

TRADITIONAL ANTI-MALARIAL DRUGS FROM SERCHHIP AND LUNGLEI DISTRICTS OF MIZORAM

**Laldinsanga, Himangshu Sarma, Taslima Jahan, Ashis Kumar
Goswami, Hemanta Kumar Sharma***

Department of Pharmaceutical Sciences, Dibrugarh University, Dibrugarh-
786004, Assam, India

Abstract

Background: *Traditional or folk or indigenous medicine concerns the health practices, knowledge and faith of different indigenous communities. It is the application of a single or combination of parts of plants, animals and mineral-based medications to diagnose, cure, mitigate or prevent illnesses or diseases. The traditional medicine has a wide application even today, especially in developing countries, where modern health services are limited.*

Objective: *The objective of this survey was to identify the medicinal plants used by different tribal communities as a folk remedy to cure malaria and fever in rural Mizoram, a state of North-East India.*

Methods: *An ethnobotanical survey was carried in between January 2012 to April 2012 by interviewing traditional healers of Mizoram. The survey was carried out in the south and central part of Serchhip and Lunglei Districts of Mizoram.*

Results and Discussion: *Based on the exhaustive interviews with the local healers practicing indigenous system of medicine a detailed list of plants were prepared. The list was prepared taking into consideration the information obtained from books related to traditional medicinal plants. The list consists of 52 plant species from 36 families, which claim ethnomedical indication to treat malaria and fever.*

Conclusion: *The present study showed the significant use of medicinal plants by different tribal communities as remedy to cure malaria and fever. The results of the present study can be used to develop a new therapeutic approach to develop new chemical entities (NCE), which are safe, effective and inexpensive.*

Keywords: Ethnobotanical; Ethnic practice; Folk medicine; Indigenous medicine; Indo-Burma biodiversity; North-East India; Tribal healer.

Introduction

Traditional therapy is regarded as an important healthcare contributor in rural areas. India is well known for its traditional system of medicine since time immemorial. Particularly in developing countries such as India, plant-based traditional therapy is a vital part in contribution to the health care of a large number of communities. Moreover, India is a land of different communities with their own beliefs, culture, religion, language and dialects. Therefore, various folk remedies were practised in this region (Hazarika, Das, Sarma & Sharma, 2018). Furthermore, India has an abundant source of bio-diversity of herbs.

North-east India is a part of both Himalaya and Indo-Burma biodiversity hotspot resulting in a plethora of medicinal plants used that are

used by different tribal communities (Myers, Mittermeier, Mittermeier, da Fonseca & Kent, 2000). Tribal people in different parts of India, use their traditional ecological knowledge (TEK), received from their ancestors. The TEK of tribes is intimately linked with geography as well as ecological and cultural factors. The application of TEK must have been the first knowledge acquired by man to satisfy his hunger, healing wounds and curing various ailments through ethnobotany study. TEK is defined as “the investigation and evaluation of the knowledge of all phases of life amongst the primitive societies and plant environment with respect to life, customs, beliefs and history of tribal communities”(Kshirsagar & Singh, 2001). Ethnomedicine, as defined by Foster and Anderson as the totality of health, knowledge, values, beliefs, skills and practices of a society, including all the clinical and nonclinical activities that relate to their health needs (Rai & Lalramnghinglova, 2010). Therefore, traditional or folk medicines have an inextricable link with human society.

Mizoram has rich flora and fauna with a variety of medicinal plants. About 95 percent of the population in the interior region of the state depends on medicinal plants for mitigation of common health problems. Even today, tribal and certain communities in Mizoram still practice herbal medicines to cure a variety of diseases and disorders (Lalfakzuala, Lalramnghinglova & Kayang, 2007). Additionally, herbal medicines are gaining popularity due to their lesser side effects and minimum cost as compared to synthetic medicines. As a result, the pharmaceutical industries are also producing various herbal formulations which have good value in the market (Kala, Dhyani & Sajwan, 2006).

The aim of the present study was to evaluate the medicinal utility of the plant utilized by different tribes of Mizoram (central and southern region)

to encourage the preservation of their culture, traditional knowledge, conservation and sustainable utilization of the plant wealth occurring in the study area. An effort has been carried out to document the ethnomedicinal uses of plants in the treatment of malaria and fever by the tribal people of Mizoram. Among the six vectors borne diseases prevalent in Mizoram, malaria still remains a major public health issue in the state. It recorded the highest number of cases of malaria among the north- eastern states of India in the last decade (shown in table 1, 2 & 3) (4 Northeastern States Have Highest Death Rates Due To Malaria). The report also demonstrated that the rural communities are more likely to suffer from malaria than urban people. The positive cases reported across the state ranges from low endemic to the high endemic (National Health Mission Mizoram).

Materials and Methods

In this study, data were collected from five folk healers as well as users of the folk remedies during the period of January 2012 to April 2012. In the gathered information was also contented disease condition, prescribe dosage form, duration, route of administration and limitation of food intake, wherever available, throughout the course of treatment. The medicinal herbal plant specimens were preserved at Department of Pharmaceutical Sciences, Dibrugarh University, Dibrugarh according to the conventional herbarium technique. Plant specimens were identified and assigned their scientific names. Plants used in the treatment of fever and malaria were included in this report.

Study area

Mizoram the 23rd state of Indian union is one of the eight North-Eastern states of India and is surrounded by Myanmar, Bangladesh, Manipur,

Table 1: Malaria Epidemiological situation of Serchhip district Mizoram.

year	population	BSC/BS E	ABER	Total malaria case	PF Case	API	SPR	SFR	Death
2000	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0
2002	53561	19311	36.05	317	235	5.92	1.64	1.22	7
2003	55967	18847	33.68	316	222	5.65	1.68	1.18	8
2004	55967	19164	34.24	317	192	5.66	1.65	1.00	15
2005	55967	16495	29.47	452	244	8.08	2.74	1.48	15
2006	55967	20291	36.26	625	327	11.17	3.08	1.61	15
2007	57725	12337	24.84	282	127	4.89	1.97	0.89	4
2008	57725	20899	36.20	343	263	5.94	1.64	1.26	1
2009	27725	10351	17.93	241	196	4.17	2.33	1.89	13
2010	60437	23962	39.65	264	228	4.37	1.10	0.97	3
2011	60437	4326	7.16	29	24	0.48	0.67	0.55	1

BSC: Blood Smear Collected; BSE: Blood Smear Examines; PF: Plasmodium falciparum; API: Annual Parasitic Incidence; SPR: Slide Positive Rate; SFR: Slide falciparum Rate

Table 2: Malaria Epidemiological situation of Lunglei district Mizoram.

year	population	BSC/BSE	ABER	Total malaria case	PF Case	API	SPR	SFR	Death
2000	109972	34506	31.38	1845	888	16.78	5.35	2.57	2
2001	115476	31103	26.93	3229	960	27.96	10.38	3.09	3
2002	115476	35011	30.32	2074	779	17.96	5.92	2.23	0
2003	122390	35979	29.40	2171	969	17.74	6.03	2.69	4
2004	122390	34767	28.41	2059	880	16.82	5.92	2.53	1
2005	122390	39342	32.14	3214	1635	26.26	8.17	4.16	23
2006	122390	40596	33.17	3492	2243	28.53	8.60	5.53	26
2007	136650	35585	26.04	2873	2125	21.02	8.07	5.97	28
2008	136650	31736	23.22	2530	2094	18.51	7.97	6.60	17
2009	136650	48471	35.47	3965	3251	29.02	8.18	6.71	22
2010	143583	82154	57.22	6110	5658	42.55	7.44	6.89	11
2011	143583	16913	11.78	1394	1303	9.71	8.24	7.70	1

BSC: Blood Smear Collected; BSE: Blood Smear Examines; PF: Plasmodium falciparum; API: Annual Parasitic Incidence; SPR: Slide Positive Rate; SFR: Slide falciparum Rate

Table 3: Malaria Epidemiological situation in Mizoram.

year	population	BSC/BSE	ABER	Total malaria case	PF Case	API	SPR	SFR	Death
2000	783712	197481	25.20	8117	4806	10.36	4.11	2.43	33
2001	806845	204492	25.34	10929	5955	13.55	5.34	2.91	43
2002	813639	219522	26.98	7859	3932	9.66	3.58	1.79	35
2003	905689	203188	23.43	7290	4167	8.05	3.59	2.05	48
2004	905689	217316	23.99	7830	4170	8.65	3.60	1.92	72
2005	905689	202155	22.32	8458	6079	9.34	4.18	3.01	84
2006	905689	205535	22.69	8649	6956	9.55	4.21	3.38	121
2007	980366	154045	15.71	5289	4189	5.39	3.43	2.72	75
2008	980366	165441	16.88	7361	6172	7.51	4.45	3.73	91
2009	980366	171793	17.52	9399	7390	9.59	5.47	4.30	119
2010	1001289	334991	33.46	15626	14664	15.61	4.66	4.38	31
2011	1032193	77495	7.51	3210	2991	3.11	4.14	3.86	22

BSC: Blood Smear Collected; BSE: Blood Smear Examines; PF: Plasmodium falciparum; API: Annual Parasitic Incidence; SPR: Slide Positive Rate; SFR: Slide falciparum Rate

Assam and Tripura (Fig.1) (Department of Environment, Forests & Climate Change - Mizoram state biodiversity board). It is located between 21° 58' to 24°35'N latitude and 92°15' to 93° 29' E longitude. Mizoram covers an area of 21087 square km. Among 15825 square km is the total forest area. The altitude ranges from 500 to 2157 m. The average daily temperature varies from 18 to 29°C in summer and from 11 to 24°C in winter. It has a no snowfall any place, however, frost is going through the eastern part. Monsoon has a direct influence on this region, with heavy rains from May to September and an average rainfall of 245 cm per year (Sharma, Chhangte & Dolui, 2001). In the local language, Mizoram means “Land of Highlanders”. The Mizo Hills, which dominate the state’s topography, rise more than 6560 ft near the Myanmar border (Sharma et al, 1999). According to 2011 census the state has a population of around 10, 91,014 and holds the 3rd highest literacy rate (91.6%) among the 28 states and seven union territories of India and also is a part of the 25 mega-biodiversity hotspots of the world (List of districts of Mizoram). The area of Serchhip District has 1,422 square km. Latitude: 23°32399' N, Longitude: 92°85746' E. and population around 64,937 (as per 2011) (Serchhip District Population Census 2011-2019, Mizoram literacy sex ratio and density). The district of Lunglei situates itself at 22°88' North latitude and 92°73' East longitude. This beautiful district has a population count of 47,355 as per the census of 2011 with an area 4,536 square km. population 161,428 (Table 4) (Lunglei District Population Census 2011-2019, Mizoram literacy sex ratio and density).

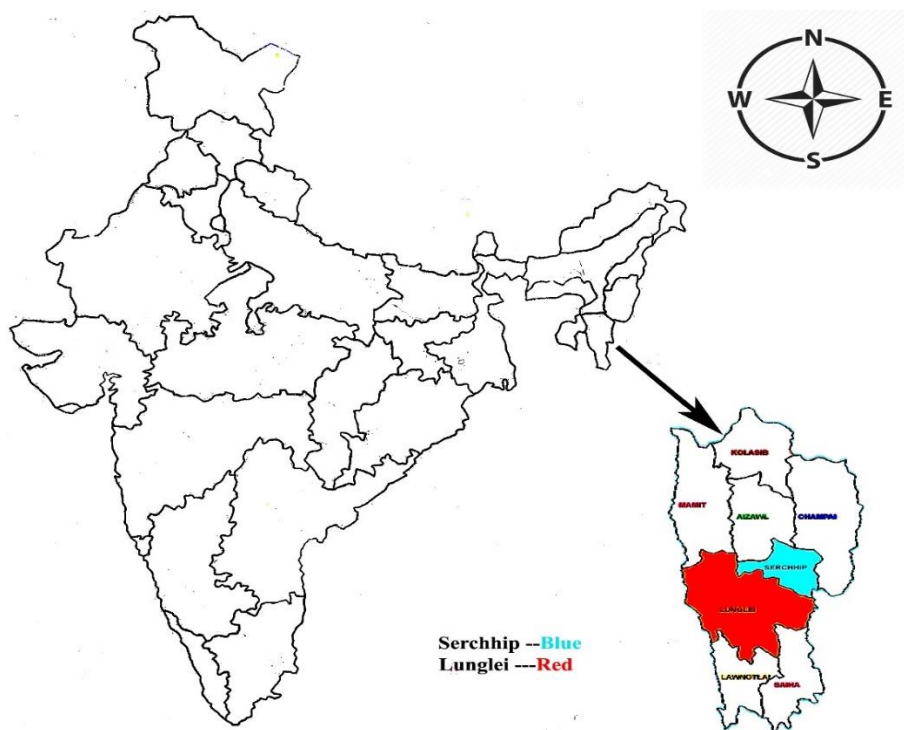


Fig. 1: Study area of Serchhip and Lunglei Districts in Mizoram, India.

Results

The plants are arranged in alphabetically by their scientific name (Family name in parentheses) followed by the local name in Mizo (M), English (E) and Assamese (A) language wherever available and herbarium specimen number along with part(s) of the plant used medicinally and method of application.

Acacia pennata L. Willd. (Mimosaceae); Khang-hu (M); Climbing acacia (E); HKS-M-16. A decoction of the leaves is given to cure headaches, fever and body aches. The fresh leaves juice mixed with milk is given to infants for indigestion. The *A. pennata* plant is utilized to cure bleeding gums and burning urination as an antiseptic. A decoction of root bark is taken orally as an antiflatulent. The boiled tender leaves of *A. pennata* is used for

Table 4: Area, population distribution and climatic condition of the study area (Health & Family Welfare Department - Number of Hospitals).

Sl. No.	District	Area (Sq.Km)	Population (As per 2011)			Annual Rainfall (in mm)	Temperature		Average Humidity in %	Literacy rate (%)	No of bed in Hospital
			Total	Male	Female		Summer	Winter			
1	Lunglei	4,536	161,428	82,891	78,537	2,313.80	20-30	11-24	78%	88.86	241
2	Serchhip	1,421	64,937	32,851	32,086	1,486	20-31	11-21	81%	97.91	60

the treatment of cholera. The barks of *A. pennata* have been utilized in the treatment of asthma and bronchitis in Myanmar (Aye, Aung, Sein, & Armijos, 2019).

Acacia concinna (Willd.) DC. (Mimosaceae); Khang-thur (M); Soap-pod (E); Pasoi tenga or Amsikira (A); HKS-M-54. The infusion of leaves is administered orally to treat malaria at a dose of 5 to 15 ml at 4 to 5 times daily until disease remedy. The infusion of leaves mixed with black pepper and tamarind is given orally to cure jaundice. A decoction of the fruits and leaves is used in constipation as a laxative. The decoction of fruits is applied topically as a hair tonic. The leaf of infusion is used to remove dandruff and skin diseases. The bark extract is applied in leprosy.

Acer oblongum Wall. ex DC. (Aceraceae); Thing-phing-phi-hlip (M); Himalayan maple (E); HKS-M-14. A decoction of the leaves and bark is administered orally to cure fever, stomachache, dysentery and retained placenta. It is also used as an antidote in food poisoning.

Ageratum conyzoides L. (Asteraceae); Vai(h)len-hlo (M); Goat weed (E); Germany-bon (A); HKS-M-11. A decoction of the roots is taken orally in the treatment of fever. The juice of the roots and paste of the leaves is applied topically in skin infections, fresh cuts, sores and toothache.

Alsonia scholaris L. R. Br. (Apocynaceae); Thuam-riat (M); Devil's Tree (E); Sotiyana (A); HKS-M-09. The crushed juice or decoction of stem bark (10 ml, 2 to 4 times daily) is administered orally to cure malaria, typhoid, asthma, diarrhoea, high blood pressure, rheumatic pains and inflammation. The milky juice (latex) of *A. scholaris* has applied to treat ulcers as antiseptic and to cure rheumatic pain. A decoction of the bark and

Laldinsanga *et al.*

roots are taken by women with rice daily for several weeks to cure excessive vaginal discharge. An infusion of the crushed leaves is applied to clean infected wounds and a wash for skin diseases.

Ananas comosus L. Merr. (Bromeliaceae); Lakhuihthei (M); Pineapple (E); Mati-kothal (A); HKS-M-87. The juice of the ripe fruit and of the leaves is taken orally to get relief from typhoid fever and convulsions. A decoction of the unripe fruits (15 to 20 ml) and of the stalk of *Colocasia esculenta* L. Schott. (Araceae) is mixed with sugar and given orally to treat bronchial asthma. The decoction of sour, unripe fruit is taken orally to improve digestion, enhances appetite and relieves dyspepsia. It also acts as a uterine tonic. The juice of ripe fruit is reduced to excessive gastric acid. The ripe fruit is useful as a laxative for relieving constipation, due to their large amount of fiber content. The juice of the ripe fruit is taken orally as a diuretic and a digestive tonic. The juice of the fresh leaves is taken orally as an anthelmintic and purgative. The juice of the plant is applied topically to cure burns, itches boils and reduce inflammation.

Andrographis paniculata (Burm. f.) Wall. ex Nees (Acanthaceae); Hnah-kha-pui (M); King of Bitters (E); Kalmegh (A); HKS-M-19. A decoction of the aerial parts of the plant is taken orally to treat malaria, fever, common cold, hypertension, diabetes and dysentery. The roots and whole plant of *A. paniculata* are utilized to treat abdominal pain, dyspepsia, respiratory infections and inflammation. The plant is applied as an antidote for snakebite and poisonous stings of insects.

Anogeissus acuminata Roxb. ex DC. Guill. (Combretaceae); Zai-rum (M); Button tree (E); HKS-M-39. A decoction of the bark is taken orally to cure fever, malaria, diarrhoea. The infusion of the leaves is administered

orally as remedy for high blood pressure. The paste of *A. acuminata* leaves are topically applied around infected wounds as antiseptic and in the treatment of measles, chicken pox, burn and sores.

Artemisia vulgaris L. (Asteraceae); Sai (M); Mugwort (E); Nilum (A); HKS-M-32. A decoction of the root or leaf is administered orally at a dose of 25-50 ml in the treatment of malaria. It has also an antipyretic and analgesic, diuretic and anti-microbial activities. The fresh leaves juice is utilized as a hemostatic agent for the nose and internal bleeding.

Artocarpus heterophyllus Lam. (Moraceae); Lam-khuang / La-ui (M); Jack fruit (E); Kathal (A); HKS-M-03. A decoction of the root and leaves (Half glass after the meal) are taken orally to treat fever. Moreover, the plant has anti-diarrheal, anti-asthmatic activities. The ashes of leaves with or without oil are applied topically to cure boils, skin cuts or wounds.

Artocarpus gomezianus Wall. ex Trécul (Moraceae); Thei-tat (M); Monky-jack (E); Khorika-dewa (A); HKS-M-91. The juice of ripe fruit is taken orally to get relief from fever due to cough. The seeds act as a purgative. The bark infusion is applied topically to cure the skin lesion and prevent skin aging.

Averrhoa carambola L. (Oxalidaceae); Thei-her-awt (M); Star fruit (E); Kordoi (A); HKS-M-06. Infusion of the ripe fruits is administered orally in the treatment of malaria and fever as antipyretic. The juice of ripe fruits is used as a laxative, appetite stimulant, astringent and urinary disorders. Moreover, the fruits are also utilized to cure throat inflammation, mouth ulcer, toothache, cough, asthma, hiccups and jaundice. The roots of star-fruits are utilized to treat chronic headache and arthralgia. The paste of

Laldinsanga *et al.*

crushed leaves or shoots is externally used to cure ringworm infection, boils, scabies, chicken-pox and headache. A decoction of the crushed seeds is used in the treatment of asthma and colic.

Begonia inflata C.B. Clarke (Begoniaceae); Se-khup-thur (M); HKS-M-63. A decoction of the rhizome at a dose of 5 to 10 ml (2-3 times daily) is taken orally to cure malaria. A decoction of the whole plant at a dose of 10 ml (two times daily) is administered orally to treat dysentery and hemorrhoids. The fresh plant is eaten in food allergy.

Borginia ciliate (Haw.) Sternb. (Saxifragaceae); Kham-dam-dawi (M); Hairy bergenia or Winter begonia (E); Patharkuchi (A); HKS-M-13. The leaf juice (30 ml twice a day) is taken orally for the cure of malaria. The root and leaf juice are utilized to cure wounds, sores, boils and skin diseases as an antibacterial. The plant is used in stomachache, liver diseases, cough, diarrhoea and diabetic condition.

Canna indica L. (Cannaceae); Kung-pui-mu-thi (M); Canna lily (E); Parijat or Sarbojaya (A); HKS-M-07. The infusion of the leaves and powdered root are taken orally (one glass daily) to cure malaria. A decoction of the fresh rhizome is utilized as dropsy, dyspepsia, febrifuge, diuretic, antipyretic, gonorrhoea and women having irregular menstrual cycle. Macerated rhizomes are applied to mitigate nosebleed. The powdered root is used to cure diarrhoea and dysentery, diaphoretic, stimulant and demulcent. Fresh leaves are utilized in baths as a remedy against arthritis and rheumatic pains. The leaves are applied externally to heal wounds. The flowers cure eye infections. Seeds juice is given to mitigate ear pain.

Cassia fistula L. (Fabaceae); Ngai-ngaw / Phung-ril (M); Golden shower (E); Xonarua (A); HKS-M-28. A decoction of the roots and pods

(45ml twice daily) is taken orally in malaria. A decoction of the roots is also used in diabetes, strangury, heart disease, dry cough, bronchitis, rheumatism, fever, inflammations, intermittent fever and stomach disorders. The ripe pods and seeds are widely utilized as a laxative. Paste of root is applied in skin diseases, burning sensations. Bark is used in wound boils, leprosy and ringworm infection.

Chickrassia tabularis Andr. Juss. (Meliaceae); Zawngtei (M); Indian red wood (E); Boga-poma (A); HKS-M-93. A decoction of leaves and bark is taken orally to treat malaria and fever. A decoction of the bark and fruit peel is taken orally (10 ml, three times daily) to prevent hyperacidity. The juice of the fruit peel and its young leaves and bark are taken orally at a dose of 5 to 10 ml, 2 to 3 times daily in the treatment of diarrhoea and fever as a febrifuge. A leaf extract has antibacterial and antifungal activities.

Clerodendrum colebrookianum Walp. (Verbanaceae); Phui-hnum (M); East Indian Glory Bower (E); Nephaphu (A); HKS-M-76. The juice of fresh leaves is administered orally to treat malaria, headache, typhoid, fever, syphilis, jaundice, high blood pressure, helminthic infections, diabetes and dysentery. The paste of the leaves is applied topically to the affected area in the case of rheumatic pains and skin diseases. A decoction of the roots is given orally to get relief from cough and asthma. The plant is also used to treat against greenish swelling (gland), dizziness and sore tongue in children.

Dichroa febrifuga Lour. (Hydrangeaceae); Khaw-sik-dam-dawi or Ui-te-pangang-hlo (M); Chinese quinine or Blue evergreen hydrangea (E); HKS-M- 78. A decoction of the roots or leaves is administered orally at a dose of 5 to 15 ml (2 to 5 times daily) to treat against fever and malaria. The

Laldinsanga *et al.*

juice of the fresh leaves is utilized to treat colds, coughs and bronchitis. The fresh leaves and roots have an emetic property.

Dillenia indica L. (Dilleniaceae); Kawr-thin-deng (M); Elephant apple (E); Ou-tenga (A); HKS-M-83. The juice of the fruit mixed with water and sugar is drunk orally to get relief from fever as a cooling beverage. The same preparation is also used in the treatment of diarrhoea, lack of appetite, abdominal pain, and heart diseases as a cardiotonic. The juice of the fruit is mixed with sugar or honey and is taken orally to get relief from cold, cough and dyspnoea. The fresh juice or cold infusion of *D. indica* fruits are applied over the scalp as a hair tonic to prevent the hair fall and cleaned the scalp hair. The paste of the bark of *D. indica* is applying topically to the affected area to remove skin pigmentation. A decoction of the bark of the plant is given to treat oral candidiasis and to remove offensive mouth odour.

Eryngium foetidum L. (Apiaceae); Bahkhawr (M); Long coriander (E); Man dhanian (A); HKS-M-109. The leaf juice of *E. foetidum* is given orally at a dose of 10 ml to get relief from fever, chills, headache, malaria and prevention of convulsions during high fever. It is also taken orally in the treatment of stomachic, vomiting, constipation, diarrhoea, fits, asthma, hypertension, worms, infertility complications and snake bites. A paste of the leaves is applied topically to the affected area to get relief from pain during burns, arthritis, scorpion stings as anti-inflammatory and analgesic.

Erythrina stricta Roxb. (Fabaceae); Far-tuah (M); Indian Coral tree (E); Modar (A); HKS-M-21. The powder, as well as a decoction of the bark (half glass 3 times a day), is administered orally in fever. The powder and juice of bark have an anti-epilepsy, anti-leprosy, anti-asthmatic, anti-dysentery, anthelmintic, anti-diuretic activities. Powder of the bark is also

utilized in the treatment of stomach ulcer, kidney trouble, rheumatism, itching and haemostatic conditions.

Gmelina arborea L. (Verbenaceae); Thlan-vawng (M); Gamari (E); Gomari (A); HKS-M-15. Crushed juice of bark, fruits and a decoction of the roots is useful in the treatment of fever, hallucination, dyspepsia, constipation, piles, worm infection, haemorrhoids, gastralgia and burning sensation. The leaves juice is used to cure gonorrhoea and is used externally as an antiseptic agent to wash for foul ulcers. Leaves paste of gmelina is applied externally on the forehead to relieve headache. The leaves juice of gmelina is applied over the inflamed area to relieve joint pain. The flowers are utilized in treating skin diseases and leprosy.

Hedyotis scandens Roxb. (Rubiaceae); Laiking tuibur (M); Indian madder (E); Bhedai lota (A); HKS-M-27. A decoction of the rhizome, root or leave (45ml twice a day) is taken orally in the treatment of fever, stomach pain, kidney stone, dysuria and uterine disorder. The plant is utilized to cure jaundice and tapeworm infection. The leaves juice is applied externally for rheumatism, sores and eye infection.

Kyllinga monocephala Rottb. (Cyperaceae); Artelubawk (M); Nut grass (E); Keya bon (A); HKS-M- 94. A decoction of the roots is administered orally at a dose of 5 ml, 2 to 3 times daily to get relief from fever, malarial chills, pruritus of the skin, thirst due to fever and diabetes. The root juice is given orally in food-poisoning as an antidote.

Lablab purpureus L. Sweet. (Fabaceae); Be-pui (M); Country bean (E); Urohi (A); HKS-M-30. A decoction of the seeds (half glass twice a daily) is taken orally against fever. The leaves juice has anti-diarrhoea, antiemetic and

stomachache activities. The seeds have antispasmodic activity. It is also potentially utilized in excessive bleeding during menstruation, skin cut as antiseptic

Lanata camara L. (Verbenaceae); Shilong tlang-sam or Til-duh-par (M); Lantana (E); Gu-phul (A); HKS-M-33. A decoction of the leaves is systemically administered to cure malaria, fever, asthma, high blood pressure. Externally, leaves are applied to treat rheumatisms, swelling, eczema, ulcers, wound healing, sores and measles.

Laportea crenulata Roxb. Gaud. (Urticaceae); Thak-pui (M); Devil or fever nettle (E); Sorat goss (A); HKS-M-69. A decoction of the root is given orally at a dose of 5 to 15 ml, twice daily to treat chronic fever, asthma, gout, mumps, whooping cough, jaundice, diarrhoea and dysentery. The leaf develops a burning sensation when a person comes in contact with the leaf, which can be cured by the use of root juice.

Melocanna baccifera Roxib. Kurz. (Poaceae); Mau-tak or Mau-mit (M); Muli bamboo (E); Tavai (A); HKS-M-116. The water deposited inside aerial stem of *M. baccifera* is used in the treatment of fever, urethritis, respiratory diseases and paralysis. The glossy part of the plant is applied topically to stop the bleeding from open wounds.

Mikania micrantha H.B.K. (Asteraceae); Japan-hlo (M); Bitter vine (E); HKS-M-75. The juice of fresh leaves is administered orally (5 to 10 ml, 2 to 4 times daily) to treat fever, malaria, diarrhoea and dysentery. The leaf juice is applied topically to treat wounds and cuts as antiseptic. The leaf juice is mixed with the leaf juice of Lungthi, and *A. asica* is taken orally in the treatment of cancer.

Morus alba L. (Moraceae); Thingtheihmu (M); Mulberry (E); Nuni (A); HKS-M-40. The crushed juice of the mulberry leaves is taken orally to treat fever, headaches, sore and inflamed eyes, sore throats, dizziness and vertigo. The fruit juice is used as cleansing and tonic and has often used as a gargle and mouthwash. The root bark is utilized to cure toothache. It has a laxative property. Mulberry leaves are used as an expectorant to cure cough. An extract of the leaves has been given by injection to treat elephantiasis. The twigs are efficacious to combat excess fluid retention and joint pain.

Musa paradisiaca L. var. *Sylvestris* (Musaceae); Changel (M); Plantain (Wild) (E); HKS-M-24. The decoction of the leaves of *M. paradisiaca* mixed with ram tulsi (*Ocimum gratissimum*) is used as a folk remedy to treat malaria. The unripe fruits of *M. paradisiaca* is traditionally utilized to cure diarrhoea, dysentery, intestinal lesions in ulcerative colitis, diabetes, gout and hypertension. The roots are applied as anthelmintic blood disorders. The plant is also used to treat pain-inflammation and snakebite.

Myrica esculenta Buch.-Ham. (Myricaceae); Kei-fang (M); Box myrtle (E); Nagatenga (A); HKS-M-31. A decoction of the bark and the juice of the unripe fruits are taken orally to relieve fever, headache, asthma, chronic bronchitis, cough, anaemia, diarrhoea, dysentery, nausea, anorexia, carminative, ulcer, oral disorders, indigestion, dyspnoea, piles, constipation, ear, nose and throat infections. The bark juice is applied externally to heal cuts and wounds. Moreover, Ayurveda literature has described bark to be useful to cure fever, bronchitis, asthma, and other respiratory infections, urinary disorders and anaemia (Kabra, Sharma, Singla, Kabra & Baghel, 2019).

Oroxylum indicum L. vent Kurz (Bignoniaceae); Ar-chang-kawm (M); Broken Bones Tree (E); Bhatghila (A); HKS-M-04 and commonly known as Pharraai. A decoction of the root-bark is taken orally in the treatment of fever at a dose of 45ml twice a day. The plant is also utilized in the management of headache, diarrhoea, dysentery, indigestion, constipation, intestinal worm infection, colic, stomach ulcer, asthma, cough, hiccough, piles. Poultice of bark is utilized to cure inflammations, sprains, rheumatism and skin infections.

Oxalis corniculata L. (Oxalidaceae); Saik-thur or Pi-chhu-humal (M); Indian sorrel (E); Tengechi-tenga or Changeri-tenga (A); HKS-M-45. The infusion of the whole plant is taken orally to cure fever, indigestion, jaundice, urinary tract infections and diarrhoea. The paste of fresh leaves is applied over the forehead to cure headache and prevent bleeding from wounds.

Passiflora nepalensis Wall. (Passifloraceae); Nau-awi-mu-hrui (M); HKS-M-110. A decoction of the root is administered orally in the treatment of malaria, dysentery, hypertension, inflammation, anxiety, opiates withdrawal symptom and insomnia. The juice of fresh leaves is given to get relief from constipation as a purgative.

Phyllanthus fraternus Web. (Euphorbiaceae); Mitthi-sun-hlu (M); Phyllanthus (E); Bhui amlokhi (A); HKS-M-36. 30 ml decoction of the whole plant or the infusion of the leaves is administered orally twice daily for two weeks to cure malaria disease. The fresh juice of the whole plant is mixed with a leaves decoction of Neem given to cure intermediate fever. The powder of dried plants is mixed with honey use orally for seven days to cure cough. The juice of the whole plant is utilized as a remedy to cure

against cholera, leprosy and dysentery. The fresh stem and leaves are taken orally in the management of diabetes, sore-throat, jaundice, anaemia. A decoction of the plant is also used to treat amenorrhea, inflammation of joints and pain.

Picrasma javantica Bl. (Simaroubaceae); Thing-dam-dawi or Khaw-sik-dam-dawi-thing (M); Quassia wood (E); Bon-poshla or Nimtitta (A); HKS-M-41. A decoction of bitter bark is taken orally to get relief from malaria and fever. The paste of leaves is applied topically to treat itching and sores.

Piper betle L. (Piperaceae); Panruang (M); Betel vine (E); Paan (A); HKS-M-17. The leaf juice is given orally to treat malaria. It has also anti-inflammatory, anti-tussive, antibacterial, antifungal, insecticidal activities, anti-diabetic, antioxidant and wound healing function.

Piper longum L. (Piperaceae); Voko-hrui (M); Long pepper (E); Pipoli (A); HKS-M-98. A decoction of the fruits with ginger and sugar is taken orally at a dose of 10 to 20 ml (3 to 4 times daily) to get relief from malaria, fever, dengue hemorrhagic fever and viral hepatitis. The juice of fruits is utilized in toothache as a gargle. The decoction of the roots (5 to 20 ml, 2 to 5 times daily) is administered orally to get relief from back pain and paralytic conditions. Infusion of the dried fruit is taken orally at a dose of 5 to 10 ml (3 to 4 times daily) to treat cough, chronic bronchitis, asthma, constipation, gonorrhoea, diarrhoea and cholera. The infusion of *P. longum* fruits mixed with honey is given orally to cure anaemia and worm infections.

Plantago major L. (Plantaginaceae); Kelbe-an (M); Cart track plant or Broad leaf plantain (E); Singa gach (A); HKS-M-64. A decoction of leaves, seed and root is administered orally at a dose of 15-20 ml three times a day in the treatment of malaria, fever, diabetes and tuberculosis. A decoction of the leaves (20 to 30 ml) mixed with sugar is administered orally for 10 to 15 days to get relief from kidney and urinary problems. The fresh leaf juice is applied topically to cure wounds, bleeding and inflammation, bee stings. It is externally instilled to get relief from ear pain. A decoction of leaves is utilized to cure toothache, gum boils and aphthae as gargle. A decoction of leaves is also taken orally to get relief from constipation, coughs and haemorrhoids.

Prunus cerasoides D. Don. (Rosaceae); Tlaizang (M); Wild Himalayan cherry (E); Diengsoh-iog-krems (A); HKS-M-86. A decoction of the bark is administered orally at a dose of 15 to 30 ml (2 to 3 times daily) to cure malaria. It is taken orally to treat kidney stones, asthma, thirst, leucoderma, leprosy and vomiting. A decoction of the bark is applied topically to get relief from joint pains. The paste of the bark is applied topically over the forehead to getting relief from hemicrania continua. The flowers have diuretic and laxative activities. The seeds are utilized as an anthelmintic.

Ricinus communis L. (Euphorbiaceae); Mu-tih (M); Castor oil plant (E); Era-gach (A); HKS-M-101. The oil obtained from the seed is used to get relief from fever and headache. The seeds are taken in the treatment of worm infection and constipation as a cathartic. The powdered seeds and oil are applied externally to treat abscesses and various skin diseases.

Rotheca serrate L. Steane & Mabb. (Verbenaceae); Lei-dam-suak (M); Beetle killer or Blue fountain bush (E); HKS-M-107. A decoction of root, stem and leaves is taken orally to cure many life threatening diseases such as malaria, fever, chronic headache, bronchitis, asthma, cholera, tuberculosis, ulcers, carminative, abdominal pain, rheumatism, liver disease and eye infection. The unripe and ripe fruits are chewed with the leaves of Piper betle to get relief from cough. It is also used as an antidote in snakebite.

Sarcococca coriacea (Hook.) sweet. (Buxaceae); Pawh-rual (M); Sweet box (E); HKS-M-37. A decoction of the leaves is administered orally to treat fever. The plant is also used in the treatment of arthritis and sprain.

Solanum xanthocarpum L. (Solanaceae); Athlo (M); Thorny Nightshade (E); Birkulitita (A); HKS-M-49. A decoction preparation of the root-bark is taken orally in the treatment of fever. It has other medicinal utility in asthma, arthritis and toothache.

Spathodea stipulata Wall. (Bignoniaceae); Zih-haw (M); Fountain tree (E); HKS-M- 66. A decoction of the stem is administered orally at a dose of 20 to 30 ml (2 to 3 times daily) to treat black-water-fever. Decoction flowers, leaves and bark are administered orally in the treatment of malaria, diabetes mellitus, oedema, HIV, dysentery, constipation, gastrointestinal disorders and liver diseases. The cold leaves infusion is taken orally in the treatment of urethral inflammation. The paste of leaves and bark is applied topically to cure ulcers, wounds and skin diseases as an antifungal. It can be effective in the control of *Aedes* mosquitoes.

Spondias pinnata (L. f.) Kert. (Anacardiaceae); Tawitaw (M); Wild Mango (E); Amora (A); HKS-M-41. A decoction of the bark is taken orally to cure fever. The bark paste is applied externally to cure arthritis, rheumatism and ringworm infection. The bark juice is administered orally in diarrhoea and dysentery.

Stereospermum personatum (Hassk.) De. Chatt. (Bignoniaceae); Zihngal (M); Trumpet flower tree (E); Dhapatita (A); HKS-M-47. A decoction of the leaves, bark, roots and flowers are used as folk remedy to treat malaria, fever, piles, gout and rheumatic pain. The flowers of the trumpet flower tree are used in diarrhoea. The fruits of *S. personatum* are used in the treatment of migraine and leprosy.

Viscum articulatum Burm. (Loranthaceae); Lengpat (M); Leafless Mistletoe (E); HKS-M-70. A decoction of the plant is administered orally at a dose of 5 to 10 ml to treat fever. The paste of the plant is applied topically to treat gout. The decoction of the leaves is applied topically to cure sores and wounds.

Vitex peduncularis Wall. (Verbenaceae); Thing-khawi-lu-pa (M); Sila-tita (A); HKS-M-44. A decoction of the young stem bark and leaves of the plant is utilized as traditional remedies to cure malaria, black water fever, typhoid and jaundice. The roots are used to treat menorrhagia.

Wrightia tomentosa Roem & Schultz (Apocynaceae); Hleng (M); Ivory tree (E); Dudhkhoro (A); HKS-M-55. Fresh fruits are crushed, mixed with little amount of water and the strained liquid is drunk (Half glass two times daily) to get relief from fever. The milky juice of raw fruits has

anticoagulant activity. In snakebite, the juice of the Ivory tree bark and the roots are administered as an antidote.

Discussion

Fever is a significant symptom of many disorders as well as infections. It is one of the vital tools for identification of diseases such as malaria, typhoid, tuberculosis etc. The lack of modern medical facilities and transportation, poverty, traditional medicinal plants are useful therapeutic remedies in many rural areas and among the tribal communities. In the present study, 52 plant species belonging to 36 families have been documented for their therapeutic uses to treat fever and malaria. Many of the reported species in this report are cultivated and some are found in the wild in Mizoram. The most commonly reported families were Verbenaceae, Leguminosae, Apocynaceae and Euphorbiaceae. The leaves, barks, bulbs, rhizomes, roots, flowers and even the whole plant are utilized as herbal remedy in the form of crushed juice, infusion, decoction and paste. The survey also pointed out that these preparations were applied more than once daily until alleviation of disease is evident.

Future scope

Although the use of traditional medicine is a phenomenon practised worldwide to treat common diseases, it is often found to be cost effective and reasonable than modern pharmaceutical products. But there are various problems associated to the use of herbal remedies for instance, there are few clinical data on safety and efficacy, as these are practiced among the traditional healers, therefore the preparation processes, standardization methods, and dosage form are unknown in most of these cases. Moreover,

the concentration of active ingredients in a plant species varies considerably, depending on geographical location (Pathak & Das, 2013). None the less, these limitations are all remediable through research. The biggest problem associated with these remedies is continuity as the traditional practices are prevalent mainly in a remote areas where education is scarce, as a result in absence of proper documentation the formulas and the regime of these remedies are forgotten with the death of the healers.

Since, the mode of imparting education for standardization of herbal medicine and practises has not developed at a speed consistent to present time. Therefore, there is a need to create awareness among common people regarding the use of herbs to treat ailments in association to conventional medication (Pal & Shukla, 2003). To change the popular public perception on the use of herbal products, a need is being felt for clinical trials and its development by the researchers, manufacturers and the regulatory agencies to ensure the quality and consistency of the traditional herbal products. Using modern technologies, the quality and consistency of the wide spectrum of herbal products can be monitored (Bent, 2008).

It is the responsibility of the regulatory authorities to ensure the purity, safety, potency and efficacy of herbal drugs. The quality control of crude drugs and herbal formulations is of paramount importance in mainstreaming its acceptability in modern system of medicine. But one of the major problems faced by the herbal drug industry is unavailability of stringent quality control parameters for herbal materials and their formulations (Abdel-Aziz, Aeron & Kahil, 2016).

Conclusion

In the last few years significant changes were observed in folk medicine and the process of its standardization as a result of enormous changes in the regulatory framework as well as improvement in the different sectors like healthcare and science and technology. The need of the hour is to document all the ethnomedical information that is still practised by the diverse ethnic communities of India before these practises are completely lost. Moreover, the government should take steps to secure the TEK of tribal communities by creating awareness among them viz-a-viz protection of their intellectual property rights, especially for those whose socioeconomic life is interlinked with forests from where they derive all their requirements, including the herbs and foodstuffs. The claims emanating from the present survey would provide a vast scope in the future, with regards to the pharmacognostic study of the herbs in order to explore their true potential. The ethnomedicinal plants, particularly threatened ones, should be cultivated in proper facilities and their genetic study should be encouraged for their future development via the tissue culture technology, agroforestry systems and herbal gardens should be encouraged for their sustainable utilization and conservation. There are a number of plants that are still not properly authenticated which are used by the different tribal communities of Mizoram for treating different diseases. The claimed therapeutic values of the reported plant species need detailed scientific studies to establish their safety and effectiveness, as it is very difficult to judge the effectiveness of folk medicine. The secondary metabolites derived from these plants can be isolated to newer compounds having biological activity and in the long run these compounds can be developed into new lead compounds by evaluating their structure activity relationship.

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