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Comprehensive list of anti-malarial plants used by different communities of Assam and Arunachal Pradesh, India

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Abstract
Traditional knowledge of treating various ailments by using medicinal plants is an age-old technique and is a common practice among different tribes of Assam and Arunachal Pradesh. These areas being malaria endemic, local people have been trying to combat this disease using locally available herbs. Extensive literature survey aids to the fact that, in Assam, 45 different plant species belonging to 30 families are used as traditional medicine against Malaria, and 102 plant species of 62 families are being used in Arunachal Pradesh. Tribes of these states possess a substantial knowledge on the traditional use of the herbal treatment of Malaria which has minimal side effects compared to medicinal treatment. This paper aims at providing a comprehensive listing of the antimalarial plants used by the tribes of Assam and Arunachal Pradesh in one platform for the ease of researchers and pharmacologists involved in such studies. The scientific name, family along with the plant part used, like root, leaves, bark/stem, etc for antimalarial studies are presented here.

Keywords: traditional knowledge, malaria, tribes, anti-malarial plant, Assam, Arunachal Pradesh

1. Introduction
Since time immemorial man has depended on Mother Nature for all their needs and has been gathering knowledge by experimenting with the various products obtained from them. The traditional knowledge so gained has been passed down to the generations. Traditional knowledge of ethnomedicine is still the key practice by some tribes for treating different health related problems across the world [1, 2]. In developing countries, about 60-80% of world's population depends on traditional medicines [3, 4]. WHO has estimated approximately 21,000 of plant species that can be used in several ailments [2, 5]. North East India is very rich in floral diversity and the resources present here can be tapped for the benefit of mankind. In North East India alone, 1350 plant species are used for therapeutic medicines [6]. There are more than 200 therapeutic plants in Assam which have various uses in different types of infection [7] and in Arunachal Pradesh; more than 500 medicinal plants have been reported to be used by the tribal communities for the medicinal purposes [6].
Malaria is the major health issue globally and nearly 40% of the world population are at risk especially the people living nearby tropical and subtropical regions [8, 9]. In addition, development of drug resistant variety of *Plasmodium* parasites in different parts of the world including Assam [10, 11] and Arunachal Pradesh [12] makes malaria elimination a big challenge, hence there is a serious need for the development of some anti-malarial drugs which is not only efficient but cost effective and eco-friendly. Thus, documenting the traditional knowledge of the local people against Malaria seems to be one of the best alternatives to treat this disease.
According to Population census 1991, in Assam, nearly 92.7% population living in rural areas and 7.3%, population living in urban areas uses traditional herbal remedies for treating wide range of diseases including Malaria rather than conventional drug treatments [11]. In ancient time, people used different plants part in treatment of malaria and like any other traditional knowledge; it has been passed on verbally from generation after generation [13, 14] with no proper written records. So research and proper documentation in this area will safeguard the legacy of the knowledge which has been practiced for generations.

There are some reports on use of medicinal plants or plant derived compounds for developing anti-malarial drugs [15]. Since the last few decades, number of researches has been going on the ethobotanical remedies for different diseases [16, 17, 18, 19, 20, 21]. This paper is an attempt to reviews some previously published data, on traditional knowledge for malaria treatment which could help in documentation of plants and a future scope for the scientists to do a wet lab experiment to validate the active plant component against malaria.

2. Antimalarial plants used by different communities of Assam

Assam is the second largest state out of eight North Eastern state *viz*. Arunachal Pradesh, Assam, Nagaland, Manipur, Meghalaya, Mizoram, Tripura and Sikkim. It is situated between $24^0 2'$ - $27^0 6'$N latitude and $89^0 8$-96^0 E longitude covering an area of 78,438 sq. km of which 23,688 sq. km area is covered by forest area [14]. Assam is rich in floral diversity of medicinal plants and malaria is the disease which is mainly treated by using traditional medicine by the tribes of Assam [22, 23]. Different plants used and their preparation methods vary among different tribes. There are many published literature [2, 11, 16, 22, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35] which gives strong evidence that the ethnic people of Assam depended on herbal medicine for various diseases with good efficiency. However, the process of calculating therapeutic index (prescribed minimum dose of the plant product without causing lethal effect) by local practitioner is still unknown to us.

Paul *et al.*, 2011 reported 32 medicinal plants from Ultapani forest range under Holtugaon division of Manas Biosphere region (Assam) and out of which, 5 plant species *viz*. *Azeratum conyzoids*, *Andrographis paniculata*, *Rauwolfia serpentine*, *Spilenthes paniculata and Vitex negundo* are used to cure malaria by the Bodo and Assamese people. In most of these plants, leaves were the most predominantly used for making the medicines.

Namsa *et al.*, 2011 documented total 22 plant species with antimalarial activity from Sonitpur district of Assam. Their work also investigated on the larvicidal and repellent properties of some of the plants like: *Annona squamosa*, *Aristolochia indica*, *Aegle marmelos*, *Cymbopogon citratus*, *Gymnopetalum cochinchinensis*, *Lantana camara*, *Ocimum sanctum*, *Piper longum and Vitex peduncularis.* Bioactive metabolites like alkaloids, coumarins, quassinoids, sesquiterpene lactones, triterpenoids, limonoids, and quinines from the tested plants were responsible for the anti-plasmodial activity [11, 36]. *Azadirachta indica* also was showed to exhibit a strong antiplasmodial property due to the presence of gedunin and nimbinin triterpenoids as the active component [11, 37].

Seven malaria prone districts (Dhemaji, Dibrugarh, Nagaon, Morigaon, Kamrup, Baksa and Goalpara) of Assam were surveyed for antimalarial plants by Gohain and his team in 2015 and they found total of 22 plants was being used by local practitioners and it basically involved four different preparation method; infusion, decoction, direct mechanical crushing and maceration for treating Malaria. Out of that 22 plant species, 5 plant species were already reported earlier but 17 plants were documented for the first time.

All these studies show that 45 different plant species belonging to 30 families are being used by traditional healers against Malaria. Out of all reported plant families, Asteraceae, Acanthaceae, Rubiaceae, Verbenaceae, Solanaceae are most commonly used (Table-1). Different tribes use different plant part like, root, rhizome, stem/ bark, flower, leaves, fruits, seeds and sometimes the whole plant is used as remedies. Of all the plant parts, leaves were most commonly used followed by root and then stem for traditional medicine preparation (Fig.1).

Table 1: List of plants used for the malaria treatment by the tribes of Assam

Sl. No.	Scientific Name	Local Name	Family	Part used	Reference
1.	*Adhatoda vasica*	Bosa	Acanthaceae	Root	[31]
2.	*Ageratum conyzoides*	larser, Jarmany bon	Asteraceae	Leaves, root	[22, 30]
3.	*Alstonia scholaris*	Satina	Apocynaceae	Stem Bark, Leaves	[11, 14, 38, 39]
4.	*Alpinia nigra* (Gaertn.) Burtt	Tora	Zingiberaceae	Leaves	[22]
5.	*Andrographis paniculata*	Sirata, Kalmegh, Mahatia	Acanthaceae	Leaves	[11, 30, 40]
6.	*Argemone mexicana*	Siyalpaduri	Papaveraceae	Leaves	[40]
7.	*Artemisia vulgaris*	Chirota,	Asteraceae	Stem and flowering tip	[11]
8.	*Asparagus racemosus*	Satmul	Liliaceae	Leaves and root	[22]
9.	*Caesalpinia bonduc* (L.) Roxb.	Lataguti	Caesalpiniaceae	Seeds	[22]
10.	*Cedrus deodara* (Roxb.) G. Don	Deodaro	Pinaceae	Stem Bark	[22]
11.	*Cinchona officinalis*	Cinchona	Rubiaceae	Stem bark	[38, 41]
12.	*Citrus medica*	Sauphria	Rutaceae	Bark	[42]
13.	*Coptis teeta*	Mishmi tita,	Ranunculaceae	Seeds, Roots, Rhizomes	[11]
14.	*Cucumis sativus* Linn.	Tioh	Cucurbitaceae	Fruit upper layer	[22]
15.	Curanga amara juss	Bhui-tita	Scrophulariaceae	Whole plant	[22]
16.	*Clerodendrum infortunatum*	Dhopat tita,	Verbenaceae	Leaves	[11]
17.	*Clerodendron colebrookianum*	Dhopat tita	Verbenaceae	Leaves	[34]
18.	*Dillenia indica*	Ow-tenga	Dilleniaceae	Fruits	[22, 43]
19.	*Flemingia strobilifera*	Makhioti	Fabaceae	Leaves	[22]
20.	*Gomphostemma parviflorum*	Bhedaitita	Lamiaceae	Leaves	[29]
21.	*Hedyotis scandens*	Jarmadawai	Rubiaceae	Root	[42]
22.	*Impatiens balsamina* L	Kanphuli-phul	Balsaminaceae	Leaves	[22]
23.	*Ichnocarpus frutescens*	Lomakandol	Apocynaceae	Leaves	[22]
24.	*Musa paradisiaca*	-	Musaceae	Flower	[44]
25.	*Nyctanthes arbor-tristis*	Sewali	Oleaceae	Leaves, seed, flower	[14, 34, 45]

26.	*Ocimum gratissimum* L.	Ram tulsi	Lamiaceae	Leaves	[22]
27.	*Oroxylum indicum*	-	Bignoniaceae	Bark	[46, 47]
28.	*Paederia foetida*	Bhedailota	Rubiaceae	Leaves	[34]
29.	*Phlogocanthus thyrsiformis* (Hardw.) Mabb	Tita bahaka	Acanthaceae	Leaves	[22]
30.	*Physalis minima*	Kopal phuta	Solanaceae	Leaves, stems	[48]
31.	*Phoebe goalparensis*	Bonsom	Lauraceae	Leaves	[49]
32.	*Piper nigrum*	Jaluk	Piperaceae	Seed	[14]
33.	*Piper longum* L.	Pipoli	Piperaceae	Leaves	[22]
34.	*Rauwolfia serpentina*	Sarpagandha, Chando gukha, Chandotita	Apocyanaceae	Root	[30]
35.	*Rubus rugosus*	Jetuli poka	Rosaceae	Leaves	[22]
36.	*Swertia chirayita*	Chirata	Gentianaceae	Leaves and stems	[48]
37.	*Stemona tuberosa*	Tita satmul	Stemonaceae	Rhizome	[22]
38.	*Solanum myriacanthum* Dunal	Kota bengena	Solanaceae	Root	[22]
39.	*Spilenthes paniculata*	Piraza, Usumai	Asteraceae	Leaves	[30]
40.	*Spilanthes acmella* Murr	Piraja	Asteraceae	Flowers and leaves	[22]
41.	*Tinospora sinensis.*	Amgrush	Menispermiaceae	Bark	[50]
42.	*Trema orientalis*	Phadam	Cannabaceae	Leaves	[39]
43.	*Vitex negundo*	Posotia, Nishinda	Verbenaceae	Leaves	[22, 30, 51]
44.	*Withania somnifera*	Ashwagandha	Solanaceae	Whole plant	[11]
45.	*Xanthium strumarium*	Agora	Compositae	Roots/ leaves	[33]

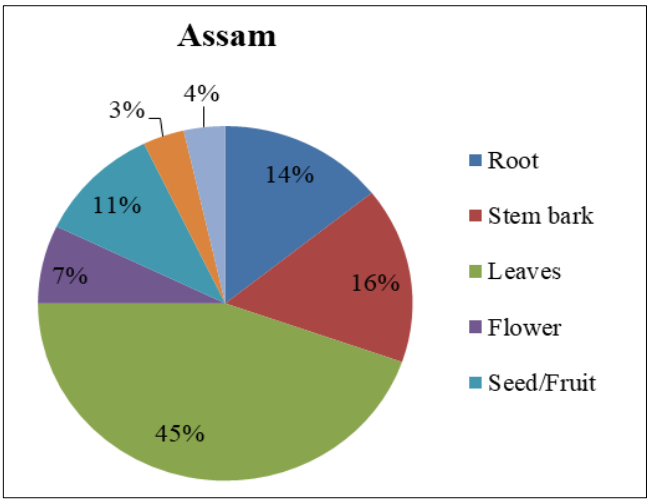

Fig 1: Different parts of plant used by ethnic people of Assam for Malaria treatment

3. Antimalarial plants used by different communities of Arunachal Pradesh

Arunachal Pradesh is the largest state (Area 83743 sq km) out of all eight north eastern states situated between $27^0 33'$ - $29^0 22'$ N latitude from $95^0 15'$ – $97^0 24'$E longitude [52] and known as one of the potential biodiversity hotspot of the world [46] because of its five climatic conditions (tropical, sub-tropical, sub-temperate, temperate, and alpine) and varied physiographic and altitudinal variations [53]. More than 28 tribes and 110 subtribes are residing in different parts of the state [47] and they have tremendous knowledge on medicinal plants and they have been using these plants for curing different ailments [20, 53, 54, 55]. It has been reported that about 500 different plant species are being used for the nutritional purpose by different tribal communities of the Arunachal Pradesh [6, 56].

Das and Tag (2006) reported 45 medicinal plants of Arunachal Pradesh used by Khamti tribes in various diseases and out of which 5 species are used in curing malaria *viz. Andrographis paniculata, Croton tiglium, Piper mullesus, Solanum torvum* and *Stephania japonica.* All these herbal medicines are administered orally sometimes singly or sometimes in combined form.

Tangjeng *et al.* (2011), reported 5 antimalarial plant species used by different tribes of Arunachal Pradesh exhibiting high efficiency against malarial infection. They have also reported the active pharmacological component of 3 plants *viz. Coptis teeta* (Berberine plamatinein and jatrorrhizine); *Terminalia chebula* (Gallic acid and Chebulinic acid), *Begonia roxburghii* (Alkaloids, flavonoids, and triterpenoids).

Upper Subansiri district of Arunachal Pradesh is also rich in floral diversity as well as in cultural diversity. Tgain, Nyshi and Galo tribe of this district uses number of locally available medicinal plants in various diseases. Murtem and Choudhry (2016) did an ethnomedicinal survey of this district and found total 140 different plant species which are use by traditional healers. Out of all these, 7 different plant species were used to treat malaria disease. Leave and root decoction of *Clerodendron colebrookianum* was reported to be used by Adi and Apatani tribes of Arunachal Pradesh in Malaria. Powdered bark *Oroxylum indicum* is used by Mongpa tribe and powdered tuber of *Stephania japonica* is used by Khamti tribes of Arunachal Pradesh in Malaria.

Singh and his fellow workers (2021) in their recent report mentioned about 11 different plant species which are used by traditional knowledge holders (TKH) of Adi tribes of Arunachal Pradesh for Malaria treatment along with other 28 species of plant which are also used in other ailments. It is worth mentioning that with changing nature of diseases, TKHs have also refined their practices. For example, earlier, TKHs used to prescribe powder of leaves of *singer* (*Alstonia scholaris*), bark of drumstick (*Moringa oleifera*), root of *nemar* (*Piper mullesua*) and local black pepper fruits for curing malaria, typhoid and jaundice, but now presently some TKH add *Tinospora cordifolia, Leucas aspera, Zingiber siangensis, Curcurma longa*and *Oroxylum indicum* as a vitamin supplement for Malaria.

From the published literature it was found that total 102 species of plant belonging to 62 families are widely used as ethonomedicine for curing Malaria by different tribes of Arunachal Pradesh. As in the case of Assam, here too maximum use of leaves was found for treatment of malaria followed by roots and then stem (Fig. 2).

Table 2: List of plants used for the malaria treatment by the tribes of Arunachal Pradesh

Sl. No.	Scientific name	Local Name	Family	Part used	Reference
1.	*Acorus calamus*	Vocha	Acoraceae	Stem	[66]
2.	*Aconitum heterophyllum*	Bonga- Karpho	Ranunculaceae	Tuberous root	[66]
3.	*Achyranthes aspera* L.	Appamargo	Amaranthaceae	Whole plant	[66]
4.	*Adiantum capillus-veneris*	Lashung	Pteridaceae	Whole plant	[66]
5.	*Ajuga macrosperma*	Athing-phang	Lamiaceae	Root	[66]
6.	*Andrographis paniculata*	Chirata, Kamtok(Khamti)	Acanthaceae	Leaves	[47, 53, 54,58,59]
7.	*Alastonia scholaris*	Tai sen	Apocynaceae	Bark	[47, 53, 57]
8.	*Allium sativum* L	Pulou	Amaryllidaceae	Cloves	[66]
9.	*Amomum aromaticum*	Sthula ella	Zingiberaceae	Seed	[66]
10.	*Artemisia nilagirica*	Namiperi	Asteraceae	Leaves	[57, 66]
11.	*Argyreia nervosa* (Burm. fil.) Bojer	Hemlata	Convolvulaceae	Seed	[66]
12.	*Artemisia vulgaris*	Damank	Asteraceae	Leaves	[66]
13.	*Aquilaria malaccensis*	Agaru	Thymelaeaceae	-	[60]
14.	*Ageratum conyzoides* L.	Enepu	Asteraceae	Leaves	[66]
15.	*Balakata baccata* (Roxb.)	Yaoulu	Euphorbiaceae	Bark	[66]
16.	*Berberis aristata*	Tipi-tire	Berberidaceae	Root	[66]
17.	*Bergenia ciliata* (Haw.)	Bra- mentock	Saxifragaceae	Root	[66]
18.	*Bidens pilosa*	Phutium	Asteraceae	Whole plant	[66]
19.	*Bombax ceiba*	Makhao	Malvaceae	Bark	[66]
20.	*Buddleja asiatica*	Feb- shang	Scrophulariaceae	Root	[66]
21.	*Calamus erectus*	Aruto	Arecaceae	Root	[66]
22.	*Campylandra aurantiaca*	Kekong kelong	Liliaceae	Rhizome	[6]
23.	*Carica papaya*	Omri	Caricaceae	Root	[6, 57, 66]
24.	*Carum carvi* L.	Tuoma	Apiaceae	Seed	[66]
25.	*Catharanthus roseus*	Dhuvephool	Apocynaceae	Leaves	[57]
26.	*Calotropis gigantea* (L.)	Tupawknung	Apocynaceae	Root	[66]
27.	*Centella asiatica* (L.)	Mawanro	Apiaceae	Leaves	[66]
28	*Chromolaena odorata* (L.)	Malinga-jumpak	Asteraceae	Leaves	[66]
29.	*Cissampelos pareira*	Ambasthu	Menispermaceae	Root	[66]
30.	*Coccinia grandis*	Kundul	Cucurbitaceae	Fruit	[66]
31.	*Coptis teeta*	Mishmi teeta	Ranunculaceae	Root	[6, 53, 57,61]
32.	*Clerodendron colebrookianum*	-	Verbenaceae	Leaves and roots	[47]
33..	*Clerodendrum serratum*	Bharangi	Verbenaceae	Roots	[52]
34.	*Clerodedron infortunatum*	Dhopat tita	Verbenaceae	Leaves	[60, 66]
35.	*Cissampelos pareira*	Tonbi	Menispermaceae	Plant	[52]
36.	*Croton tiglium*	Saklang	Euphorbiaceae	Leaves, Flower	[54]
37.	*Dactylorhiza hatagirea*	Salep, Wanpolagpa	Orchidaceae	Rhizome	[66]
38.	*Debregeasia longifolia*	Jirpollee	Urticaceae	Tender leaves	[66]
39.	*Dioscorea pentaphylla* L.	Ni-Mawan	Dioscoreaceae	Rhizome	[66]
40.	*Dillenia indica* L.	Jaopa	Dilleniaceae	Leaves	[66]
41.	*Drymaria cordata* (L.)	Kadokairon	Caryophyllaceae	Whole plant	[66]
42.	*Elsholtzia blanda*	Popit- namdung	Lamiaceae	Leaves	[66]
43.	*Entada phaseoloides* (L.)	Ghillagos	Fabaceae	Stem	[66]
44.	*Embelia ribes*	Biakol-lata	Primulaceae	Fruit	[66]
45..	*Eryngium foetidum*	Damgra/Tanumtananang	Apiaceae	Leaves	[62, 66]
46.	*Euphorbia neriifolia* L	Changrawng	Euphorbiaceae	Leaves	[66]
47.	*Euphorbia hirta*	Dudhboon	Euphorbiaceae	Whole plant	[66]
48.	*Euphorbia royleana*	Changrong	Euphorbiaceae	Stem	[66]
49.	*Fagopyrum esculentum*	Chhika	Polygonaceae	Grain	[66]
50.	*Ficus racemosa*	Phangrok	Moraceae	Root	[66]
51.	*Flemingia strobilifera* (L.)	Liang-sukh	Fabaceae	Root	[66]
52.	*Garcinia pedunculata*	Tabing-asing	Clusiaceae	Fruit	[66]
53.	*Holarrhena pubescens*	Dudhkuri	Apocynaceae	Bark	[66]
54.	*Hypodematium crenatum*	Bhutkesar	Hypodematiaceae	Leaves	[66]
55.	*Justicia adhatoda*	Ngamok-phare	Acanthaceae	Leaves	[66]
56.	*Kalanchoe pinnata*	Hurroreshia	Crassulaceae	Leaves	[66]
57.	*Lantana camara*	Luanha	Verbenaceae	Leaves	[66]
58.	*Leucas aspera*	Droni	Lamiaceae	Leaves	[66]
59.	*Ligularia amplexicaulis*	Rihu	Asteraceae	Stem	[66]
60.	*Marsilea minuta*	Kanjal	Marsileaceae	Leaves	[66]
61.	*Moringa oleifera*	Nung-Boko	Moringaceae	Bark	[57]
62.	*Musa balbisiana*	Siambyong	Musaceae	Root	[66]
63.	*Nardostachys jatamansi*	Pangposh	Caprifoliaceae	Rhizome	[66]
64.	*Nyctanthes arbor-tristis*	Hewali	Oleaceae	Leaves	[57]

65.	*Oroxylum indicum*	-	Bignoniaceae	Bark	[47, 61, 66]
66.	*Ocimum tenuiflorum* L.	Tulashi	Lamiaceae	Leaves	[66]
67.	*Oxalis corniculata*	Kanjal (small)	Oxalidaceae	Whole plant	[66]
68.	*Panax pseudoginseng*	Ginseng	Araliaceae	Root	[66]
69.	*Paris polyphylla*	Dipogoiak	Melanthiaceae	Rhizome	[66]
70.	*Paederia foetida*	Yepe- tere	Rubiaceae	Leaves	[66]
71.	*Perilla frutescens*	Namdung	Lamiaceae	Leaves	[66]
72.	*Piper mullesua*	Nemar/ Pipli/ Pan	Piperaceae	Leaves and fruits	[54, 57]
73.	*Piper longum* L.	Ahoma	Piperaceae	Fruit	[66]
74.	*Piper nigrum*	Marcha	Piperaceae	Seed	[66]
75.	*Picrasma javanica*	Nisso	Simaroubaceae	Bark	[66]
76.	*Picrorhiza kurroa*	Rente	Scrophulariaceae	Whole plant	[47, 66]
77.	*Polygonatum multiflorum*.		Convallariaceae	Roots	[63]
78.	*Phlogacanthus thyrsiflorusa*	Fenching phul	Acanthaceae	Leaves	[53]
79.	*Phyllanthus Amarus*	Bhumiamlai	Phyllantheceae	Root	[66]
80.	*Plantago asiatica* (Wallich)	Donihana-khang	Plantaginaceae	Leaves	[66]
81.	*Psidium guajava* Linn.	Halah	Myrtaceae	Leaves	[66]
82.	*Punica granatum* L.	Dalemsing	Lythraceae	Unripe fruit	[66]
83.	*Rauwolfia densiflora*	Ruki	Apocynaceae	Root, seeds	[64, 66]
84.	*Ricinus communis* L.	Changkhro	Euphorbiaceae	Root	[66]
85.	*Scoparia dulcis* L.	Roukrit	Plantaginaceae	Leaves	[66]
86.	*Smilacina purpurea*	-	Liliaceae	Roots	[63]
87..	*Smilacina oleracea*	-	Liliaceae	Roots	[63]
88.	*Solanum nigrum*	-	Solanaceae	Leaves, roots, stem	[61]
89.	*Solanum torvum*	Mehengchang	Solanaceae	Fruits	[54, 57]
90.	*Solanum spirale*	Banko	Solanaceae	Leaves	[57, 64]
91.	*Solanum khasianum*	Koppir	Solanaceae	Fruits	[57]
92.	*Stephania japonica*	Yapom Geep, Raikey	Manispermaceae	Tubers	[47, 54]
93.	*Stephanis hernandifolia*	Bhimraj	Menispermaceae	Tuber	[52]
94.	*Swertia chirayita*	Gonga Marpo (Monpas)	Gentianaceae	Whole plant	[65]
95.	*Swertia nervosa*	Yanshi-pong-yong (Monpas	Gentianaceae	Whole plant	[65]
96.	*Swertia chirata*	Puwtik titta	Gentianaceae	Whole plant	[66]
97.	*Terminalia chebula*	Logyo	Combretaceae	Fruit	[53]
98.	*Tinospora cordifolia* (Willd.)	Swein kije	Menispermaceae	Leaves	[66]
99.	*Toddalia asitica*	Kanchana	Rutaceae	Roots, bark	[52]
100.	*Tupistra aurantiaca*	Rinkey	Liliaceae	Stem	[47]
101.	*Xanthium strumarium*	-	Asteraceae	Root	[60]
102.	*Zingiber officinale* Roscoe	Deing	Zingiberaceae	Rhizome	[66]

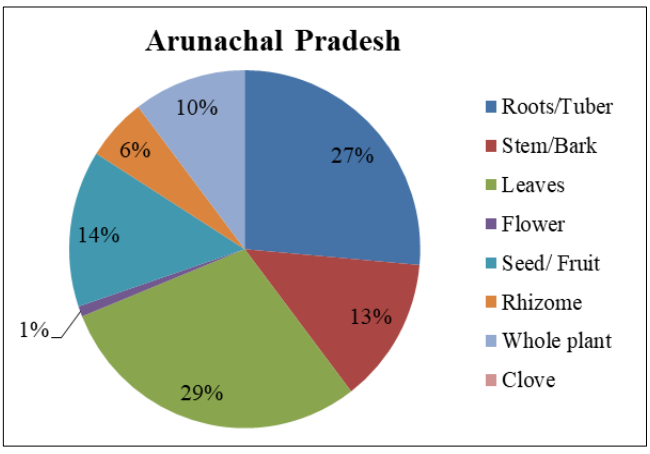

Fig 2: Different parts of plant used by ethnic people of Arunachal Pradesh in Malaria treatment

4. Conclusion

These studies revealed that tremendous resources are available in these states and the knowledge of the traditional healers are immense but it is just that those are not being scientifically tested and validated. Whatever little studies have been carried out in these areas indicated that these medicines practiced by them are rarely associated with any side effects [44]. Local traditional healers not only are experts in treating many of these ailments but also making decoctions with the locally available plants to boost the immunity of the patients. Sadly, this traditional knowledge are mostly rested with the community elderly people and the younger generations have a minimal knowledge on this as the interest in such science is slowly declining in them. With modernization and accessibility to modern medicines and the least concern by the young generations, this traditional knowledge is facing a serious threat of losing its essence. Hence it is important to document and conserve all the locally known medicinal plants for the betterment of human kind and their welfare, as many of these plants may be a potential source of remedies for many serious ailments which is yet to be explored. Lab based screening of the active component and clinical trial of these medicinal plants against Malaria can bring a new hope to the human health care system where other kinds of medicines have either failed or not proved very efficacious. Proper comprehensive and scientific research needs to be carried out to validate their efficacy and safety through pharmacological studies. This study therefore provides a comprehensive list of the potential plants which have been used in the recent pasts by the local traditional healers of these states and which could be further researched on for developing drugs against malaria.

5. Conflict of interest: The authors have declared that they have no competing interests.

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