



RESEARCH ARTICLE

# Traditional knowledge of ethnomedicinal plants used by the Mishing community in Sivasagar District, Assam (India)

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## Abstract

Ethnobotany plays a significant role in traditional medicine practices. The present study aims to enlist the ethnomedicinal plants used by the Mishing community in Sivasagar district, Assam, India. The study was conducted from March 2021 to March 2022 to record the ethnomedicinally important plants used by the Mishing community. In the present study, 109 plant species were used in different ethnomedicinal practices which belong to 55 families and 101 genera. Out of 55 families, Asteraceae is dominant with the highest number of medicinal plants (8 species, 7.33%). In the survey, the symptomatic diseases category showed the highest agreement with an  $F_{IC}$  of 0.64%. The most commonly used plant parts for medicinal treatments were leaves (68 species, 62.38%). In comparison to other plant parts, the utilization of leaves causes less distress to the plant ensuring sustainability and its further conservation. It is concluded that the Mishing community of Sivasagar (Assam) District uses various medicinal plants to cure different diseases as their primary source of health care. This will be a significant contribution to the herbal and pharmaceutical industries for the welfare of mankind.

## Keywords

Assam; ethnobotany; mishing; Sivasagar; traditional knowledge

## Introduction

Traditional knowledge plays a crucial role in resource conservation, specifically of native plant species important for local communities (1-4). Since time immemorial, the local communities have been collecting ethnomedicinal plants from the wild in various parts of the world (5-12) and the information is passed from generation to generation (13). This information has to be conserved particularly in countries facing a high risk of biodiversity loss because of urbanization, migrations, deforestation, and natural disasters. In India, traditional knowledge is decreasing day by day at an alarming rate because of the above-mentioned factors. As a mega biodiversity hot spot, Northeast India is wealthy in endemic flora (14-18) and shelter to nearly 1,350 medicinal plants with great economic value that are utilized in different ethnomedicinal concoctions (19). Apart from being wealthy in floristic diversity, the region is also rich in diversified culture and traditional knowledge between 145 tribal communities (20). NE India is considered as one of the ecological hot spots of the globe and has plenty of medicinal plants familiar to the local people (18, 21-23). Assam, an important state of northeastern India falls under the Indo-Burma Global Biodiversity Hotspot (24). The Mishing tribes are especially found in the Dhemaji,

Lakhimpur, Sonitpur, Jorhat, Sivasagar, Dibrugarh, and Tinsukia districts of Assam. The Mishing people as a riverine tribe build their houses on elevated platforms about 4-5 feet from the ground, locally called Chang-ghar. Due to the lack of suitable communication and hospitals, they developed traditional recovery practices to protect themselves from various diseases, and till now they are still relying on traditional medicinal practices. Since ancient times the Mishing tribe of Sivasagar District of Assam, have been using medicinal plants to cure various illnesses over many centuries through the indigenous knowledge system that has been passed down through generations. The utilization of medicinal plants is decreasing rapidly because of certain factors like modern lifestyles and developments in medical sciences. To defeat this problem, appropriate documentation and assessment of the traditional knowledge of the local people is crucial (25). Thus, appropriate documentation and preservation of ethnomedicinal knowledge have become an urgent necessity before getting lost and superseded by modern medical facilities. Because of the accessibility of the current lifestyle and medical facilities, the culture of utilizing indigenous knowledge to cure common ailments is neglected. Therefore, traditional household practices are decreasing rapidly at an alarming rate in this region. No such work was done at the district level except for some preliminary basic work like Das & Pathak (2013) and Panging & Sharma (2017). Therefore, the present investigation was conducted to report the medicinal plants utilized by the Mishing community in the Sivasagar District; and to expose the medicinal plants with maximum ethno-medicinal significance for future value addition to their presence and protection for long-term purposes. The present work attempts to find out the ethno-medicinal recipes used by the Mishing community of Assam, to enlist the diversified medicinal plants used by the traditionally rich community, the recipes along with the use value of the plants, and the informant's consensus factor.

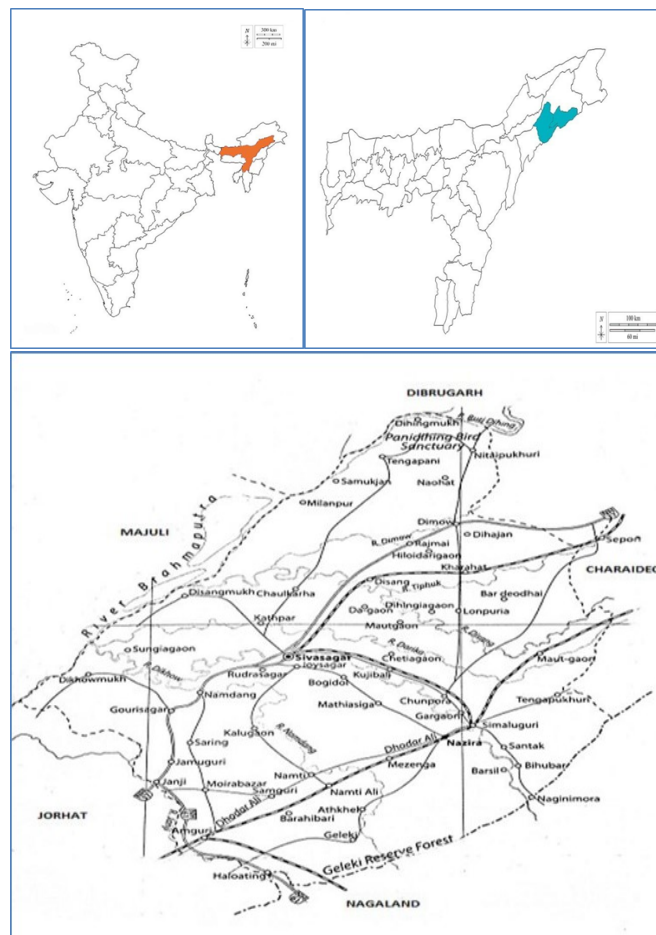
This type of work has tremendous significance in the field of science and medicine as the traditional knowledge holders of indigenous communities possess diverse knowledge of the local healthcare system as well as traditional medicine practices which often becomes the preliminary base for the discovery of many crude drugs.

## Materials and Methods

### Study Area

The survey was carried out in the Sivasagar district of Assam which belongs to the Upper region of the state. The district is situated between 26°45'-27°15'N latitude & 94°25'-95°25'E longitude covering a geographical area of approximately 2,668 sq. km (**Fig. 1**). It is surrounded by the districts Dibrugarh & Charaideo on East, Jorhat on the West, the mighty river Brahmaputra on the North & neighboring states Meghalaya & Arunachal Pradesh on the South. The climate is mainly humid sub-tropical which is characterized by heavy rainfall & high relative humidity (above 90%). According to the 2011 Census of India report, the district has a population of around 1,151,050 out of

which 22,123 were Mishing people (1.92% of the total population). The tribe is distributed in about 26 villages mainly on the river banks (like Desang, Dikhow, and Demow). The following 9 villages were selected as the study sites for the survey- Demowmukh Mishing Gaon, Desangpar Jurdubi Mishing Gaon, Koibotra Doloni Mishing Gaon, Desangmukh Sumoni Gaon, Desangmukh Majorbari Gaon, Desangmukh Ligoribari Gaon, Desangpar Dighol Doriyali and Boloma Gaon.



**Fig.1.** Map of study area (Sivasagar District, Assam, India)

### Field Survey and Collection of Data

The study was conducted from 2021 March to 2022 March in various localities following standard ethnobotanical methods using a specially designed questionnaire (28). All the relevant data including those of traditional uses of the medicinal plants used by the Mishing community of Sivasagar District were collected following the ISE code of ethics (2006). Using specially designed questionnaire, data was collected through personal interviews as well as through focused group discussions with a total of 50 informants. Several visits were made to remote places in the district at different time intervals for primary data collection. Based on the information obtained from the ethnic tribe the identification of the key informants became possible. With their cooperation, the plants were collected from the forest and the local names of the given plants were recorded in a structured questionnaire, comprising scientific names, family, local names of plants, parts used, application, method of preparation, and route of administration. In the present study, a total of 50 informants with a strong traditional knowledge base were

selected for data collection. During the process, importance was given to collecting data with a detailed account of every informant including their identity, address, qualifications, and tribal group. This was recorded before the collection of traditional knowledge-based information in the local language.

### Plant Collection, Identification and Preservation

Plants were collected by the herbal practitioners of the Mishing community for proper recognition during the mature stage. Also, voucher specimens related to ethno-medicinal information were collected during the reproductive phase for proper identification. Collected specimens were first tagged with the local name during the survey; then they were identified by following relevant taxonomic literature such as Flora of Assam (29); Assam's Flora (30); A checklist of Angiosperms and Gymnosperms (31), also comparing with the deposited voucher specimens at GUBH (Gauhati University Botanical Herbarium). Digital databases like "IPNI: International Plant Name Index (<https://www.ipni.org>)" and "POWO: Plants of the World Online (<https://powo.science.kew.org>)" were used for checking the accepted scientific nomenclature of each specimen.

### Statistical analysis

The collected data is represented orderly in tabular format. Demographic data contains the details about the informants; whereas data related to medicinal plants such as scientific name, family, vernacular name, use value, parts used, disease, and mode of application were tabulated together.

### Determination of Use Value (UV)

By determining the use value the relative importance of each recommended medicinal plant was calculated (32, 33), for measuring the relative importance of plants used by local healers on a quantitative basis:

$$UV = \sum U_i/n$$

Here,

$U_i$  = number of use reports cited by each informant for a given species

$n$  = total number of informants

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

### Determination of informants' consensus factor ( $F_{ic}$ )

Usually, the informants' consensus factor ( $F_{ic}$ ) is determined to find out the uniformity in the data given by the informants of the study area. By using the following formula  $F_{ic}$  was calculated (34-37).

$$F_{ic} = (N_{ur} - N_t) / N_{ur-1}$$

Here,

$N_{ur}$  = number of use reports in a particular category of illness by informants

$N_t$  = number of species of taxa that are used for the treatment of a particular disease category by informants of the study.

The informants' consensus factor value ranges from 0 to 1. When  $F_{ic}$  is higher or close to 1, it indicates higher reports about a plant species used by the informants in a specific ailment. When it is low or close to 0, it indicates disagreement by the informants about a plant used for a particular ailment.

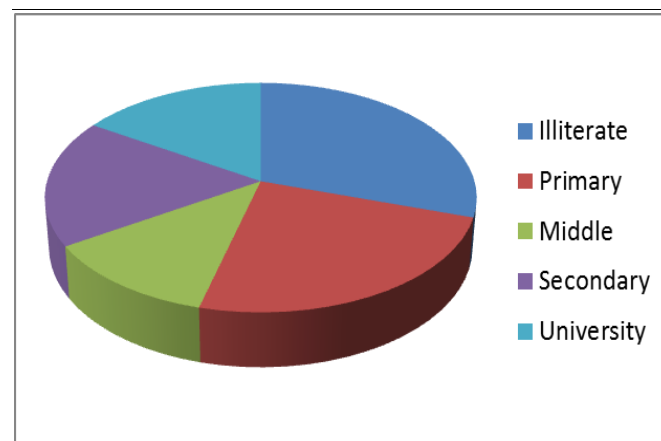
## Results and Discussion

### Demography

In the Sivasagar District, Assam a total of 50 informants of the age group range from 30-79 years were interviewed (**Table 1**). Out of 50 informants, 18 were male (36%) and 32 were female (64%). From the present work, it was found that the average age of the informants was 59 years. Most of the informants were involved with other livelihood activities being farmers, social workers, teachers, shopkeepers, and housewives. The illiteracy rate was found to be 24% while the literacy rate at the primary level was 22%, the middle level was 20%, the secondary level was 18% and the university level was 16% (**Table 2; Fig. 2**).

**Table 1.** Distribution of ethnic informants based on age and sex

Age group	Male	Female	No. of Individuals	Percentage (%)
20-29	00	03	03	6
30-39	02	07	09	18
40-49	06	08	14	28
50-59	03	05	08	16
60-69	06	06	12	24
70-79	01	03	04	8
Total	18	32	50	100



**Fig.2.** Pie chart showing the informants percentage based on educational status

**Table 2.** Educational status of the informants

Education level	No. of Individuals	Percentage (%)
Illiterate	12	24
Primary	11	22
Middle	10	20
Secondary	09	18
University	08	16

### An overview of medicinal plants

In the present study, 109 plant species were used in different ethnomedicinal practices which belong to 55 families and 101 genera. These were found to be used to heal certain human diseases which were grouped under 17 ICPC (International Classification of Primary Care) disease categories. It was found that the most documented ethnomedicinal plants were followed by herbs, shrubs, trees, lianas, and epiphytes (Fig. 3). The details on traditional knowledge accomplished by the Mishing people of Sivasagar District were arranged by scientific names together with their families, vernacular names and applications (Table 3). This is because of the availability of non-conventional herbs which are simple to plant in home gardens as compared to shrubs, trees, lianas, and epiphytes which take a longer period to grow. Due to this

reason herbs possess strong medicinal properties and more healing effects to combat illnesses (38-40). Most of these traditionally used plants are used by the Mishing tribe in their daily life for their livelihood and also to clear out serious/chronic health problems.

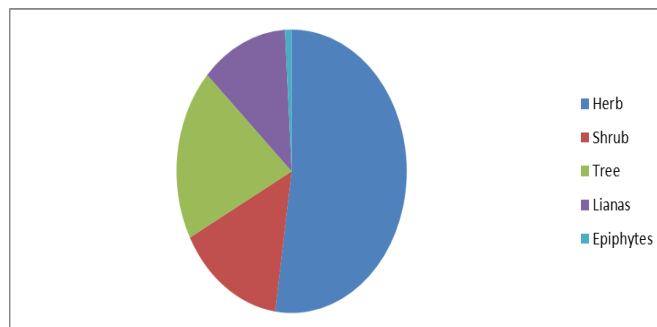


Fig.3. Percentage distribution of the medicinal plants habit wise

**Table 3.** Description of plants with use value, parts used, application, method of preparation, and route of administration collected from Sivasagar District, Assam, India

Sl. No.	Scientific name	Family	Common name	Use Value	Parts used	Application	Method of preparation	Route of administration
1	<i>Acmella ciliata</i> (Kunth) Cass.	Asteraceae	Huhoni-bon	0.14	Wh, Fl	Tongue bump, vision, fever, cough, headache, body pain, post-parturition pain	Raw, vegetable	Oral
2	<i>Acorus calamus</i> (L.)	Acoraceae	Bosh	0.14	Rh, L	Fever, stomach pain, dizziness	Raw, pill	External, oral
3	<i>Aegle marmelos</i> (L.) Correa	Rutaceae	Bael	0.02	Fr	Leukorrhoea	Juice	Oral
4	<i>Ageratum conyzoides</i> (L.)	Asteraceae	Gendhali-bon	0.08	L	Cut & wound,	Paste	External
5	<i>Allium cepa</i> (L.)	Amaryllidaceae	Piyanj	0.04	Bu	Diarrhoea (children), dizziness	Paste	External
6	<i>Allium sativum</i> (L.)	Amaryllidaceae	Nohoru	0.24	Bu	Fever, gall bladder stone, gastric, hypertension, post-parturition weakness, toothache	Raw, oil infusion, paste, juice, vegetable	External, oral
7	<i>Aloe vera</i> (L.) Burm. f.	Asphodelaceae	Sal-kunwori	0.06	L	Fever	Raw	External
8	<i>Alternanthera sessilis</i> (L.) R.Br. Ex DC.	Amaranthaceae	Mati-kanduri	0.04	L, St	Gastric, pneumonia	Vegetable, water infusion	Oral
9	<i>Amaranthus spinosus</i> L.	Amaranthaceae	Hati-khutura	0.12	L, St, R	Cut & wound, pinned, tuberculosis, leukorrhoea	Raw, juice	Oral, external
10	<i>Ananas comosus</i> (L.) Merr.	Bromeliaceae	Anaras, Mati-kothal	0.02	L	Roundworm	Paste	Oral
11	<i>Andrographis paniculata</i> (Burm.f.) Nees	Acanthaceae	Kalmegh	0.04	L	Fever	Water infusion	Oral
12	<i>Artocarpus heterophyllus</i> Lam.	Moraceae	Kothal	0.06	Fr, L	Diabetes, tonsillitis	Water infusion, smoke	Oral, external
13	<i>Azadirachta indica</i> A. Juss.	Meliaceae	Mahaneem	0.06	L	Itchiness, malaria, small-pox	Raw, water infusion	External, oral
14	<i>Bambusa tulda</i> Roxb.	Poaceae	Banh	0.08	L, B	Over menstrual bleeding, cuts & wounds, epiglottis enlargement	Juice, paste	Oral, external
15	<i>Basella alba</i> (L.)	Basellaceae	Puroisak	0.02	L, St	Piles	Pill	Oral
16	<i>Blumea lacera</i> (Burm. f.) DC.	Asteraceae	(Barbie in mishing)	0.02	L	Boil	Paste	External
17	<i>Bombax ceiba</i> L.	Malvaceae	Himolu (SinggiAppun)	0.02	L	Boil	Paste	External

18	<i>Cardiospermum halicacabum</i> L.	Sapindaceae	Kopalphuta	0.04	L	Gastric, and joint pain	Juice, paste	Oral, external
19	<i>Centella asiatica</i> (L.) Urb.	Apiaceae	Bor-manimuni	0.08	Wh, L	Leucorrhoea, dysentery, boil, pneumonia	Juice, paste	Oral, external
20	<i>Centipeda minima</i> (L.) A. Braun & Asch.	Asteraceae	Hasiyotibon	0.02	Wh, L	Waist pain	Juice	Oral
21	<i>Chrysopogon aciculatus</i> (Retz.) Trin.	Poaceae	Bonguti	0.04	St, Rh	Pneumonia, urinary infection	Pill, water infusion	Oral
22	<i>Cissampelos pareira</i> (L.)	Menispermaceae	Tubukilota	0.02	L	Sore throat	Paste	External
23	<i>Cissus quadrangularis</i> (L.)	Vitaceae	Harjuralota	0.04	Wh	Bone fracture, breakage	Paste	External
24	<i>Citrus × aurantiifolia</i> (Christm.) Swingle	Rutaceae	Kaji-nemu	0.10	L, Fr	Dizziness, itchiness, typhoid pneumonia, post-parturition pain, stomach scars	Juice, water infusion	Oral, external
25	<i>Citrus × limon</i> (L.) Osbeck	Rutaceae	Golnemu	0.12	L, Fr, Sp	Pneumonia, jaundice, dysentery, roundworm, diarrhea	Juice, paste, pill, water infusion	Oral
26	<i>Clerodendrum colebrookeanum</i> Walp.	Lamiaceae	Nephaphu	0.04	L	Hypertension	Juice, vegetable	Oral, external
27	<i>Coccinia grandis</i> (L.) Voigt	Cucurbitaceae	Belipoka	0.08	L, St	Dysentery, leucorrhoea, pneumonia	Water infusion, pill, juice	Oral
28	<i>Cocos nucifera</i> (L.)	Arecaceae	Narikol	0.18	Fr	Jaundice, fever, small-pox, dizziness, cuticle pain, heat rash	Juice	Oral, external
29	<i>Colocasia esculenta</i> (L.) Schott.	Araceae	Kola kosu, bonoriyako su	0.04	Rh, La	Cancer, epiglottis enlargement	Paste, raw	External
30	<i>Commelina diffusa</i> Burm.f.	Commelinaceae	Kona-himolu	0.02	L, St	Jaundice	Juice	Oral
31	<i>Coriandrum sativum</i> (L.)	Apiaceae	Dhaniya	0.02	S	Gall bladder	Water infusion	Oral
32	<i>Crinum asiaticum</i> (L.)	Amaryllidaceae	Bon-nohoru	0.02	Bu	Urinary problems (children)	Raw, smoked	External
33	<i>Curcuma caesia</i> Roxb.	Zingiberaceae	Kola halodhi	0.06	Rh	Stomach pain, gastric	Paste, raw	Oral
34	<i>Curcuma longa</i> (L.)	Zingiberaceae	Halodhi	0.1	Rh	Menstruation pain, dizziness, bone fracture, joint pain, memory booster	Raw, paste, pill, juice	Oral, external
35	<i>Cyathula prostrata</i> (L.) Blume	Amaranthaceae		0.02	L	Cut & wound	Paste	External
36	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Dubori bon	0.1	Wh	Cut & wound, dysuria, urinary problem	Juice, paste	Oral, external
37	<i>Datura metel</i> (L.)	Solanaceae	Dhatura	0.02	L	Bone-breakage	Paste	External
38	<i>Dillenia indica</i> (L.)	Dilleniaceae	Ow-tenga (Sompapayur)	0.02	Fr	Boil	Paste	External
39	<i>Drymaria cordata</i> (L.) Willd. ex. Schult.	Caryophyllaceae	Lai-jabori	0.02	L	Sinusitis	Juice	External
40	<i>Eclipta prostrata</i> (L.)	Asteraceae	Keheraj	0.2	L, St	Pneumonia, jaundice, menstruation pain, over-menstrual bleeding, external scars, dysentery, stomach pain, post-parturition pain	Paste, juice, pill	External, oral
41	<i>Eleocharis dulcis</i> (Burm.f.) Trin. Ex Hensch.	Cyperaceae	Sensu	0.02	Co	Asthma	Juice	Oral
42	<i>Elettaria cardamomum</i> (L.) Maton	Zingiberaceae	Elachi	0.08	Fr	Cough, pneumonia, jaundice, gallbladder stone	Pill, raw	Oral



43	<i>Eleusine indica</i> (L.) Gaertn.	Poaceae	Bobosa bon	0.04	Wh, R	Pneumonia, scabies	Water infusion, raw	Oral, external
44	<i>Eryngium foetidum</i> L.	Apiaceae	Man-dhoniya	0.02	L	Indigestion	Juice	Oral
45	<i>Ficus carica</i> L.	Moraceae	Dimaru	0.06	L	Post-parturition weakness, post-parturition bleeding, menstruation pain	Vegetavble, juice	Oral
46	<i>Ficus hispida</i> L.f.	Moraceae	(Tapot)	0.02	L	Pneumonia	Water infusion	Oral
47	<i>Ficus lamponga</i> Miq.	Moraceae	(Takhot)	0.02	L	Ear pain	Smoke	External
48	<i>Foeniculum vulgare</i> Mill.	Apiaceae	Sauf	0.02	S	Gall bladder stone	Water infusion	Oral
49	<i>Guilandina bonduc</i> L.	Fabaceae	Letaguti	0.2	S	Cough, stomach pain, pneumonia	Water infusion, pill	Oral
50	<i>Hellenia speciosa</i> (J.Koeing) S.R.Dutta	Costaceae	Jam-lakhuti	0.06	Rh	Leukorrhoea	Juice	Oral
51	<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	Jobaphool (Goshaniappun)	0.14	L, Fl	Fever, boil, small-pox	Paste	External
52	<i>Houttuynia cordata</i> Thunb.	Saururaceae	Masandari	0.06	L	Diarrhoea, gastric, dysentery	Raw, juice, vegetable, paste	Oral
53	<i>Hydrocotyle sibthorpioides</i> Lam.	Araliaceae	Horu-manimuni	0.18	Wh	Leukorrhoea, diarrhoea, pneumonia, dysentery, memory boosting	Raw, juice, vegetable, paste, pill	Oral
54	<i>Impatiens tripetala</i> Roxb. Ex DC.	Balsaminaceae	Demdeuka	0.04	L	Cancer, fever	Paste	External
55	<i>Jatropha curcas</i> L.	Euphorbiaceae	Bongali-enera	0.04	L, St	Diarrhoea, toothache	Paste, smoke	External
56	<i>Kalanchoe pinnata</i> (Lam.) Pers.	Crassulaceae	Dupor-tenga	0.04	L	Gall bladder stone, kidney stone	Juice, paste	Oral
57	<i>Lawsonia inermis</i> L.	Lythraceae	Jetuka	0.02	L	Cuticle pain	Paste	External
58	<i>Leucas aspera</i> (Willd.) Link	Lamiaceae	Durun bon	0.3	L	Boil, cough, stomach pain, gastric, cold, tonsillitis, sinusitis, eye pain, itchiness	Paste, water infusion, juice, vegetable, raw	External, oral
59	<i>Lippia alba</i> (Mill.) N.E.Br. Ex Britton & P. Wilson	Verbenaceae	(Pelutoying in mishing)	0.02	L	Roundworm	Vegetable	Oral
60	<i>Lygodium japonicum</i> (Thunb.) Sw.	Schizaeaceae	Kopou-dhekiya (Rakanmakat)	0.02	L	Menstruation pain	Pill	Oral
61	<i>Mesosphaerum suaveolens</i> (L.) Kuntze	Lamiaceae	Tokma	0.02	S	Urinary infection	Water infusion	Oral
62	<i>Mikania micrantha</i> Kunth	Asteraceae	Premlota	0.12	L	Dysentery, stomach pain, cut & wound	Paste, juice, pill	External, oral
63	<i>Mimosa pudica</i> L.	Fabaceae	Lajukilota	0.02	L	Pneumonia	Water infusion	Oral
64	<i>Miscanthus fuscus</i> (Roxb.) Benth	Poaceae	Nol, Khagori	0.02	L, St	Cancer	Paste	External
65	<i>Momordica charantia</i> L.	Cucurbitaceae	Tita-kerela	0.02	L	Nasal bleeding	Juice	External
66	<i>Morinda angustifolia</i> Roxb.	Rubiaceae	Akalbih (Aawmpul)	0.02	L	Boil	Paste	External
67	<i>Moringa oleifera</i> Lam.	Moringaceae	Sojina	0.02	B	Epilepsy	Water infusion	Oral
68	<i>Musa acuminata</i> Colla	Musaceae	Malbhogkol	0.04	Fr, Rh	Leukorrhoea, piles	Raw, juice	Oral
69	<i>Myristica fragrans</i> Houtt.	Myristicaceae	Jaiphal	0.06	S	Pneumonia, jaundice, gall bladder stone	Pill, water infusion	Oral
70	<i>Nicotiana tabacum</i> L.	Solanaceae	Mansadha	0.04	L	Toothache	Raw	External

71	<i>Nigella sativa</i> L.	Ranunculaceae	Kaljira	0.02	S	Gall bladder stone	Water infusion	Oral
72	<i>Nyctanthes arbor-tristis</i> L.	Oleaceae	Sewali phool	0.08	L, Fl	Fever, pneumonia, cough	Water infusion	Oral
73	<i>Ocimum tenuiflorum</i> L.	Lamiaceae	Tulashi	0.12	L	Cough, small-pox, ear pain	Paste, juice, pill, raw	Oral, external
74	<i>Oldenlandia corymbosa</i> L.	Rubiaceae	Bon-jaluk	0.14	L, St	Body pain, cough, stomach pain, pneumonia, dysentery	Vegetable, water infusion, pill	Oral
75	<i>Paederia foetida</i> L.	Rubiaceae	Bhedailota	0.16	L	Menstruation pain, boil, diarrhoea, gastric, post-parturition weakness, itchiness, pneumonia	Juice, paste, vegetable	Oral
76	<i>Persicaria chinensis</i> (L.) H.Gross	Polygonaceae	(Sibe-takkir)	0.02	L, St	Boil	Paste	External
77	<i>Phyla nodiflora</i> (L.) Greene	Verbenaceae	(Gakhirkuse rai)	0.04	L	Lactation deficiency, pneumonia	Juice	Oral
78	<i>Phyllanthus emblica</i> L.	Phyllanthaceae	Amlakhi	0.04	Fr	Liver weakness, hair fall	Juice, paste	Oral, external
79	<i>Phyllanthus niruri</i> L.	Phyllanthaceae	Bon-amlakhi	0.02	R	Pneumonia	Water infusion	Oral
80	<i>Physalis angulata</i> L.	Solanaceae	(Tumpet)	0.02	R	Pneumonia	Water infusion	Oral
81	<i>Piper betle</i> L.	Piperaceae	Paan	0.1	L	Cough; post-parturition vomiting, pain; pneumonia, stomach scars	Raw, paste, juice, water infusion	Oral
82	<i>Piper nigrum</i> L.	Piperaceae	Jaluk	0.6	Fr	Pneumonia, jaundice, over menstrual bleeding, gall bladder stone, cough, asthma, stomach pain, cold, menstruation pain, fever, headache, body pain, post-parturition weakness & pain, waist pain, stomach scars	Pill, juice, water infusion, vegetable	Oral
83	<i>Plumbago zeylanica</i> L.	Plumbaginaceae	Agasiat	0.08	L, R	Tuberculosis, hairy caterpillar bite, liver weakness	Oil infusion, paste, pill, vegetable	Oral, external
84	<i>Pogostemon benghalensis</i> (Burm.f.) Kuntz	Lamiaceae	Hukloti	0.02	L	Stomach pain	Vegetable	Oral
85	<i>Persicaria glabra</i> (Willd.) M.Gomez	Polygonaceae	Bihlogoni	0.08	L	Fever, cough, headache, body pain	Vegetable	Oral
86	<i>Portulaca oleracea</i> L.	Portulacaceae	Malbhogkhutura	0.08	Wh, L	Cough, asthma, jaundice	Juice, pill	Oral
87	<i>Potentilla indica</i> (Andrews) Th. Wolf	Rosaceae	Goru-khis (Bog-jer)	0.04	Rh	Tongue bump, throat ulcer	Paste, juice	Oral
88	<i>Pouzolzia zeylanica</i> (L.) Benn.	Urticaceae	Borali-bokua	0.02	L	Cut & wound	Paste	External
89	<i>Psidium guajava</i> L.	Myrtaceae	Madhuri	0.16	L	Pneumonia, stomach pain, cough, dysentery	Juice, pill, paste	Oral
90	<i>Punica granatum</i> L.	Lythraceae	Dalim	0.02	Pe	Epilepsy	Water infusion	Oral
91	<i>Rhynchostylis retusa</i> (L.) Blume	Orchidaceae	Kopouphool	0.02	L	Ear pain	Juice	External
92	<i>Rubus alceifolius</i> Poir.	Rosaceae	Jetuli-poka	0.02	L	Menstruation pain	Juice	Oral
93	<i>Sapindus mukorossi</i> Gaertn.	Sapindaceae	Manisal	0.08	S	Pneumonia, cough	Water infusion, pill	Oral
94	<i>Scoparia dulcis</i> L.	Plantaginaceae	Bon-cheni	0.02	L	Boil	Paste	External
95	<i>Sida rhombifolia</i> L.	Malvaceae	Hun-boriyal	0.12	L, Fr, R	Pneumonia, jaundice, tongue bump	Pill, juice, raw	Oral
96	<i>Solanum violaceum</i> Ortega	Solanaceae	Horubhekuri	0.04	R	Asthma, pneumonia	Juice, pill	Oral
97	<i>Streblus asper</i> Lour.	Moraceae	Gowalsali, hora gos	0.06	L	Boil, dysentery, pneumonia	Paste	External
98	<i>Syzygium aromaticum</i> (L.) Merr. & L.M. Perry	Myrtaceae	Laung	0.18	Fl	Cough, pneumonia, jaundice, over menstrual bleeding, gall bladder stone, leucorrhoea, toothache, menstruation pain	Pill, paste, raw, vegetable, water infusion	Oral
99	<i>Tagetes erecta</i> L.	Asteraceae	Narjiphool	0.08	L	Cut & wound, boil	Paste	External
100	<i>Tamarindus indica</i> L.	Fabaceae	Teteli	0.04	Fr	Hypertension, dizziness	Raw, juice	Oral

101	<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Combretaceae	Arjun gos	0.02	B	Menstruation pain	Juice	Oral
102	<i>Terminalia chebula</i> Retz.	Combretaceae	Hilikha	0.04	Fr	Liver weakness, jaundice	Juice, pill	Oral
103	<i>Tetragymma leucostaphyllum</i> (Dennst.)	Vitaceae	Nol-tenga	0.08	L	Boil, diabetes, dysentery, diarrhea	Paste, juice, vegetable	External, oral
104	<i>Tinospora cordifolia</i> (Willd.) Hook.f. & Thomson	Menispermaceae	Amarlota, hogunilota	0.02	B	Gall bladder stone	Water infusion	Oral
105	<i>Vitex negundo</i> L.	Lamiaceae	Pasatiya	0.14	L	Fever, dysentery, cough, headache, body pain	Water infusion, juice,	Oral
106	<i>Volkameria inermis</i> L.	Lamiaceae	-	0.02	L	Dysentery	Juice	Oral
107	<i>Xanthium strumarium</i> L.	Asteraceae	Agoruwa	0.02	R	Cough	Pill	Oral
108	<i>Zanthoxylum nitidum</i> (Roxb.) DC.	Rutaceae	Tejmui	0.02	B	Toothache	Raw	External
109	<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Ada	0.28	Rh	Pneumonia, jaundice, cough, stomach pain, cold, pneumonia, gastric, post-parturition weakness, toothache	Raw, juice, paste, pill, vegetable, water infusion	Oral

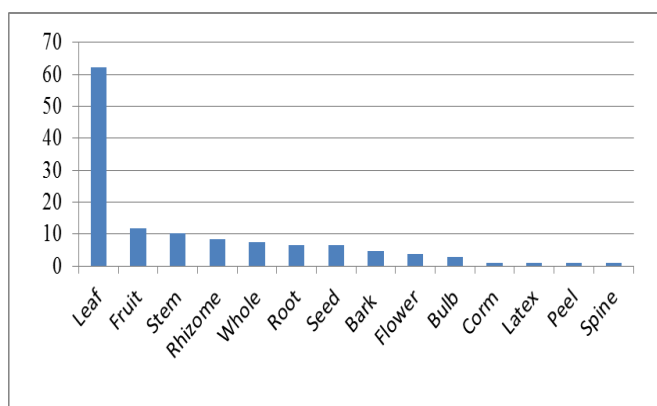
(Abbreviation: L-Leaf, Wh-Whole plant, St-Stem, B-Bark, Fr-Fruit, Fl-Flower, Pe-Peel, R-Root, Bu-Bulb, Co-Corm, S-Seed, Rh-Rhizome, La-latex)

### Plant parts used and types of medication

The tribe has a deep native knowledge on the use of different plant parts and their therapeutic properties. Commonly used parts of plants were leaf, root, rhizome, flower, fruit, bulb, bark, stem, seed, and whole plant for different purposes in their daily life. The most commonly used plant parts for medicinal treatment were leaves (68 species, 62.38%). In comparison to other parts of plants, the use of leaves causes less distress to the plant thus ensuring sustainability and its further conservation (18). It is then followed by fruit (13 species, 11.92%), stems (11 species, 10.09%), rhizomes (9 species, 8.25%), Whole plant (8 species, 7.33%), root (7 species, 6.42%), seeds (7 species, 6.42%), bark (5 species, 4.58%), flowers (4 species, 3.66%), bulbs (3 species, 2.75%), corm (1 species, 0.91%), Latex (1 species, 0.91%), peel (1 species, 0.91%), Spine (1 species, 0.91%)(Fig. 4).

Out of 55 families, Asteraceae is dominant with the highest number of medicinal plants (8 species, 7.33%); followed by Lamiaceae (7 species, 6.42%); Poaceae, Solanaceae and Moraceae (5 species, 4.58%) (Table 4).

The medicinal plants that were used in different forms to treat various human diseases were plant juice (48 species, 44.03%) followed by plant paste (46 species, 42.20%), water infusion (31 species, 28.44%), pill (26 species, 24.52%), eaten raw (24 species, 22.01%), vegetable (18 species, 16.51%), smoke (4 species, 3.66%), oil infusion (2 species, 1.83%)(Fig. 5).



**Fig. 4.** Bar diagram showing the percentage of parts used of the medicinal plants

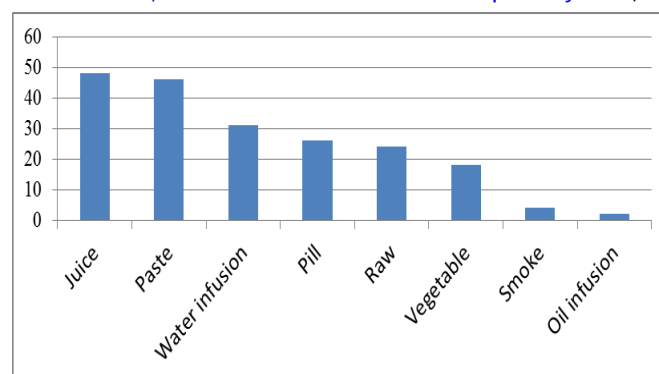
### Quantitative data on the ethnomedicinal uses

#### Use value (UV)

In this study, the use value ranges from 0.6-0.02 (Table 3). The most frequently used species were *Piper nigrum* L. with a 0.6 use value and *Leucas aspera* (Willd.) Link with 0.3 use value; followed by *Zingiber officinale* Roscoe with a use value of 0.28. Various works have been done on the above-mentioned plants to evaluate their medicinal properties. *Piper nigrum* L. has medicinal properties such as antioxidant (41), Neuroprotective (42), Anti-inflammatory (43), Anticancer (44), Analgesic (43), hypoglycemic, and hypolipidemic (45) activities, etc. It is scientifically proven that *Leucas aspera* L. is a very potential source of traditional medicine as it shows Antioxidant (46), Antimicrobial (47), Anticancer (48), Anti-inflammatory (49), Hepatoprotective (50), Larvicidal (51), Renoprotective (52), Anthelmintic (53) activities, etc. *Zingiber officinale* Roscoe is also a very important herb in traditional medicinal practices. Works have been done on its medicinal properties such as Antiviral (54), Radioprotective (55), Anti-inflammatory (56), Anticancer (57), Antioxidant (58) activities, etc. (Fig. 6 and 7).

#### Informant consensus factor (F<sub>IC</sub>)

In ethnomedicinal studies, F<sub>IC</sub> analysis gives a measure of accessibility for the given information of data collection (59). In this study, the medicinal plants used to cure various ailments in the Sivasagar District of Assam were classified into 17 ICPC (International Classification of Primary Care) (<https://www.who.int/standards/classifications/other-classification/international-classification-of-primary-care>)

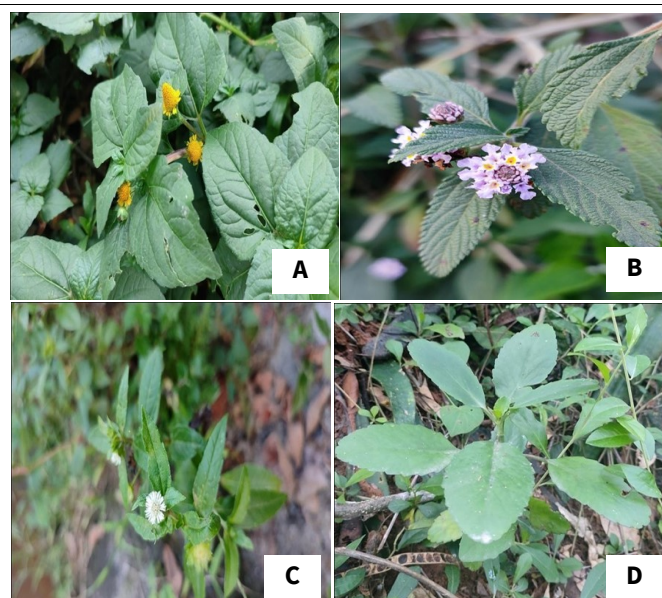


**Fig. 5.** Bar diagram showing the forms of medication of the medicinal recipes



**Table 4.** Category wise distribution of various medicinal plant taxa in Sivasagar District

Sl. No.	Family	Number of genera	Percentage of genera	Number of species	Percentage of species
1	Asteraceae	8	8	8	7.34
2	Lamiaceae	7	7	7	6.42
3	Poaceae	5	5	5	4.59
4	Moraceae	3	3	5	4.59
5	Solanaceae	4	4	4	3.67
6	Apiaceae	4	4	4	3.67
7	Zingiberaceae	3	3	4	3.67
8	Rutaceae	3	3	4	3.67
9	Malvaceae	3	3	3	2.75
10	Amaranthaceae	3	3	3	2.75
11	Fabaceae	3	3	3	2.75
12	Rubiaceae	3	3	3	2.75
13	Amaryllidaceae	2	2	3	2.75
14	Sapindaceae	2	2	2	1.83
15	Menispermaceae	2	2	2	1.83
16	Lythraceae	2	2	2	1.83
17	Verbenaceae	2	2	2	1.83
18	Polygonaceae	2	2	2	1.83
19	Rosaceae	2	2	2	1.83
20	Myrtaceae	2	2	2	1.83
21	Vitaceae	2	2	2	1.83
22	Piperaceae	1	1	2	1.83
23	Cucurbitaceae	1	1	2	1.83
24	Phyllanthaceae	1	1	2	1.83
25	Combretaceae	1	1	2	1.83
26	Acoraceae	1	1	1	0.92
27	Other 28 families	28	28	28	25.69
Total	54	100	100%	109	100%

**Image 1-** A- Informant showing *Morinda angustifolia* Roxb., B- Informant showing *Plumbago zeylanica* L.**Image 2-** Some medicinal plants collected from study site: A- *Acmella ciliata* (Kunth) Cass., B- *Lippia alba* (Mill.) N.E.Br. Ex Britton & P. Wilson, C- *Eclipta prostrata* (L.) L., D- *Kalanchoe pinnata* (Lam.) Pers.

disease categories and the  $F_{IC}$  value of each disease category was calculated (Table-5). In the investigation, the symptomatic diseases category showed the highest agreement with a  $F_{IC}$  of 0.64%. It was followed by external injuries (0.54%), heart and cardiovascular system disorders and diabetes (0.50%), digestive system disorders (0.44%), gynecological problems (0.41%), pneumonia (0.40%), ENT (0.33%), respiratory & pulmonary system diseases (0.3%), hepatological & dermatological diseases (0.29%), musculoskeletal & nervous system disorders (0.21%), urinogenital & renal and miscellaneous disorders (0.2%), oral & dentistry (0.09%). The lowest agreement between the informants was documented in the responses related to cancer and piles both with 0%  $F_{IC}$  Value. Earlier different workers followed this  $F_{IC}$  value as an important tool to conduct respective ethnobotanical studies (60-64). These studies show the greatest level of agreement between the different ethnic tribes of the state of Assam having a rich traditional knowledge with diverse flora as well as fauna together with rich tradition and culture.

## Conclusion

The current study presents a comprehensive dataset on the traditional medicinal knowledge and ethnobotanical practices of the Mishing tribe in Sivasagar District. A total of 109 plants associated with 17 different disease categories were documented. While the majority of these plants belong to various angiospermic families, one belongs to the pteridophytic family.

In treatment of various diseases, senior villagers and traditional healers gave more preferences to some medicinal plants, such as *Piper nigrum* L., and *Leucas aspera* (Willd.) Link, *Zingiber officinale* Roscoe, *Allium sativum* L., *Guilandina bonduc* L., *Eclipta prostrata* (L.) L., *Cocos nucifera* L., *Hydrocotyle sibthorpioides* Lam., *Syzygium aromaticum* (L.) Merr. & L.M.Perry, *Paederia foetida* L. and *Psidium guajava* L. The most commonly utilized plant parts for medicinal treatments were leaves (68 species, 62.38%). In comparison to other plant parts, the use of leaves causes less threat to the plant ensuring sustainability and its further conservation. In this survey, the symptomatic disease category showed the highest agreement with a  $F_{IC}$  of 0.64%. The lowest agreement between the informants was recorded in the responses related to cancer and piles both with a  $F_{IC}$  of 0%. These statistical analyses of the medicinal plants have validated their relative importance and capability towards curing different ailments. Therefore, plants having ethno medicinal properties can be chemically tested for proper recognition of bioactive compounds which can be utilized further for drug designing. This will be a significant contribution to the herbal and pharmaceutical industries for the welfare of mankind. This current investigation offers a fresh perspective aimed at raising awareness and establishing management strategies for both the ethnomedicinal plants and the floral diversity within Sivasagar District.

**Table 5.** Informant Consensus Factor (IFC) by disease category in Sivasagar District, Assam, India

Sl. No.	Disease category	Use Report ( $N_{ur}$ )	No. of taxa ( $N_t$ )	$F_{IC}$
1	Symptomatic diseases [Fever, cold, headache, dizziness]	49	18	0.64
2	External injuries [Cut & wound, pinned, cuticle pain, external scars]	23	11	0.54
3	Heart & cardiovascular system disorders [Hypertension]	5	3	0.5
4	Diabetes	3	2	0.5
5	Digestive system disorders [Gastric, stomach ache, diarrhea, dysentery, indigestion, roundworm, stomach scars]	55	31	0.44
6	Gynecological problems [Menstruation pain, over-menstrual bleeding, leucorrhoea, post-parturition vomiting, bleeding, weakness, lactation deficiency]	35	21	0.41
7	Pneumonia	48	21	0.41
8	ENT diseases [Ulceration, sore throat, throat bumps, tonsillitis, sinusitis, ear pain, nasal bleeding]	13	9	0.33
9	Respiratory & pulmonary system diseases [Tuberculosis, cough, asthma]	31	22	0.3
10	Hepatological [Gall bladder, liver weakness, jaundice]	28	20	0.29
11	Dermatological diseases [Boil, itchiness, small-pox, scabies, heat rash]	25	18	0.29
12	Musculoskeletal & nervous system disorders [Bone fracture, joint pain, waist pain, body pain, epilepsy]	15	12	0.21
13	Urinogenital & renal [Dysuria, kidney-stone, urinary infection & problems]	6	5	0.2
14	Miscellaneous disorders [Vision, memory booster, hairy caterpillar bite, malaria]	6	5	0.2
15	Oral & dentistry problems [Tongue bumps, toothache, uvule enlargement]	12	11	0.09
16	Cancer	3	3	0
17	Piles	2	2	0

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## Authors' contributions

The fieldwork was conducted by PB. PB and BD calculated the main statistical data. NN and BD helped in the identification of the specimens. BD, MN, and PJS collectively wrote the manuscript. NN supervised the work; all authors read, corrected, and approved the manuscript.

## Compliance with ethical standards

**Conflict of interest:** Authors do not have any conflict of interest to declare.

**Ethical issues:** None.

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