rich cultural diversity of various ethnic groups. Therefore, the present study has been undertaken to identify and document the medicinal plant species, their specific process of preparation, and the range of diseases treated by the traditional phytomedicines prepared by the Mishing tribes of Jorhat district. The present study integrates the documentation of different kinds of ethnomedicinal plants along with different ethnic fermented food products, highlighting the holistic healthcare practices of the Mishing community of Jorhat district, Assam. The medicinal plants are extensively utilized to treat several diseases, mainly including diabetes, dysentery, and jaundice; notably, the same kinds of medicinal plants are used to prepare fermented food products that enhance their medicinal as well as nutritional qualities. By conducting this study across different zones of the Jorhat district, the variations help gain more information instead of concentrating on a single

region. This work explicitly emphasizes documenting the preparation procedures and health benefits of different ethnic fermented foods and beverages used by the community. Documenting these plants along with fermented food production strategies within a single study is essential to understand and correlate the comprehensive approach of the community to holistic healthcare practices, nutritional parameters, customs, traditions, and cultural identity.

This study aimed to (i) document ethnomedicinal plants used by the Mishing community, (ii) quantitatively evaluate plant use patterns, and (iii) record traditional fermented food and beverage preparation practices.

## Materials and Methods

### Study area

The survey was conducted in Assam's Jorhat district (Figure: 1), which is located the state of Assam in northeastern India, lies approximately between 26.20°N to 27.10°N latitude and 93.40°E to 94.20°E longitude. Different Mishing community dominant villages were selected for the study. The site selection was mainly based on the dominance of Mishing population, Accessibility & Availability of traditional healing practices along with rich diversity of medicinal plants. This geographical position places Jorhat in the upper Brahmaputra Valley, giving it a subtropical climate with rich alluvial plains. Diverse types of vegetation such as cultivated medicinal herbs, grasses, aquatic plants, tropical semi-evergreen vegetation, moist deciduous vegetation were observed. The district's location along these coordinates makes it an important cultural, educational, and tea-producing hub of Assam. As per the 2011 Census of India, Jorhat district had a total population of 1,092,256. Of these, 556,805 were males and 535,451 were females. Urban population accounted for about 20.19**%** (220,534 people), and rural population about 79.81**%** (871,722 people). The district had a literacy rate of approximately 82.15% overall.

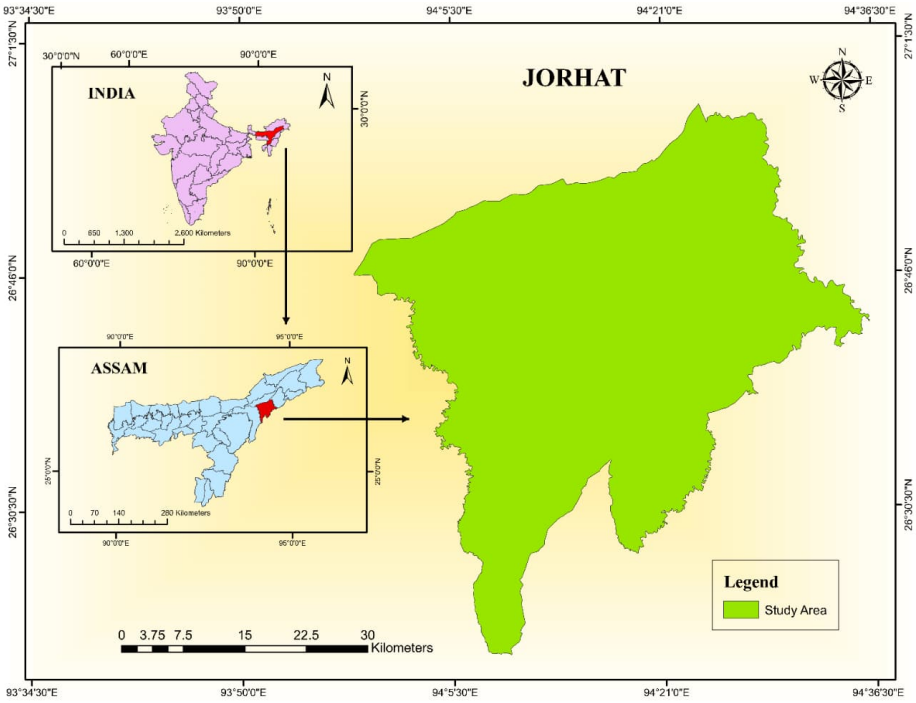


Figure: 1 Map showing the study area (Jorhat district) of Assam using Google Earth (earth.googlee.com/static/multi-threaded/versions/10.55.0.1/index.html?.)

## Materials and Methods

### Data collection and field survey

The study was carried out utilizing a specifically created questionnaire in a variety of locations between March 2024 and 2025; the ethnobotanical research mainly starts with the selection of a study area along with the specific community whose culture, custom and tradition should be interpreted. We were visited 10 villages (Charighoria, Upor Kareng, Kalbari, Neulgaon, Bormukoli, Bahfalla, Borpomua gaon, Kumarbari gaon, Jengrai Chapori and Kawoimari Bonoria Mishing Gaon) of Jorhat district during the first week of every month for 12 consecutive months. A prior consent should be taken along with ethical guidance are under consideration (International Society of Ethnobotany). Data was collected by survey or using standard questionnaires. The collected data was properly analyzed by using Microsoft Excel (MS-Excel) and MS Word was

used for documentation of data in word format. Later a conclusion was drawn. The study was conducted following the International Society of Ethnobiology (ISE) Code of Ethics (2006). In addition, ethical guidelines under the Nagoya Protocol on Access and Benefit Sharing were strictly followed. Prior Informed Consent (PIC) was obtained from all informants before conducting interviews, and participants were clearly informed about the objectives of the study. The knowledge shared by the community was documented with their consent, ensuring confidentiality and respect for traditional knowledge systems. No commercial use of the information is intended, and the study acknowledges the intellectual contribution of the

indigenous Mishing community**.** Here all pertinent information was gathered, including the traditional medicinal plant applications of the Mishing population in Jorhat District. Informants were selected using purposive and snowball sampling to include both knowledgeable individuals and general community members. Key informants such as traditional healers and elderly persons were prioritized due to their expertise in ethnomedicinal practices. Efforts were made to ensure representation across different age groups and genders, recognizing variations in knowledge distribution. The inclusion of younger informants also helped assess the transmission of traditional knowledge. Overall, this mixed approach improved the reliability and comprehensiveness of the data**.** Data was gathered from 50 informants through in-person interviews and targeted group discussions using a specifically created questionnaire. For the purpose of gathering primary data, many trips were undertaken to isolated locations around the district at various times. The identification of the key informants was made feasible by the data gathered from the ethnic tribe. With their assistance, the plants were gathered from the forest, and a systematic questionnaire was utilized to record the local names of the plants that were provided. This questionnaire included the scientific names, family, parts used, application, preparation process, and administration route of the plants. Fifty informants with a good foundation in traditional knowledge were included in the current investigation. Data collection was prioritized throughout the process, and each informant's identity, residence, credentials, and tribal group were all thoroughly documented. This was noted prior to the gathering of information based on traditional knowledge in the local tongue.

A specially created protocol is utilized to record the plant species used in the preparation of ethnic fermented foods and the methods employed by the Mishing community. The procedure involves hands-on tasks related to its preparation process as well as active interactions with the informants.

***Collecting, Identifying, and maintaining Plants***

The Mishing community's herbalists gathered plants for accurate identification when they reached maturity. During the survey, collected specimens were initially recognized using the local name. They were subsequently identified using pertinent taxonomic literature, including Flora of Assam (Kanjilal *et al.* 1940) and Assam's Flora (Chowdhury 2005). The approved scientific name of each species was verified using digital resources such as "IPNI: International Plant Name Index (*https://www.ipni.org*)" and "POWO: Plants of the World Online (*https://powo.science.kew.org*)". Generally, we have to collect the voucher specimen for proper identification of Plant species. But, due to some of our technical and logistic issues encountered during the survey, we are unable to include voucher specimen deposition and herbarium details. The present study mainly focused on the documentation of ethnomedicinal plants and ethnic fermented food & beverages of Mishing community of Jorhat district. So, voucher specimens weren't collected or deposited in any recognized herbarium during the study. Therefore, herbarium accession numbers and acronyms couldn't be added into the manuscript.

**Statistical analysis**

The collected data is organized in tabular format. Data related to medicinal plants, such as botanical name, family, local name, parts used, preparation and route of administration, and use value, were tabulated together. All statistical computations, graphs, and other graphics were prepared using Microsoft Excel.

**Determination of Use Value (UV)**

The Use Value (UV) is a quantitative ethnobotanical index used to assess the relative importance of plant species based on informant knowledge. Where $U_i$ represents the number of use-reports cited by each informant for a given plant species, and $n$ denotes the total number of informants interviewed. This index reflects how frequently a particular plant is mentioned and utilized within the community. A higher UV indicates that a plant is widely recognized and frequently used, suggesting its significant role in traditional healthcare practices. Conversely, a lower UV suggests limited recognition or use, which may indicate either lesser importance, restricted knowledge distribution, or specialized application.

To quantify the relative relevance of plants utilized by Indigenous healers, the use value of each suggested medicinal plant was determined (Zenderland *et al.* 2019).

$$UV=\sum Ui/n.$$

**Determination of Informant Consensus Factor (ICF)**

To assess the consistency of the data provided by the informants in the research region, the informants' consensus factor (ICF) is often calculated. ICF was computed using the formula below (Henrich *et al.* 1998).

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

Here, Nur = number of use reports in a particular category of illness by informants
Nt = number of species of taxa that are used for the treatment of a particular disease category by informants of the study.

The consensus factor value of the informants falls between 0 and 1. Higher reports of a plant species utilized by the informants in a certain disease are indicated when the ICF is greater than or around 1. It suggests disagreement among informants on a plant used to treat a certain disease when it is low or near zero.

**Determination of Relative Frequency Citation (RFC)**

RFC mainly reveals the local importance of every ethnomedicinal plant species found in the particular study area (Tardio & Pardo-De-Santayan, 2008). RFC value can be calculated by using the following formula:

$$RFC = FC/N$$

FC=Number of Informants who cited the plant
N= Total number of Informants

RFC value ranges from 0 to 1. RFC value (1) indicates that the plant species is widely known and mostly cited by local community. 0 RFC value indicates that no informants cited the plant.

**Determination of Fidelity Level (FL %)**

FL% is a systematic method of finding the effectiveness of potentiality of the collected medicinal plants encountered by the informants during the field visit (Frieman *et al.* 1986). It can be calculated by using the following formula:

$$FL\ \% = Np/N \times 100$$

Where, Np is the total respondents who practically utilized a species for a particular ailment
N is the total informants who reported the utility of a species for an ailment

## Results

The informant selection was properly planned to ensure suitable demonstration of different age groups, genders, and educational backgrounds within the community. Informants were selected by using snowball sampling method having the informants with deep understanding of traditional practices. The study had 50 respondents, 17 of whom were men and 33 of whom were women. The majority of participants were in the 41-65 age category indicating that they possessed a considerable ethnomedicinal practices and healing knowledge. Particularly among female herbalists 66 and above category showed significant contributions. This demographic dispersion guaranteed a varied and trustworthy source of data for recording ethnomedicinal practices in the research region.

Table 1. Demographic characteristics of the informants involved in the study

| **Informant categories** | **Education** | | | | **Age** | | | **Total** |
|---|---|---|---|---|---|---|---|---|
| | Illiterate | Primary | Secondary | Higher secondary | 15-40 | 41-65 | 66 and above | |
| Herbalists male | 9 | 5 | 1 | 2 | 1 | 11 | 5 | 17 |
| Herbalists female | 10 | 12 | 7 | 4 | 11 | 10 | 12 | 33 |
| Married male | 5 | 5 | 0 | 0 | 1 | 8 | 1 | 10 |
| Married female | 9 | 10 | 4 | 1 | 5 | 15 | 4 | 24 |

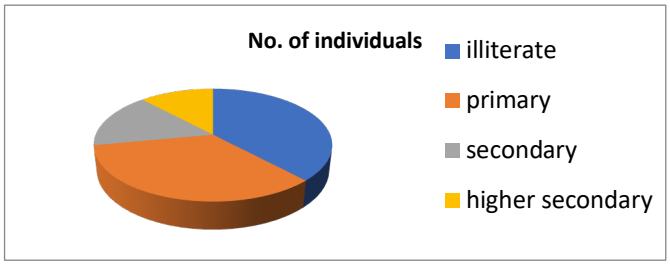


Figure 2. Educational qualifications of the informants

Based on the data illustrated in the form of Use Value (UV) (Table 2), Relative frequency citation (RFC) (Table:2), Informant consensus factor (ICF) (Table 4) and Fidelity Level (FL%) (Table 3) of ethnomedicinal plants showed significant traditional importance among the people of Mishing community. The highly cited or high RFC value containing plant species included *Ocimum sanctum* and *Azadirachta indica* (0.96). *Hibiscus rosa-sinensis* had the second highest RFC value (0.92) used for relieving headaches. *Curcuma longa*, *Piper longum*, *Piper nigrum* and *Paederia foetida* are some commonly cited plant species.

Table 2. List of ethnomedicinal plants used by the people of the Mishing community in Jorhat district, Assam.

| **Family**<br><br>**Family name** | **Botanical name** | **Vernacular Name** | **Part Used** | **Preparation, route of administration and condition relieved** | **Use value** | **Number of informants who cited the plant=FC** | **Relative Frequency Citation (RFC)= (FC/N)** |
|---|---|---|---|---|---|---|---|
| Acoraceae | *Acorus calamus* L. | boch | Roots | Used in the treatment of cough. | 0.68 | 1 | 0.02 |
| Araceae | *Colocasia esculenta* (L.) Schott | kosu | Stem | The sap of the stem is used in the treatment of ant stings, bee stings, or wasp stings. | 0.60 | 12 | 0.24 |
| Arecaceae | *Cocos nucifera* L. | narikol | Fruit | Used in the treatment of jaundice, fever, smallpox etc. | 0.36 | 2 | 0.04 |
| Amaryllidaceae | *Allium sativum* L. | nohoru | Bulbs | Raw garlic taken to manage hypertension and maintain diabetes. | 0.88 | 4 | 0.08 |
| Asphodelaceae | *Aloe vera* (L.) Burm.f. | salkuwori | Leaves | Used in the treatment of fever and pruritic disorders. | 0.72 | 5 | 0.1 |
| Orchidaceae | *Rhynchostylis retusa* (L.) Blume | Kopouful | Leaves | Leaves are used in the management of ailment like otalgia. | 0.36 | 15 | 0.3 |
| Commelinaceae | *Commelina benghalensis* L. | Konahimolu | Leaves and stem | Used in the treatment of jaundice and ocular disorder. | 0.72 | 12 | 0.24 |
| Pontideriaceae | *Pontederia crassipes* (Mart.) Solms | Panimeteka | Flowers and roots | Roots used to alleviate Pneumonia and flowers used in the treatment of abdominal pain. | 0.52 | 1 | 0.02 |
| Bromeliaceae | *Ananas comosus* (L.) Merr. | matikothal | Tender leaf base | Used in the management of intestinal disorder like dysentery and helminthiasis. | 0.40 | 15 | 0.3 |
| Poaceae | *Bambusa balcoa* Roxb | bholuka bah | Young leaves, Shoots | Used in the treatment as pain killer to treat insect bites. | 0.52 | 14 | 0.28 |
| | *Cynodon dactylon* (L.) Pers. | dubori bon | Leaves | Extracts are taken to treat leukorrhea. | 0.72 | 10 | 0.2 |
| | *Saccharum officinarum* L. | kuhiyar | Stem | Juice is used in the treatment of urinary tract infection. | 0.40 | 22 | 0.44 |
| Costaceae | *Hellenia speciosa* (J.Koenig) S.R.Dutta | Jom lakhuti | Leaves | Leaf paste is used in the treatment of urinary tract infection. | 0.56 | 13 | 0.26 |
| Musaceae | *Musa balbisiana* Colla | vim kol | Fruit, Roots | Raw fruit juice and boiled roots are used in the treatment of dysentery and diarrhea. | 0.72 | 11 | 0.22 |
| | *Musa paradisiaca* L. | Jahajikol | Stem, roots | Root decoction is taken to treat dysentery and digestive issues. Cooked stem or juice of banana stem is taken to treat urine infection and nephrolithiasis. | 0.88 | 12 | 0.24 |
| Zingiberaceae | *Curcuma caesia* Roxb. | kola halodhi | Rhizome | Rhizome paste is applied on a fracture or injury to get relief from pain. | 0.88 | 12 | 0.24 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | *Curcuma longa* L. | haldi | Rhizome | Raw paste is applied on wounds for healing, and juice of raw turmeric is taken to treat gastric ulcers. | 0.92 | 30 | 0.6 |
| Piperaceae | *Peperomia pellucida* (L.) Kunth | ponounawa | Root | Root extract is used in the treatment of leukorrhea. | 0.68 | 15 | 0.3 |
| | *Piper betle* L. | paan | Leaf | Used in the treatment of cough. | 0.48 | 30 | 0.6 |
| | *Piper longum* L. | pipoli | Seeds | Raw long peppers or boiled extract of long peppers are taken to alleviate respiratory problems, cough, indigestion, or diarrhea. | 0.52 | 31 | 0.62 |
| | *Piper nigrum* L. | jaluk | Seed | Used to treat Pneumonia. | 0.72 | 31 | 0.62 |
| Saururaceae | *Houttuynia cordata* Thunb. | masundari | Leaves | Leaf paste is taken to enhance appetite and treat dysentery, gastric disorders or ulcers. | 0.76 | 11 | 0.22 |
| Menispermaceae | *Tinospora cordifolia* (Willd.) Hook.f. & Thomson | hoguni lota | Leaves, stem | Used in the management of diabetes. | 0.88 | 2 | 0.04 |
| Ranunculaceae | *Nigella sativa* L. | Kaljeera | Seed | Used in the treatment of cholelithiasis. | 0.72 | 12 | 0.24 |
| Crassulaceae | *Bryophyllum pinnatum* (Lam.) Oken | duportenga | Leaves | Leaf paste is used to treat several diseases like renal calculi, cholelithiasis and urinary tract infections. | 0.96 | 1 | 0.02 |
| Vitaceae | *Cissus quadrangularis* L. | harjura lota | Whole plant | Used in the treatment of bone repair. | 0.72 | 10 | 0.2 |
| Moraceae | *Artocarpus heterophyllus* Lam. | kothal | Fruit and leaves | Fruits are eaten by diabetic people and leaves are good for tonsillitis. | 0.22 | 5 | 0.1 |
| | *Ficus auriculata* Lour. | dimoru | Leaves | Leaves are used in the management of diabetes. | 0.36 | 5 | 0.1 |
| Rosaceae | *Potentilla indica (*Andrews) Th.Wolf | gorukhis | Leaves | Leaf paste is used as an antiseptic. It is applied on wounds or burns and boils. | 0.36 | 12 | 0.24 |
| Fabaceae | *Senna tora* (L.) Roxb. | medelua | Leaves | Leaf paste is applied on the head to get relief from headaches. | 0.64 | 2 | 0.04 |
| | *Tamarindus indica*L. | teteli | Leaves | Leaf extract is used in the treatment of leukorrhea. | 0.48 | 35 | 0.7 |
| | *Vachellia farnesiana* (L.) Wight & Arn. | torua kadam | Bark | Bark juice is used in the treatment of dysmenorrhea. | 0.72 | 11 | 0.22 |
| Cucurbitaceae | *Momordica charantia* L. | titakerela | Leaves | Leaf juice is used in the treatment of epistaxis. | 0.16 | 2 | 0.04 |
| Calophyllaceae | *Mesua ferrea* L. | nahor | Bark | Used in the treatment of piles. | 0.52 | 12 | 0.24 |
| Clusiaceae | *Garcinia pedunculata* Roxb. ex Buch.Ham. | thekera | Fruit | The fruits are preserved. The preserved fruits are later on taken along with hot water to treat digestive diseases and urinary tract infections. | 0.52 | 11 | 0.22 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Euphorbiaceae | *Euphorbia neriifolia* L. | hiju | Stem | Traditionally, a small portion of the stem is cut and worn as a ring to treat a boil. | 0.44 | 10 | 0.2 |
| | *Jatropha curcas* L. | bongali era | Stems | The stems are used as a toothbrush, and the sap are used to treat tooth cavities or toothache. | 0.64 | 22 | 0.44 |
| | *Ricinus communis* L. | era gos | Leaves | Leaf pastes along with mustard oil applied to the body to treat myalgia. | 0.80 | 2 | 0.04 |
| Phyllanthaceae | *Phyllanthus emblica* L. | amlokhi | Fruit | Used to treat alopecia. | 0.72 | 45 | 0.9 |
| Oxalidaceae | *Oxalis corniculate* L. | horutengesi | Leaves | Used in the treatment of diabetes. | 0.72 | 36 | 0.72 |
| Malvaceae | *Abroma augustum* (L.) L.f. | gorokhia korai | Leaves and roots | Used in the treatment of dysmenorrhea. | 0.68 | 12 | 0.24 |
| | *Hibiscus rosa-sinensis* L. | jobaful | Leaves, Flower | Leaf paste is applied over the head to get relief from headaches. | 0.40 | 46 | 0.92 |
| | *Sida acuta* Burm.f. | bariyal | Leaves | Leaf paste is used in the treatment of dysmenorrhea. | 0.52 | 11 | 0.22 |
| | *Sida rhombifoliΩ* L. | hunborial | Root | Root extract is used in the treatment of leukorrhea. | 0.76 | 10 | 0.2 |
| Caricaceae | *Carica papaya* L. | amita | Flower | Flower is eaten to manage diabetes. | 0.80 | 30 | 0.6 |
| Meliaceae | *Azadirachta indica* A.Juss. | neem | Leaves | Leaf paste is used in the treatment of wound healing and allergies. Leaves decoction is taken to manage gastrointestinal disorder and skin infection. | 0.88 | 48 | 0.96 |
| Anacardiaceae | *Mangifera indica* L. | aam | Leaf | Used in the treatment of renal calculi. | 0.32 | 20 | 0.4 |
| Rutaceae | *Aegle marmelos* (L.) Corrêa | bel | Leaves, flowers | Used in the treatment of cough. | 0.48 | 22 | 0.44 |
| | *Citrus maxima* (Burm.) Merr. | robabtenga | Fruits | Fruits are eaten in empty stomach to alleviate gastritis. | 0.72 | 14 | 0.28 |
| | *Citrus aurantiifolia* (Christm.) Swingle | kajinemu | Leaves and fruits | Used to treat disorders like Typhoid, Pneumonia as well as dizziness. | 0.92 | 23 | 0.46 |
| | *Citrus jambhiri* Lush. | gulnemu | Fruit | The fruit is preserved in glass containers by using salt. The preserved lemon is later on taken to cure digestive issues. The seeds are also smashed and taken in the treatment of helminthiasis. | 0.92 | 20 | 0.4 |
| | *Murraya koenigii* (L.) Spreng. | narasingha | Leaves | Leaves are used as food in the management of hypotension. | 0.84 | 33 | 0.66 |
| | *Xanthoxylum oxyphyllum* Edgew. | mejenga | Tendered shoots | Used in the treatment of helminthiasis. | 0.88 | 20 | 0.4 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sapindaceae | *Sapindus mukorossi* Gaertn | monisaal | Seeds | The seed is soaked in water and then it is used to gurgle in order treat sore throat, cough or viral infection. | 0.60 | 12 | 0.24 |
| Combretaceae | *Terminalia chebula* Retz. | hilikha | Leaves | Leaf decoction is used to treat renal calculi. | 0.48 | 38 | 0.76 |
| | *Terminalia arjuna* (Roxb. exDC.) Wight & Arn. | arjun gos | Bark | Used in the treatment of inflammation. | 0.88 | 22 | 0.44 |
| Lythraceae | *Lawsonia inermis* L. | jetuka | Leaves | Leaves extracts are used to treat hair fall problems, skin infections, nail infections, wounds, and fungal infections. | 0.76 | 30 | 0.6 |
| Myrtaceae | *Syzygium aromaticum* (L.) Merr. &L.M.Perry | long | Flower | Used in the treatment of multiple disorders like cough, Pneumonia, Abnormal uterine bleeding, toothache etc. | 0.84 | 21 | 0.42 |
| | *Psidium guajava*L. | modhuri | Leaves | Leaves extracts are used to treat dysentery and diarrhea. | 0.64 | 30 | 0.6 |
| Amaranthaceae | *Achyranthes aspera* L. | bionihabota | Leaf | Used in the treatment of cough. | 0.72 | 1 | 0.02 |
| | *Alternanthera sessilis*(L.) DC. | matikanduri | Whole plant | Boiled plants are used as food to manage dysentery and improve eyesight. | 0.68 | 21 | 0.42 |
| | *Amaranthus spinosus* L. | hatikhutura | Leaf, Stem | Leaves used in the management of cut while stems are used in the treatment of tuberculosis. | 0.44 | 10 | 0.2 |
| | *Amaranthus tricolor* L. | bikholyakarani | Leaves | Used in the management of cuts and wound healing. | 0.40 | 10 | 0.2 |
| Basellaceae | *Basella alba* L. | puroi | Leaves and stems | Used for smooth and regular menstrual cycle and also as digestive for maintaining good colon. | 0.76 | 12 | 0.24 |
| Caryophyllaceae | *Drymaria cordata*(L.) Willd. exSchult. | lai jabori | Leaves | Leaves extract is used in the treatment of sinusitis. | 0.76 | 20 | 0.4 |
| Polygonaceae | *Persicaria glabra* (Willd.) M.Gómez | pothoruabihlongoni | Leaves | Used in the treatment of cough and management of headache. | 0.48 | 12 | 0.24 |
| Balsaminaceae | *Impatiens tripetala* Roxb. exDC. | koriabijol | Roots, Stems | Used in the treatment of jaundice. | 0.56 | 12 | 0.24 |
| Apocynaceae | *Alstonia scholaris* (L.) R.Br. | sotiana | Latex, Stem | Latex is used in the treatment of skin diseases and stem is used in the treatment of diarrhea, dysentery etc. | 0.52 | 20 | 0.4 |
| | *Calotropis gigantea* (L.) W.T.Aiton | akongos | Latex | Leaf pastes are mixed with mustard oil and applied to the body to alleviate pain. | 0.57 | 12 | 0.24 |
| | *Catharanthus roseus* (L.) G.Don | nayantora | Leaves | Flowers and leaves are used in the management of diabetes. | 0.80 | 10 | 0.2 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | *Tabernaemontana divaricata* (L.) R.Br. exRoem. & Schult. | kothona | Leaves | Leaves extract is used in the treatment of jaundice. | 0.52 | 10 | 0.2 |
| Gentianaceae | *Swertia chirayita* (Roxb.) H.Karst. | chirota | Leaf | Used in the treatment of asthma. | 0.68 | 20 | 0.4 |
| Rubiaceae | *Paederia foetida* L. | bhedailota | Leaves | Leaves are used as food in the treatment of gastrointestinal infections. | 1.00 | 30 | 0.6 |
| Convolvulaceae | *Ipomoea aquatica* Forssk. | khuakolmou | Leaves | Used as leafy vegetable to manage dyspepsia. | 0.44 | 23 | 0.46 |
| Solanaceae | *Datura stramonium* L. | dhatura | Leaves | The leaves along with heated mustard oil are pasted on the body parts to alleviate body aches. | 0.44 | 20 | 0.4 |
| | *Physalis minima* L. | pokmou | Fruits, leaves | Leaf paste is applied to the body to manage pruritic conditions. Fruits are eaten to improve immunity. | 0.48 | 15 | 0.3 |
| | *Solanum indicum* L. | bhekuritita | Fruit | Eaten raw or smashed after boiling in the management of diabetes. | 0.72 | 10 | 0.2 |
| Acanthaceae | *Justicia adhatoda* L. | bogabahak | Leaf | Used in the treatment of cough. | 0.80 | 5 | 0.1 |
| Lamiaceae | *Clerodendrum colebrookianum* Walp. | nefafu | Leaves | Boiled leaves are used in the management of hypertension. Cooked or boiled leaves are eaten to manage diabetes, dysentery or gastrointestinal disorders. | 0.88 | 25 | 0.5 |
| | *Mentha spicata* L. | pudina | Leaves | Leaf paste is taken to improve appetite and alleviate indigestion. | 0.80 | 20 | 0.4 |
| | *Leucas aspera* (Willd.) Link | durun bon | Whole plant | Decoction are taken in the treatment of gastroenteritis, boiled leaves are used for bathing to manage dermatological disorders., leaves extract are used in the treatment of sinusitis. | 0.96 | 30 | 0.6 |
| | *Ocimum sanctum* L. | tulsi | Leaves | Leaves extract is taken in the treatment of cough and sore throat. | 1.00 | 48 | 0.96 |
| | *Pogostemon benghalensis* (Burm.f.) Kuntze | sukloti | Leaves | Leaves are used as food with other herbs to manage gastrointestinal disorders. | 0.76 | 12 | 0.24 |
| | *Vitex negundo* L. | posotiya | Whole plant | The leaves or whole plant are boiled and used in the management of allergy or pox. The leaves are cooked along with other medicinal herbs to regulate sore throat and cough. | 0.72 | 18 | 0.36 |
| Linderniaceae | *Bonnaya ruellioides* (Colsm.) Pennell | kasidoriya | Leaves | Leaves decoction is used in the treatment of ocular infection or irritation. | 0.48 | 14 | 0.28 |
| Oleaceae | *Nyctantes arbor-tristis* L. | hewali | Leaves | Traditionally employed for wound hemostasis. | 0.44 | 20 | 0.4 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Plantaginaceae | *Bacopa monnieri* (L.) Wettst. | brahmi | Leaves | Eaten as raw juice to enhance memory power. | 0.88 | 29 | 0.58 |
| Asteraceae | *Acmella paniculata* (Wall. ex DC.) R.K.Jansen | marsang | Leaves, Flower | Leaves are cooked along with medicinal herbs and local chicken and are taken in the treatment generalized body pain. Flowers are smashed and used for toothaches. | 0.76 | 12 | 0.24 |
| | *Ageratum conyzoides* L. | gendhali bon | Leaves | Leaves used in cut to stop wound hemostasis. | 0.92 | 12 | 0.24 |
| | *Eclipta prostrata* (L.) L. | keharaj | Leaves | Leaf decoction used as digestive medicine. | 0.68 | 2 | 0.04 |
| | *Mikania micrantha* Kunth | premlata | Leaves | Leaves decoction is used in the treatment of dysentery; Leaf pastes are used to treat wounds. | 0.68 | 12 | 0.24 |
| | *Tagetes erecta* L. | narjiful | Leaves | Leaves extract used to stop wound hemostasis. | 0.92 | 12 | 0.24 |
| Apiaceae | *Centella asiatica* (L.) Urb. | bormanimuni | Whole plant | Decoctions are taken to treat urinary tract infection, cough, and gastroenteritis and for the improvement of eyesight. | 0.84 | 20 | 0.4 |
| | *Eryngium foetidum* L. | mandhonia | Leaves | Used in the treatment of digestive disorder. | 0.48 | 12 | 0.24 |

Table 3. Checklist of ethnomedicinal plants showing Fidelity Level (FL %) of ethnomedicinal plants used by the Mishing community of Jorhat district, Assam.

| Botanical Name | Preparation, route of administration and condition relieved | Np= Total no. of informants who practically use in their life | N= Total no. of informants who say it is useful | Fidelity level (Np/N ×100) |
|---|---|---|---|---|
| *Abroma augustum* (L.) L.f. | Used in the treatment of dysmenorrhea. | 5 | 10 | 50% |
| *Achyranthes aspera* L. | Used in the treatment of cough. | 1 | 1 | 100% |
| *Acmella paniculata* (Wall. ex DC.) R.K. Jansen | Leaves are cooked along with medicinal herbs and local chicken and are taken in the treatment generalized body pain. Flowers are smashed and used for toothaches. | 1,3 | 4,5 | 25%, 60% |
| *Acorus calamus* L. | Used in the treatment of cough. | 1 | 1 | 100% |
| *Aegle marmelos* (L.) Corrêa | Used in the treatment of cough. | 2 | 2 | 100% |
| *Ageratum conyzoides* L. | Leaves used in cut to stop wound hemostasis. | 1 | 3 | 33.33% |
| *Allium sativum* L. | Raw garlic taken to manage hypertension and maintain diabetes. | 1,2 | 1,3 | 100%, 66.6% |
| *Aloe vera* (L.) Burm.f. | Used in the treatment of fever and pruritic disorders. | 6,5 | 6,6 | 100%, 83.33 |
| *Alstonia scholaris* (L.) R.Br. | Latex is used in the treatment of skin diseases and stem is used to treat diarrhea, dysentery etc. | 3,2,1 | 4,4,4 | 75%, 50%, 25% |
| *Alternanthera sessilis* (L.) DC. | Boiled plants are used as food to manage dysentery and improve eyesight. | 3,1 | 4,3 | 75%, 33.33% |
| *Amaranthus spinosus* L. | Leaves used in the management of cut while stems are used in the treatment of tuberculosis. | 1 | 3 | 33.33% |
| *Amaranthus tricolor* L. | Used in the management of cuts and wound healing. | 3,1 | 5,2 | 60%, 50% |
| *Ananas comosus* (L.) Merr. | Used in the management of intestinal disorder like dysentery and helminthiasis. | 1,1 | 1,4 | 100%, 25% |
| *Artocarpus heterophyllus* Lam. | Fruits are eaten by diabetic people and leaves are good for tonsillitis. | 1,2 | 3,5 | 33.33%, 40% |
| *Azadirachta indica* A.Juss. | Leaf paste is used in the treatment of wound healing and allergies. Leaves decoction is taken to manage gastrointestinal disorder and skin infection. | 3,1,5 | 10,5,6 | 30%, 20%, 83.33% |
| *Bacopa monnieri* (L.) Wettst. | Eaten as raw juice to enhance memory power. | 20 | 21 | 95.23% |
| *Bambusa balcoa* Roxb | Used in the treatment as pain killer to treat insect bites. | 1 | 2 | 50% |
| *Basella alba* L. | Used for menstrual cycle regulation and also as digestive for maintaining good colon. | 2,2 | 3,7 | 66.66%, 28.57% |
| *Bonnaya ruellioides* (Colsm.) Pennell | Leaves decoction is used in the treatment of ocular infection or irritation. | 1,1 | 3,3 | 33.33%, 33.33% |
| *Bryophyllum pinnatum* (Lam.) Oken | Leaf paste is used to treat several diseases like renal calculi, cholelithiasis, and urinary tract infections. | 2,1,5 | 10,5,9 | 20%, 20%, 55.55% |
| *Calotropis gigantea* (L.) W.T. Aiton | Leaf pastes are mixed with mustard oil and applied to the body to alleviate pain. | 2 | 3 | 66.66% |
| *Carica papaya* L. | Flower is eaten to manage diabetes. | 1 | 3 | 33.33% |
| *Catharanthus roseus* (L.) G.Don | Flowers and leaves are used in the management diabetes. | 5 | 10 | 50% |
| *Centella asiatica* (L.) Urb. | Decoctions are taken to treat urinary tract infection, cough, and gastroenteritis and for the improvement of eyesight. | 2,3,1,2 | 3,3,3,3 | 66.66%, 100%, 33.33%, 66.66% |

| | | | | |
|---|---|---|---|---|
| *Cissus quadrangularis* L. | Used in the treatment bone fracture. | 3 | 12 | 25% |
| *Citrus aurantiifolia* (Christm.) Swingle | Used to treat disorders like Typhoid, Pneumonia as well as dizziness. | 1,3,3 | 2,5,5 | 50%, 60%, 60% |
| *Citrus jambhiri* Lush. | The fruit is preserved in glass containers by using salt. The preserved lemon is later on taken to cure digestive issues. The seeds are also smashed and taken to treat helminthiasis. | 1,5 | 2,8 | 50%, 62.5% |
| *Citrus maxima* (Burm.) Merr. | Fruits are eaten in empty stomach to alleviate gastritis. | 5 | 10 | 50% |
| *Clerodendrum colebrookianum* Walp. | Boiled leaves are used in the management of hypertension. Leaves are cooked or boiled. It is taken to cure diabetes, dysentery or gastric disorders. | 1,3,1,5 | 3,6,6,6 | 33.33%, 50%, 33.33%, 83.33% |
| *Cocos nucifera* L. | Used in the treatment of jaundice, fever, smallpox etc. | 6,5,1 | 10,6,6 | 60%, 83.33%,16.66% |
| *Colocasia esculenta* (L.) Schott | The sap of the stem is used to treat ant stings, bee stings, or wasp stings. | 1,2,2 | 1,4,3 | 100%, 50%, 66.6% |
| *Commelina benghalensis* L. | Used in the treatment of jaundice and ocular disorder. | 5,2 | 10,3 | 50%, 66.66% |
| *Curcuma caesia* Roxb. | Rhizome paste is applied on a fracture or injury to get relief from pain. | 1 | 3 | 33.33% |
| *Curcuma longa* L. | Raw paste is applied on wounds for healing, and juice of raw turmeric is taken to treat gastric ulcers. | 1,3 | 2,5 | 50%, 60% |
| *Cynodon dactylon* (L.) Pers. | Extracts are taken to treat leukorrhea. | 1 | 2 | 50% |
| *Datura stramonium* L. | The leaves along with heated mustard oil are pasted on the body parts to alleviate body aches. | 3 | 3 | 10% |
| *Drymaria cordata* (L.) Willd. ex Schult. | Leaves extract is used to treat sinusitis. | 3 | 5 | 60% |
| *Eclipta prostrata* (L.) L. | Leaf decoction used as digestive medicine. | 1 | 3 | 33.33% |
| *Eryngium foetidum* L. | Used in the treatment of digestive disorder. | 3 | 4 | 75% |
| *Euphorbia neriifolia* L. | Traditionally, a small portion of the stem is cut and worn as a ring to treat a boil. | 1 | 2 | 50% |
| *Ficus auriculata* Lour. | Leaves are used in the management of diabetes. | 1 | 10 | 10% |
| *Garcinia pedunculata* Roxb. ex Buch.Ham. | The fruits are preserved. The preserved fruits are later on taken along with hot water to treat digestive diseases and urinary tract infections. | 3,1 | 10,3 | 30%, 33.33% |
| *Hellenia speciosa* (J.Koenig) S.R.Dutta | Leaf paste is used in the treatment of urinary tract infection. | 1 | 3 | 33.33% |
| *Hibiscus rosa-sinensis* L. | Leaf paste is applied over the head to get relief from headaches. | 2 | 10 | 20% |
| *Houttuynia cordata* Thunb. | Leaf paste is taken to enhance appetite and treat dysentery, gastric disorders or ulcers. | 1,3,2 | 5,9,5 | 20%, 33.33%, 40% |
| *Impatiens tripetala* Roxb. ex DC. | Used in the treatment of jaundice. | 6 | 9 | 66.66% |
| *Ipomoea aquatica* Forssk. | Used as leafy vegetable in the treatment of gastrointestinal disorder. | 3 | 5 | 60% |
| *Jatropha curcas* L. | The stems are used as a toothbrush, and the sap are used to treat tooth cavities or toothache. | 3 | 9 | 33.33% |
| *Justicia adhatoda* L. | Used in the treatment of cough. | 3 | 5 | 75% |
| *Lawsonia inermis* L. | Leaves extracts are used to treat hair fall problems, skin infections, nail infections, wounds, and fungal infections. | 2 | 6 | 33.33% |

| | | | | |
|---|---|---|---|---|
| *Leucas aspera* (Willd.) Link | Decoction are taken in the treatment of gastroenteritis, boiled leaves are used for bathing to manage dermatological disorders., leaves extract are used in the treatment of sinusitis. | 1,3,1 | 4,4,2 | 25%, 75%, 50% |
| *Mangifera indica* L. | Used in the treatment of renal calculi. | 2 | 5 | 40% |
| *Mentha spicata* L. | Leaf paste is taken to improve appetite and alleviate indigestion. | 1,3 | 3,4 | 33.33%, 75% |
| *Mesua ferrea* L. | Used in the treatment of piles. | 1 | 3 | 33.33 |
| *Mikania micrantha* Kunth | Leaves decoction is used in the treatment of dysentery; Leaf pastes are used to treat wounds. | 3,4 | 5,5 | 60%, 80% |
| *Momordica charantia* L. | Leaf juice is used to treat epistaxis. | 5 | 12 | 41.66 |
| *Murraya koenigii*(L.) Spreng. | Leaves are used as food to treat hypotension. | 1 | 6 | 16.66% |
| *Musa balbisiana* Colla | Raw fruit juice and boiled roots are used in the treatment of dysentery and diarrhea. | 2,1 | 4,5 | 50%, 20% |
| *Musa paradisiaca* L. | Root decoction is taken to treat dysentery and digestive issues. Cooked stem or juice of banana stem is taken to treat urine infection and nephrolithiasis. | 1,3,1 | 2,5,3 | 50%, 60%, 33.33% |
| *Nigella sativa* L. | Used in the treatment of cholelithiasis. | 10 | 15 | 66.66% |
| *Nyctanthes arbor-tristis* L. | Traditionally employed for wound hemostasis. | 5 | 12 | 41.66% |
| *Ocimum sanctum* L. | Leaves extract is taken in the treatment of cough and sore throat. | 15,10 | 15,12 | 100%, 83.33% |
| *Oxalis corniculata* L. | Used in the treatment of diabetes. | 9 | 12 | 75% |
| *Paederia foetida* L. | Leaves are used as food to treat gastrointestinal infections. | 6 | 6 | 100% |
| *Peperomia pellucida* (L.) Kunth | Root extract is used in the treatment of leukorrhea. | 1 | 3 | 33.33% |
| *Persicaria glabra* (Willd.) M.Gómez | Used in the treatment of cough and headache. | 10,5 | 11,10 | 90.9%, 50% |
| *Phyllanthus emblica* L. | Used to treat alopecia. | 2 | 3 | 66.66% |
| *Physalis minima* L. | Leaf paste is applied to the body to treat pruritus infections. Fruits are eaten to improve immunity. | 1,3 | 3,4 | 33.33%, 75% |
| *Piper betle* L. | Used in the treatment of cough. | 21 | 25 | 84% |
| *Piper longum* L. | Raw long peppers or boiled extract of long peppers are taken to alleviate respiratory problems, cough, indigestion, or diarrhea. | 1,2,1,1 | 3,5,5,3 | 33.33%, 40%, 20%, 33.33% |
| *Piper nigrum* L. | Used to treat Pneumonia. | 10 | 15 | 66.66% |
| *Pogostemon benghalensis* (Burm.f.) Kuntze | Leaves are used as food with other herbs to manage gastrointestinal disorders. | 6 | 10 | 60% |
| *Pontederia crassipes* (Mart.) Solms | Roots used to alleviate Pneumonia and flowers used in the treatment of abdominal pain. | 3,5 | 8,10 | 37.5%, 50% |
| *Potentilla indica* (Andrews) Th. Wolf | Leaf paste is used as an antiseptic. It is applied on wounds or burns and boils. | 1,3,1 | 3,6,6 | 33.33%, 50%, 16.66% |
| *Psidium guajava* L. | Leaves extracts are used to treat dysentery and diarrhea. | 2,5 | 3,9 | 66.66%, 55.55% |
| *Rhynchostylis retusa* (L.) Blume | Leaves are used in the treatment of ailment like Otalgia. | 2 | 5 | 40% |
| *Ricinus communis* L. | Leaf pastes along with mustard oil applied to the body to treat myalgia. | 4 | 5 | 80% |
| *Saccharum officinarum* L. | Juice is used in the treatment of urinary tract infection. | 1 | 4 | 25% |
| *Sapindus mukorossi* Gaertn. | The seed is soaked in water and then it is used to gurgle in order treat sore throat, cough or viral infection. | 1,3,3 | 5,5,5 | 20%,60%, 60% |
| *Senna tora* (L.) Roxb. | Leaf paste is applied on the head to get relief from headaches. | 1 | 5 | 20% |

| | | | | |
|---|---|---|---|---|
| *Sida acuta* Burm.f. | Leaves are used in the treatment of dysmenorrhea. | 1 | 3 | 33.33% |
| *Sida rhombifolia* L. | Root extract is used in the treatment of leukorrhea. | 2 | 11 | 18.18% |
| *Solanum indicum* L. | Eaten raw or smashed after boiling to treat diabetes. | 3 | 5 | 75% |
| *Swertia chirayita* (Roxb.) H.Karst. | Used in the treatment of asthma. | 5 | 6 | 83.33% |
| *Syzygium aromaticum* (L.) Merr. & L.M.Perry | Used against cough, Pneumonia, Abnormal uterine bleeding, toothache etc. | 1,3,5 | 2,5,7 | 50%, 30%, 71.4% |
| *Tabernaemontana divaricata* (L.) R.Br. exRoem. & Schult. | Leaves extract is used to treat jaundice. | 2 | 5 | 40% |
| *Tagetes erecta* L. | Leaves extract used to stop wound hemostasis. | 1 | 2 | 50% |
| *Tamarindus indica* L. | Leaf extract is used to treat leukorrhea. | 5 | 15 | 33.33% |
| *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn. | Used in the treatment of inflammation. | 1 | 3 | 33.33% |
| *Terminalia chebula* Retz. | Leaf decoction is used to treat renal calculi. | 1. | 3,5,6 | 33.33% |
| *Tinospora cordifolia* (Willd.) Hook.f. & Thomson | Used in the management of diabetes. | 8 | 15 | 53.33% |
| *Vachellia farnesiana* (L.) Wight & Arn. | Bark juice is used in the treatment of dysmenorrhea. | 3 | 10 | 30% |
| *Vitex negundo* L. | The leaves or whole plant are boiled and used in the management of allergy or pox. The leaves are cooked along with other medicinal herbs to regulate sore throat and cough. | 5,2,1,1,3 | 6,3,3,2,5 | 83.33%, 66.66%, 33.33%, 50%, 60% |
| *Xanthoxylum oxyphyllum* Edgew. | Used in the treatment of helminthiasis. | 3 | 7 | 42.8% |

Table: 4 Checklist calculation of Informant consensus factor (ICF) of the ethnomedicinal Species.

| Name of the disease | (Nt) | (Nur) | ICF= (Nur-Nt/Nur-1) |
|---|---|---|---|
| Abdominal Pain | 7 | 10 | 0.33 |
| Urinary tract Infections | 6 | 12 | 0.54 |
| Dysentery | 9 | 22 | 0.61 |
| Leukorrhea | 4 | 10 | 0.66 |
| Cough | 12 | 41 | 0.7 |
| Jaundice | 4 | 12 | 0.72 |
| Blood Pressure | 3 | 10 | 0.77 |
| Gastric Ulcers | 3 | 10 | 0.77 |
| Sore Throat | 3 | 10 | 0.77 |
| Diabetes | 6 | 25 | 0.79 |
| Gastrointestinal disorders | 7 | 30 | 0.79 |
| Pruritic disorder | 6 | 25 | 0.79 |
| Renal calculi/Nephrolithiasis | 3 | 12 | 0.81 |
| Diarrhea | 4 | 20 | 0.84 |
| Ant Sting/Bee Sting/Wasp Stings | 2 | 10 | 0.88 |
| Dysmenorrhea | 2 | 10 | 0.88 |
| Toothache | 2 | 10 | 0.88 |
| Pneumonia | 5 | 15 | 0.90 |
| Sinusitis | 2 | 12 | 0.90 |
| Boil | 2 | 13 | 0.91 |
| Headache | 3 | 25 | 0.91 |
| Myalgia | 2 | 15 | 0.92 |
| Uterine cramps | 3 | 30 | 0.93 |
| Fever | 2 | 20 | 0.94 |
| Allergies | 2 | 25 | 0.95 |
| Smallpox | 2 | 25 | 0.95 |
| Alopecia | 1 | 29 | 1 |
| Ascariasis/ round worm infection | 1 | 05 | 1 |
| Asthma | 1 | 20 | 1 |
| Blood Sugar | 1 | 09 | 1 |
| Cholelithiasis | 1 | 12 | 1 |
| Dizziness | 1 | 10 | 1 |
| Enhance Memory Power | 1 | 35 | 1 |
| Epistaxis | 1 | 12 | 1 |
| Fracture or Injury | 1 | 15 | 1 |
| Fungal Infections | 1 | 15 | 1 |
| Helminthiasis | 1 | 9 | 1 |
| Hemostasis | 1 | 12 | 1 |
| Immunity | 1 | 12 | 1 |
| Optic Disease | 1 | 10 | 1 |
| Otalgia | 1 | 10 | 1 |
| Piles | 1 | 10 | 1 |
| Pulmonary disorders | 1 | 25 | 1 |
| Tonsillitis | 1 | 8 | 1 |
| Tuberculosis | 1 | 10 | 1 |
| Typhoid | 1 | 11 | 1 |
| Wounds or Burns | 1 | 10 | 1 |

Figure 3 illustrates the distribution of plant parts used in ethnomedicinal practices by the Mishing community. Among all plant parts, leaves were found to be the most frequently utilized, which may be attributed to their easy accessibility, ease of preparation, and rich phytochemical composition. Roots and stems were the second most commonly used parts, often

associated with the treatment of chronic and internal ailments due to their concentrated bioactive compounds. In contrast, flowers, fruits, seeds, and other plant parts were less frequently used, possibly due to their seasonal availability and comparatively limited traditional applications. The dominance of leaf usage also reflects a sustainable harvesting practice, as it allows continued growth and conservation of plant species.

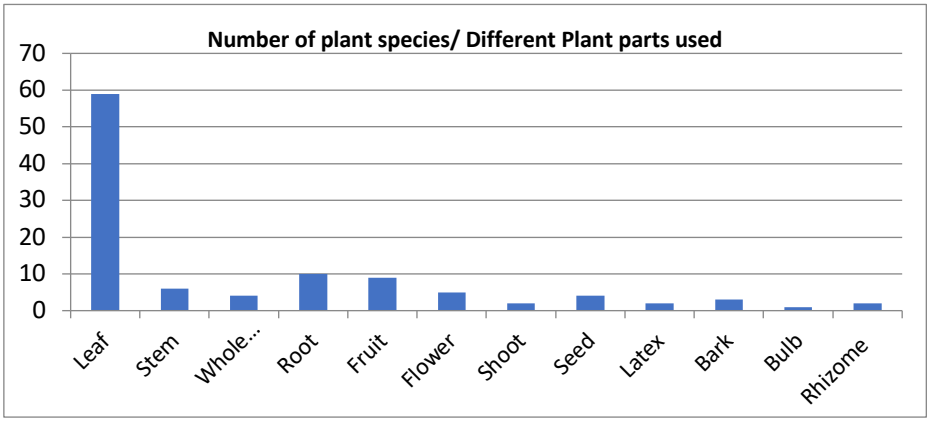


Figure 3 Number Plant species against the different plant parts that are used by Mishing community in Jorhat district, Assam.

Table 4 and Figure 4 shows the top 10 plant species with the highest Use Value (UV), indicating their ethnomedicinal importance and frequency of use among the informants. *O. sanctum* L. and *P. foetida L*. recorded the highest UV (1.00), followed by *B. pinnatum* and *L. aspera* with 0.96, and *A. conyzoides*, *T. erecta*, *C. bonduc*, *C. aurantiifolia*, *C. jambhiri*, and *C. longa*, each showed a UV of 0.92.

Table: 4 Top 10 highest UV species

| **Rank** | ***Botanical Name*** | **Family** | **Use Value** |
|---|---|---|---|
| 1 | *Ocimum sanctum* L. | Lamiaceae | 1.00 |
| 2 | *Paederia foetida* L. | Rubiaceae | 1.00 |
| 3 | *Bryophyllum pinnatum* (Lam) oken | Crassulaceae | 0.96 |
| 4 | *Leucas aspera* (Willd.) Link | Lamiaceae | 0.96 |
| 5 | *Ageratum conyzoides* L. | Asteraceae | 0.92 |
| 6 | *Tagetes erecta* L. | Asteraceae | 0.92 |
| 7 | *Caesalpinia bonduc* (L.) Roxb. | Caesalpiniaceae | 0.92 |
| 8. | *Citrus aurantiifolia* (Christm.) Swingle. | Rutaceae | 0.92 |
| 9. | *Citrus jambhiri* Lush. | Rutaceae | 0.92 |
| 10. | *Curcuma longa* L. | Zingiberaceae | 0.92 |

The FL% analysis revealed that some of the medicinal plants used by the people of Mishing community had highest FL% of 100%. It included *A. calamus*, *A. marmelos*, *O. sanctum* and *P. foetida,* indicating complete agreement among informants regarding their therapeutic applications. *B. monnieri* demonstrated a very high FL value of 95.23% for enhancing memory power, while *P. glabra* exhibited 90.9% FL value for treating cough. High FL percentages were also observed in *P. betle*, *S. chirayita* and *R. communis.*

The Informant Consensus Factor (ICF) values indicated a high level of agreement among the informants regarding the treatment of different diseases using medicinal plants. The highest value of 1.0, demonstrating perfect consensus among the informants was found for diseases such as blood sugar regulation, ear pain, eye disease, worm infection, fracture or injury, respiratory problems, gall bladder stone, tonsillitis, wounds or burns, piles, typhoid, dizziness, fungal infections, tuberculosis, asthmatic problems, enhancement of memory power and reduction of blood flow. Additionally, smallpox (0.95), allergies (0.95), fever (0.94), menstrual cramps (0.93), body pain (0.92), headache (0.91), pneumonia (0.90), and sinusitis (0.90) all showed high ICF values. Comparatively lower ICF values for stomach pain (0.33), urine infections (0.54), and dysentery (0.61) suggested greater variation in plant selection for treating these ailments.

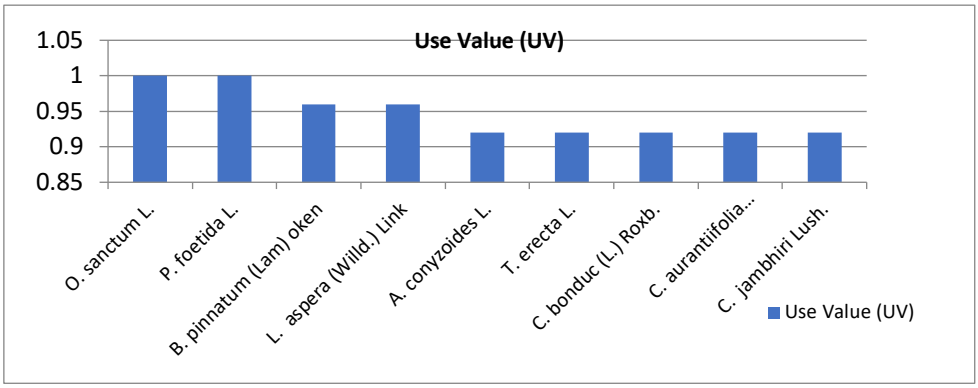


Figure: 4 Top 10 highest UV species.

Table 5 and Figure 5 represent the no. of plant species used for different disease categories. Gastrointestinal disorders recorded the highest use with 32 species (26.89%), followed by respiratory disorders with 22 species (18.48%), dermatological disorders with 14 species (11.76%), reproductive and general health disorders with 11 species (9.24%). In contrast, cardiovascular and ophthalmic disorders had the lowest representation with 3 species (2.52%) each, and auditory disorders were treated by only 1 species (0.84%).

Table 5. Disease Category Frequency

| Disease category | No. of species used | Percentage |
|---|---|---|
| Gastrointestinal disorders | 32 | 26.89% |
| Respiratory disorder | 22 | 18.48% |
| Dermatological disorders | 14 | 11.76% |
| Reproductive disorders | 11 | 9.24% |
| General Health disorders | 11 | 9.24% |
| Metabolic disorders | 9 | 7.56% |
| Urinary Disorder | 9 | 7.56% |
| Oral disorders | 4 | 3.36% |
| Cardiovascular disorders | 3 | 2.52% |
| Ophthalmic disorders | 3 | 2.52% |
| Auditory disorders | 1 | 0.84% |

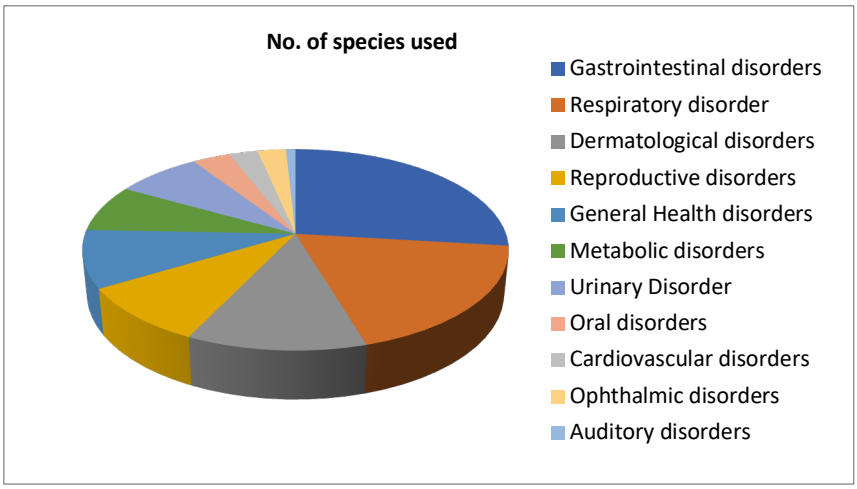


Figure. 5. Disease Category Frequency

Table 6 and Figure 6 show the dominant preparation modes of medicinal plants used in the study area. Paste was the most commonly used preparation mode with (30.50%), followed by extract (16.94%) and decoction (15.25%). Juice and raw forms each showed 10.16%, while boiled and cooked preparations represented 8.47% and 6.77%, respectively. The least preferred mode was maceration, with only 1.69% usage.

Table 6. Dominant Preparation Mode

| Route of administration | Frequency of use | Percentage |
|---|---|---|
| Oral administration | 69 | 72.63% |
| Topical administration | 24 | 25.26% |
| Inhalation | 2 | 2.10% |

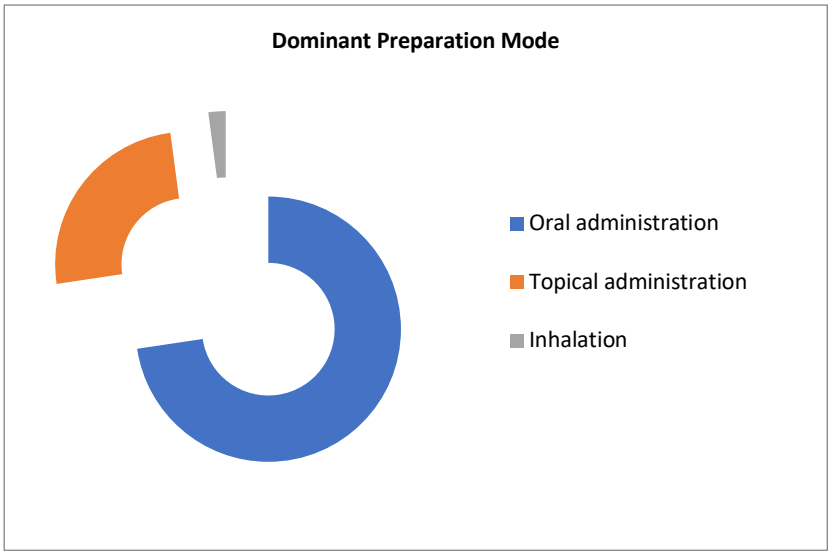


Figure. 6 Dominant Preparation Mode

Table 7 and Figure 7 represent the routes of administration of medicinal plants. Oral administration showed the most common way of administration with 72.63%, followed by topical administration with 25.26%. While inhalation was least administered, representing only 2.10%.

Table 7 Route of administration

| **Preparation Mode** | **Frequency of Use** | **Frequency percentage** |
|---|---|---|
| Paste | 18 | 30.50% |
| Extract | 10 | 16.94% |
| Decoction | 9 | 15.25% |
| Juice | 6 | 10.16% |
| Raw | 6 | 10.16% |
| Boiled | 5 | 8.47% |
| Cooked | 4 | 6.77% |
| Maceration | 1 | 1.69% |

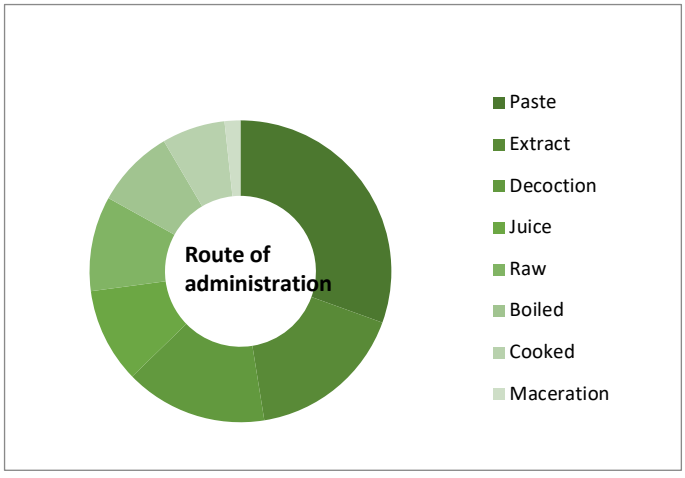


Figure 7. Route of Administration

In the present study, a total of 94 medicinal plant species were documented which are belonging to 56 families. The families are Lamiaceae,Rutaceae, Apocynaceae, Asteraceae, Euphorbiaceae, Solanaceae, Fabaceae, Malvaceae, Musaceae, Piperaceae, Poaceae, Zingiberaceae, Araceae, Apiaceae, Amaryllidaceae, amaranthaceae, Caricaceae, Caryophyllaceae, Crassulaceae, Costaceae, Clusiaceae, Dilleniaceae, Linderniaceae, Lythraceae, Meliaceae, Moraceae, Myrtaceae, Plantaginaceae, Rosaceae, Rubiaceae, Sapindaceae, Saururaceae,Thelypteridaceae*etc*.The families Lamiaceae and Rutaceae exhibited the highest number of species, indicating their prominent role in the traditional healthcare system of the Mishing community. This dominance may be due to their wide distribution in the region as well as the presence of diverse bioactive compounds with therapeutic properties. Several other families were represented by a moderate number of species, while many families showed minimal representation with only one or a few species. This uneven distribution reflects the selective utilization of plant families based on their availability, medicinal efficacy, and the depth of traditional knowledge associated with them (Figure 8). Some characteristic species are shown in Figure 9.

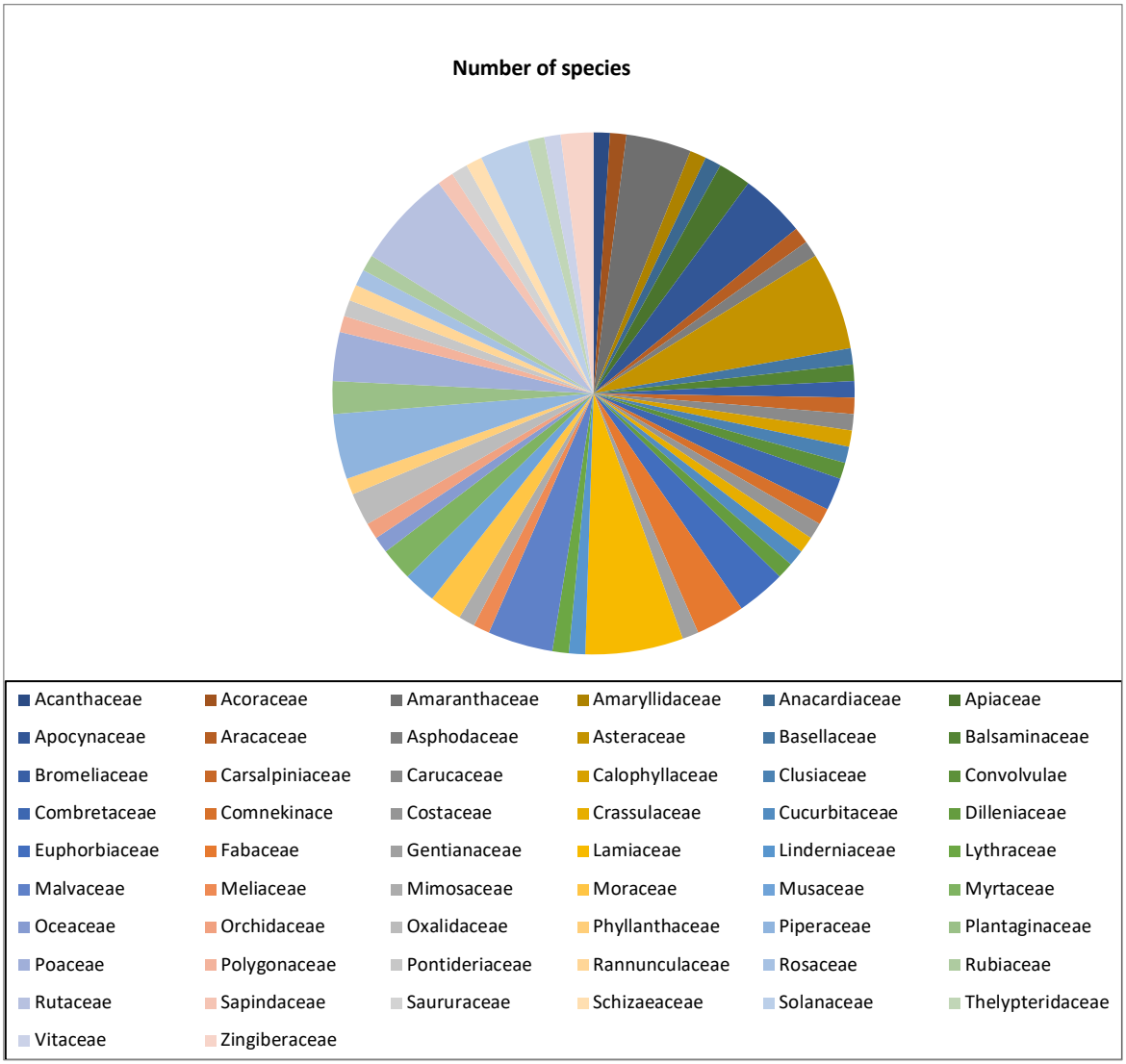


Figure 8. Number of plant species per distinctive families


Figure 9. Some of the medicinal plants used by the people of *Mishing*community in Jorhat district. (A- *Euphorbia neriifolia*L., B-*Tabernaemontanadivaricata*(L.) R.Br. ex Roem. & Schult., C-*Hellenia speciosa* (J.Koenig) S.R.Dutta, D- *Ficus auriculata* Lour.E- *Oxalis corniculata*L., F- *Peperomia pellucida* (L.) Kunth., G-*Scoparia dulcis*L., H- *Ocimum sanctum* L., I- *Curcuma longa* L., J- *Clerodendrum colebrookianum*Walp., K-*Hibiscus rosa sinensis* L., L-*Calotropis gigantean* (L.) W.T.Aiton )

**Ethnic fermented food and beverages**

Details on preparation methods and types of preparation are given in Figures 10 and 11.

**A. Numsing (Fermented Fish Product):** Numsing is a traditional fermented fish dish that is significant to the *Mishing* tribe of Assam's culture and nutrition [Figure: 11(b)]. It is often created by fermenting tiny dry fish in bamboo tubes or earthen pots with rice powder, herbs, and occasionally leafy greens. The herbs are generally aromatic, digestive and leafy medicinal plants that include *Colocasia esculenta*, *Ocimum sanctum, Clerodendrum colebrookianum, Houttuynia cordata, Zanthoxylum oxyphyllum, Piper nigrum*. The mixture is then left for a few days to develop taste. By producing protein-rich food that may be eaten with rice or used to make curries and chutneys, the fermentation process improves nutrition and preservation. In addition to being a food item, Numsing is a component of the *Mishing* culinary tradition, which reflects their long-standing understanding of fermentation methods and close ties to riverine nature.

**Method of Numsing Preparation**

Numsing is a paste-like substance that is semi-dried and semi-smoked, made by combining several plant species with fish. A maximum of two to five kilograms of various fish is needed to prepare Numsing. Various plant ingredients are utilized to make Numsing. Gathering various fish from the market and washing them with clean water. Fish are dried in the kitchen or sundry room on a specially constructed bamboo rack after the gills, scales, and guts have been removed. Various plant ingredients were combined with dry fish in a traditional grinder (Kubuli).After being sealed with dry paddy straw, the mixture was moved to the otung, a bamboo container. Later it should be stored in the kitchen for two months.

**B**. **Po: roapong:** Deeply ingrained in the Mishing tribe's social and cultural life, Po: ro Apong is a traditional rice beer from Assam. A starter cake known as "opo" or "sajpani," which includes a variety of medicinal herbs that promote fermentation, is used to assist ferment rice. The medicinal plants are *Zingiber officinale, Ananas comosus, Centella asiatica, Pteridium aquilinum, Oryza sativa, Leucas aspera, Piper nigrum, Costus speciosus, Artocarpus heterophyllus, Lygodium flexuosum, Saccharum officinarum, Drymaria cordata, Psidium guajava, Murraya koenigii, Vitex negundo, Piper longum, Hydrocotyle rotundifolia, Cinnamomum tamala, Phlogacanthus thyrsiformis, Solanum torvum etc.* After being cooked, cooled, and combined with the starter, the rice is allowed to ferment for a few days in bamboo or clay pots. Po: ro Apong, the resultant beverage, is fragrant, somewhat alcoholic, and frequently drunk at weddings, festivals, and communal feasts. In addition to being a beverage, it represents hospitality, solidarity, and ritual importance because it is served to both visitors and deities, signifying the Mishing people's strong links to tradition and the natural world.

**Preparation of Po: roapong**

Remarkably, the various tribes' methods for making rice beer were essentially the same, with the exception of the plants they employed. However, Po: roapong, another distinctive rice beer, is made by the Mishing tribe. This alcoholic beverage's extraction and preparation methods differed slightly from those of other alcoholic beverages. Paddy husk and dried paddy straw were partially burned to collect the ash in a different container in order to make this beverage. The boiled rice was combined with the ash that had been collected and the powdered starting cake. After that, the mixture was put into an earthen pot that had been extensively fumigated, rendering it blackish, and the mouth was shut using straw and *Thelypteris parasitica* (L.) Tardieu leaves. Depending on the amount of starter used, the season of preparation, and whether the environment is warmer or colder, the fermentation process often takes a week or two. The Ta: suk, a bamboo basket in the shape of a cone, was suspended from a pole to collect fluids. Banana leaves were spread across the bamboo baskets inside walls. At the base of the bamboo basket, which acts as a filtration screen, was a bundle of Amrong, or paddy straw. After filling the Ta: suk with the fermented mixture (boiled rice plus ash), warm water was added from above, which typically removes the alcohol and other soluble ingredients of the rice beer. The fermented mixture is first cooled with cold water, and then hot water is gradually added one after the other. For the initial batches, the filtrate stays chilly until it becomes hot, at which point the operation is terminated. After that, the filtrate (Apong) was gathered and put in a container just beneath the bamboo basket. However, adding too much water is not recommended, as it is thought to lessen the beverage's sweetening and intoxicating effects. However, because it is thought to be a laborious procedure to produce, Po: roapong is often made for big, significant community events like festivals, rituals, and other cultural gatherings. The steps involved in it were shown in [Figure: 10 (a-i)]

**C. Iku (Fermented bamboo shoot):**

The *Mishng* community uses fermented bamboo shoots to make Iku (Figure 11 (a)). In addition to bamboo shoots, Iku is prepared using an earthen pot, a bamboo tray, hollowed-out mature bamboo stems that have been opened from one side (*Bambusa balcoa*), a traditional grinder called a Kubuli, and tools.

**Preparation of Iku**

The bamboo shoots are cleaned thoroughly, then peeled and ground. This ground material is stored in "killing" pots made of soil. After adding salt, chili, and a small bit of water, the earthen pot's mouth is covered with banana leaves for around 30 days to allow for fermentation. In the kitchen, this pot is typically stored in bamboo racks.


Figure 10 :(a-i) *Po: roapong* Preparation steps.

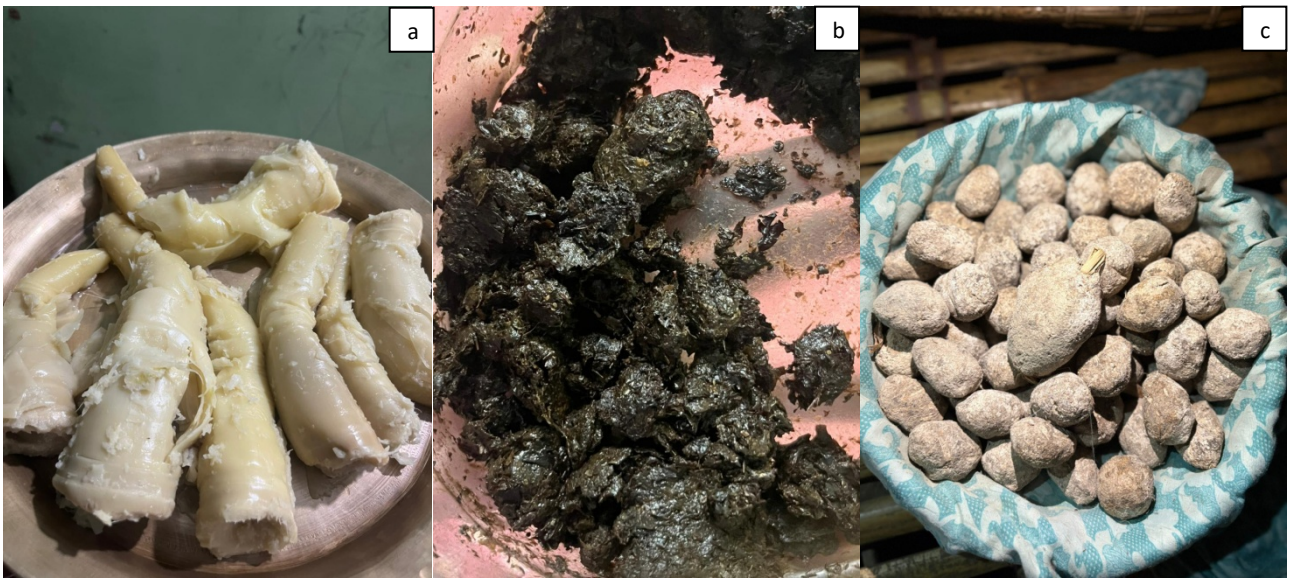

Figure: 11 Fermented Bamboo shoot [Iku] (a), Fermented Fish Product [Numsing] (b), Starter Cake [Apop] (c)

**D. Noggin Apong:**

Nogin Apong is an ethnic rice beer which is prepared by the Mishing community of Assam and Northeast India. It is naturally fermented beverage which is made from boiled rice and mixed with starter cake composed of different medicinal herbs.

**Preparation of Noggin Apong**

The first step of preparing Nogin apong is to take and clean some adequate amount of rice grains. The cleaned rice grains are cooked in a large pot properly. Once, the cooked rice starts cooling down, it is then transferred to a bamboo mat or banana leaves. It is spread out thoroughly to cool it down. After that, enough powdered Apop cake is added and mixed properly to the cooked rice. Then the mixture is transferred to an earthen pot carefully. Usually, it takes 7-10 days for complete fermentation. The fermented rice is known as Noginarug in mishing language. Once, the fermentation process is achieved, some amount of noginarug is taken out from the earthen pot in another container. Then, sufficient amount of water is added to noginarug in the container. It is mixed and stirred rigorously. Once the mixture becomes milky, it is sieved. The filtrate which is achieved at the end of the process is known as the Nogin Apong.

**E. Apop (Starter Cake):**

Apoppitha serve as microbial culture for fermentation of substrate to produce both Nogin Apong and Po: ro Apong [Figure: 11 (c)]. Rice grain is the prime component of preparing Apop along with the leaves of various medicinal plant species.

**Method of Preparation:**

Multiple steps and several days are required for the completion of Apoppitha. It is significant to refer that each plant used in Apop preparation is helpful to get the final product. Generally, the medicinal plants are collected from local habitats. The gathered leaves are properly cleaned and dried in the sun or on Pe'rap (a bamboo platform constructed over the fireplace).Now, the next step is to soak the rice grains in water. The soaked rice grains are then mixed with the dried leaves. The mixture is then pounded into fine sticky paste in Ki: per (wooden mortar) with E'gi (wooden pestle). Small cakes of round or oval shapes are made from the sticky paste. The prepared cakes are kept on a bed of paddy straw and Rukji leaves (*Amphineuron opulentum*). It is dried properly for 3-5 days in the sun or on Pe'rap. The freshly prepared Apop cakes are covered with another layer of Rukji and paddy straws. Lastly, the apoppithas or cakes are stored in earthen pots or bamboo containers. The pots or containers are covered with paddy straws or Rukji leaves and are placed near fireplace for future purpose.

**Fermented food and Beverages of North east India:**

Different tribal communities of North east India prepare similar types of fermented food and beverages. The difference usually lies in the ingredient used, method of preparation and preservation. Fermented foods are rich in nutrients such as carbohydrate, protein, vitamins, minerals, free amino acid, essential fatty acids (Das *et al.* 2016; Barooah *et al.* 2020).

Many fermented fish products prepared in North east India have similar process of preparation, and similar ingredients, for example, the 'Napham', a traditional fermented product of the Bodo tribe of NE India have similarities with that of 'Numsing' in terms of raw materials, their preparation method and health benefits. In both the cases, same medicinal herb (*Colocasia esculenta*) is crushed with the dried fish, although while preparing 'Numsing', a variety of other medicinal herbs is also used. The Garo tribes of Meghalaya prepare 'Nakham' a traditional fermented fish product, while the two former tribes use *Colocasia* with the dry fish, the Garos use 'Khar' (alkali prepared from banana leaves). They are stored in Bamboo containers, made air tight for proper fermentation and kept near the fireplace for several days by all the three tribes. The preparations have cultural significance and are believed to be rich in nutrients. Also when Numsing or Napham is consumed with other food, it is believed to enhance the flavor of the food (Narzary *et al.* 2016). It is also a way of preserving seasonal fishes, so that it can consumed during the season of scarcity. Another community of Manipuri people consume 'Ngari' the method of preparation of Ngari is different than that of Numsing, Napham, Nakham. 'Ngari' is prepared with mustard oil and salt only, it is fermented in an earthen pot that is coated with oil. The pH value of 'Namsing' and 'Napham' were found to follow a similar trend of being acidic during the initial days of their preparation and alkaline to neutral during last few days of fermentation, the acidic and alkaline conditions are essential for the process of fermentation to occur. Some bacterial genera such as *Staphylococcus* and *Bacillus* were common isolates in both the preparation while the species of both the genus different significantly in Numsing and Napham. As in case of 'Numsing', the *Bacillus* species isolated were *B. subtilis*, *B. tequilensis*, *B. siamensis* while in case 'Napham', the *Bacillus* isolate include *B. velezensis, B.tropicus*. The 'Ngari' prepared by Manipuri community is rich in Lactic acid bacteria such as *Lactococcus plantarum*, *Lactobacillus platarum*, *Bacillus subtilis, Bacilus pumilus. Bacillus* is the most common beneficial bacteria found in fermented fish (Sharma *et al.* 2020). The differences in bacterial composition of fermented product relies on the regional availability of fish, preparation pot, storing bamboo container and the microenvironment of the microbes (Barooah *et al.* 2020; Narzary *et al.* 2021; Das *et al.* 2026).

Fermented traditional beverages of North east India include 'Jou' prepared by the Bodo tribes. 'Chu' prepared by Garo tribes 'Chako' prepared by the Rabha tribe, 'Xaj', prepared by the Ahom and the Tiwa community, 'Judima' prepared by Dimasa Kachari tribe. A step that is common to preparation of all the traditional beverages with that of 'Po ro Apong' documented in the present study is the step of starter cake preparation using different and similar medicinal plants which is further used as a microbial culture for further preparation of fermented beverages (Narzary *et al.* 2026; Barooah *et al.* 2020). The method of preparation is also almost similar. All the traditional beverages have cultural significance; they are consumed during rituals, festivals, funerals. They have been reported to have antioxidant properties (Borah *et al.* 2021). Different types of microbes were found to be associated with the starter cake. The microbial community different significantly in all the starter cake. The starter cake of 'Po ro Apong' called 'Apopitha' or 'Apop'has amylolytic microbes, *Rhodotorula taiwainensis.* While the starter cake of 'Jou' called 'Amao' contained LAB, *Roseburia*, *Saccharomyces cerevisiae*, *Pichia burtonii*. The starter cake of Ahom community called the 'Xaj pitha' had *Candida tropicalis* and *Candida glabrata*. The most common microbe found in most of the starter cake is *Wickerhamomyces anomalus* and *Saccharomyces cerevisiae.* The consumption of these traditional beverages has been reported to enhance the functioning of gut microbiota by providing nutrients like amino acid, carbohydrates, minerals. The *Rosburia* and *Saccharomyces* species are considered probiotics supporting immunity against pathogens (Loying *et al.* 2024).

Similar to the 'Iku', a fermented bamboo shoot item prepared by the Missing community, 'Khorisa' is prepared by the Assamese community, 'Ekung' and 'Hirring' by Nyshi and Apatani community, 'Miya mikhri' by Dimasa tribe, and 'Mesu' prepared by people of Sikkim. The bamboo species used to prepare Iku is *'Bambusa balcooa'*. Including *Bambusa balcooa*, the Nyshi and Apatani tribe also uses *Dendrocalamus giganteus* munro, *Dendrocalamus hamiltonii* Nees et Arn. ex Munro. The Assamese community also uses D. hamiltonii, B. balcooa to prepare 'Khorisa. Other bamboo species includes *B. vulgaris, B. tulda.* The process of preparation differs among the communities. 'Iku' is prepared in earthened pot, and hollow bamboo shoot. While 'poka khorisa' is left for fermentation in air-tight containers. 'Ekung' and 'Hirring' is prepared in a bamboo basket which is inserted in the ground, sealed using leaves and left for fermentation. 'Mesu' is prepared using hollow bamboo shoots, which is then filled with cut bamboo shoots. All the fermented bamboo shoots were found to be rich in *Lactobacillus* species, some of which are considered essential probiotics. 'Khorisa' contained *Lactobacillus brevis*, *L. plantarum*, *L. pentosus*, while bacteria isolated from 'Mesu' were *Lactobacillus brevis* and *L. plantarum.* While 'Ekung' and 'Hirring' were found to contain *Lactobacillus lactis, L.brevis, L.casei.* The fermented bamboo shoots are rich in fibre, carbohydrates, protein, and minerals. They are considered to have anti-aging, anti-oxidant properties (Barooah *et al.* 2020; Narzary *et al.* 2016; Sharma *et al.* 2020).

Table: 8 A comparative analysis of fermented food and beverages prepared by different communities of North east India

| Sl. no | Fermented food and beverages | Community of consumers | Functional significance | Potential prebiotic value | References |
|---|---|---|---|---|---|
| 1. | Fermented fish | Missing | Cultural and nutritional | *Bacillus subtilis, B.siamensis* | (Narzary *et al.* 2016; Loying *et al.* 2024; Das *et al.* 2026; Sharma *et al.* 2020) |
| | Numsing | | | | |
| | Napham | Bodo | | *Bacillus velezensis* | |
| | Ngari | Manipuri | | *Bacillus subtilis, B. pumilus, Lactobacillus plantarum* | |
| | Po ro Apong (Apop) | Missing | | *Rhodotorula taiwainensis* | (Barooah *et al.* 2020; Loying *et al.* 2026) |
| | Jou (Amao) | Bodo | | *Lactic acid Bacteria, Roseburia, Saccharomyces cerevisiae* | |
| | Xaj (Xaj pitha) | Ahom | | *Wickerhamomyces anomalus* | |
| | Khorisa | Assamese | | *Lactobacillus brevis,L. plantarum* | |
| | Ekung and Hirring | Nyshi and Apatani | | *Lactobacillus brevis, L.casei* | |

## Discussion

The present study documented 94 ethnomedicinal plant species which belongs to 56 different families used by the mishing community of Jorhat district, Assam. The huge number of species which have been recorded in the study reflects the strong dependence of the mishing community for treatment of various ailments such as diabetes, dysentery, jaundice, gastric disorders, skin diseases etc. Apart from mishing community several other tribal communities too have reported contribution to primary healthcare. This extensive use of medicinal plants also shows the close interaction between local people and the surrounding environment. Such diversity may be linked with the appropriate environmental conditions and rich soil condition of upper Assam. Furthermore, the high use values of certain species highlights their cultural importance in traditional healing process. Among the surveyed families, Lamiaceae and Rutaceae showed the highest number of species. Members of Lamiaceae are known to have essential oils, alkaloids, flavonoids etc that contribute to the medicinal importance particularly for treatment of digestive issues, respiratory ailments etc. Rutaceae family members are widely recognized for their antimicrobial and antioxidant properties. While members of Asteraceae are most widely used by the community of Mizoram in another study, this can be due to difference in community wise practices as well as the highest number of plant species under the said family could also be one of the reasons than Lamiaceae of present study. In this study, leaves were the most frequently used plant parts which may indicate sustainable harvesting practices since leaves cause less damage to plants compared to root or bark extract.

The documented medicinal plants had wide therapeutic applications for different diseases like diabetes, skin disorders, menstrual issues, urinary infections etc. Several plant species recorded in this study such as *Ocimum sanctum, Centella asiatica, Curcuma longa* have been reported to possess significant anti-microbial, anti-oxidant, anti-inflammatory properties. The high use of these species shows their repeated use and cultural acceptance among Mishing community. Similar therapeutic use of many recorded species has also been documented among other ethnic groups, suggesting possible inter community knowledge exchange and ethnomedicinal traditions. Certain medicinal plants also work as substrate for the growth of microorganisms involved in the process of fermentation (Gadhoumi *et al.* 2021).Similar studies have reported the usage of same plant species by other tribes of North east India for the preparation of their traditional fermented beverages. The Karbi tribes of Assam use leaves of *Artocarpus heterophyllus* to prepare their traditional beverage known as 'hor-alank'. In another study, leaves of *Lygodium sp, Centella asiatica* and the seeds of *Piper nigrum* have been used by the Ahoms of Assam to prepare 'xaj-pani'- their traditional beverage. The Deoris of Assam prepare 'Sujen' by using the leaves of *Lygodium flexusum* and the stem and rhizome of *Costus speciosus*(Das et al. 2012).This repository of traditional knowledge plays vital role in the making of beneficial beverages and in the treatment of various diseases.

The present study also documented some important fermented foods including Numsing , Iku, Nogin apong, Po : Ro apong . These fermented food products represent an important component of cultural identity, healthcare practices of Mishing community. The use of some medicinal plants such as *Zingiber officinale, Centella asiatica, costus speciosus* during fermentation suggests a strong relationship between traditional food systems. Fermentation not only improves the food preservation but also enhances nutritional quality and probiotic potential. Previous studies from Northeast India have reported the use of medicinal herbs unto traditional fermented beverages. The preparation of fermented foods and beverages among mishing community reflects indigenous knowledge regarding microbial fermentation, and utilization of local bioresources. Several studies have reported the use of same plant species for the treatment of same or different diseases by other tribes of Northeast India. *Centella asiatica* is used by the Mishing tribe to treat liver infection, and diarrhea similarly this plant is also used by the tribes of Meghalaya to treat diarrhea and dysentery (Laloo and Hemalatha, 2011). The same species is used to treat indigestion and conjunctivitis by the tribes of Jaintia hills. Similar to the Mishing tribes, the tribes of Tripura use the leaves *Psidium guajava* to cure diarrhea, dysentery and stomach related disorders. *Cinnamomum t*amala is used by the Mishing as well as Tribes of Meghalaya for the treatment of diarrhea. A study reports the use of *Piper longum* for Malaria and body ache by Jaintia tribes, the same plant is used by the Mishing to treat muscle aches (Sajem and Gosai, 2006).

Despite the richness of ethnomedicinal knowledge which have been documented in the present study, several conservation concerns remain significant. The traditional knowledge among the Mishing community is mainly transmitted orally, making it more vulnerable due to urbanization, deforestation, migration etc. New generations are more dependent on modern healthcare systems, which may lead to reduction of transmission of indigenous knowledge practices. Habitat degradation, deforestation, agricultural expansion, and overexploitation of medicinal plants also threaten the sustainability of important medicinal plant species. In addition, awareness programs must be adopted for such.

Although this study provides much valuable ethnobotanical knowledge, certain limitations should be acknowledged. The study was mainly restricted to selected villages of Jorhat district and involved only 50 informants, which may not fully represent the complete ethnomedicinal knowledge of the entire Mishing community.

The study mainly focused on qualitative ethnobotanical documentation and basic quantitative such as use value, while detailed phytochemical, microbiological, and pharmacological analyses were beyond its scope. Similarly, the microbial diversity associated with fermented foods and beverages was not investigated under laboratory conditions.

Another limitation is that the dependence of oral narratives and informant memory which involves variation. So, the future research should include larger sample size, phytochemical characterization etc.

## Conclusions

The study documented 94 medicinal plant species belonging to 56 families. Among the recorded families, Asteraceae, Lamiaceae, and Rutaceae contributed the highest number of medicinal plant species (six species each). Leaves were the predominantly used plant part signifying its local accessibility and healing property. Besides the dominance of these three families, several other families such as Amaranthaceae, Apocynaceae, Malvaceae and Piperaceae has second highest value in terms of utilization thereby reflecting a wide range of plant types in the ethnomedicinal practices of the Mishing community in Jorhat. The medicinal herbs are not merely considered as remedy but also possess substantial significance in the context of community's cultural traditions and customs. The traditional knowledge associated with this indigenous group has been circulating over successive generations and the remedies transmitted verbally acts as primary or baseline therapy to improve routine ailments by the community people. The high use value of some plants depicts that they are not randomly selected by the informants but have genuine cultural significance.

The study further reveals the powerful interrelationships between ethnomedicinal plants and ethnic fermented foods. It has been noted that a total of 20 plant species loaded with immense therapeutic value were used to prepare the starter cultures of fermented beverages such as Po:ro and Nogin Apong. In the preparation of Numsing, medicinal herbs such as *Colocasia esculenta* was combined with dried fish, which is highly rich in Phytochemicals and used against numerous ailments by the community. In the course of fermentation, the straw ashes and raw material used in the preparation yields all the essential minerals to the ethnic fermented product. Together with Numsing and alcoholic beverages, another major fermented food Iku has disease curative potential and abundant in probiotic candidates. The traditional beverages of missing tribe have religious significance as it is offered in most of the rituals within their community. To be incorporated into larger healthcare systems, these ethnomedicinal practices and utilization fermented foods and beverages need to be documented and

validated through scientific research. Future research must concentrate on the pharmacological validation of these traditional therapies, their possible commercialization, and methods for preserving traditional knowledge along with the laboratory-based validation of microbial candidates of starter cultures. The Mishing people's ethnomedicinal history should be acknowledged and conserved as it can improve healthcare and protect biodiversity.

## Declarations

**Ethics approval and consent to participate:** Ethical approval was not required as per institutional guidelines; however, the study strictly followed the ethical principles of ethnobiological research. Prior Informed Consent (PIC) was obtained from all participants before data collection. The study also adhered to the Nagoya Protocol on Access and Benefit Sharing, ensuring respect for indigenous knowledge and community rights.

**Consent for publication**: All the participants and their practices shown in images gave their direct consent to have the image in the paper and being published.

**Availability of data and materials**: The data provided by the authors in the work is original in nature.

**Competing interests**: The authors must not have any financial and non-financial interest that to be disclosed.

**Funding**: No Research funding was received to conduct the work efficiently.

**Author contributions**: PG and SK carried out the whole survey and prepared the foremost framework of the manuscript. PG supervised the research, DD, RD, SD and TS performed the sufficient revisions, illustrations and contributed to the representation of the findings. All the authors offered equal contribution to the work and equally support in the manuscript writing process.

**Acknowledgements:** The authors would like to acknowledge the different village informants of Jorhat district to help in the survey process, as contributing their ethnomedicinal practices, fermented food production strategies to the mankind through this manuscript.

## Literature cited

Adhikari PP, Talukdar S, Borah, A. 2018. Ethnomedicobotanical study of indigenous knowledge on medicinal plants used for the treatment of reproductive problems in Nalbari district, Assam,India. Journal of Ethnopharmacology 210: 386-407. doi: 10.1016/j.jep.2017.07.024

Ashfaq S, Ahmad M, Zafar M, Sultana S, Bahadur S,Abbas N. 2019. Medicinal plant biodiversity used among the rural communities of arid regions of northern Punjab, Pakistan. Indian Journal of Traditional Knowledge 18(2): 226-241. doi:10.30848/pjb2019-2(31)

Barbhuiya AR, Sharma GD, Arunachalam A, Deb S. 2009. Diversity and conservation of medicinal plants in Barak valley, Northeast India. Indian Journal of Traditional Knowledge 8(2):169-175

Barooah C, Ahmed I. 2014. Plant diversity of Assam (a checklist of angiosperms and gymnosperms), ASTEC. Bigyan Bhawan, Guwahati, Assam

Barooah M, Bora SS, Goswami, G. 2020. Ethnic fermented foods and beverages of Assam. Ethnic fermented foods and beverages of India. Science History and Culture 85-104. doi:10.1007/978-981-15-1486-9_3

Bhandari JS. 1984. Ethnohistory, ethnic identity and contemporary Mishing society. Indian Anthropologist 14(2):79-103

Bhat P, Hegde GR, Hegde G, Mulgund GS.2014. Ethnomedicinal plants to cure skin diseasesan account of the traditional knowledge in the coastal parts of Central Western Ghats, Karnataka, India. Journal of ethnopharmacology 151(1):493-502.doi: 10.1016/j.jep.2013.10.062

Bhattacharjya DK, Akhtar J, Deka P, Bharadwaj A.2023. An ethnobotanical survey on phytomedicines based on traditional knowledge in the Barpeta district, Assam, India. Journal of Ayurveda and Integrative Medicine 14(4): 100763.doi: 10.1016/j.jaim.2023.100763

Boadu AA,Asase A.2017.Documentation of herbal medicines used for the treatment and management of human diseases by some communities in southern Ghana. Evidence-Based Complementary and Alternative Medicine 2017(1): 3043061.doi:10.1155/2017/3043061

Borah D, Gogoi T, Sarma J, Borah PJ, Gohain B, Mili C, Tangjang S. 2021. Compendium of plants used for preparation of traditional alcoholic beverages by four major ethnic communities of Assam, northeast India. Biodiversitas: Journal of Biological Diversity 22(4). doi:10.13057/biodiv/d220451

Buragohain P, Das B, Nath M, Sarma PJ, Boro M, Roy S, Nath N. 2024. Traditional knowledge of ethnomedicinal plants used by the Mishing community in Sivasagar District, Assam (India). Plant Science Today 11.doi:10.14719/pst.3360

Charah, H.2014. A study on Mishing tribe. GLOBUS Journal of Progressive Education 4(1):7-20.

Choudhury PR, Choudhury MD, Ningthoujam SS, Mitra A, Nath D.Talukdar, AD. 2015. Plant utilization against digestive system disorder in Southern Assam, India. Journal of Ethnopharmacology 175: 192-197.doi: 10.1016/j.jep.2015.09.020

Choudhury S, Sharma P, Choudhury MD, Sharma GD. 2012. Ethnomedicinal plants used by Chorei tribes of Southern Assam, North eastern India. Asian Pacific Journal of Tropical Disease 2: S141-S147.doi: 10.1016/S2222-1808(12) 60140-6

Chowdhury S. 2005.Assam's Flora Present Status of Vascular Plants. Assam Science Technology and Environment Council, Guwahati

Cox PA. 2000. Will tribal knowledge survive the millennium. Science 287(5450): 44-45.doi: 10.1126/science.287.5450.44

Daimari M, Roy MK, Swargiary A, Baruah S, Basumatary S. 2019. An ethnobotanical survey of antidiabetic medicinal plants used by the Bodo tribe of Kokrajhar district, Assam. Indian Journal of Traditional Knowledge (IJTK)18(3):421-429.

Das AJ, and Deka SC. 2012. Fermented foods and beverages of the North-East India. International Food Research Journal 19(2):377

Das AJ, Deka SC, Miyaji T. 2012. Methodology of rice beer preparation and various plant materials used in starter culture preparation by some tribal communities of North-East India: A survey. International Food Research Journal 19(1): 101

Das AK, Dutta BK, Sharma GD. 2008. Medicinal plants used by different tribes of Cachar district, Assam. Indian Journal of Traditional Knowledge 7(3):446-454

Das G, Patra JK, Singdevsachan, SK, Gouda S, Shin HS. 2016. Diversity of traditional and fermented foods of the Seven Sister states of India and their nutritional and nutraceutical potential: a review. Frontiers in Life Science 9(4):292-312. doi:10.1080/21553769.2016.1249032

Das M, Pegu A. 2023 An Ethnobotanical Survey of Medicinal Plants Used by Mising Tribe of The Gohpur Sub-Division of Biswanath District, Assam. Journal of Complementary Medicine Research 14(2):233

Das S, Phukan PS, Kalita D. 2026. Integrative bacterial-metabolite compositional profiling of traditional fermented fish paste (Napham) reveals a core bacterial consortium for differential synthesis of fermentation-derived functional metabolites. Antonie van Leeuwenhoek 119(2): 47.doi:10.1007/s10482-026-02261-6

Debbarma M, Pala NA, Kumar M,Bussmann RW. 2017. Traditional knowledge of medicinal plants in tribes of Tripura in northeast, India. African Journal of Traditional, Complementary, and Alternative Medicines14(4): 156.doi: 10.21010/ajtcam. v14i4.19

Deka D, Sarma GC. 2010. Traditionally used herbs in the preparation of rice-beer by the Rabha tribe of Goalpara district, Assam. Indian Journal of Traditional Knowledge 9(3):459-462

Gadhoumi H, Gullo M, De Vero L, Martinez-Rojas E, SaidaniTounsi M, Hayouni, EA. 2021. Design of a new fermented beverage from medicinal plants and organic sugarcane molasses via lactic fermentation. Applied Sciences 11(13): 6089.doi:10.3390/app11136089

Heinrich M, Ankli A, FreiB, Weimann C, Sticher O.1998. Medicinal plants in Mexico: Healers' consensus and cultural importance. Social Science & Medicine 47(11): 1859-1871.doi: 10.1016/s0277-9536(98)00181-6

Jain SK, Goel AK. 1995. A Manual of Ethnobotany, Jodhpur

Jeyaram K. 2009. Traditional fermented foods of Manipur

Kanjilal UN, Kanjilal PC, Das A, De RN.1940. Flora of Assam. Government of Assam Publication

Kanneganti J, Mina U, Singh A, Gautam A,Somvanshi P. 2023. Anti Mtb Medicinal Plants Database (AMMPDB): A curated database of Indian anti-tubercular medicinal plants. Journal of Ayurveda and Integrative Medicine 14(2): 100712.doi: 10.1016/j.jaim.2023.100712

KayaniS, Ahmad M, Sultana S, Shinwari ZK, Zafar M, Yaseen G, Hussain M, Bibi T. 2015. Ethnobotany of medicinal plants among the communities of Alpine and Sub-alpine regions of Pakistan. Journal of Ethnopharmacology 164: 186-202.doi: 10.1016/j.jep.2015.02.004

Keishing, S. and Banu, T., 2015. Fermented fish (ngari) of Manipur-preparation technique and its potential as a functional food ingredient. Elixir Food Sci eince85:34502-34507

Keith HS, Steinkraus I.1996. Handbook of indigenous fermented food. Marcel, New York, USA

Laloo D, Hemalatha, S. 2011. Ethnomedicinal plants used for diarrhea by tribals of Meghalaya, Northeast India. Pharmacognosy Reviews 5(10): 147.doi: 10.4103/0973-7847.91108

Leonti M, Sticher O, Heinrich M. 2002. Medicinal plants of the Popoluca, México: organoleptic properties as indigenous selection criteria. Journal of Ethnopharmacology 81(3): 307-315.doi:10.1016/s0378-8741(02)00078-8

Leonti M. 2011. The future is written: Impact of scripts on the cognition, selection, knowledge and transmission of medicinal plant use and its implications for ethnobotany and ethnopharmacology. Journal of Ethnopharmacology 134(3): 542-555.doi: 10.1016/j.jep.2011.01.017

Loying R, Kalita J, Manna P .2024. Rice-Based Alcoholic Fermented Beverages of North-East India: Insight into Ethnic Preparation, Microbial Intervention, Ethnobotany, and Health Benefits. Journal of Food Biochemistry 2024(1): 1-23.doi :10.1155/2024/7769743

Mihai RA, Guerra NJL, Catana RD. 2024. Assessment of phenolic composition and antioxidant activity of fermented Andean blackberry beverage enriched with medicinal plants of Ecuador. Notulae Botanicae Horti Agrobotanici Cluj-Napoca 52(3):13423-13423. doi:10.15835/nbha52313423

Namsa ND, Mandal M, Tangjang S. 2011. Anti-malarial herbal remedies of northeast India, Assam: an ethnobotanical survey. Journal of Ethnopharmacology 133(2):565-572. doi: 10.1016/j.jep.2010.10.036

Narzary Y, Brahma J, Brahma C, Das S. 2016. A study on indigenous fermented foods and beverages of Kokrajhar, Assam, India. Journal of Ethnic Foods 3(4): 284-291. doi: 10.1016/j.jef.2016.11.010

Narzary Y, Das S, Goyal AK, Lam SS, Sarma H, Sharma D. 2021. Fermented fish products in South and Southeast Asian cuisine: indigenous technology processes, nutrient composition, and cultural significance. Journal of Ethnic Foods 8(1):33. doi:10.1186/s42779-021-00109-0

Panging SM, Sharma S. 2017. Studies on ethnomedicinal and traditional healing practices among Mishing community of Desangmukh Gaon Panchayat, Sivasagar district of Assam, India. Journal of Medicinal Plants Studies 5(4):193-196

Ralte L, Sailo H, Singh YT. 2024. Ethnobotanical study of medicinal plants used by the indigenous community of the western region of Mizoram, India. Journal of Ethnobiology and Ethnomedicine 20(1): 2.doi:10.1186/s13002-023-00642-z

Rasool A, Bhat KM, Sheikh AA, Jan A, Hassan S. 2020. Medicinal plants: Role, distribution and future. Journal of Pharmacognosy and Phytochemistry 9(2):2111-2114

Rout J, Sajem AL, Nath M. 2012. Medicinal plants of North Cachar Hills district of Assam used by the Dimasa tribe. Indian Journal of Traditional Knowledge 11(3):520-527

Saikia AP, Ryakala VK, Sharma P, Goswami P, Bora U. 2006. Ethnobotany of medicinal plants used by Assamese people for various skin ailments and cosmetics. Journal of Ethnopharmacology 106(2): 149-157.doi: 10.1016/j.jep.2005.11.033

Sajem AL, Gosai K. 2006. Traditional use of medicinal plants by the Jaintia tribes in North Cachar Hills district of Assam, northeast India. Journal of Ethnobiology and Ethnomedicine2(1):33. doi:10.1186/1746-4269-2-33

Sekar S, Mariappan S. 2007. Usage of traditional fermented products by Indian rural folks and IPR

Sharma A, Kapoor AC. 1996. Levels of antinutritional factors in pearl millet as affected by processing treatments and various types of fermentation. Plant Foods for Human Nutrition 49(3):241-252

Sharma I, Yaiphathoi S. 2020. Role of microbial communities in traditionally fermented foods and beverages in North East India. Recent Advancements in Microbial Diversity 445-470. doi:10.1016/b978-0-12-821265-3.00019-0

Sharma UK, Pegu S, Hazarika D, Das A. 2012. Medico-religious plants used by the Hajong community of Assam, India. Journal of Ethnopharmacology 143(3): 787-800. doi: 10.1016/j.jep.2012.06.053

Singh AG, Kumar A, Tewari DD. 2012. An ethnobotanical survey of medicinal plants used in Terai Forest of western Nepal. Journal of Ethnobiology and Ethnomedicine 8(1): 19.doi:10.1186/1746-4269-8-19

Tamang JP. 2012. Microorganisms and nutritional value of ethnic fermented foods and alcoholic beverages of North East India. Indian Journal of Traditional Knowledge 11(1):7-25

Teramoto Y, Yoshida S, Ueda S. 2002. Characteristics of a rice beer (zutho) and a yeast isolated from the fermented product in Nagaland, India. World Journal of Microbiology and Biotechnology 18(9): 813-816.doi:10.1023/a:1021293804327

Trotter RT, Logan MH. 2019. Informant consensus: a new approach for identifying potentially effective medicinal plants. Plants and Indigenous Medicine and Diet 91-112. doi:10.4324/9781315060385-6

Zenderland J, Hart R, Bussmann RW, Paniagua Zambrana NY, Sikharulidze S, Kikvidze Z, Kikodze D, Tchelidze D, Khutsishvili M, Batsatsashvili K. 2019. The use of “use value”: quantifying importance in ethnobotany. Economic Botany 73(3): 293-303.doi:10.1007/s12231-019-09480-1