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Folk medicinal plants in forest fringe villages of tribal's hill districts of Nagaland, India

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In forest fringe villages, folk medicines play a pivotal role in human health care management. The aim of present study was to document the plants employed in the folk medicines by ethnic groups inhabiting forest fringe villages of Nagaland. Field survey was conducted for over two years in 32 forest fringe villages of Nagaland. The data were collected through semi-structured interviews and quantitatively analyzed by statistical tools *i.e.,* Use-value, Relative frequency of citation and Informant consensus factor to identify promising plants for future studies. This research documented 96 medicinal plants employed in the treatment of 59 ailments of human being. The quantitative analysis of the data indicates that some species have relatively high "use value (*UV*)" and "relative frequency of citation (*Rfc*)", these are: *Azadirachta indica* A. Juss., *Phyllanthus emblica* L. with 0.67 as UV and 3.6 as Rfc. Maximum consensus among informants was observed for the treatment of tooth and gum ailment and under this category *Solanum aculeatissimum* Moench was frequently cited by informants. Those plants which receive high relative frequency of citation values may serve as potential source for pharmacological studies, especially *Azadirachta indica* A. Juss. (used as insect repellent), *Phyllanthus emblica* L. (used in abdominal pain and indigestion), *Alstonia scholaris* (L.) R.Br. (in flatulence), *Aloe vera* Mill. (in constipation), *Canna indica* L. (in genital infection), *Gmelina arborea* Roxb. ex Sm. (prevent miscarriage), *Parkia timoriana* (DC.) Merr. (in bleeding piles), *Carica papaya* (DC.) Merr. (cure ringworm), *Solanum aculeatissimum* Moench (in foot and toe infection), *Thalictrum foliolosum* DC. (for vomiting and indigestion), *Mentha spicata* L. (in stomach ache), *Elettaria cardamomum* (L.) Maton (incough and cold), *Zingiber officinale* Roscoe (in cough and cold) and *Persicaria hydropiper* (L.) Delarbre (in skin infection).

Keywords: Folk medicinal plants, Fringe villages, Participatory rural appraisal, Use-value, Nagaland, India

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Nagaland, a beautiful state lies in the lap of eastern Himalayas decorated with loftiest hills and green valleys, which are magical in influence and musical in spirit. The entire state encompasses 16,579 sq km of area which constitutes about 0.50% of total geographical area of the country. The state has significant variation in topography and climatic conditions, therefore, different types of forests are found over 8629.30 sq. km which is about 52% of its geographical area. These forests are the home to 16 major tribes: *Angami, Ao, Chakhesang, Chang, Kachari, Khiamniungan, Konyak, Kuki, Lotha, Phom, PocHurry, Rengma, Santam, Sumi, Yimchnger* and *Zeme-Liangmai*. Forest people are dependent on the surrounding plant resources for food, fodder, shelter and medicine. This knowledge is essential for the survival therefore orally transmitting from generation to generation[1-3]. The ethnobotany of Nagaland has been previously studied by many researchers[4-17]. It has been observed that quantitative ethnobotanical studies within forest fringe villages of Nagaland was not conducted so far. Keeping this in mind, we set out to investigate 32 different forest fringe villages of Mon, Mokokchung and Wokha districts of Nagaland using quantitative statistical techniques. The aim of this study was: (1) to document the knowledge on ethnomedicines of forest fringe villages of Mon, Mokokchung and Wokha districts, and (2) to identify potential plants by quantitative studies for phytochemical and pharmacological investigation in future.

Methodology

Study area

The studies were carried out during 2018-19 and 2019-20 in Mon (26°43'N 95°02'E), Mokokchung (26°19'N

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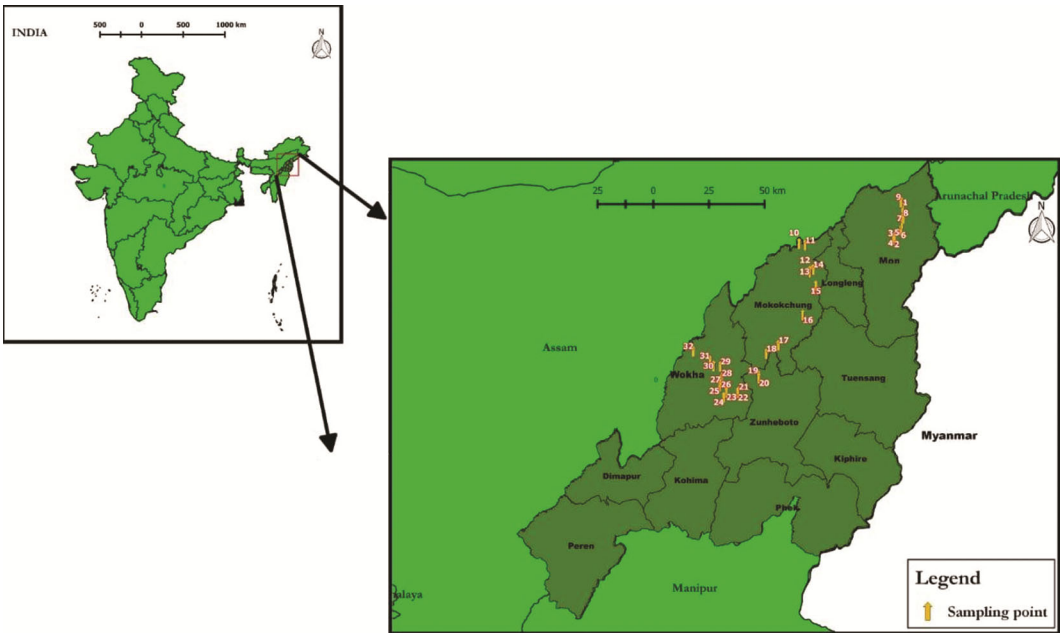

Fig. 1 — Geographical location of Mon, Mokochung and Wokha dist. in Nagaland and location of sampled forest fringe villages: 1. Takang, 2. Tahjan, 3. Mon Village, 4. Chanthambo, 5. Tammong, 6. Lampong, 7. Phoktang, 8. Toimai, 9. Tizit, 10. Tuli, 11. Pawla, 12. Amguri, 13. Kangtsung, 14. Merangkong, 15. Chantongya, 16. Mongsenyimti, 17. Imti, 18. Chuntia, 19. Astami 20. V.K Town, 21. Tsungiki, 22. Chukitong, 23. New Wokha, 24. Old Wokha, 25. Longsachung, 26. Ekham, 27. Yikhum, 28. Englam, 29. Doyang, 30. Baghty, 31. Sansi, 32. Bhandari village

94°3'E) and Wokha (26°06'N 94°16'E) districts of Nagaland (Fig. 1). The districts situated in remote locations and full of natural forests, total forest cover of studied districts was approx. 3835 sq. Km, which is about 23% of total geographical area of the state (Supplementary Table 1). The major tribes in the study area are *Konyak, Ao* and *Lotha* (Supplementary Table 2 and Fig. 2). A total of 32 forest fringe villages were randomly selected for sampling (Fig. 1). Details of sampling villages in all three districts are as follows: (a) Mon districts 9 villages were selected: 1. Takang, 2. Tahjan, 3. Mon, 4. Chanthambo, 5. Tammong, 6. Lampong, 7. Phoktang, 8. Toimai and 9. Tizit ; (b) Mokokchunj district 11 villages were selected: 10. Tuli, 11. Pawla, 12. Amguri, 13. Kangtsung, 14. Merangkong, 15. Chantongya, 16. Mongsenyimti, 17. Imti, 18. Chuntia, 19. Sastamiand, 20. V.K Town; (c) Mokokchunj district 12 villages were selected: 21. Tsungiki, 22. Chukitong, 23. New Wokha, 24. Old Wokha, 25. Longsachung, 26. Ekham, 27. Yikhum, 28. Englam, 29. Doyang, 30. Baghty, 31. Sansi and 32. Bhandari.

Survey, data collection and analysis

We have used semi-structure conversation while interaction with the key informants and walk-in-wood methodology of a Participatory Rural Appraisal (PRA) approach was adopted for survey[18,19]. Our key informants were traditional healers, community elders, farmers and house-wives. A total of 32 villages were surveyed and 160 people were interviewed and ethnomedicinal information were gathered along with voucher specimens. All plants were identified using relevant floras and by matching the voucher specimens with the herbaria of Botanical Survey of India, Shillong, Meghalaya. The scientific names of the plant specimens were updated according to the Plants of the World online (http://www.plantsoftheworldonline.org/). The nomenclatures of families were updated according to APG IV system of classification[20]. Some of the voucher specimens were collected from local village markets and weekly markets of forest fringe areas. Finally voucher specimens collected during the study have been deposited at the Herbarium of Rain Forest Research Institute, Jorhat, Assam, India.

Quantitative studies

Quantitative studies were performed to study the relative importance of plant species to different ethnic groups, preference information on different species and may also aid in the conservation of biodiversity[21].

Use-value

To verify the local importance of each species in the study area, the use value (UV) evaluation

Fig. 2 — Field photographs of *Konyak, Ao* and *Lotha* tribes of Mon, Mokochung and Wokha districts of Nagaland, India

technique was adopted. This technique calculates how many therapeutic uses for a given species an informant knows comparative to the average knowledge among the[22,23]. A high use value indicates a relatively important species for the local tribes or cultural group.

$$\text{Use value (UV)} = \frac{\sum \text{Number of uses mentioned by each informant for a given species}}{\text{Total number of informants}}$$

Relative frequency of citation (*Rfc*)

Relative frequency of citation helps in the identification of the popular medicine in the area because most of the key informants cites such remedies during conversation[24]; it is calculated by following formula:

$$\text{Relative frequency of citation (Rfc)} = \frac{\text{Frequency of citation}}{\Sigma\ \text{Frequency of citation of all medicines}} \times 100$$

$$\text{Frequency of citation} = \frac{\text{Number of informants who cited the medicine}}{\text{Total number of informants interviewed}} \times 100$$

Informant consensus factor (*Fic*)

The informant agreement ratio (IAR) or informant consensus factor (Fic) was used to determine the consensus between the informants for specific use category.

It identifies sets of plants employed in the treatment of particular illness category[18]. The Fic values range between 0 and 1. The high Fic value indicates relatively more consensus among the informants for particular remedy. It is calculated by following formula:

$$\text{Fic} = \frac{\text{Number of mentions in each usage category (Nur)} - \text{number of taxa used in each category(Nt)}}{\text{Number of mentions in each usage category(Nur)} - 1}$$

Results and Discussion

In summary, the result presents ethnomedicinal claims on 96 plant species employed in the treatment of 59 types of ailments treated by 151 types of remedies. *Konyak*, *Ao* and *Lotha* tribes people used these remedies for management of primary health care (Table 1).

As the present communication is showing the traditional medicines has wide range of medicines for common ailments of human being and play is pivotal role in the primary health care management in forest fringe villages of Mon, Mokokchung and Wokha district of Nagaland. It has been observed that majority of medicinal plants are herbs (52%), followed by tree (26%), shrub (11%) and climber (9%).

Medicinal plant diversity in folklore

A total of 96 plant species were documented belonging to 90 genera under 57 families. The highest number of folk medicinal plants were from family Asteraceae (8 species) followed by Zingiberaceae (6 species); Liliaceae and Solanaceae (5 species), etc. The families Asteraceae, Zingiberaceae, Liliaceae and Solanaceae are frequently used probably due to the rich diversity in respective families in study area.

Plant parts used and treatment of diseases

In the preparation of medication, either the whole plant or plant part such as leaves, shoot, roots/rhizome/ tuber/corm, flower, fruit/pod, lobes, seeds, bark, gum, resin, latex, fiber etc. are used. Figure 3 shows leaves were the most frequently used plant part (35%), followed by fruit/pod (16%), stem (16%), root (11%), rhizome (6%), whole plant (6), seed (4) and flower (5.8%), fiber, resin, gum and latex (6%).

A wide variety of human ailments were treated through different herbal remedies, 96 ethno-medicinal plants were used to treat 59 health problem by *Konyak, Ao* and *Lotha* tribes of Mon, Mokokchung and Wokha district of Nagaland. It was observed that most of the species were used in the treatment of multiple ailments of human being, most diversified uses were recorded for *Phyllanthus emblica* in the

Table 1 — Ethnobotanical plants documented as useful in traditionally healing human health diseases in fringe forest villages of Mon, Mokokchung and Wokhs district of Nagaland.

S. No.	Scientific name [Family] & specimen number; Habit	Vernacular name	UV	Time of collection	Rfc	Parts: uses	Preparation	Application & dosage
1.	*Acorus calamus* L. [Acoraceae] RFRIH 117; Herb	*Themeprii*	0.27	Year round	2.3	Rh: fever, diarrhoea, dysentery	Decoction	Oral (2 teaspoon); 2×1 after meal
					1.6	Wp: indigestion, flatulence	Decoction	Oral (2 teaspoon); 2×1 after meal
2.	*Justicia adhatoda* L. [Acanthaceae] RFRIH25; Shrub	*Sangtam tu*	0.47	Year round	3.0	Rt & Sbk: cough, cold, short breathing	Decoction	Oral (2 teaspoon); 2×1
					0.9	Lf: joint pain, lumber pain & sprains	Fire warmed	Topically
3.	*Aegle marmelos* (L.) Correa [Rutaceae] RFRIH54; Tree	*Charamjang*	0.40	May-Jun	2.8	Fr (u): dysentery	Raw	Oral (10gm); 2×1
					1.7	Fr(r): cough	Juice	Oral (1 glass); 3×1
4.	*Ageratum conyzoides* L. [Asteraceae] RFRIH30; Herb	*Nhasa*	0.13	Jun-Nov	1.9	Lf: contraceptive for female	Juice	Oral (1 cup); 2×1
5.	*Albizia chinensis* (Osbeck) Merr. [Fabaceae] RFRIH 22; Tree	*Amwosu*	0.20	Year round	2.1	Lf: skin infection	Extract	Ointment; 3×1
					1.2	Sbk: expel intestinal worm	Powder	Oral (2 teaspoon with water); 3×1
6.	*Albizia procera* (Roxb.) Benth. [Fabaceae] RFRIH63; Tree	*Sapotusu*	0.33	Year round	2.6	Sbk: backache	Paste	Topically
					2.3	Sbk: inflammation, pain in the joints & muscles	Decoction	Oral (1 teaspoon); 3×1
7.	*Allium ascalonicum* L. [Amaryllidaceae] RFRIH53; Herb	*Rupchi*	0.33	Year round	2.6	Lf: expel intestinal worm	Juice	Oral 1 teaspoon); 2×1
					0.7	Lf: wound	Raw crushed	Ointment; 3×1
8.	*Allium sativum* L. [Amaryllidaceae] RFRI 86; Herb	*Lasung; Chiimeria*	0.53	May-Jul	3.2	Lb: gastric problems, constipation	Raw	Oral (2-3 lobes) empty stomach; 1×1
					1.3	Lb: cough & sore throat	Roasted	Oral (2-4 lobes with honey); 3×1
					0.9	Lb: chest & back pain	Crushed warm with mustard oil	Topically
9.	*Alnus nepalensis* D. Don [Betulaceae] RFRIH 84; Tree	*Lutusu*	0.40	Year round	2.8	Sbk: stomachache & dysentery	Paste	Topically; till cure
					0.8	Rt: diarrhoea	Decoction	Oral (1 cup); 3×1
					0.7	Lf: wound & cuts	Paste	Ointment
10.	*Aloe vera* (L.) Burm.f. [Asphodelaceae] RFRIH94; Herb	*Alo naro*	0.60	Year round	3.4	Lf: constipation, indigestion, bleeding during stool pass	Raw	Oral empty stomach (1 cup); 1×1
					2.6	Lf: cooling effect, prevent skin dryness	Juice	Topically in the morning
11.	*Alstonia scholaris* (L.) R.Br. [Apocynaceae] RFRIH91; Tree	*Tughami; Subo*	0.47	Year round	3.0	Sbk: flatulence	Decocted with Sbk of *Baliospermum solanifolium* (Burm.) Suresh	Oral (1 teaspoon); 2×1
					0.4	Lf: rheumatic pain, toothache & earache	Decoction	Oral (1 teaspoon); 2×1
12.	*Amorphophallus paeoniifolius* (Dennst.) Nicolson [Araceae] RFRIH20; Herb	*Shitsu nupang*	0.20	Dec- Feb	2.1	Cm: knee inflammation	Decoction	Oral (1 teaspoon); 3×1
					1.2	Cm: inflammation in anal area & bleeding while passing stool	Decoction	Oral (2 teaspoon) 2×1
					0.4	St: expel intestinal worm	Decoction	Oral (2 teaspoon) 2×1

(*contd.*)

Table 1 — Ethnobotanical plants documented as useful in traditionally healing human health diseases in fringe forest villages of Mon, Mokokchung and Wokhs district of Nagaland. (*contd.*)

S. No.	Scientific name [Family] & specimen number; Habit	Vernacular name	UV	Time of collection	Rfc	Parts: uses	Preparation	Application & dosage
13.	*Artemisia nilagirica* (C.B.Clarke) Pamp. [Asteraceae] RFRIH87; Herb	*Penianiapfii*	0.13	Year round	1.9	Lf: inflammation in anal area & bleeding while passing stool, mosquito repellent	Decoction	Topically
14.	*Azadirachta indica* A.Juss. [Meliaceae] RFRIH93; Tree	*Neem tu; Neem*	0.67	Year round	3.6	Lf: insect & mosquito repellent	Dry smoked	Smoked; Topically
					2.6	Lf: skin infection	juice	Oral chewed (5-10 Lf); 2×1
					2.6	Lf: mouth ulcer, expel intestinal worm, stop vomiting	Juice	Oral (1 glass); 1×1
15.	*Bambusa tulda* Roxb. [Poaceae] RFRIH36; Herb	*Awuti*	0.47	Year round	3.0	St: pox & other skin ailments	Soup	Oral (1 glass) 2×1
					0.2	St: insect bites & injuries	Paste	Topically
16.	*Begonia palmata* D.Don [Begoniaceae] RFRIH16; Herb	*Tisii*	0.33	Year round	2.6	St: toothache	Raw	Chewed
					0.7	Rt: inflammation & bleeding	Decoction	Oral (1 cup); 2×1
17.	*Bergenia ciliata* (Haw.) Sternb. [Saxifragaceae] RFRIH19; Herb	*Tsiakhadaru*	0.27	Year round	2.3	Rt: gastritis, loss of hunger, loose motion & vomiting	Decoction	Oral (1 teaspoon); 2×1
18.	*Bidens pilosa* L. [Asteraceae] RFRIH39; Herb	*Tenyiitsiithu*	0.13	Apr-Dec	1.9	Lf: wound healing & remove pus	Paste	Ointment
19.	*Blumea lacera* (Burm.f.) DC. [Asteraceae] RFRIH7; Herb	*Pieriikezhau*	0.13	Jun-Dec	1.9	Lf: frequent urination, inflammation in anal area & bleeding while passing stool	Paste	Orally (1 teaspoon) with water; 1×1
20.	*Bombax ceiba* L. [Malvaceae] RFRIH29; Tree	*Apunebo*	0.40	Year round	2.8	Fw: dysentery & stomachache	Decoction	Oral (1 teaspoon); 3×1
					1.1	Fw: diarrhoea, erectile dysfunction	Powder	Oral (half spoon) with water; 2×1
					0.6	Sd: infection in penis	Powder	Oral (1 teaspoon) with water; 1×1
21.	*Callicarpa arborea* Roxb. [Lamiaceae] RFRIH82; Tree	*Tachisu*	0.33	Year round	2.6	Sbk: skin infection, insect bites	Decoction	Oral (1 teaspoon); 2×1
22.	*Canna indica* L. [Cannaceae] RFRIH99; Herb	*Amjitera*	0.53	Year round	3.2	Rt: infection in genitals	Decoction	Oral (2 teaspoon) with fermented rice; 2×1
23.	*Cardiocrinum giganteum* (Wall.) Makino [Liliaceae] RFRIH44; Herb	*Ketsii*	0.20	Apr-Nov	2.1	Lf: body pain, bruishes & heals wound	Paste	Topically
24.	*Carica papaya* L. [Caricaceae] RFRIH31; Tree	*Mamazu; Papaw*	0.47	Year round	3.0	Lt: ringworm	Latex	Topically
					1.7	Fr: inflammation in anal area & bleeding while passing stool, ingestion & flatulence	Raw	Oral (250 g); 3×1
25.	*Caryota urens* L. [Arecaceae] RFRIH45; Tree	*Asang renra*	0.33	Year round	2.6	Sd: heaviness in stomach & pain	Porridge	Oral (50-100 g); 2×1
					1.2	Fl: promote hair growth	Crushed tender flowers	Topically 1/2 hr before bath

(*contd.*)

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26.	*Catharanthus roseus* (L.) G.Don [Apocynaceae] RFRIH14; Herb	*Ziesa*	0.20	Year round	2.1	Lf: blood purification	Decoction	Oral (2 teaspoon); 2×1
27.	*Cautleya spicata* (Sm.) Baker [Zingiberaceae] RFRIH21; Herb	*Pfhesi*	0.13	Year round	1.9	Lf & Rh: ear boils	Juice	Few drop topically
28.	*Centella asiatica* (L.) Urb. [Apiaceae] RFRIH85; Herb	*Longshikok; Gara*	0.20	Jul-Sept	2.1	Lf: diarrhoea	Juice	Oral (3-4 teaspoon) with milk
29.	*Thalictrum foliolosum* DC. [Ranunculaceae] RFRIH66; Herb	*Okhruvi*	0.5	Year round	3.1	Wp: burning sensation in chest or stomach, vomiting & indigestion	Decoction	Oral (1 teaspoon); 2×1
					0.7	Lf: boils & pimples	Juice	Topically
30.	*Cheilocostus speciosus* (J. Koenig) C.D. Specht [Costaceae] RFRIH12; Shrub	*Moori*	0.27	Oct-Dec	2.3	Rh: muscle cramp & muscle pain	Juice	Topically; 3 or 2×1
					1.7	Rh: expel intestinal worm, increase bowel movement	Decoction	Oral (2 teaspoon before sleep); 1×1
					1.3	Rh: fever & breathing trouble	Decoction	Oral (1 cup); 2×1
31.	*Chenopodium album* L. [Amaranthaceae] RFRIH100; Herb	*Kehie*	0.33	Jun-Sept	2.6	Lf & St: blood purification, regularize urine flow	Decoction	Oral (1 teaspoon); 2×1
32.	*Clerodendrum glandulosum* Lindl. [Lamiaceae] RFRIH37; Shrub	*Umerem*	0.40	Year round	2.8	Lf: headache, irregular heartbeat, dizziness & fatigue	Decoction	Oral (1 glass); 2×1
33.	*Coix lacryma-jobi* L. [Poaceae] RFRIH9; Herb	*Keseiko*	0.20	Sept-Dec	2.1	Sd: diarrhoea, dysentery	Raw	Oral (50 gm); 2×1
					2.7	Rt: expel intestinal worm	Decoction	Oral (2 teaspoon) before sleep; 1×1
34.	*Hellenia speciosa* (J.Koenig) S.R.Dutta [Costaceae] RFRIH76; Herb	*Khwiinothi*	0.13	May-Aug	1.9	Rh: difficulty & shortness of breathing	Decoction	Oral (1 cup); 2×1
35.	*Cucumis sativus* L. [Cucurbitaceae] RFRIH4; Climber	*Zungi*	0.53	May-Aug	3.2	Fr: burning sensation in chest or stomach, flatulence & dysentery	Raw or cooked	Oral (150-200 g); 3×1
36.	*Curcuma angustifolia* Roxb. [Zingiberaceae] RFRIH5; Herb	*Khwiikhwii*	0.33	Jun-Sept	2.6	Lf: nasal blockage	Boiled	Steam inhale; 1×1
37.	*Cyathocline purpurea* (Buch.-Ham. ex D.Don) Kuntze [Asteraceae] RFRIH52; Herb	*Pieriikeciiu*	0.13	May-Oct	1.9	Lf & St: stomach pain & flatulence	Decoction	Oral (1-2 teaspoon); 2×1
38.	*Cymbopogon flexuosus* (Nees ex Steud.) W.Watson [Poaceae] RFRIH40; Herb	*Riiga*	0.27	Year round	2.3	Lf: insect repellent	Paste	Topically
39.	*Deeringia amaranthoides* (Lam.) Merr. [Amaranthaceae] RFRIH95; Shrub	*Thezute*	0.20	Year round	2.1	Lf: body pain, wounds	Raw	Topically
40.	*Dioscorea alata* L. [Dioscoreaceae] RFRIH80; Vine	*Tsumgrem shii*	0.33	Year round	2.6	Tb: backache	Paste	Topically
					1.6	Tb: prevent miscarriage	Raw	Tuber tied over abdomen
41.								(*contd.*)

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S. No.	Scientific name [Family] & specimen number; Habit	Vernacular name	UV	Time of collection	Rfc	Parts: uses	Preparation	Application & dosage
42.	*Dioscorea pentaphylla* L. [Dioscoreaceae] RFRIH51; Climber	*Achuchu*	0.40	Year round	2.8	Tb: sexual weakness & impaired urine formation, bleeding while passing stool	Decoction	Oral (1 cup); 2×1
43.	*Lablab purpureus* (L.) Sweet [Fabaceae] RFRIH114; Herb	*Ciiba*	0.27	Oct-Feb	2.3	Lf, rt & pd: stomach pain, flatulence & heaviness in stomach	Decoction	Oral (1 teaspoon); 3×1
					0.9	Sd: Expel intestinal worm	Decoction	Oral (2 teaspoon) before sleep
44.	*Drymaria cordata* (L.) Willd. ex Schult. [Caryophyllaceae] RFRIH81; Herb	*Pfiipfiino*	0.20	Year round	2.1	Wp: Nasal blockage	Smoke	Vapor inhale (4-5 min); 3×1
45.	*Duabanga grandiflora* (Roxb. Ex DC.) Walp [Lythraceae] RFRIH6; Tree	*Shefuxasu*	0.33	Year round	2.6	Sbk: skin infection	Powder	Topically
46.	*Elettaria cardamomum* (L.) Maton [Zingiberaceae] RFRIH70; Herb	*Elachi*	0.40	year round	2.8	Sd: indigestion	Powder	Oral (5-10 g); 2×1 with water
					3.1	Sd: cough & cold	Paste	Oral (1 teaspoon) with cream before sleep
47.	*Elsholtzia blanda* (Benth.) Benth. [Lamiaceae] RFRIH154; Herb	*Riinu*	0.20	Year round	2.1	Lf: cut & skin infection	Paste	Topically
48.	*Equisetum arvense* L. [Equisetaceae] RFRIH11; Herb	*Shiihie*	0.13	Year round	1.9	St: abdominal pain & dark urine	Decoction	Oral (1 teaspoon) 2×1
49.	*Eucalyptus globulus* Labill. [Myrtaceae] RFRIH78; Tree	*Malistu*	0.40	Year round	2.8	Lf: cold	Boiled leaves	Inhale (4-5 min.); 3×1
					0.7	Lf & fr: dandruff & scalp infection	Paste	Topically
50.	*Ageratina adenophora* (Sprengel.) R.M.King & H.Rob. [Asteraceae] RFRIH105; Herb	*Tsunha*	0.27	Year round	2.3	Lf: stop bleeding	Paste	Topically
51.	*Fagopyrum esculentum* Moench [Polygonaceae] RFRIH18; Herb	*Garei*	0.33	Apr-Dec	2.6	Wp: expel intestinal worm	Decoction	Oral (1 cup); 2×1
					0.8	Wp: high pulse rate & headache	Decoction	Oral (2 teaspoon); 2×1
52.	*Ficus benjamina* L. [Moraceae] RFRIH35; Tree	*Nebathi*	0.47	Year round	3.0	Lf: heaviness in stomach & pain	Decoction	Oral (1 teaspoon); 2×1
					1.5	Sh: cough, dysentery	Decoction	Oral (2 teaspoon); 2×1
53.	*Ficus carica* L. [Moraceae] RFRIH33; Tree	*Mongozono*	0.53	May-Jun	3.2	Fr: fatigue & frequent urination	Raw	Oral (2-3 fruits); 1×1
					0.9	Fr: lumpy or hard stool & heaviness in stomach	Juice	Oral (2 teaspoon); 3×1
54.	*Gmelina arborea* Roxb. Ex Sm. [Lamiaceae] RFRIH124; Tree	*Thsughusu*	0.60	Year round	3.4	Sbk: prevent miscarriage	Powder	Oral along with Sbk *Rubia manjith* Roxb. and seeds of *Asparagus racemosus* Willd. (20 g); 2×1

(*contd.*)

Table 1 — Ethnobotanical plants documented as useful in traditionally healing human health diseases in fringe forest villages of Mon, Mokokchung and Wokhs district of Nagaland. (*contd.*)

S. No.	Scientific name [Family] & specimen number; Habit	Vernacular name	UV	Time of collection	Rfc	Parts: uses	Preparation	Application & dosage
55.	*Gmelina arborea* Roxb. Ex Sm. [Lamiaceae] RFRIH124; Tree	*Thsughusu*	0.60	Year round	3.4	Sbk: prevent miscarriage	Powder	Oral along with Sbk *Rubia manjith* Roxb. and seeds of *Asparagus racemosus* Willd. (20 g); 2×1
					2.1	Fr: burning sensation & irritation while urination	Raw	Oral (2-3 fruits); 2×1
					0.7	Lf: fatigue & frequent urination	Juice	Oral (2 teaspoon) with water; 2×1
56.	*Houttuynia cordata* Thunb. [Saururaceae] RFRIH160; Herb	*Gatha*	0.27	Mar-Nov	2.3	Lf & rt: high pulse rate & headache	Decoction	Oral (one cup); 2×1
57.	*Impatiens pulcherrima* Dalzell [Balsaminaceae] RFRIH121; Herb	*Gaii*	0.33	Year round	2.6	St: fatigue, pain in joint & muscle & swelling in limbs	Decoction	Oral (2 teaspoon); 2×1
58.	*Jasminum polyanthum* Franch. [Oleaceae] RFRIH97; Climber	*Mezhagakhwii*	0.20	Year round	2.1	Lf & sh: stomach pain & blood in stool	Decoction	Oral (one cup); 2×1
59.	*Justicia adhatoda* L. [Acanthaceae] RFRIH170; Shrub	*Kojii kakra*	0.2	Year round	2.1	Lf, sd & fr: burning sensation in chest, stomach pain & indigestion	Decoction	Oral (2 teaspoon); 3×1
60.	*Leea compactiflora* Kurz. [Vitaceae] RFRIH111; Shrub	*Anapobo*	0.20	Year round	2.1	Lf: body pain, insect bite	Paste	Topically; 3×1
61.	*Magnolia champaca* (L.) Baill. ex Pierre [Magnoliaceae] RFRIH83; Tree	*Chighusu*	0.40	Jun-Sept	2.8	Fl: inflammation & pain in the joints & muscles	Oil	Topically; 2×1
					1.0	Fl & fr: muscle cramp	Juice	Oral (one cup); 2×1
					1.7	Sbk: lumpy or hard stools, straining bowel movement & impaired urine formation	Powder	Oral (one teaspoon); 2×1
62.	*Melastoma malabathricum* L. [Melastomataceae] RFRIH27; Shrub	*Tughaloji shedu*	0.20	Year round	2.1	Lf: stop bleeding from cut	Paste	Topically
					0.4	Fl: bleeding and pain while passing stool	Decoction	Oral (one cup); 2×1
63.	*Melia dubia* Cav. [Meliaceae] RFRIH3; Tree	*Khosubo*	0.33	Year round	2.6	Sbk: expel intestinal worm	Powder	Oral (1 teaspoon); 2×1
					1.4	Lf: stop bleeding from cut	Decoction	Oral (1 cup); 2×1
64.	*Mentha spicata* L. [Lamiaceae] RFRIH119; Herb	*Tephinitso*	0.47	Year round	3.0	Lf: stomachache, vomiting & throat infection	Raw or paste	Oral (5-6 leaves); 3×1
65.	*Mirabilis jalapa* L. [Nyctaginaceae] RFRIH64; Herb	*Thevanoni*	0.33	Year round	2.6	Lf: inflammation of body part	Juice	Topically; 3×1
66.	*Morus alba* L. [Moraceae] RFRIH8; Tree	*Sulithi*	0.40	Apr-Aug	2.8	Fr: swelling of body	Raw	Oral (15-20 fruits); 3×1
67.	*Musa paradisiaca* L. [Musaceae] RFRIH88; Herb	*Somomo; Plantain*	0.47	Year round	3.0	Wp: stomach pain & vomiting	Juice	Oral (1 teaspoon) with water at 30 min. interval
68.	*Mussaenda macrophylla* Wall. [Rubiaceae] RFRIH161; Shrub	*Nokderang*	0.47	Year round	3.0	Rt: liver disorders & indigestion	Juice	Oral (1 teaspoon) macerate with milk and left overnight; 2×1
69.								(*contd.*)

Table 1 — Ethnobotanical plants documented as useful in traditionally healing human health diseases in fringe forest villages of Mon, Mokokchung and Wokhs district of Nagaland. (*contd.*)

S. No.	Scientific name [Family] & specimen number; Habit	Vernacular name	UV	Time of collection	Rfc	Parts: uses	Preparation	Application & dosage
70.	*Nicotiana plumbaginifolia* Viv. [Solanaceae] RFRIH107; Herb	*Sada*	0.33	Apr-Dec	2.6	Lf: insect repellent	Paste	Topically
71.	*Osbeckia crinita* Benth.ex Triana [Melastomataceae] RFRIH10; Shrub	*Khukhe*	0.20	May-Nov	2.1	Rt & st: dysentery, indigestion & stomachache	Decoction	Oral (1 teaspoon); 2×1
72.	*Paederia foetida* L. [Rubiaceae] RFRIH206; Climber	*Siizii*	0.33	Nov-Feb	2.6	Lf & sh: stomach pain	Decoction	Oral (1 teaspoon); 2×1
					1.3	Rt: expel intestinal worm	Decoction	Oral (1 cup) with 1 glass water; 2×1
73.	*Panax pseudogingseng* Wall. [Araliaceae] RFRIH210; Herb	*Gingseng*	0.47	Jun-Oct	3.0	Rh: abdominal cramp, indigestion and sexual weakness	Decoction	Oral (1 glass); 2×1
74.	*Paris polyphylla* Sm. [Melanthiaceae] RFRIH159; Herb	*Keciiu; Tinhyiimia*	0.40	May-Aug	2.8	Rh: inflammation of body parts	Paste	Topically
75.	*Passiflora edulis* Sims. [Passifloraceae] RFRIH68; Climber	*Antsulashi*	0.27	Oct-Jan	2.3	Fr: hard stool & staining bowel movement	Raw	Oral (3-4 fruits) daily
					0.5	Lf: headache & high pulse rate	Decoction	Oral (8-10 leaves) boiled with water; 2×1
76.	*Phyllanthus emblica* L. [Phyllanthaceae] RFRIH173; Tree	*Lozu*	0.67	Jun-Sept	3.6	Fr: flatulence, indigestion, vomiting & abdominal pain	Raw	Oral (2-3 fruits); 1×1
					2.3	Fr: cough, cold, bronchitis & sore throat	Paste from dry fruit	Topically massage on chest & throat along with mustard oil
77.	*Phyllanthus fraternus* G. L Webster [Phyllanthaceae] RFRIH200; Tree	*Khollethi*	0.33	Jun-Sept	2.6	Lf, fr & rt: abdominal pain, pain or irritation while urination in woman & loose watery bowel movement	Decoction	Oral (1 cup); 2×1
78.	*Piper betle* L. [Piperaceae] RFRIH23; Climber	*Patu*	0.53	Oct-Jan	3.2	Lf: abdominal pain & indigestion	Raw	Oral (2-3 leaves) with little salt
79.	*Polyalthia longifolia* (Sonn.) Thwaites [Annonaceae] RFRIH220; Tree	*mongmong*	0.33	Year round	2.6	Lf & rt: flatulence, expel intestinal worm	Decoction	Oral (2 cups); 2×1
80.	*Persicaria hydropiper* (L.) Delarbre [Polygonaceae] RFRIH149; Herb	*Jakremtsu*	0.47	Jul-Oct	3.0	Wp: skin itching & infection	Paste	Topically
					1.7	Lf: flatulence, abdominal pain & little urination	Juice	Oral (1 cup); 2×1
81.	*Polygonum molle* D. Don [Polygonaceae] RFRIH195; Herb	*Gazie*	0.27	Jun- Oct	2.3	Sh: toothache & swelling painful gums	Raw	Oral (chew aerial part); 2×1
82.	*Psidium guajava* L. [Myrtaceae] RFRIH32; Tree	*Motiram tu*	0.47	Year round	3.0	Lk & sbk: diarrhoea	Decoction (8-10 fresh leaves and 10 g bark boiled in 100 ml of water)	Oral (2-3 teaspoon); 3×1
83.	*Ranunculus diffusus* DC. [Ranunculaceae] RFRIH24; Herb	*Niepukeme he*	0.27	Apr-Dec	2.3	Wp: bruises & wound	Decoction	Topically; 2×1

(*contd.*)

Table 1 — Ethnobotanical plants documented as useful in traditionally healing human health diseases in fringe forest villages of Mon, Mokokchung and Wokhs district of Nagaland. (*contd.*)

S. No.	Scientific name [Family] & specimen number; Habit	Vernacular name	UV	Time of collection	Rfc	Parts: uses	Preparation	Application & dosage
84.	*Rhododendron campanulatum* D. Don. [Ericaceae] RFRIH43; Shrub	*Metsiiben naro*	0.47	Apr-May	3.0	Lf: headache & cold	Powder	Snuff with tobacco leaves; 2-3×1
					0.4	Lf: inflammation & pain in the joints & muscles, pain & irritation while urination	Juice	Topically; 2-3×1
85.	*Rubus foliosus* Weihe [Rosaceae] RFRIH227; Shrub	*Yevuithi*	0.33	Year round	2.6	Rt: fever with chills & sweeting at certain intervals	Decoction	Oral (1 glass); 2×1
86.	*Sapindus mukorossi* Gaertn. [Sapindaceae] RFRIH92; Tree	*Ering jang*	0.20	Jul-Dec	2.1	Fr: foot & toe infection	Juice	Topically; 3×1
87.	*Solanum aculeatissimum* Jacq. [Solanaceae] RFRIH61; Herb	*Chiikrii*	0.47	Year round	3.0	Fr: toothache & swelling gums	Juice	Topically applied after brushing the teeth; 2 ×1
					0.5	Fr: expel leech	Juice	Tropically; 1 ×1
88.	*Solanum nigrum* L. [Solanaceae] RFRIH141; Herb	*Likokji*	0.40	Aug-Oct	2.8	Fr: cough & cold	Raw	Oral (2-3 fruits) crushed with water; 2×1
					1.7	Rt: difficulty & shortness of breathing	Raw	Oral (10-12 fruits) crushed and dip in milk for overnight; 2×1
89.	*Solanum spirale* Roxb. [Solanaceae] RFRIH190; Shrub	*Zieriiprii*	0.33	Year round	2.6	Fr & lf: expel intestinal worm & impaired urine formation	Raw or decoction	Oral (2-3 fruits); 2×1
90.	*Spilanthes acmella* (L.) L. [Asteraceae] RFRIH103; Herb	*Kevega*	0.27	Year round	2.3	Fr: toothache & gum inflammation	Paste	Topically; 2×1
91.	*Spondias pinnata* (L.f.) Kurz [Anacardiaceae] RFRIH74; Tree	*Mezunglashi*	0.20	Jun- Aug	2.1	Lf: foot & toe infection	Juice	Topically; 2×1
					0.2	Sbk: skin burn, itching	Paste	Topically; 2-3×1
92.	*Stephania hernandiifolia* (Willd.) Walp. [Menispermaceae] RFRIH41; Climber	*Takulaizu*	0.20	Year round	2.1	Rt: abdominal pain & diarrhoea	Raw	Oral (chew 5-10 g root); 2×1
93.	*Terminalia chebula* Retz. [Combretaceae] RFRIH96; Tree	*Nankgkajang*	0.60	Nov-Jan	3.4	Fr: muscle cramp	Powder	Oral (half spoon); 3×1
					2.1	Sbk: constipation	Powder	Oral (1 teaspoon) with salt & water; 2×1
94.	*Thunbergia coccinea* Wall. Ex D.Don [Acanthaceae] RFRIH140; Vine	*Tefiidziirie*	0.13	Year round	1.9	Tb: abdominal cramp, vomiting, flatulence & mild fever	Juice	Oral (2 teaspoon); 2×1
95.	*Urtica urens* L. [Urticaceae] RFRIH59; Herb	*Jaklemtsu*	0.20	Jul-Oct	2.1	Lf: constipation and impaired urine formation	10-15 leaves decocted in two cups of water	Oral (2-3 teaspoons); 2×1
					1.2	Rt: stop bleeding	Paste	Topically
96.	*Verbena officinalis* L. [Verbenaceae] RFRIH13; Herb	*Hunutamtsu; Vervain; Viichii*	0.33	Apr-Oct	2.6	Wp: fever with chills & sweating at certain intervals	Juice	Oral (1 teaspoon) with 1cup water; 2×1
97.	*Zanthoxylum rhetsa* (Roxb.) DC. [Rutaceae] RFRIH188; Herb	*Mongret*	0.47	Year round	3.0	Lf & fr: fever, pain and swelling	Paste	Topically; 2-3×1

(*contd.*)

Table 1 — Ethnobotanical plants documented as useful in traditionally healing human health diseases in fringe forest villages of Mon, Mokokchung and Wokhs district of Nagaland. (*contd.*)

S. No.	Scientific name [Family] & specimen number; Habit	Vernacular name	UV	Time of collection	Rfc	Parts: uses	Preparation	Application & dosage
98.	*Zingiber officinale* Roscoe [Zingiberaceae] RFRIH60; Herb	*Sung sung*	0.53	Year round	3.2	Rh: cough, cold, fever & throat pain	Roasted	Oral (2–3 g) with honey; 3 ×1
					0.3	Rh: chicken pox	Juice	Oral (1 teaspoon) with half spoon of leaf extract of *Ocimum basilicum* L.; 3×1
99.	*Parkia timoriana* (DC.) Merr. [Fabaceae] RFRIH223; Tree	*Yunchak; Lunchak*	0.47	Feb-Apr	3.0	Pd: bleeding while passing stool	Raw or cooked	Oral (half cup); 1×1
					1.2	Sbk: diarrhoea & dysentery	Extract	Oral (1 teaspoon); 2×1
					0.4	Sbk & Lf: skin infection	Paste	Topically; 2×1

Abbreviations: UV, use value; Rfc, relative frequency of citation; cm, corm; fr, fruit; lb, lobe; lf, leaf; pd, pod; rh, rhizome; rt, root; sbk, stem bark; sd, seed; sh, shoot; st, stem; tb, tuber wp, whole plant; 1×1, once a day; 2×1, twice a day; 3×1, thrice day.

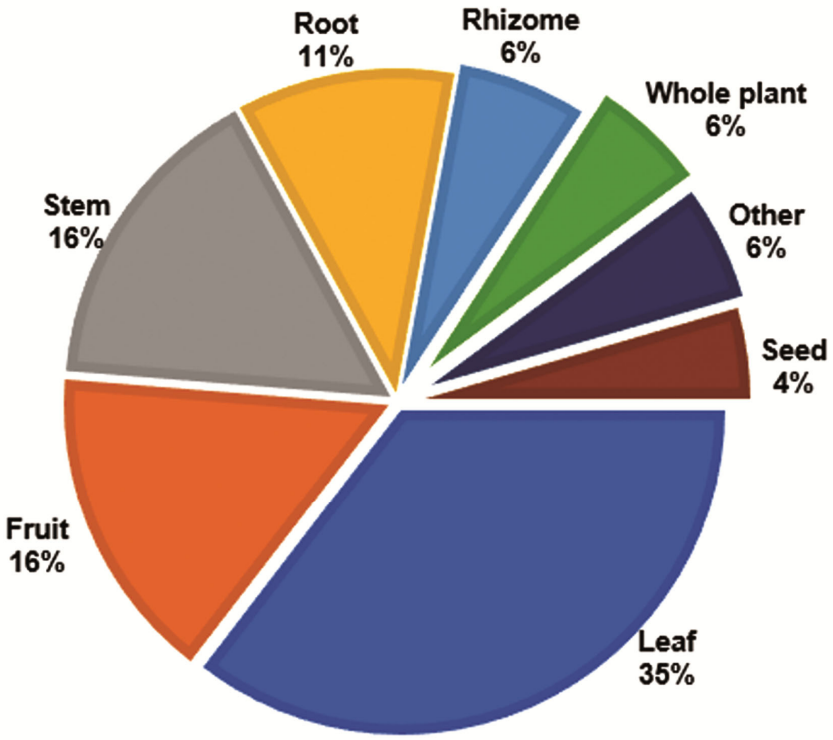

Fig. 3 — Plant Part use as ethno-medicine in sampled villages

treatment of eight ailment (flatulence, indigestion, vomiting, abdominal pain, cough, cold, bronchitis and sore throat). However, 15 species have been documented for one medical property *i.e., A. conyzoides, C. indica, C. roseus, C. spicata, C. asiatica, C. angustifolia, C. flexuosus, D. cordata, D. grandiflora, A. adenophora, M. jalapa, M. alba, N. plumbaginifolia, P. polyphylla, P. guajava*

In the study area majority of plant were used to treat, ailments related to digestive system (58 species), followed by skeletomuscular (26 species), dermatological (18 species), intestinal worms (16 species), cough and cold (13 species), urinary ailments and wound/injury (11 species each) *etc*. (Supplementary Table 3).

A total of 151 types of remedies were prepared by use of 96 plant species, of these decoctions was the most common method used in 49 remedies (Fig. 4),

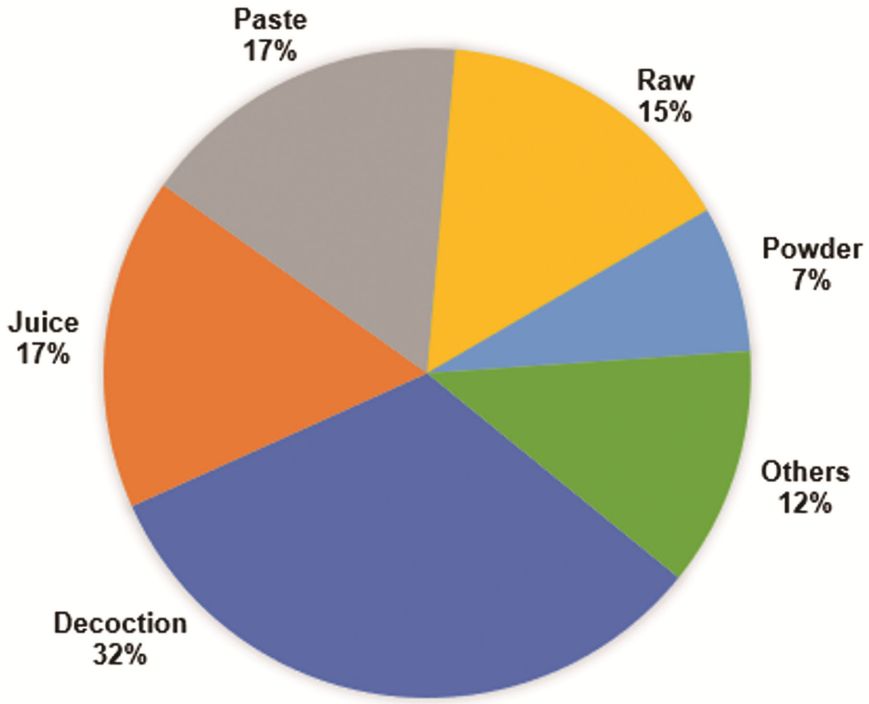

Fig. 4 — Methods of remedy preparation

Use value (UV), informant consensus factor (Fic) and relative frequency of citation (Rfc)

On the basis of information gathered from key participants the user-value (UV) was calculated for each species (Table. 1). It indicates usefulness of the species as medicine in the study area, hence, more useful species receives relatively high number[16,19] these are: *A. indica* and *P. emblica* (0.67); *A. vera, G. arborea, T. chebula* (0.60); *A. sativum, C. indica, C. sativus, F. carica, P. betel* and *Z. officinale* (0.53); The high user-value indicates the relatively important of these species to the tribal people of the study area.

The Fic technique was utilized to work out informant's consensus for the treatment of certain category of ailments[15]. In the current study, the Fic value ranged from 0.48 to 0.97. The high values of Fic indicate larger consensus among informants regarding medicinal uses of species for certain categories of human ailments. Supplymentary Table 3 shows, informants had highest consensus for the treatment of tooth and gum ailment category (0.97) treated by 5 species and lowest consensus was for digest ailments (0.48) treated by 58 species. (Table 1).

The effective medicines were popular among the communities, thereby received more citations. Hence, relative frequency of citation (Rfc) technique was applied for the identification of effective medicine in the communities under study. Fic was used to identify species of particular importance within a culture[25]. Highest relative frequency of citation (Rfc) was 3.6 for *A. indica* (insect and mosquito repellent) and *P. emblica* (flatulence, indigestion, vomiting and abdominal pain). This signifies that all these ethnomedicinal plants are highly promising and could be use during non-availability of modern health care facilities[26].

Conclusion

In this study, 96 ethno-medicinal plants having therapeutic uses for 59 human ailments were documented. Quantitative data analysis through UV, Rfc and Informant consensus factor Fic techniques were used for identification of popular and effective medicines and also in identification of species in demand by local community. High Rfc was recorded for *A. indica* and *P. emblica*. The Fic was more for the treatment of tooth and gum ailment and under this category *S. aculeatissimum* was frequently cited by informants. Thus, these species could be used for further pharmacological investigations. The high use value species identified in our study are being harvested on large scale from wild, and hence need further study on population status and conservation.

Supplementary Data

Supplementary data associated with this article is available in the electronic form at https://nopr.niscpr.res.in/jinfo/ijtk/IJTK_22(04)(2023)770-782_SupplData.pdf

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Conflict of Interest

Authors have no conflict of interest.

Authors' Contributions

The roadmap of the project was planned by both the authors. Manish Kumar Singh has collected ethnobotanical information in field and complied data. Data analysis, writing of article including tables and figures has been prepared by Kumar Avinash Bharati. Throughout the process of research and writing both the authors exchanges ideas and helped each other to complete the project.

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