



Traditional knowledge of medicinal plants in different tribes of Arunachal Pradesh in Northeastern India

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Abstract

Tribes living in the Northeastern part of India rely on different plants as their source of medicines for different ailments from ancient times. This study documents the traditional knowledge of medicinal plants used by the indigenous tribes of Arunachal Pradesh. Data were collected using a structured questionnaire in consultation with the tribal practitioners. The study documents 54 medicinal plants belonging to 32 families used by eight different tribes. Among these people of the *Monpa* tribe uses *Oroxylum indicum* (L.) Vent., to treat diarrhea and stomach ache, *Singpho* uses *Amaranthus spinosus* (L.) for skin infection, *Cannabis sativa* (L.) and *Emblica officinalis* both are used by *Apatani* and *Adi* tribes to cure hepatic problems. Both *Idu* and *Tagin* tribe uses *Piper nigrum* (L.) and *Piper mullesua* Ham ex D. Don to cure respiratory diseases. The plant *Ageratum conyzoides* (L.) is widespread among the native tribes of Arunachal Pradesh, and it is used to stop the bleeding among *Singpho*, *Tangsa*, *Idu*, and *Nyishi* tribes. There was a significant agreement among the informants regarding ethnomedicinal uses of plants, with Factor of Informants Consensus (FIC) value ranging from 0.2 to 0.48, with an average value of 0.355. This study underlines the importance of traditional medicinal knowledge that is fading in the era of urbanization and suggests documentation to preserve the knowledge.

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Introduction

Traditional healing is the oldest form of a structured treatment method based on the underlying philosophy and set of principles by which it is practiced. It is the medicine from which all later forms of medicine are developed. Arunachal Pradesh is one of the northeastern provinces of India, also known as the land of the rising sun, with its snow covering the thundering mountain's peak, untamed wild crystal-clear rivers, gurgling waterfalls abundant with a dazzling array of flora and fauna, are the gift by the mother nature. Arunachal Pradesh covered 83,743sq. km of forest, which has been enriched by plants (5,000spp.), terrestrial mammals (85spp.), and birds (500spp.) (Khongsai and Kayang, 2011). It is home to 28 major tribes and 110 sub-tribes that have lived together with peace and harmony since time immemorial (Deb *et al.*, 2009; Goswami *et al.*, 2009). Each of these tribes has a unique way of traditional culture and lifestyle, occupying different geographical regions (Tag *et al.*, 2005). Since ancient times, the native people of Arunachal Pradesh have been using natural herbal medicinal plants.

According to WHO's estimates, more than 80% of people in developing countries depend on traditional medicines for their primary health needs. More than 500 species of medicinal plants have been reported so far from the hills of Arunachal Pradesh. Millions of rural households in India use medicinal plants in a self-help mode. Thus, for some 4-5 hundred million people, traditional medicine is the only alternative source of healthcare in the absence of the ailing Government run healthcare systems. They are supported by over one million traditional village-based carriers of herbal medicinal traditions (LSPSS, 1993). Traditional medicine has been extensively used to cure liver disorder, urinary disorders, bone settings, and even severe diseases like cancer (Mao, 2002). However, there is an urgent need to document these practices to conserve the knowledge and expand the practices (Pretorius, 1998; Lois, 2003; Legendre *et al.*, 1998). The current work is based on the indigenous knowledge of medicinal plants and treatment methods against common ailments that prevails among the different tribes of Arunachal Pradesh.

Materials and methods

A survey was carried out during 2015 to 2017 to collect the information on the medicinal plants used by the local tribes, *viz.* Monpa (M), Singpho (S), Tangsa (T), Padam (P), Apatani (Ap), Idu (I), Nyishi (N), and Tagin (Ta). The survey was carried out in different tribes of Arunachal Pradesh, and information was collected to confirm the traditional medicinal plants' identity. The forest and village exploration was conducted with the help of local guides and friends. The information to confirm the medicinal plants used by the different tribes of Arunachal Pradesh was done by visiting different villages and towns, followed by a personal interview with the villagers and local medicinal practitioners. Voucher specimens were collected from the field, and their identification was made as per standard herbarium techniques (Jain and Rao, 1926) and through various floral inventories (Hooker, 1894; Rawat and Chowdhury, 1998; Saklani and Jain, 1994). The survey was done in the town of Roing (28°8'34"N 95°50'34"E) and the village of Anini of Lower Dibang Valley (28°47'53"N 95°54'13"E) for the Idu Mishmi tribes. For Apatanis, the interviews were conducted at Ziro valley in the Lower Subansiri district (27.566389°N 93.831389°E). Singphos live on the banks of Teang and Noa Diking rivers and extend towards the south-east into the land of the Khamptis, and the interview was done at Bordumsa town in Changlang District (27°31'10"N 95°53'18"E). Monpas live in Tawang and West Kemeng districts, and the interview with the local people was done in the Tawang (27°35'18"N 91°51'55"E). Changlang district, along with the Indo-Myanmar front, is occupied by the Tangsas tribe, and the interview was done in Nampong (27.28°N 96.13°E). Tagin tribe lives in upper Subansiri, and interviews were done around Daparijo (27°59'10"N 94°13'15"E). The interview was done on Itanagar (27°06'00"N 93°37'12"E) and Naharlagun (27.103029°N 93.700848°E) for the Nyishis tribe. The Adis (Padam) live in East, West, and Upper Siang District and also in Lower Dibang Valley, and the survey was conducted on Pasighat (28.07°N 95.33°E), Dambuk (28°16'N 95°37'E), and Roing (28°8'34"N 95°50'34"E) (Fig. 1).

The data obtained on the homogeneity of the informant's knowledge on medicinal plants was

analyzed through the informant consensus factor (F_{IC}) (Trotter and Logan, 1986) (Table 1)

Table 1. Ethno botanical consensus index for traditional medicinal plant used categories.

Illness Category (Diseases & disorders)	No. of taxa (N _t)	Number of use reports (N _{ur})	Informants' consensus index factor (F _{IC}) ^a
Dermatological disorder (Skin Infection, Measles, Leprosy, Scruvy, Itching, Eczema, Healing Wounds)	12	19	0.39
Gastrointestinal disorder (Cholera, Stomach ache, stomach disorders, Indigestion, Bowel Disorder)	16	24	0.35
General health (Liver problem, tuberculosis, rheumatism, diabetes, high bp, asthma, toothache, measles, gonorrhoea, cough, bronchitis, throat pain, influenza, fever, eye infection, tumor, uterine problem, jaundice, body ache, vomiting, malaria, tonsillitis.)	33	62	0.48
Miscellaneous (Body stimulation, snake bite, blood purifier, eradicate lice, hair vitalizer, bone fracture)	5	6	0.2

^aF_{IC}=N_{ur}-N_t/(N_{ur}-1), providing a value between 0 and 1, where a high value indicates a high rate of informant consensus.

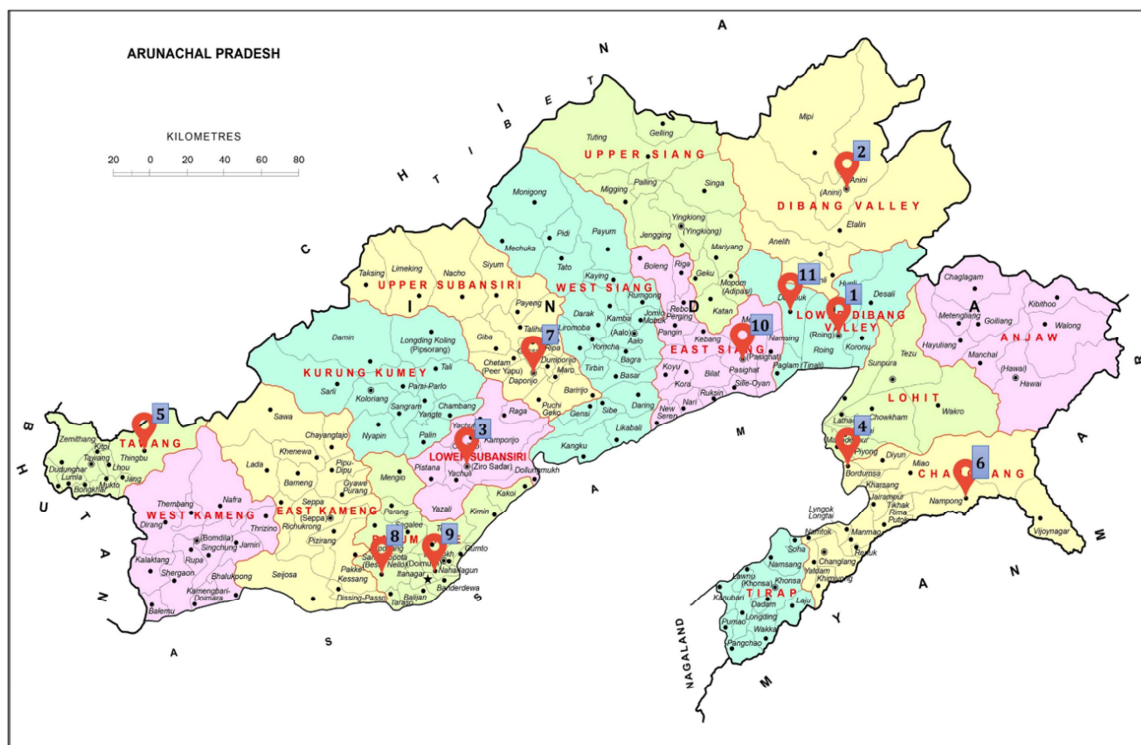


Fig. 1. Study sites (Map adapted from Arunachal Pradesh Administrative Divisions 2011). The red dots with numbers denote the places selected for the respective study within Arunachal Pradesh. 1. Roing (28°8'34"N 95°50'34"E), 2. Anini of Lower Dibang Valley (28°47'53"N 95°54'13"E), 3. Ziro valley in the Lower Subansiri district (27.566389°N 93.831389°E), 4. Bordumsa town in Changlang District (27°31'10"N 95°53'18"E), 5. Tawang (27°35'18"N 91°51'55"E), 6. Nampong (27.28°N 96.13°E), 7. Daparijo (27°59'10"N 94°13'15"E), 8. Itanagar (27°06'00"N 93°37'12"E), 9. Naharlagun (27.103029°N 93.700848°E), 10. Pasighat (28.07°N 95.33°E), 11. Dambuk (28°16'N 95°37'E).

A consensus factor of F_{IC} was calculated as follows:

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

Where, N_{ur} - number of use-reports of

Informant's for a particular illness

Usage

N_t - number of species used for a

Particular illness category for all

Informants

Results and discussions

Since the timeless era, the native people of Arunachal Pradesh have utilized the available medicinal plants in their daily life, whether to cure chronic illnesses or prevent common diseases. They also utilized the plants as a part of their food. Some local people are mainly self-contained and still refuse to use modern medicine and prefer traditional medicine methods to treat some particular diseases (Table 2) (Fig. 2). Monpas still use traditional medicine like *Oroxylum indicum* (L.) Vent to treat diarrhea and stomach ache rather than taking modern medicine. Some plants have cultural roots in more than one tribe; Monpas and Singpho use *Amaranthus spinosus* (L.) for skin infection, *Cannabis sativa* (L.), and *Emblica officinalis* both are used by Apatani and Adi tribes for gastrointestinal disorders, and general health problems. *Houttuynia cordata* is also used by Singpho and Adi-Padam tribes. Idu and Tagin tribes use *Piper nigrum* (L.) and *Piper mullesua* Ham ex D. Don plant to treat pain. Plants like *Ageratum conyzoides* (L.) are widespread among the native tribes of Arunachal Pradesh and are used as medicine to stop the bleeding among Singpho, Tangsa, Idu, and Nyishi tribes. Some plant like *Centella asiatica* (L.) is famous among Nyishi tribe for the treatment of stomach disorders (Jeeva *et al.*, 2005) and for reducing high blood pressure and is very common in the local vegetable markets. *Syzygium cumini* (L.) is popular among the Adi tribe, the Adis use the fruits to treat diarrhea and dysentery; not only the fruit but the seed that has been dried and crushed are given to the diabetic person. A few common medicinal plants used by different tribes are listed in Table 3.

The Asteraceae is the most dominant family of medicinal plants in the northeast state of India (Saklani and Jain, 1994). Several research works has been carried out on ethnomedicinal plants in different regions of Arunachal Pradesh (Bhabajit *et al.*, 2014; Chowlu *et al.*, 2017; Murtem and Chaudhry, 2016). Community wise ethnobotanical study was conducted on Adi and Monpa communities in and around Arunachal Pradesh (Chakraborty *et al.*, 2017; Jeyaprakash *et al.*, 2017). Moreover, studies were conducted on the ethnomedicinal and nutritional importance of four selected plants viz. *Drymaria cordata*, *Solanum spirale*, *Solanum torvum* and *Spilanthes paniculata* from Eastern Himalayan region of Arunachal Pradesh (Arya *et al.*, 2017). For medicinal plants with limited abundance and slow growth, destructive harvesting generally results in resource exhaustion and ultimately leads to species extinction, e.g., among the Idu tribe, the *Coptis teeta*, and *Coptis salisb*, the plants are native to the jungles of Anini (Eastern Himalayas of India), but due to overexploitation, the plant has become vulnerable to future extinction.

Thus, sustainable uses of traditional plants and good agricultural practices are very much important, and that can only be done by educating the native people about the different approaches to conservation and sustainable uses of the medicinal plants (Fig. 3) (Fig. 4). Factor informant consensus (Fic) was measured to study the total usage of plant species according to cultural applicability. Health disorders were categorized into groups with number of plant taxa used for particular groups. Plant with high Fic value can be consider as more pharmacologically active as compared to low Fic value. High Fic value was observed as 0.48 for general health problems. Fic values will be high if maximum respondents acknowledge one or few plants to treat a specific disease. (Hassan *et al.*, 2017).The product of this factor ranges from 0 to 1. A high value (close to 1) indicates that relatively few taxa (usually species) are used by a large proportion of people, while a low value indicates that the informants disagree on the taxa to be used in the treatment within a category of

illness (Canales *et al.*, 2005). We need to randomized clinical trials for some of the manual therapies and further research is required to ascertain the efficacy and safety of traditional medicine practiced, because most of the plants involved in traditional practice described in this paper are based on ethno-medicinal knowledge

where the proper research has not done and sometimes the traditional medicinal plants might have some side effect on the consumers. Thus, proper research on the plants is in need. We must develop a proper study about the traditional medicine and the ratio of curative measurement applied to different patients on the use of the plants.

Table. 2. Medicinal plants used by *Mongpa* (M), *Singpho* (S), *Tangsa* (T), *Padam* (P), *Apatani* (Ap), *Idu* (I), *Nyishi* (N) tribes of Arunachal Pradesh.

SN	Scientific name	Family	Local name	Uses
1.	<i>Aesculus assamica</i> Griffith	Hippocastanaceae	<i>Ozon sak</i> (M)	The paste leaves are applied against the skin infection, and bathing with the plant extract reduces a backache
2.	<i>Amaranthus spinosus</i> L.	Amaranthaceae	<i>Maon</i> (M)	The roots paste is applied to the body against contagious skin infection
3.	<i>Oroxylum indicum</i> (L) Vent	Bignoniaceae	<i>Bhatgilla</i> (M)	Fresh pieces of barks are used in liver problems, stomach ache and rheumatism. The root extract is used against the treatment of tuberculosis and diarrhoea.
4.	<i>Spilanthus acmella</i> L.	Asteraceae	<i>Namlang marching</i> (M)	The roots and flowers are crushed together and the extract is pasted on the gums during a toothache.
5.	<i>Spilanthus acmella</i> L.	Asteraceae	<i>Namlang marching</i> (M)	The roots and flowers are crushed together and the extract is pasted on the gums during toothache.
6.	<i>Ageratum coyzoides</i> L.	Compositae	<i>Chinmut</i> (S)	The whole plant paste is applied to the fresh wound and for blood clotting.
7.	<i>Citrus medica</i> L.	Rutaceae	<i>Narang</i> (S)	The fruits are taken during indigestion.
8.	<i>Houttuynia cordata</i> Thunb.	Saururaceae	<i>Nekir name</i> (S)	The leaf is taken during dysentery. The crushed leaves and stems are used in case of measles, gonorrhoea and skin troubles.
9.	<i>Piper mullesua</i> Ham. ex D. Don	Piperaceae	<i>Namar</i> (S)	The seed powder mixed with honey is taken against rheumatism, cough and bronchitis problems.
10.	<i>Amaranthus spinosus</i> L.	Amaranthaceae	<i>Yankhi soulpa</i> (S)	The roots paste is applied to the body against contagious skin infection.
11.	<i>Ageratum coyzoides</i> L.	Compositae	<i>Namninyng</i> (T)	The whole plant paste is applied to the fresh wound and for blood clotting.
12.	<i>Mikania scandens</i> Willd.	Asteraceae	<i>Chakpan</i> (T)	Crushed leaves are applied to cuts and wounds to stop the excessive bleeding that helps blood clotting.
13.	<i>Piper mullesua</i> Ham. ex D. Don	Piperaceae	<i>Ahoma</i> (T)	The seed powder mixed with honey is taken against rheumatism, cough and bronchitis problems.
14.	<i>Solanum indicum</i> L.	Solanaceae	<i>Paitae bakey</i> (T)	The dried fruits are chewed to increase the body stimulation.
15.	<i>Zanthoxylum armatum</i> DC	Rutaceae	<i>Oeigin</i> (T)	The dried fruits are warmed and eaten against cough, bronchitis and throat pain.
16.	<i>Acorus calamus</i> L.	Acoraceae	<i>Boch</i> (P)	The juice of rhizome is taken as an antidote to snake bites. It is also used for the treatment of asthma, bronchitis and different types of stomach problem to children.
17.	<i>Berberis aristata</i> D.C.	Berberidaceae	<i>Kanchan</i> (P)	Alkaloid obtains from plants is used as dye. Crushed bark mixed with water is used as eye lotion.
18.	<i>Adhatoda zeylanica</i> Med.	Acanthaceae	<i>Vasak</i> (P)	Leaves extract is taken for cold and cough. The decoction of leaves is used for treatment of tumour and uterine problems.
19.	<i>Cannabis sativa</i> L.	Cannabaceae	<i>Bhang</i> (P)	Two-three pieces of fresh leaves are eaten during stomach disorder.
20.	<i>Emblica officinales</i>	Euphorbiaceae	<i>Amla</i> (P)	The fresh as well as the dried fruits are taken

SN	Scientific name	Family	Local name	Uses
	L.			for liver trouble, diabetes, jaundice, heart related problems and blood purifier.
21.	<i>Houttynia cordata</i>	Saururaceae	<i>Machandari</i> (P)	The whole plants extract is taken for cholera. Rhizome is eaten as raw for cough; roots for stomach disorder, and leaf for dysentery.
22.	<i>Gmelina arborea</i> Roxb.	Verbenaceae	<i>Gamari</i> (P)	The crushed root is taken to purify the blood. Barks are chewed in case of stomach trouble.
23.	<i>Cannabis sativa</i> L.	Cannabaceae	<i>Bhang</i> (Ap)	The leaves along with water are taken for stomach disorder.
24.	<i>Emblica officinalis</i> Gaertn.	Euphorbiaceae	<i>Amolodi</i> (Ap)	Fresh fruits are taken as liver tonic. The dried fruits are chewed against the treatment of diabetes, jaundice, and heart-related problems.
25.	<i>Paedaria foetida</i> L.	Rubiaceae	<i>Phadobas lodi</i> (Ap)	leave paste is applied during body ache, and tubers are eaten for proper digestion
26.	<i>Spilanthus acmella</i> L.	Asteraceae	<i>Marcha</i> (Ap)	roots and flower paste are applied during toothache
27.	<i>Ageratum conyzoides</i> L.	Compositae	<i>Enepu</i> (I)	leaves paste is used for blood clothing and root juice for anthelminthic
28.	<i>Coptis teeta</i> Salisb.	Ranunculaceae	<i>Mishmi teeta</i> (I)	the rhizome paste is taken during diarrhoea, fever, and dysentery
29.	<i>Clerodendron colebrookianum</i> Walp.	Verbanaceae	<i>Naphaphu</i> (I)	leaves are taken to reduce blood pressure
30.	<i>Musa paradisiacal</i> L.	Musaceae	<i>Akona</i> (I)	roots and leaves paste are taken during fever, bodyache and vomiting
31.	<i>P. nigrum</i> L.	Piperaceae	<i>Ahoma</i> (I)	fruit juice is use to eradicate lice
32.	<i>Aloe barbadense</i> Mill.	Aloecaceae	<i>Ghrit-kumari</i> (N)	The mucilage of leaves is applied to cuts and burns. The fresh cut leaves are applied on face for smoother skin. Also used for dermatitis.
33.	<i>Centilla asiatica</i> L.	Apiaceae	<i>Aghinya</i> (N)	The whole plants juice is given for leprosy, tuberculosis and asthma patients.
34.	<i>Citrus medica</i> L.	Rutaceae	<i>Narang</i> (N)	The fruits are taken in indigestion and also given as cardio tonic. The leaves are used for the treatment of epilepsy, convulsion and cough. The leaves juice is applied on the hair as hair vitalizer
35.	<i>Oxalis corniculata</i> L.	Oxalidaceae	<i>Amrul</i> (N)	The whole plants are eaten as raw for bowel disorder and proper digestion. The leave extract is taken against scurvy diseases.
36.	<i>Ageratum conyzoides</i> L.	Asteraceae	<i>pashpaya</i> (N)	leave paste is applied on wounds to check bleeding.
37.	<i>Cassia alata</i> L.	Fabaceae	<i>kra-Pat</i> (N)	leaves juice is applied to eczema and itching
38.	<i>Centella asiatica</i> (L.) Urban	Apiaceae	<i>Barang</i> (N)	leaves are used in to reduce high pressure and bowel troubles
39.	<i>Curcurma longa</i> L.	Zingiberales	<i>Longobom</i> (N)	rhizomes paste is used in bone fracture and healing wounds.
40.	<i>Musa sapientum</i> Linn	Musaceae	<i>Nyoro –Kopa</i> (N)	boiled unripe fruits are taken during dysentery and diabetes.
41.	<i>Solanum khasianum</i> Cl.	Solanaceae	<i>Thitbya-ke</i> (N)	Roots decoction is used to treat malaria.
42.	<i>Spilanthus acmella</i> Merr	Compositae	<i>Mershang</i> (N)	Flowers are chewed during toothache.
43.	<i>Terminalia myriocarpa</i> Muell.	Combretaceae	<i>Chirata</i> (N)	plant extract is taken during fever.
44.	<i>Syzygium cumini</i> L.	Myrtaceae	<i>Jamun</i> (P)	The fruits are eaten during diarrhoea and dysentery.
45.	<i>Zingiber officinale</i> Roscoe	Zingiberaceae	<i>Avanti</i> (P)	Rhizome extract is taken for treatment of cough, bronchitis, fever, influenza and other throat problems.
46.	<i>Spilanthus paniculate</i> Wall ex DC.	Asteraceae	<i>marcha</i> (I)	Flowers are chewed during tooth ache
47.	<i>Bryophyllum calycinum</i> Salisb.	Crassulaceae	<i>Eh yadap</i> (Ta)	fresh leaves juice is taken for jaundice.
48.	<i>Clerodendrum serratum</i> (L)	Lamiaceae	<i>Tapin</i> (Ta)	Fresh tender leave was applied to check the blood pressure.

SN	Scientific name	Family	Local name	Uses
49.	<i>Embelia ribes</i> Burm(f)	Myrsinaceae	Onior (Ta)	leaves and fruits are taken during diarrhoea.
50.	<i>Ficus hispida</i> (Blanco)	Moraceae	Cheyum (Ta)	sap of stem is applied on burn injury.
51.	<i>Gynocardia odorata</i> (R. Br)	Achariaceae	Tiku (Ta)	leaves were chewed during tooth ache.
52.	<i>Piper longum</i> L.	Piperaceae	Satu rikki (Ta)	leaves and stem extract were applied for joint pain and arthritis.
53.	<i>Piper nigrum</i> L.	Piperaceae	Rari (Ta)	leaves and fruits are taken during tonsillitis and fever.
54.	<i>Tinospora cordifolia</i> (Miers)	Menispermaceae	Sayen kiji (Ta)	leaves juice was applied in skin disease.

Table 3. List of a few most common medicinal plants used by different tribes.

Tribes	Medicinal plant	Uses
Monpas	<i>Oroxylum indicum</i> (L.) Vent	diarrhoea and stomach ache
Monpas and Singpho	<i>Amaranthus spinosus</i> (L.)	skin infection
Apatani and Adi	<i>Cannabis sativa</i> (L.) and <i>Emblica officinalis</i>	gastrointestinal disorder and general health problems.
Singpho and Adi	<i>Houttuynia cordata</i>	gastrointestinal disorder
Idu and Tagin	<i>Piper nigrum</i> (L.)	eradication of lice
Singpho and Tangsa	<i>Piper mullesua</i> Ham ex D. Don	medicinal purpose
Singpho, Tangsa, Idu and Nyishi	<i>Ageratum conyzoides</i> (L.)	to stop bleeding
Nyishi tribe/other communities	<i>Centella asiatica</i> (L.)	treatment of stomach disorders and to reduce high blood pressure
Adi (Padam)	<i>Syzygium cumini</i> (L.)	diarrhoea and dysentery, diabetic person

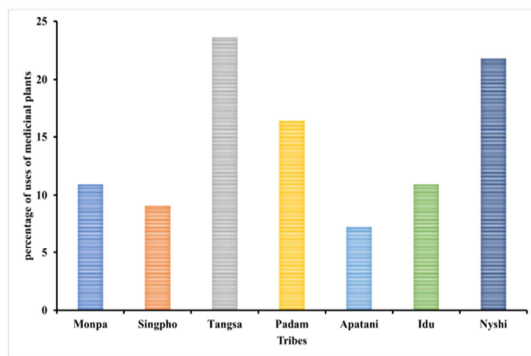


Fig. 2. Percentage of uses of medicinal plants by different communities of Arunachal Pradesh.

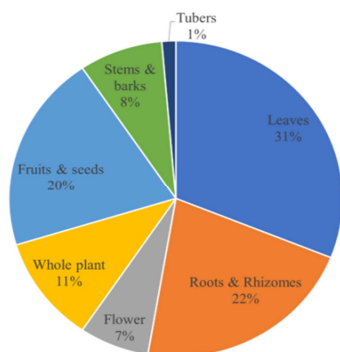


Fig. 3. Morphological plant parts used in traditional medicines.

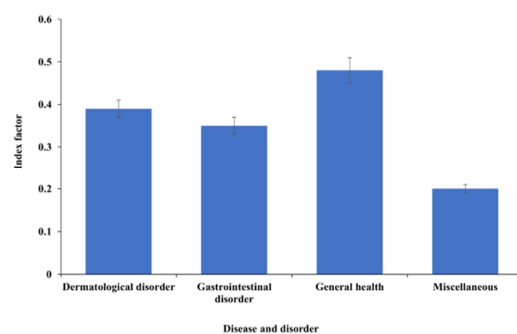


Fig. 4. Category of ailments and their informal consensus factor.

Conclusion

This study underlines the importance of documentation to conserve the traditional ecological knowledge which is fading in the era of urbanization, and it underlines the importance of traditional knowledge and its utilization for the greater benefit of humankind.

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