

ETHNO MEDICINAL PLANTS IN FRINGE FOREST OF BALPAKRAM NATIONAL PARK, MEGHALAYA

MANISH KUMAR SINGH^{1*}, DINESH KUMAR MEENA², KUMAR AVINASH BHARATI³ & RAJESH KUMAR⁴

^{1,2}Rain Forest Research Institute, Jorhat-785 001, ³Botanical Survey of India, Kolkata, West Bengal 700016, ⁴Department of Botany, Bareilly College, Bareilly-243005, India Email: mksingh@icfre.org

Received - 04.12.2017; Reviewed and accepted - 25.12.2017

ABSTRACT

Objective: The aims of present study were to document wild medicinal plants found in fringe forest of BNP and to explore potential species for phyto-chemical and pharmacological studies. **Methods:** Fieldwork was conducted over a period of two years, utilizing the "transect walk" method of Participatory Rural Appraisal (PRA). The data were analyzed using the following techniques: frequency of citation and informant consensus factor (Fic). **Results:** This research documented 60 species of medicinal plants belonging to 43 families which were used in the treatment of 32 ailments of humans. The ailments are categorized into 14 categories (symptoms/similarities, etc). The Fic values indicate that there was a high degree of consensus among informants on how to treat injuries, respiratory ailments, circulatory system ailments, digestive disorders, colds and fevers. **Conclusion:** Based on the information collected, the highest cited plant is *Aeglemarmelos* with RFC value of 0.83, followed by *Averrhoacarombola* (0.72), *Antidesmabunius* (0.72), *Osbeckiastellata* (0.67), *Curcuma domestica* (0.61), *Acoruscalamus* (0.61), *Terminaliachebula* (0.61), *Cinnamomumtamala* (0.61) and *Ageratum conyzoides* (0.61) and thus these medicinal plants may prove useful for pharmacological studies in new drug development projects.

Keywords: Fringe forest, Balpakram National Park (BNP), wild medicinal plants, ailments, transect walk method.

INTRODUCTION

Traditional medicine has been prevalent in every country since the beginning of the civilization[1]. The majority of the rural population uses traditional medical solutions and approach local healers and medicine men. Some of the reasons that local people prefer to use traditional medicine are the following: the traditional system is time tested, local people have faith in the traditional system and the medicines are easily available, at a low cost [2,3]. Northeast India has preserved the great treasure of ancient medical tradition because of its remote location, poor infrastructure and poverty[3]. The Balpakram National Park (also known as "The Land of Spirits") of Meghalaya, are among those interior sites that have preserved this ancient tradition. The BNP stands 3000 ft above ground in Meghalaya, surrounded by Garo hills as well as clouds of mysterious stories. The native Garo tribes inhabiting this region believe that this land to be highly sacred and of immense religious importance. This belief is due to many strange yet natural formations, physical and biological, found in this area. The Balpakram National Park is the home to a wide variety of flora, fauna and marine fossils. The wildlife include Wild water buffalo, Red panda, Elephant, Tiger, Leopards, Wild cows, Deers, Marbled cat etc. Besides this, the Park is full of medicinal plants and rare and endemic insectivorous plants like the *Nepenthes Khasiana* (Pitcher Plant), *Paphiopedilumvenustum* and *Drosera* (Sundew plant), Agarwood (*AquillariaAgallocha*) and Sanjeevani (samppangi), are the magical medicinal plant also found in the park.

The natives inhabiting forest fringe villages of BNP have been using these plant species to meet their day-to-day needs since time immemorial. Also, the traditions of collecting, processing and applying plants and plant based medications, long and carefully maintained by individuals with a profound knowledge, have been handed down from generation to generation among the indigenous people. This park possesses a great plant wealth that is yet to be fully utilized on a commercial scale. Such utilization could accrue abundant benefit to the farmers of the region. Thus documentation of their traditional knowledge is the best starting point for effective in situ conservation, which requires accurate

and up to date information on the status of medicinal plant populations, the extent and nature of plant use by local communities and the capacity of the resource base to support different economic activities [4]. Also this knowledge can be used in the evaluation and in creation of awareness of the importance of medicinal plant as it is generally easier for the public to relate to the cultural significance than the results of scientific trials. An understanding of the many aspects of human influences on biodiversity and the underlying driving forces of the influences is of crucial importance for setting priorities and directing efforts towards conservation and sustainable use [5,6]. Thus aim of the present studies is to highlight the most frequently used medicinal plants by tribal's inhabiting fringe forest around Balpakram national park of Meghalaya and the diseases against which these plants were used and stressing the need for sustainable management of medicinal plant resources.

Area

The study was conducted within 3 km fringe forest area of Balpakram National Park Balpakram is located between latitudes 25°20' N and 25°30' N, and longitudes 90°45' E to 91° E . Balpakram National Park lies to the extreme South of Garo Hills, Meghalaya at a distance of 62 kms. from Baghmara, and 167 Km from nearest major town Tura. This pocket of pristine beauty named Balpakram National Park is also close to the international boundary of Bangladesh. The total acquired area at present is 352 Sq. Kms of which 220 sqKms area only had been notified and remaining areas are under acquisition process (Fig. 1). Round the year the park experiences three seasons: summer, monsoon, and winter. The winter season, between November and February, is mild and dry, with a mean high of 25 °C (77 °F) and low of 7 °C (44 °F). During this season, beels (small lake) and nallahs (water channels) dry up. The summer season between March and May is hot, with temperatures reaching a high of 37 °C (99 °F). During this season, animals usually are found near water bodies. The rainy monsoon season lasts from June to September, and is responsible for most of Balpakram's annual rainfall of 6000 mm (236 inch).

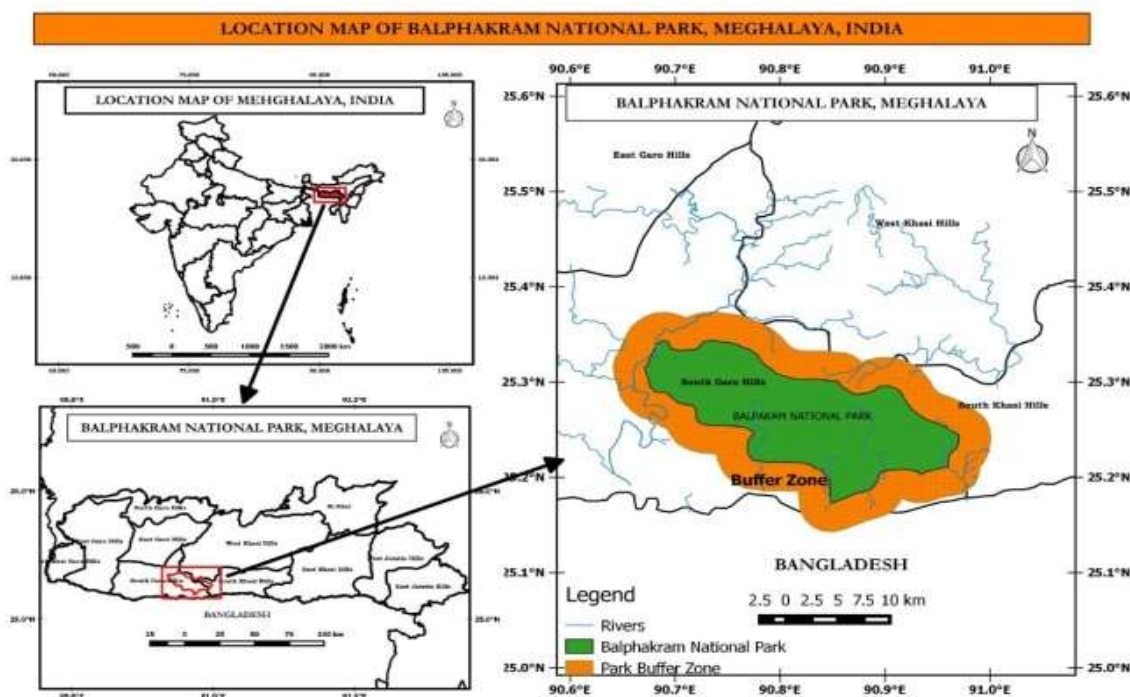


Fig.1: Geographical position of Balphakram National Park and the location of fringe village.

METHODOLOGY

Field survey and data collection

Regular field trips were conducted within 3 km around fringe forest of BNP, during the years 2015- 2017, to investigate the ethnobotany of wild medicinal plants, utilizing by inhabiting Garo tribes. The methodology followed during field work was based mainly on detailed questionnaires. Prior informed consent was obtained from the respondents before interviewing them and a total of sixty people (41 men & 19 women) were interviewed during the field survey. A Transect Walk method of a Participatory Rural Appraisal (PRA) was adopted [7,8]. This method involves semi-structured interviews and discussion with key-research participants such as, community elders, farmers and house-wives. Observance on status was measured at 04 levels (DAFOR scale) i.e. Abundant, common, frequent and rare [9]. The botanical names of the plant specimens were updated according to the Plant List (www.theplantlist.org). The nomenclatures of families are updated according to APG III system of classification[10]. All plants were identified using relevant floras and by matching the specimens in the herbaria of Botanical Survey of India at Shillong. Where necessary, interpreters were employed in order to acquire details of uses and other information on plants and their environment. Tribal markets or weekly hats were also visited to study the plants and plant products sold there.

2.2 Analysis of quantitative data

Quantitative ethnobotanical techniques have great scientific interest as they reflect cultural value systems and may also aid in the conservation of biodiversity. These techniques compare the uses and cultural importance of different plant species [5,7]. The local importance of each species was measured by a use-value (UV) evaluation technique. This technique measures how many medicinal uses for a given species an informant knows relative to the average knowledge among all informants [7, 12, 13, 14]. A high use-value indicates a relatively important species.

UV =

$$\frac{\text{Number of uses mentioned by each informant for a given species}}{\text{Total number of informants}}$$

The relative frequency of citation (Rfc) for each medicine used to treat a particular ailment is the frequency of citation by informants

compared with all other medicines cited in the study [15, 16]. The high consensus for a particular medicine demonstrates use is genuine for that cultural group.

Relative frequency of citation (Rfc)

$$= \frac{\text{Frequency of citation} \times 100}{\text{Frequency of citation of all medicines}}$$

Frequency of citation =

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

The informant agreement ratio (IAR) or informant consensus factor (Fic) technique was used to figure out the consensus between informants for the treatment of a certain use category. The IAR or Fic value illustrates the cultural coherence of the selection of a set of medicinal plants used in the treatment of a certain illness category [6, 17]. A high Fic value indicates the use of relatively few species in the treatment of a certain category of ailment. The Fic values range between 0 and 1.

$$\text{Fic} = \frac{\text{Number of use reports number of taxa}}{\text{Number of use reports} - 1}$$

RESULTS & DISCUSSION

A total of 60 medicinal plant species belonging to 43 families have been identified which were collected from fringe forest habitats around BNP and were used by Garo tribal peoples to cure extensive range of diseases. The information regarding the scientific names, local names, families, habit, parts used and the therapeutic uses of the plants recorded and status of occurrence in fringe forest were given in the Table-1 and the photographs of some of the important wild medicinal plants are given in figure 5-20.

During the study period, a high degree of informant consensus for each species was observed. It was observed that the herbs are the most important medicinal plants which are used largely by the local people, followed by the trees, shrubs, climbers and ferns respectively (Fig.2). Amongst the collected plants, comprise 28 herbs species followed by trees (17sp.), shrubs (12 sp.), climbers (2 sp.) and fern (1 sp.)

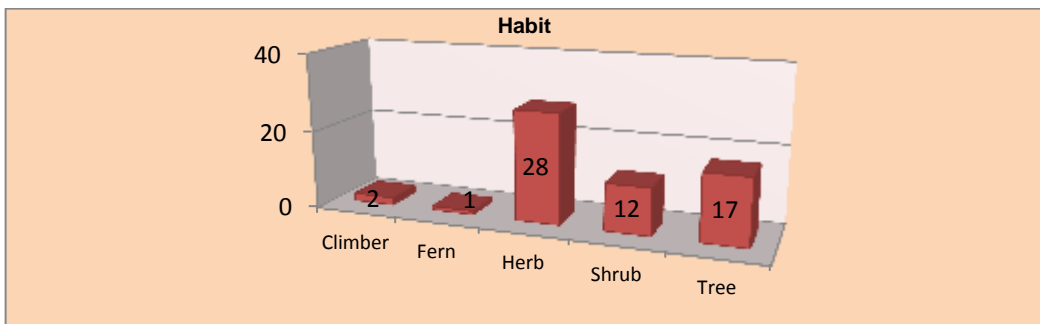


Fig. 2: Diagram showing the uses of different medicinal plants.

Out of 43 families, most predominant are Zingiberaceae (6), Rubiaceae (3), Rutaceae, Euphorbiaceae (3), Lauraceae (3), Rosaceae (3), in terms of number of species used (Fig. 3).

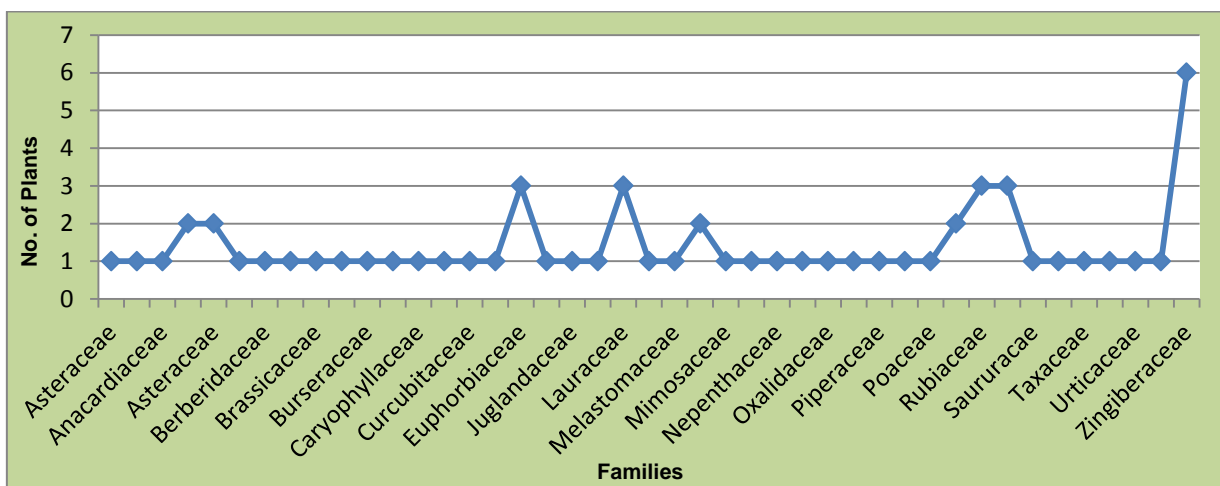


Fig. 3: Number of plants per family used in Fringe Forest of BNP.

Out of various plant parts used as medicine (Fig. 4), usage of leaf has shown highest percentage (29%) followed by root (21%), bark (20%), rhizome (8%), seed (4%), whole plant (4%), fruit (3%), tuber (3%), twig (3%), flower (2%), stem (2%) and pitcher (1%).

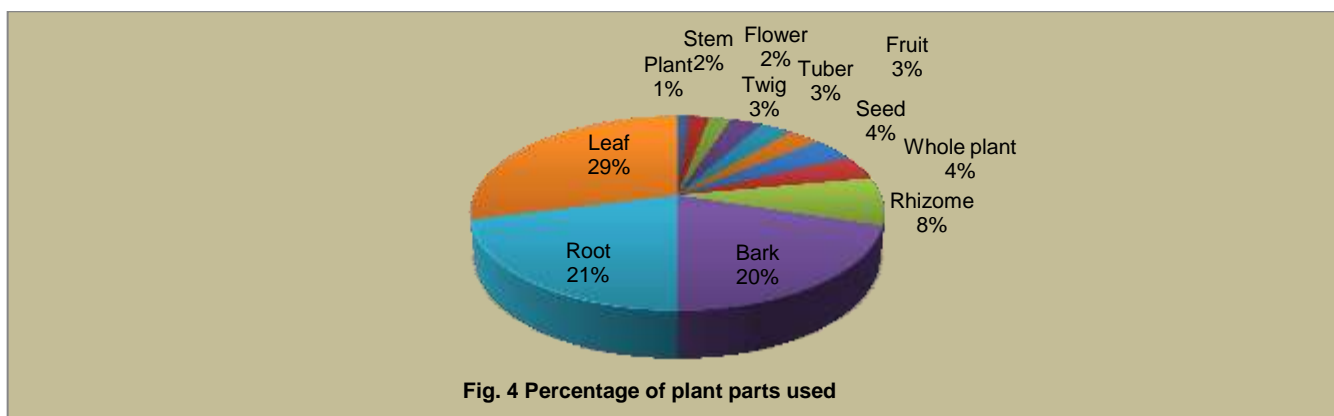


Fig. 4 Percentage of plant parts used

The Preparation of these medicinal plants are either applied Externally (E) or taken Internally (I). Internal application of plants is more frequent (66%) in the present study area than external 10 applications (33%). Out of 32 ailments of human beings i.e. herbal medicines are applied externally in 10 ailments namely body pain,

boil, bone fracture, cut and wounds, headache, joint pain, toothache, snake bite etc. and taken orally in 22 ailments viz. hypertension, jaundice, bleeding, blood purification, cough and cold, diarrhoea, dysentery, fever, indigestion, jaundice, malaria, stomach pain, uterine disorders, stress, piles etc



Fig. 5: Pozolzia hita (Herb)



Fig. 6: Kaempferia rotunda (Herb)



Fig. 7: Eleusine indica (Herb)



Fig. 8: Osbeckia stellata (Herb)



Fig. 9: Azadirachta indica (Tree)



Fig. 10: Gynocardia odorata (Tree)



Fig. 11: Averrhoa carambola (Tree)



Fig. 12: Antidesma bunius (Tree)



Fig. 13: *Melia azedarach* (Tree)



Fig. 14: *Betula alnoides* (Tree)



Fig. 15: *Hedyotis diffusa* (Herb)



Fig. 16: *Nepenthes khasiana* (Herb)



Fig. 17: *Adiantum philippense* (Fern)



Fig. 18: *Dendrobium moschatum* (Orchid)



Fig. 19: *Oxalis corniculata* (Creeper)



Fig. 20: *Drymaria cordata* (Creeper)

Table 1. Enumeration of wild medicinal plants used by Garo tribes of fringe forest of BNP, Meghalaya

ABUNDANT MEDICINAL PLANTS						
S.No.	Species Name and Specimen number	Local Name	Family	Habit	Part used and Mode of Utilization	
1.	<i>Ageratum conyzoides</i> (Linn.) RFRIH -62	Ksangdagem	Asteraceae	Herb	Paste made from leaves and lime is applied on cuts acting as homeostatic.	
2.	<i>Eupatorium adenophorum</i> (L.) RFRIH -19	Bat iong	Asteraceae	Herb	Crushed leaves applied on injuries.	
3.	<i>Averrhoa carambola</i> (L.) RFRIH -07	Sohpyrshong	Averrhoaceae	Tree	Ripe fruit are taken as medicine for jaundice.	
4.	<i>Drymariacordata</i> (L.) Willd.exRoem&Schult) RFRIH -86	Bat-nongrim	Caryophyllaceae	Herb	The whole plants are crushed and the juice is applied for burns, skin diseases and snake bites.	
5.	<i>Gaultheria fragrantissima</i> (Wall) RFRIH -35	'La thynrait	Ericaceae	Shrub	Paste made from leaves is applied to bone fractures and sprains.	
6.	<i>Antidesmabunius</i> (L.) RFRIH -47	Soh-syllai	Euphorbiaceae	Tree	Patients suffering from pains in the joints are bathed with the solution from the boiled leaves	
7.	<i>Allium tuberosum</i> (Roxb) RFRIH -58	Jyllang	Liliaceae	Herb	Extract of whole plant is used against problems, especially for hypertension.	
8.	<i>Osbeckia stellata</i> (Buch.Ham ex D. Don) RFRIH -78	Soh-lyngkthut	Melastomaceae	Herb	Paste of leaves is applied to wounds of various types, against snake bites, and also used to stop nose bleeding.	
9.	<i>Oxalis corniculata</i> (L.) RFRIH -95	Jabuit	Oxalidaceae	Herb	Used as medicine for diarrhoea.	
10.	<i>Houttynia cordata</i> (Thunb) RFRIH -21	Jamyrdoh	Saururaceae	Herb	Leaves are eaten raw for blood purification and also applied to treat sores and boils.	
11.	<i>Amomum aromaticum</i> (Roxb) RFRIH -11	lashi saw	Zingiberaceae	Herb	During nausea and vomiting, the rhizome is smashed and made into paste in hot water and taken directly.	
12.	<i>Curcuma domestica</i> (Velaton) RFRIH -40	Shynrai stem	Zingiberaceae	Herb	Rhizome paste with leaves of <i>Lindera latifolia</i> and fruits of <i>Piper longum</i> applied for various skin disease; paste of rhizome of this plant, ginger and mustard oil applied and tied around fractures to set the bone.	
13.	<i>Zingiber zerumbet</i> (Sm.) RFRIH -59	Ing-Blei	Zingiberaceae	Herb	Fresh rhizome is consumed to relieve stress	
COMMON MEDICINAL PLANTS						
14.	<i>Rhussemialata</i> (Murr) RFRIH -23	Sohma	Anacardiaceae	Tree	The fruits are soaked in water which is drunk for stomachache. Buds are boiled and taken for diarrhoea.	
15.	<i>Acorus calamus</i> (L.) (Araceae) RFRIH -61	U-bet	Araceae	Herb	Leaves boiled in water for 2-3 hours and the vapour inhaled for influenza and headache.	
16.	<i>Hypocharis radicata</i> (L.) RFRIH -96	bat jhurkthang	Asteraceae	Herb	Tender leaves are eaten raw or boiled to control stomach upset.	
17.	<i>Betula alnoides</i> (Buch Ham) RFRIH -76	Dienglieng	Betulaceae	Deciduous Tree	Root extract is given for indigestion and flatulence.	
18.	<i>Rorippa nasturtium-aguaticum</i> (L.) Hayak RFRIH -14	Tyrso-um	Brassicaceae	Herb	Whole plant taken boiled or raw as a tonic usually during pneumonia or other pulmonary ailments.	
19.	<i>Bauhinia variegata</i> (L.) RFRIH -06	Diengtharlong	Caesalpiniaceae	Moderate size tree	Flowers are boiled and eaten for piles for dysentery	
20.	<i>Terminalia chebula</i> (Retz.) RFRIH -34	Sohsalukah	Combretaceae	Small Tree	Fruits are roasted and eaten as a diuretic. Root paste is used for conjunctivitis.	
21.	<i>Engelhardtia spicata</i> (Bl) RFRIH -30	Dienglyba	Juglandaceae	Tree	A fine paste made from inflorescence and young leaves is applied on scabies and other skin diseases.	

22.	<i>Elsholtzia blanda</i> (Benth) RFRIH -35	Bat-skain	Lamiaceae	Shrub	The juice of the leaves is applied for mosquito bites and as mosquito repellent.
23.	<i>Cinnamomum pauciflorum</i> (Nees) RFRIH -57	Diengtarthia	Lauraceae	Tree	Extract of bark and young shoots, mixed with coconut oil, is used as an antiseptic
24.	<i>Cinnamomum tamala</i> (Nees&Eberm.) RFRIH -72	La tyrppad	Lauraceae	Tree	Leaves are fried in mustard oil and placed on tooth to remove toothache.
25.	<i>Litsea khasiana</i> (Meissn) RFRIH -97	Diengmosu	Lauraceae	Shrub	Powdered roots along with Piper nigrum and sugar candy is given for chronic bronchitis.
26.	<i>Albizzia chinensis</i> (Osb) RFRIH -02	Diengphallut	Mimosaceae	Tree	Bark decoction is applied on ringworm and also as antidote to insect bites.
27.	<i>Psidium guajava</i> (L.) RFRIH -27	Sohprium	Myrtaceae	Small Tree	The leaves are crushed and the extract is drunk in case of chronic dysentery.
28.	<i>Plantago erosa</i> (Wall.) RFRIH -49	Shkorblang	Plantaginaceae	Herb	Paste of leaves used for bandaging of wounds; leaves are warmed on the fire and wilted leaf is kept pressed on boils for quick burst and removal of puss.
29.	<i>Eleusine indica</i> (L.) RFRIH -63	Lang krai	Poaceae	Herb	Root juice is used for jaundice.
30.	<i>Potentilla fulgens</i> (Hk.) RFRIH -41	Lynniang	Rosaceae	Herb	The rootstocks are believed to strengthen the gums and teeth and also reported to be used in diarrhoea. Slices of the rootstock are chewed with betelnut, lime and betel leaf locally. It has been reported to be antidiabetic
31.	<i>Hedyotis scandens</i> (Roxb) RFRIH -83	Mo-shohshu	Rubiaceae	Herb	Ground leaves taken for gastric troubles; decoction of the dried leaves is taken for cough and cold.
32.	<i>Hedyotis diffusa</i> Willd. RFRIH -98	Mangaluk	Rubiaceae	Herb	Leaves are eaten with fish after childbirth
33.	<i>Rubia cordifolia</i> (L.) RFRIH -22	Rhoi	Rubiaceae	Shrub	Paste of leaves is applied for ulcer and the crushed roots for poisonous stings of insects and caterpillars.
34.	<i>Citrus latipes</i> (Swingle) RFRIH -38	Sohkymphor	Rutaceae	Slow-growing shrub	Fruit juice is taken as an appetizer; paste of leaves is applied on joints suffering from gouty and rheumatism. Juice of fruit are rubbed on rashes and ringworm
35.	<i>Smilax glabra</i> (Roxb.) RFRIH -16	Khong	Smilacaceae	Deciduous Climber	The juice of leaves is applied for skin diseases. Sometimes the leaves are dried and the resultant powder, mixed with oil, is applied for skin diseases.
36.	<i>Schima wallichii</i> (Choisy) RFRIH -77	Diengngan	Theaceae	Evergreen tree	Young leaves are boiled; the solution is taken to cure flatulence.
37.	<i>Pouzolzia hirta</i> (Bl.) RFRIH -64	Memsleh	Urticaceae	Herb	The roots are used for hair tonic. The roots are crushed or boiled in water which is then used in the bath to promote good hair growth.
38.	<i>Clerodendrum colebrookianum</i> (Walp.) RFRIH -05	Sla jarem	Verbenaceae	Shrub	Leaves are boiled and the water is taken to reduce high blood pressure.
39.	<i>Kaempferia rotunda</i> (L.) RFRIH -92	IngsMoh	Zingiberaceae	Herb	Medicine for stress-related stomach trouble and as general tonic.

FREQUENTLY REPORTED MEDICINAL PLANTS

40.	<i>Colocasia esculenta</i> (Schott) RFRIH -55	La wang	Araceae	Herb	Tender leaves are bound on forehead to cure high temperature due to fever. Partially cooked corms are
-----	---	---------	---------	------	---

41.	<i>Mahonia pycnophylla</i> (Fedde) RFRIH -48	Ningmat	Berberidaceae	Shrub	used to cure bone disease. The juice of the bark and leaves diluted with distilled water and used for eye problems.
42.	<i>Buddleja macrostachya</i> (Benth) RFRIH -71	Jalongkrem	Buddlejaceae	Large deciduous shrub	Leaves are used for venereal disease.
43.	<i>Garuga pinnata</i> (Roxb) RFRIH -08	Diengkhiang	Burseraceae	Deciduous tree	Fruit juice is given for indigestion, stem juice is applied for conjunctivitis and leaf juice with honey is given for asthma
44.	<i>Hodgsonia heteroclite</i> (Roxb.) RFRIH -65	Sohrisa	Curcubitaceae	Climber	Paste from roots with ginger and lime cures fever.
45.	<i>Mallotus philippensis</i> (Lamk) Muell RFRIH -42	Diengchandan	Euphorbiaceae	Herb	Powdered fruits with little sugar are given for tapeworm.
46.	<i>Croton tiglium</i> Linn. RFRIH -54	Runi bih	Euphorbiaceae	Shrub	Fruits are used as antidote
47.	<i>Gynocardia odorata</i> (R.Br) RFRIH -12	Sohliang	Flacourtiaceae	Evergreen tree	Seeds for leprosy, nausea and rheumatism.
48.	<i>Azadirachta indica</i> (A. Juss.) RFRIH -94	Diengnim	Meliaceae	Tree	Extracts of boiled leaves are used for diarrhoea and dysentery.
49.	<i>Melia azedarach</i> (L.) RFRIH -39	Diengjarasang	Meliaceae	Tree	Barks is used as an anthelmintic, leaves and fruits are used as febrifuge to cure malarial fever, flowers are crushed and applied as poultice on skin eruption.
50.	<i>Dendrobium moschatum</i> RFRIH -26	Tiewdieng	Orchidaceae	Herb (Orchid)	Juice of leaves is used as ear-drops for ear pain.
51.	<i>Erythrina arborescens</i> (Roxb) RFRIH -91	Dieng-song	Papilionaceae	Deciduous tree	The leaves are made into paste with ginger and applied for skin diseases of pig.
52.	<i>Piper griffithii</i> (DC) RFRIH -53	Mritkhlaw	Piperaceae	Herb	Dried seeds are powdered and mixed with honey and the yolk of egg and this is taken for severe cough.
53.	<i>Rubus ellipticus</i> (Sm) RFRIH -82	Soh-shiah	Rosaceae	Shrub	The fruits and crushed roots are used to cure dysentery.
54.	<i>Zanthoxylum acanthopodium</i> (DC) RFRIH -13	Ja-iur	Rutaceae	Shrub	Medicinal spice for stomach disorders, fish poison insecticide and vermicide.
55.	<i>Zanthoxylum limonella</i> (Dennst.) Alst. RFRIH -88	Hajor	Rutaceae	Aromatic deciduous Shrub	Leaves as vegetable and the spine is of medicinal importance
56.	<i>Curcuma angustifolia</i> (Roxb) RFRIH -43	'niang-sohpet	Zingiberaceae	Rhizomatous herb	Paste of rhizome and leaves is boiled in water and given to children for gripe.
57.	<i>Costus speciosus</i> (J. Konig ex Retz Smith) RFRIH -43	Sla pangmat	Zingiberaceae	Herb	Rhizome cut and ground into pieces and the powder is eaten against bronchitis, inflammation, anemia and rheumatism
RARE MEDICINAL PLANTS					
58.	<i>Adiantum phillipense</i> (Linn.) RFRIH -43	Tyrkhangkhyllai	Adiantaceae	Fern	Paste of leaves is applied to fractured bones.
59.	<i>Nepenthes khasiana</i> (Hk.f.) RFRIH -73	Ksetphare	Nepenthaceae	Herb	The juice of young flowers or unopened pitchers mixed with rice beer (kyiad) and taken to cure stomach-ache, eye sores or urinary troubles.
60.	<i>Taxus baccata</i> (L.) RFRIH -66	DiengsehBlei	Taxaceae	Shrub	Leaves along with ginger are made into paste and applied on tumors.

Table 2: Informants consensus factor (FIC) for various disease categories.

Disease category	Number of Use Reports (Nur)	Number of Taxa (Nt)	Informants consensus index factor (FiC)
Digestive system disorders	164	43	0.74
Endocrine system disorder	27	7	0.77
Genitourinary system disorders	45	11	0.77
Ill-Defined symptoms	2	1	1
Infections/infestations	124	30	0.76
Inflammation	5	2	0.75
Injuries	63	17	0.74
Mental disorders	13	4	0.75
Muscular-skeletal system disorders	55	14	0.76
Nervous system disorders	30	8	0.76
Nutritional disorders	24	6	0.78
Pain	56	14	0.76
Pregnancy/birth/puerperium disorders	5	2	0.75
Respiratory system disorders	52	13	0.76
Skin/subcutaneous cellular tissue disorders	37	10	0.75

As per the diseases recorded in the study area, these have been categorized under 15 disease categories (Table 2). The highest FIC value has been shown by Ill-Defined symptoms (1) followed by nutritional disorders (0.78). Based on the information provided by the interviewee, the highest cited plant is *Aegle marmelos* with RFC value of 0.83. Other plants with prominent RFC value are *Averrhoa carombola* (0.72), *Antidesma bunius* (0.72), *Osbeckia stellata* (0.67), *Curcuma domestica* (0.61), *Acorus calamus* (0.61), *Terminaliachebula* (0.61), *Cinnamomum tamala* (0.61) and *Ageratum conyzoides* (0.61).

CONCLUSION

It has been cleared that the tribal of fringe forest of Balpakram national park make wide use of a large variety of medicinal plants available to them. Also the demand for these medicinal plants in the local market has increased many folds and thus causing a threat to these wild species. In order to protect the diversity of medicinal plants of the state, the following are being suggested: This data on medicinal plants will serve as a useful tool to prepare development and action plan for herbal drug industry for improving and uplifting the life and economy of the state. What is urgently required is the integration of all aspects of medicinal plants diversity in our planning for development of local community with linkages to conservation and protection of all kinds of plants traditionally used by indigenous people. An effective way of giving protection to biodiversity and ethno-medicinal plants is to provide a legal cover to the habitat or the species to enable enforcement agencies to have authority to control/regulate their enactment. In situ and ex situ conservation of endangered or likely to be endangered (rare) species should immediately be started. Use of spontaneous and wild collected plants must be limited as far as possible and replaced step by step by cultivation. Rural people should be encouraged to raise their own ethno medicinal gardens or herb gardens in their vicinity to ensure conservation of the depleting biodiversity in medicinal plants. Research priority should be given to develop appropriate technology for propagation, cultivation, processing, chemical characterisation and marketing of medicinal plants, useful and endangered species. Local people should be trained how to propagate, preserve and collect the medicinal plants as a part of extension. They should be educated and provided with the proper guide lines, so that there is a continuous regeneration of wild flora. It is again important that we should not disturb the local forest flora, which is generally susceptible to environmental changes which may lead to extinction of natural species. With the erosion of the tribal cultures, the traditional healers have become a threatened category. Also the genetic diversity in medicinal plants has diminished due to shifting cultivation and large scale destruction of their natural location. The overexploitation of medicinal resources in unscientific manner by unskilled labour and poor natural or artificial regeneration has resulted in virtual extinction of certain vital species.

ACKNOWLEDGEMENT

The authors acknowledge local informants residing in fringe forest of Balpakram National Park of Meghalaya for sharing traditional knowledge and their active participation during the field study. The authors are also grateful to the Botanical Survey of India, Shillong for their valuable help in the plant identification process. We also express our gratitude to Dr. H.B. Singh, Retd. Chief Scientist, CSIR-NISCAIR, New Delhi who provides valuable inputs related to scientific terminologies for the various wild medicinal plants. The first author is also thankful to GIS Lab, RFRI, for providing the detailed map of the Balpakram national park of Meghalaya. He also expresses his gratitude to Dr. RSC Jayraj, Director, RFRI, Jorhat for his valuable suggestions and help rendered during the writing of this paper.

REFERENCES

- Dubos R. Man, Medicine and Environment. New York: Mentor. 1969.
- Bharati KA, Sharma BL. Some ethnoveterinary plant records for Sikkim Himalaya. Indian Journal of Traditional Knowledge, 2010; 9: 344-346.
- Dwivedi SK. Overview of ethno-veterinary practices in India. In: ICAR Summer Short Course on Techniques for Scientific Validation and Evaluation of Ethno-Veterinary Practices, Aug. 3-12, 1998, Division of Medicine, IVRI, Izatnagar, India 1998; pp. 1-5.
- Kayang H, Kharbuli B, Myrboh B and Syiem D. Medicinal plants of khasi hills of meghalaya, india, 10.17660/ActaHortic. 2005; 675:75-80.
- Anas A. Biodiversity, Conservation of Some Medicinal Plants of Katsina State Nigeria, International Journal of Health and Medicine. 2016; 1(1): 30-32.
- BygA&Balslev H. Diversity and use of plants in Zahamena eastern Madagascar BiodiversConserv. 2001; 10: 951-970.
- Henrich M, Edwards S, Moerman DE & Leonti M. Ethnopharmacological field studies: A critical assessment of their conceptual basis and methods. J Ethnopharmacol. 2009;124: 1-7.
- Albuquerque UP, Lucena RFP, Monteiro JM, Florentio ATN & Almeida CFCBR. Evaluating two quantitative ethnobotanical techniques. Ethnobotany Research and Applications. 2006; 4: 051-060.
- Cunningham AB. Applied Ethnobotany People wild plant use and conservation, Earth scan publishing limited, London. 2001.
- Sutherland WJ. Ecological Census Techniques: A handbook, 2nd edn. (Cambridge University Press). 2006.
- Haston E. The Linear Angiosperm Phylogeny Group (LAPG) III: a linear sequence of the families in APG III. Bot J Linnean Soc. 2009; 161(2):128-131.

12. Gomez-Beloz A. Plant knowledge of the WinikinaWarao: the case for questionnaires in ethnobotany. *Economic Botany*. 2002; 56: 231-241.
13. Phillip O and Gentry AH. The useful plants of Tambopata, Peru: I. Statistical hypothesis tests with a new quantitative technique. *Economic Botany*. 1993a; 47: 15-32.
14. Phillip O and Gentry AH. The useful plants of Tambopata, Peru: II- Additional hypothesis testing in quantitative ethnobotany. 1993b; *Economic Botany*, 47: 33-43.
15. Kumar A, Pandey VC &Tiwari DD. Documentation and determination of consensus about phytotherapeutic veterinary practices among the Tharu tribal community of Uttar Pradesh, India. *Trop Anim Health Prod*. 2012; 44: 863-872.
16. Kumar A, Tewari DD &Tewari JP. Ethnomedicinal knowledge among Tharu tribe of Devipatan division. *Indian J TraditKnowle*. 2006; 5: 310-313.
17. Kumar R, Singh M and Bharati AK Ethnobotany of Tharus of Dudhwa National Park, India. *Mintage J. of Pharmaceutical and Medical sciences*. 2013; 2(1): 6-11.

© 2018 by the authors; licensee MJPMs, India. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<http://creativecommons.org/licenses/by/4.0/>)