



Ethnomedicinal plants used by Adi community of Upper Siang District of Arunachal Pradesh in North-East India

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Abstract

The present study revealed rich ethnobotanical knowledge on utilization of medicinal plants in traditional healthcare system of indigenous communities from remote villages of Upper Siang district, Arunachal Pradesh. Thirty-eight ethnomedicinal plant species belonging to 36 genera and 26 families were reported from the study area, with Asteraceae as the most dominant family and herbs as dominant life-forms. Leaves were the most frequently used plant parts while flowers were least used in preparation of medicine. The most common forms of medicinal preparations were paste form followed by cooked, raw (direct consumption) and as decoction. Apart from medicinal uses, the recorded plants were also used as edible fruits, vegetables, spices and condiments, hunting and fishing. The present study would serve as a tool for identifying important medicinal plant species for further pharmacological research, scientific validation, and for initiating appropriate conservation measures for sustainable utilization.

Key words: *Adi* community; Upper Siang; Traditional medicine, Eastern Himalaya

INTRODUCTION

Plants are important sources of therapeutic drugs and play a significant role in the survival of the tribal and ethnic communities. Nearly 80 % of the rural people in the developing countries primarily rely on traditional medicine to meet their primary health care needs (WHO 2001). The medicinal plants have traditionally played an important role in the socio-cultural, spiritual and medicinal arena of the local communities of Eastern Himalaya (Arya *et al.* 2017). In the North-East India, several reports are available on medicinal plants species used in traditional healthcare practices by different tribal communities for treatment of minor and major ailments (Chakraborty *et al.* 2012). The state of Arunachal Pradesh covers a major portion of the Indian Eastern Himalaya with a geographical area of 83,743 sq.km. It comprises a part of the Indo-Burma global biodiversity hotspot (Myers *et al.* 2000). The distinct geographical location and climatic condition makes it an ideal repository of a rich biodiversity including medicinal plants (Doley *et al.* 2010; Sati *et al.* 2012). Arunachal Pradesh is estimated to contain nearly 50% of the total flowering plant species in India and over 500 species of medicinal plants have been reported so far (Rao & Hajra 1986; Haridasan *et al.* 2003). However, the region is still largely remained unexplored due to steep topography and inclement weather events.

The critical literature search revealed that ethnomedicinal plants species used by different indigenous communities of Arunachal Pradesh for treatment of various types of diseases/ disorders have been largely reported from tropical and subtropical regions (Doley *et al.* 2010; Ghosh *et al.* 2014; Shankar & Rawat 2008). In Upper Siang district, only few discrete studies

were available from different pockets of the district including Dehang-Debang Biosphere Reserve (DDBR) (Kagyung *et al.* 2010), Daying Ering Wildlife Sanctuary (Jeyaprakash *et al.* 2017) and Yingkiong and Maryang valleys (Danggen *et al.* 2018). From these studies, it was observed that the knowledge and utilization pattern of ethnomedicinal plants by the local communities differ from one place to another even within the same district. The present study was undertaken to document the ethnobotanical knowledge and utilization of medicinal plants in traditional healthcare systems of the Adi community residing in Upper Siang district of Arunachal Pradesh. The resulting database would be helpful in prioritization of important medicinal plants of the study area for scientific validation studies.

MATERIALS AND METHODS

Study area

The study was conducted in Upper Siang District, Arunachal Pradesh which lies within a geographical coordinate between 28°09'09" N to 29°19'10" N Latitude and 94°17'36" E to 95°25'35" E Longitude, covering a geographical area of 6188 sq. km. The district mainly comprises of three climatic zones, viz., tropical (300-900 m asl), subtropical (900-1500 m asl) and sub-temperate (>1500 m asl) (Choudhary *et al.* 2012). The district has been divided into 11 administrative circles and has a total population of 35,320 (9). The majority of the population belong to *Adi* tribe while the other tribes like *Memba*, *Khamba* and *Idu-Mishmi* are also found to inhabit the region. Six villages, viz., Gobuk, Moying, Simong, Haleng, Karko and Gette, situated within an altitudinal range of 404 m to 1201 m asl (Figure 1) were covered in the present study. Among the surveyed villages, Simong has the highest population with 179 households and a total population of 672. Haleng was the smallest village with 19 households and a population of 50 people.

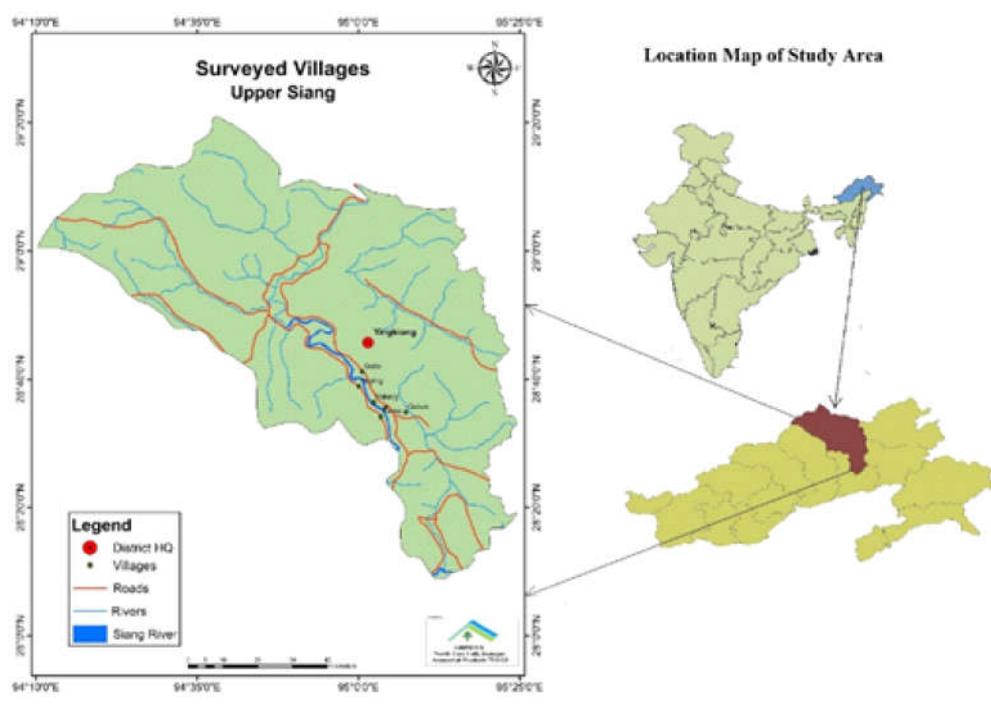


Figure 1. Location map showing the study area with pointed locations of surveyed villages

Data collection

The study was conducted through interaction with local knowledgeable persons of the surveyed villages from different age-groups, educational status and profession. Snowball sampling approach (Johnson 2014) was used in selection of informants for the study. The Headmen (*Gao Burah*) of the respective villages were consulted and Prior Information Consent (PIC) was obtained for conducting interview with the villagers. The Headman (*Gao Burah*) and Traditional Medical Practitioners (TMP) of the target villages were identified as Key informants due to their age, present or previous ethnomedicinal practices and experiences. The selected Key informants were again asked to identify other persons of their village who may be able to provide substantial information related to plant based ethnomedicinal knowledge. All the informants were previously explained about the purpose and objectives of the study and prior informed consent (PIC) was obtained from each informant before proceeding with the interviews and group discussions. Only those persons who agreed to take part in the questionnaire interviews were taken as informants and detail information regarding their name, village, age, gender, occupation, education and signature were entered in the datasheets.

Altogether 139 informants comprising of 86 males and 53 females were interviewed during the study. All the informants were categorised into 6 different age-groups: 25 - 35, 35 - 45, 45 - 55, 55 - 65, 65 - 75 and >75 years old. Majority of informants belong to the age group of 55-65 years and least number from the >75 years age group (Figure 2). Information was collected from informants using open-ended questionnaires, semi-structured interviews and focussed group discussions. The questionnaires contain questions about name of the medicinal plants, traditional uses, habit, availability (common/rare), source of collection (cultivated/wild), parts used, mode of administration, and also if any conservation efforts were being adopted by the villagers or the government. Field surveys were also conducted around the village and nearby forest areas with the local informants for correct identification and collection of medicinal plants used by them. The ethnomedicinal plant species were identified by consultation of herbarium materials and experts at Botanical Survey of India, Arunachal Pradesh Regional Centre, Itanagar and State Forest Research Institute, Itanagar.

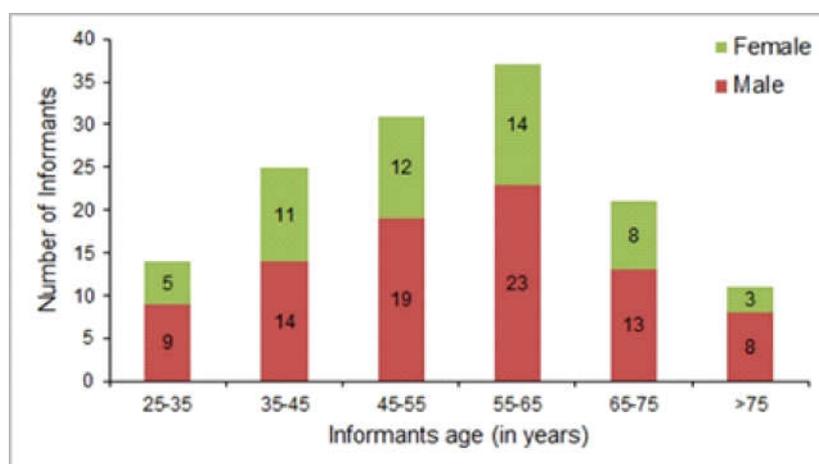


Figure 2. Number and age-group of informants interviewed during the survey

RESULTS

Diversity of ethnomedicinal plants

Present investigation has revealed a total of 38 species of ethnomedicinal plants belonging to 36 genera and 26 families used by the indigenous Adi communities of Upper Siang District of

Arunachal Pradesh (Table 1). Asteraceae was found to be the most dominant family of ethnomedicinal plants recorded from the study area, which was followed by Ranunculaceae, and Solanaceae and Oxalidaceae (Figure 3). The remaining 22 families were represented by a single species only. The maximum number of species recorded were herbs (50 %) followed by shrubs, trees and climbers (Figure 4). The indigenous communities (Adi) of Upper Siang district have been using these plants to treat different types of minor and major diseases and ailments prevalent in the localities which ranging from stomachache, diarrhoea, dysentery, cuts and wounds, burn injuries and toothache to snake bites, malaria, bone fractures and high blood pressure. Apart from medicinal uses, the recorded plants were also reported as wild edible fruits, vegetables, spices and condiments, poison arrows used in hunting large animals and fish poisoning.

Table 1. List of ethnomedicinal plants reported from Upper Siang District, Arunachal Pradesh

Botanical name [Family]; Local name; Voucher specimen	Habit	Traditional uses
<i>Aconitum ferox</i> Wall. ex Ser. [Ranunculaceae]; <i>Emo</i> ; GBP/NE/WM-36	Herb	Rhizome/leaf in the paste form is used as antidote for snake bite, boil, body pain and swelling. Used as arrow poison for hunting large animals like bear, tiger
<i>Aconitum heterophyllum</i> Wall. ex Royle [Ranunculaceae]; <i>Emo</i> ; GBP/NE/WM-11	Herb	Rhizome/leaf in the paste form is used as Antidote for snake bite, boil, body pain and swelling. Used as arrow poison for hunting large animals like bear, tiger
<i>Ageratum conyzoides</i> L. [Asteraceae]; <i>Bonger</i> ; GBP/NE/OP-06	Herb	Leaf paste is used in the Cuts and wounds
<i>Artemisia nilagirica</i> C.B.Clarke [Asteraceae]; <i>Pamp</i> ; GBP/NE/OP-32	Shrub	Leaf juice & paste is used in cough, headache, sores, wound and nose bleeding
<i>Averrhoa carambola</i> L. [Oxalidaceae]; <i>Kadung</i> ; GBP/NE/WM-51	Tree	Juice of the fruits is used in Jaundice
<i>Begonia roxburghii</i> (Miq.) A.DC. [Begoniaceae]; <i>Babeyaying</i> ; GBP/NE/OP-48	Herb	Shoot and rhizome in the boiled or raw form is used in stomach problem, dysentery, diarrhoea
<i>Bidens pilosa</i> L. [Asteraceae]; <i>Gomnik</i> ; GBP/NE/OP-25	Herb	Leaf, seeds and roots are used in cuts and wounds, ulcers, ear and eye problems; Skin inflammation; hepatitis, urinary tract infection, malaria,
<i>Blumea fistulosa</i> (Roxb.) Kurz [Asteraceae]; <i>Rumdum</i> ; GBP/NE/WM- 13	Herb	Leaf in the boiled/cooked form is used in Diarrhoea
<i>Campylandra aurantiaca</i> Baker [Asparagaceae]; <i>Kekong kelong</i> ; GBP/NE/WM-15	Herb	Paste of the root is used in vomiting and headache
<i>Carica papaya</i> L. [Caricaceae]; GBP/NE/OP-09	Tree	Mature seeds are crushed and used for fertility control in Women
<i>Castanopsis indica</i> (Roxb. ex Lindl.) A.DC. [Fagaceae]; <i>Hirang</i> ; GBP/NE/WM-22	Tree	Paste of the leaves applied to wounds to stop bleeding. Plants also used in religious festival 'Solung puja'.
<i>Centella asiatica</i> (L.) Urban [Apiaceae]; <i>Loram/ Kipum Yayum</i> ; GBP/NE/OP-29	Herb	Shoots in the raw form are used in Gastric problem, constipation, blood purification
<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob [Asteraceae]; <i>Heling</i> ; GBP/NE/WM-44	Shrub	Leaf paste is used in major cuts and wounds

Botanical name [Family]; Local name; Voucher specimen	Habit	Traditional uses
<i>Coptis teeta</i> Wall. [Ranunculaceae]; <i>Mishmi teeta/ Rinko</i> ; GBP/NE/OP-17	Herb	Decoction of the leaves and roots are used in blood clotting, stomach trouble, malaria
<i>Crassocephalum crepidioides</i> (Benth.) J. Moore; [Asteraceae]; <i>Gende</i> ; GBP/NE/WM-47	Herb	Leaf & tender shoots are boiled and consumed as vegetable during constipation. The cooked leaf is also used in insomnia
<i>Drymaria cordata</i> (L.) Willd. ex. Schult. [Caryophyllaceae]; <i>Kaira</i> ; GBP/NE/OP-49	Herb	Paste of the leaves applied to ringworm and other skin diseases; bone fracture; leech bite
<i>Embelia ribes</i> Burm.f [Myrsinaceae]; <i>Hingkong</i> ; GBP/NE/OP-37	Shrub	Tender leaves and shoots eaten as cooked vegetable and is said to act as stomachic
<i>Entada scandens</i> (L.) Benth. [Leguminosae]; <i>Pio-pia/ pyopa</i> ; GBP/NE/WM-35	Climber	Crushed seeds are used in hair wash and as anti-dandruff.
<i>Erigeron bonariensis</i> L. [Asteraceae]; <i>Daglentado</i> ; GBP/NE/WM-16	Herb	Vapour of the leaf is used in Sinusitis problem
<i>Gymnocladus assamicus</i> Kanjilal ex P.C. Kanjilal [Mimosaceae]; <i>Dekang</i> ; GBP/NE/WM-42/	Tree	Pods are crushed and used as hair wash to remove dandruff
<i>Mikania micrantha</i> Kunth [Asteraceae]; GBP/NE/WM-08	Climber	Leaf paste is used in itching, skin diseases, headache; cut and wound healing
<i>Musa sapientum</i> L. [Musaceae]; <i>Kopak</i> ; GBP/NE/OP-54	Herb	Juice of the Pseudo-stem in Diarrhoea, dysentery
<i>Oxalis corniculata</i> L. [Oxalidaceae]; GBP/NE/OP-26	Herb	Shoot used as Appetizer, headache, Relieves intoxication from wine; Diarrhoea
<i>Paderia foetida</i> L. [Rubiaceae]; <i>Yepeter</i> ; GBP/NE/WM-19	Climber	Stem is boiled and used in gastritis, diarrhoea, dysentery, stomach disorder, paste of leaves applied to skin diseases
<i>Paris polyphylla</i> Sm. [Liliaceae] GBP/NE/OP-18	Herb	Decoction of the rhizome is used in Piles, constipation and high fat
<i>Phoebe cooperiana</i> P.C. Kanj. & Das [Lauraceae]; <i>Tapir</i> ; GBP/NE/WM-34	Tree	Bark paste is for wounds and boils, itching
<i>Polygonum barbatum</i> L. [Polygonaceae]; <i>Rukji</i> ; GBP/NE/WM-14	Herb	Paste of the leaves applied to ringworm and other skin diseases
<i>Pothos scandens</i> L. [Araceae]; <i>Lomanglose</i> ; GBP/NE/WM-30	Climber	Stem and leaf paste are used in treatment of Bone fracture
<i>Pouzolzia bennettiana</i> Wight [Urticaceae]; <i>Oyik</i> ; GBP/NE/WM-33	Herb	Leaves in the cooked form as vegetable is used in Dysentery
<i>Psidium guajava</i> L. [Myrtaceae]; <i>Muduri</i> ; GBP/NE/OP-52	Tree	Leaves in the raw form are eaten in Diarrhoea
<i>Rauvolfia densiflora</i> Benth [Apocynaceae]; <i>Rukzi</i> ; GBP/NE/WM-40	Shrub	Decoction of root, bark and seeds in equal quantity diluted with water (3:2) is administered orally to cure malaria
<i>Spilanthes acmella</i> (L.) L. [Asteraceae]; <i>Marbang/ Marsang</i> ; GBP/NE/OP-04	Herb	Raw inflorescence is used in toothache
<i>Solanum spirale</i> Roxb. [Solanaceae]; <i>Bangka</i> ; GBP/NE/OP-12	Shrub	Fruits and leaves in the raw form or boiled form are used in the cuts and wounds, stomach-ache

Botanical name [Family]; Local name; Voucher specimen	Habit	Traditional uses
<i>Solanum torvum</i> Sw. [Solanaceae]; <i>Aying tanyum</i> ; GBP/NE/OP-45	Shrub	Smoke inhalation or direct use of the fruit is used in Toothache
<i>Trichosanthes cordata</i> Roxb. [Cucurbitaceae]; <i>Dongkorijong</i> ; GBP/NE/WM-27	Climber	Decoction of the root is used in Dysentery, diarrhoea
<i>Zanthoxylum rhetsa</i> (Roxb.) DC. [Rutaceae]; <i>Onger</i> ; GBP/NE/WM-23	Shrub	Leaves are boiled and used in Jaundice, fever, headache
<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm. [Zingiberaceae]; <i>Kekir</i> ; GBP/NE/OP-20	Herb	Decoction of the rhizome is used in Stomach-ache, diarrhoea, cough

Utilization pattern of different species for treatment of diseases

These plants were used by the local people and traditional medicinal practitioners (TMP) to treat different types of minor and major ailments including cuts and wounds, cold, fever including malarial fever, cough, gastrointestinal problem, pain reliever, diabetes, cancer and other diseases. The diseases treated were categorised into 10 different groups (Table 2). Maximum number of species were being used for treatment of gastrointestinal disorders, dermatological disorder and general health (Figure 5). In terms of number of uses for each species, *Bidens pilosa* was ranked first, being used for treatment of maximum number of ailments (7 categories), followed by *Artemisia nilagirica* being used in 4 ailment categories. *Zanthoxylum rhetsa*, *Aconitum heterophyllum*, *A. ferox* and *Drymaria cordata* were used for treating 3 different types of ailments, while the remaining species were reported to be used in 2 different types of ailments or lesser (Figure 6).

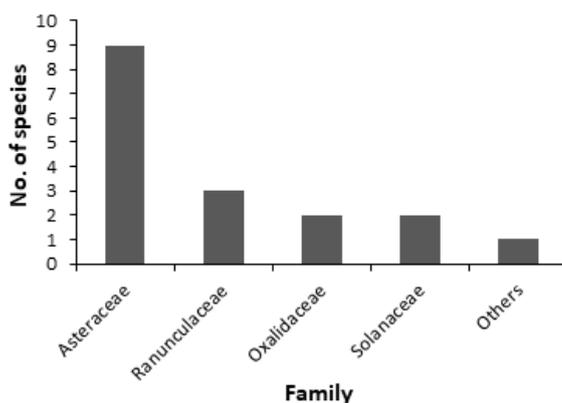


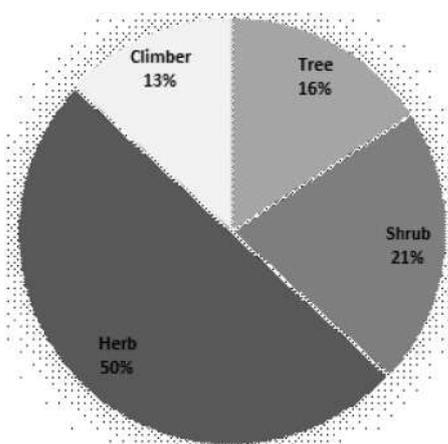
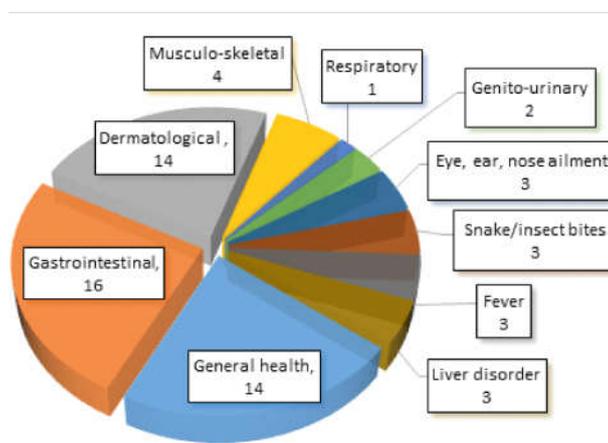
Figure 3. Family-wise representation of ethnomedicinal plants reported from the study area (Others = families with only 1 species): Lamiaceae, Apiaceae, Apocynaceae, Araceae, Asparagaceae, Begoniaceae, Caricaceae, Caryophyllaceae, Cucurbitaceae, Fagaceae, Lauraceae, Leguminosae, Liliaceae, Mimosaceae, Musaceae, Myrsinaceae, Myrtaceae, Polygonaceae, Rubiaceae, Rutaceae, Urticaceae, Zingiberaceae)

Plant parts used, mode of preparation and administration

The most frequently used plant parts for the preparation of medicine were leaves, followed by roots and rhizomes, seeds and shoot part. Flowers were the least used plant part for medicine preparation and was reported only from one species (Figure 7). The mode of preparation and administration of the medicines varies according to the nature of ailment treated. The most common forms of medicinal preparations were paste form followed by

Table 2. Categorisation of traditional medicinal uses

Category of ailment	Diseases/disorders
General health	Headache, high blood pressure, insomnia, dental care, hair care, health tonic
Gastrointestinal	Appetizer, Gastritis, indigestion, vomiting, piles, stomach disorder, diarrhoea, cholera, dysentery, ulcer, Intestinal worm
Dermatological	Antiseptic/cut and wounds, boils, allergic swelling, Burns, Ringworm
Musculo-skeletal	Bone fracture, toothache, body pain, sprain, headache, rheumatism, ulcer
Respiratory	Cold, cough, asthma
Genito-urinary	Gynaecological disorder, urinary tract infection, etc
Eye, ear, nose ailments	Eye and ear infection, sinusitis, nose bleed
Snake/insect bites	Snake bites, leech bites
Fever	General fever, malaria, typhoid fever
Liver disorders	Hepatitis, Jaundice

**Figure 4.** Habit groups of ethnomedicinal plant species reported from the study area**Figure 5.** Traditional use categories of medicinal plants from the study area

cooked, raw (direct consumption) and as decoction (Figure 8). Other forms of usage such as juice of leaves and fruits and smoke/steam inhalation were also observed for few species and ailments such as toothache and respiratory problems. The common use of medicinal plants in paste form suggested that fresh plant material were frequently used. This was further confirmed through field observation and interaction with the informants who revealed that they prefer to collect plants from the wild only when necessary and in required quantity. However, for some seasonal species and those species which were not commonly available near the village, the useful plant parts were collected during the growing season, dried and stored for later use. During field survey, it was observed that roots and rhizomes of *Aconitum* spp., *Campylandra aurantiaca*, *Coptis teeta* and *Paris polyphylla* were preserved by local people in dried form and kept over the fire-place for long storage. The use of fresh materials has its advantages as it prevents deterioration of volatile compounds, the concentration of which may be reduced by drying.

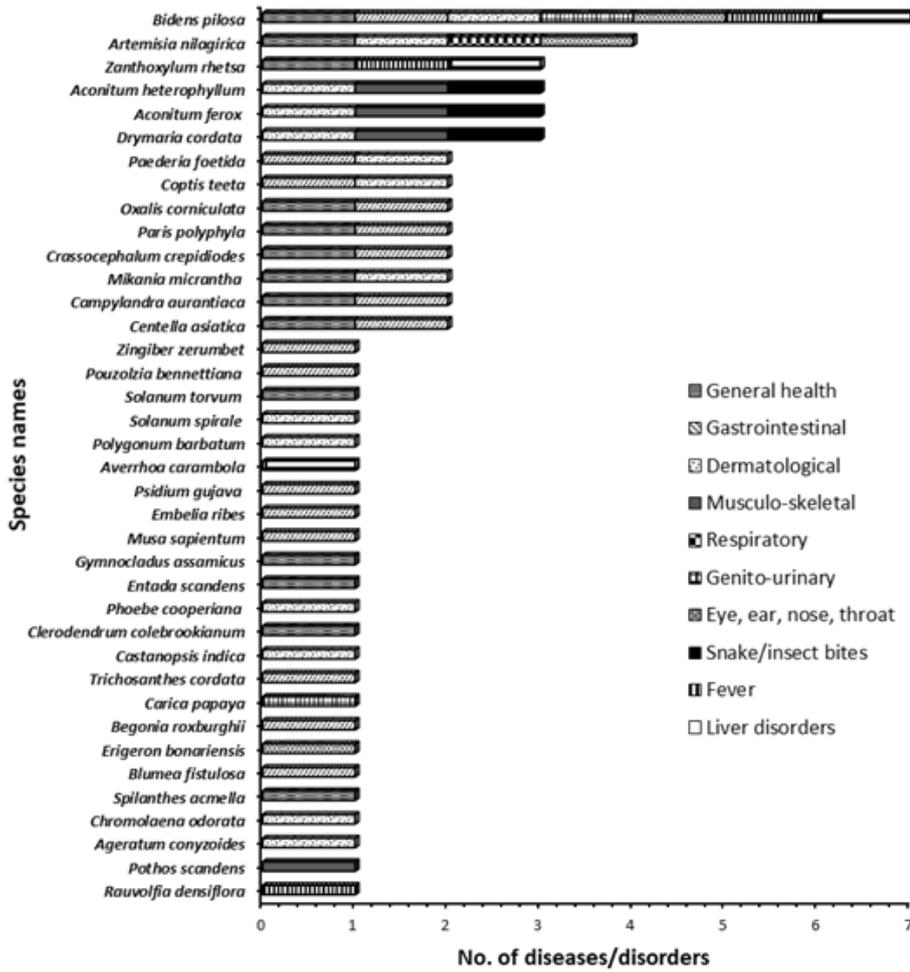


Figure 6. Ranking of species on the basis of their usage for treatment of different categories of ailments

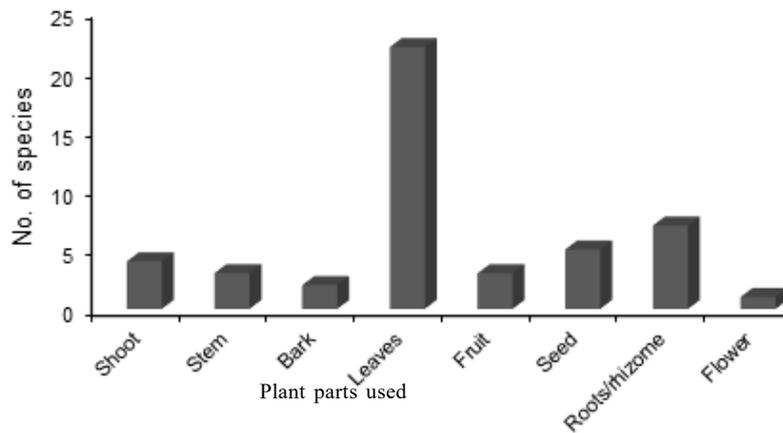


Figure 7. Plant parts used for preparation of traditional medicine

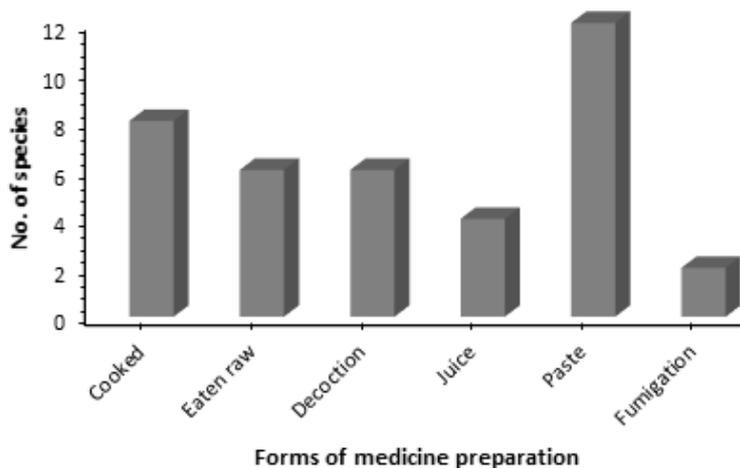


Figure 8. Different forms of medicine preparation from ethnomedicinal plant species

The mode of medicine administration varies depending on the nature of ailment and part of the body affected. For external ailments like dermatological problems, wounds, bone fracture, body pain, toothache, etc., the crushed or ground paste is applied directly on the affected area. For internal ailments such as gastrointestinal problems, fever, headache, the medicine can be administered orally in raw or cooked form, water suspension and decoction. However, there was a lack of specific dosage for administration and the amount to be taken varies depending on the age of the individual as well as on the severity of the ailment and as advised by the concerned local medicinal practitioner. This may be considered as a disadvantage of the traditional medicinal practices which needs to be addressed through scientific studies to determine the correct doses, side effects and contraindications of different medicinal preparations.

DISCUSSION

A number of plant species reported in the present study have also been mentioned by other researchers being used by the *Adi* community residing in different areas of East Siang district (Baruah *et al.* 2013; Das *et al.* 2013; Payum *et al.* 2015a) and few villages of Upper Siang district (Kagyung *et al.* 2010), which were located close to our study area. This suggested that these plant species are widely utilised as medicine among the indigenous communities of this region and there might be a pre-existing mechanism of knowledge sharing between the people of different villages regarding the cross-cultural uses of these ethnomedicinal plants. The member of Asteraceae has been reported as the most dominant medicinal plants in the northeastern region of India (Haridasan *et al.* 2003). In agreement with our results, dominance of medicinal plants of Asteraceae was also reported by Jeyaprakash *et al.* (2017) in their study in East Siang district of Arunachal Pradesh. The wide use of herbaceous plants as medicine may be mainly due to the relatively easy availability of herbs in the study area compared to shrubs and trees as observed during our field survey. A few plants recorded in the present study including *Ageratum conyzoides*, *Chromolaena odorata* and *Spilanthes acmella* have also been reported to be widely used in traditional medicine in other parts of the world such as Africa, Asia, and South America for treatment of various diseases (Dubey *et al.* 2013, Kamboj & Saluja 2008, Pandith *et al.* 2013). *Paris polyphylla* is a well-known folk medicinal herb commonly used in Traditional Chinese Medicine for hundreds of years (Bureau of Chinese Herb Administration, 1999) and an important herbal drug for the treatment of inflammation, fractures, parotitis, hemostatis, snake bite and abscess in folk medicine (Wu *et al.* 2012). Kagyung *et al.* (2010) reported that *Campylandra*

aurantiaca and *Coptis teeta* were the most commonly used medicinal plants among the *Adi* community residing in the Dehang-Dibang Biosphere Reserve area of Arunachal Pradesh. In fact, *C. aurantiaca* has been mentioned by Gajurel *et al.* (2015) as one of the high value medicinal plants of Arunachal Pradesh. Other species such as *Pouzolzia bennettiana*, *Zanthoxylum rhetsa* and *Phoebe cooperiana* are one of the most preferred wild vegetable and fruit plants among the indigenous communities of Arunachal Pradesh and found to sold in the local markets (Payum *et al.* 2013a, 2013b, 2015b).

CONCLUSION

The present study revealed that the practice of traditional medicine is still an integral part of the people of the study area, especially in remote villages where accessibility to modern healthcare services are limited. However, recently there has been a decline in the traditional knowledge and lack of interest were witnessed among the younger generations due to the loss of direct contact and association with nature. This has posed a threat on the very existence of such valuable traditional knowledge system. Therefore, detailed research and documentation is urgently needed to identify important species of ethnomedicinal plants used by different communities of the state. Many of the ethnomedicinal plants recorded in the present study were found to possess a variety of pharmacological properties and bioactive compounds which further supported their use in traditional healthcare practices. Lack of integrated approach for studies on ethnomedicinal plants, pharmacology and phytochemistry, especially from this region, provides a greater opportunity for further venturing research on the phytochemical and pharmacological aspects of these ethnomedicinally important species. The resultant knowledge would also be useful for addressing conservation priorities and value-addition of the selected species for the benefit of the indigenous communities.

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