

Full Length Research Paper

# Traditional medicinal knowledge of underutilized minor fruits as medicine in Manipur

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A number of underutilized minor edible fruits have been identified during the methodical field survey conducted during the year 2012-2013 in the Imphal valley (excluding Jiribam sub-division, Imphal East) of Manipur. Information on medicinal claims was collected from elderly people of 30-75 years age group of both genders after interviewed (using standard questionnaires) on the different types of underutilized minor fruit plants they have been used for generations and their medicinal uses. Study revealed the therapeutic application of 39 plant representing 29 genera and 23 families used as medicine by the *Meitei* community. Tree species contributed in maximum having 76 % while shrubs 10% and herbs recorded 7 % of the total underutilized fruits as medicine. These plants are used for a wide range of common ailments like diuretic, laxative, jaundice, diabetes, diarrhea, dysentery etc. Fruits and leaves are the major plant parts used for the preparation of medicine having 52 % and 22%. The study describes details of their scientific name, common name, local name, family, part used, medicinal benefit and period of availability in the local market. They have great potential and further investigations are needed for its medicinal compound identification from such underutilized minor fruit crops.

**Key words:** Manipur, *meitei*, underutilized fruit, medicinal value.

## INTRODUCTION

Geographically, the state of Manipur is located at 23.80°-25.68°N latitude and 93.03°-94.78°E longitude covering total geographical area of 22,327 km<sup>2</sup> and situated in the far-flung North-Eastern Hilly Region of India. The state is surrounded by Nagaland on the North, Assam on the West, Mizoram on the South and Myanmar on the East. The state has a central valley (Imphal Valley) inhabited by the *Meitei* and *Meitei pangal* whereas the hilly areas are inhabited by 30 different tribes of *Naga and kuki tribes* (Yumnam and Tripathi, 2012). The North – Eastern region of India including Manipur is part of both Himalaya as well as Indo-Burma biodiversity hotspots in the world supporting about 50% of the total India's biodiversity but represent only 8% of the total geographical area of India (Moa *et al.*, 2009). Further, India is extremely rich in medicinal plants comprising about 8000 species and around 70% of medicinal plants are found in the tropical

areas mostly in the various forest types spread across the western and Eastern Ghats, the Vindhya, Chhota Nagpur plateau, Aravalis, the Tarai region in the foothills of Himalayas and the North-Eastern region (Khonbongmayum *et al.*, 2005). In Manipur, the *Meitei* community inhabiting in the valley regions have the traditional knowledge of eating minor and underutilized fruit crops as medicine from time immemorial to treat different ailments and are associated with various folklore and rituals, which are performed by traditional herbal healers of medicinal men and women locally known as "*Maibas*" and "*Maibis*" (Singh, *et al.*, 2003). History reveals that in the beginning of the 14<sup>th</sup> century there has been a good description of medicinal plants and herbal treatment for many diseases (Khonbongmayum, *et al.*, 2005). A number of works on ethnobotany of Manipur have been done since 1980s and some comprehensive accounts of its folklore are available (Singh and Singh, 2000 and Moa *et al.*, 2009). In Manipur, out of the total fruit crops area of 68, 000 ha (Anon, 2011), fruit crops like citrus (Khasi mandarin locally called *Komla*), pineapple

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(Queen type locally called *kihoh*) and banana (Variety Meiteihei locally called *Laphoi*) occupied a large scale and other fruit crops like *Artocarpus heterophyllus* Lam., *Passiflora edulis* Sims., *Passiflora edulis* var. *flavicarpa*, *Psidium guajava*, *Carica papaya*, *Punica granatum*, *Mangifera indica* L., *Annona reticulata*, *Averrhoa carambola*, *Phyllanthus acidulous*, *Citrus aurantifolia*, *Citrus granata*, *Citrus lemon* Burn., *Citrus macroptera* and *Elaegnus umbellate* Tumb. Occupied small scales which are grown homestead garden as minor fruit crops. But other fruit crops like *Aegle marmelos*, *Aphanamixis polystachya* (wall) Parkerm., *Artocarpus lakoocha* Roxb., *Baccaurea ramiflora* Lour., *Calamus tenuis*, *Celtis timorensis*, *Dillinia indica* Linn., *Duchesnea indica* Focke., *Dillenia*, *Flacourta jangomas*, *Schleichera olease*, *Emblica officinalis*, *Ficus glometra* Roxb., *Ficus hispida* Linn. f, *Flacourtia jangomas*, *Garcinia pedunculata* Roxb., *Glycosmis arborea*, *Litsea cubeba*, *Litsea glutinosa* Robins., *Litsea monopetala* (Roxb) Pearson, *Malus bacata* Borkh., *Meyna laxiflora* Robym., *Musa paradisiaca* Linn., *Olea ferruginea*, *Rhus chinensis*, *Terminalia chebulata*, *Ficus palmate* Linn., *Juglan regia*, *Baccaurea ramiflora*, *Gracinia pedunculata*, *Euphorbia longan*, *Sterculia villosa* Roxb., *Spondias pinnata*, *Dillinia indica*, *Rubus elliptiens* Sm., *Rubus moluccanus* Linn., *Phyllanthus fraternus* Web., *Syzygium cumini*, *Terminalia chebula* Retz. and *Ficus auriculata* are found in the wild form in the forest area or in the uncultivated areas without any maintenance as underutilized minor fruit crops. However, this underutilized minor fruit crops are used as medicine from time immemorial either in raw or in the form of beverages, pickled or cooked/ boiled as indigenous dish called *Eromba* as medicine (Yumnam and Tripathi, 2012). Raw plants part (young leaves and shoot) of *Rhus semialata* Murr., *Passiflora edulis* Sims. and *Passiflora edulis* var. *flavicarpa* are used either chopped or as a whole with their indigenous preparation *Ametpa* (indigenous sauce) or *Eromba* (indigenous dish) as medicine and leaves of *Punica granatum* L., *Olea ferruginea* and *Psidium guajava* are also eaten fresh with salt as medicinal purpose. *Ametpa* is prepared by smashing roasted/burnt/steamed green or red dried chillies with roasted/burnt/steamed fermented fish (*ngari*) and salt (Yumnam and Tripathi, 2012). *Eromba* for medical purpose is prepared by smashing roasted/burnt/steamed chillies with roasted/burnt/steamed fermented fish, salt boil with pseudotem or spathe of *Musa paradisiaca* Linn. and *Musa* sp. and leaves of *Passiflora edulis* Sim. and *Passiflora edulis* var. *flavicarpa* as medicinal dish. Besides, leaves and fruit peel of lime and lemon, aonla and Indian hog plum leaves are used as ingredient for the herbal hair lotion locally called "*Chinghi*". Most of the underutilized fruits are used in day to day diets of by the *Meitei* community and are also sold in the local market of the Imphal valley during their harvesting period (Table 1). They are also used as life sustaining diversified food

bases and for nutrient security of rural people throughout the year. Singh *et al.*, (1994) also reported that ethno botanical use of plants, derived from biodiversity of the world has been known since time immemorial and several plants were used to cure diseases and to maintain good health. Though, small in geographical area, the state experiences different agro-climatic zones viz., sub-temperate hill zone, mild tropical hill zone, mild tropical plain zone, sub-tropical hill zone and sub-tropical plain zone. Over the last 5-10 years, a change in attitude is noticed among the policy makers and general public with regard to quality and/or standard of life which ultimately demands quality as well as diverse source of food. The protective foods which mainly comprising of vitamins and minerals are being searched in these novel crops of underutilized fruit crops (refer to also minor, neglected, under exploited, under developed, new promising, novel, traditional, niche, etc) are now viewed with greater emphasis than in the past in recognition of their role in fulfilling the nutritional security apart from food security. The 21<sup>st</sup> century has witnessed increase in awareness to rescue and improve the use of those crops left aside by research, technology, marketing system as well as conservation efforts. These underutilized crops have been included in world-wide plan of action after having successfully raised the interest of decision makers. Leading international research organization such as the Consultative Group on International Agricultural Research (CGIAR), are among those taking a keen interest in strengthening the work on these species. The Global Forum on Agriculture Research (GFAR) in 1999 also emphasized the role of underutilized species in raising income of the rural poor. These novel crops also will help these rural sectors in mitigating the malnutrition and hence enabling them a quality life (Swaminathan, 1999). The tradition of eating underutilized fruits are handed down from generation to generation and believed that they get direct medicinal benefit by this mode of eating. The people living in rural and hilly area have the advantage of long life span and healthy as compared to those living in big cities and towns, which may be attributed to the local vegetables and fruits having medicinal properties and consumed by the people here. However, in North-east India, limited efforts has been made to explore the potential of medicinal plants found in these region (Katoky *et al.*, 2007) and no work has been reported on the ethno botanical uses of minor and underutilized fruits found in Manipur as medicine by the *Meitei* community. Considering the above gap in our knowledge, the present study was carried out which provides first hand information about consumption of underutilized minor fruit either as raw, fermented or cook as medicine by *Meitei* and the nutritional values they believed to get from this mode of eating. Therefore, it is now apparent that policy be framed and executed to explore the hidden potential of these novel fruit species to strengthen the security in terms of food and nutrition.

**Table 1.** List of underutilized fruit crops as medicine by *the Meitei* community of Manipur.

Sl. No.	Plant name	Common name	Local Name	Family	Part Use	Habit	Ethno medicinal uses	Fruiting season
1	<i>Aegle marmelos</i>	Beal	Heiri- khagok	Rutaceae	Fruit	T	Mature fruit as against diarrhea and dysentery and ripe fruit as tonic, laxative and good for heart	Jan-Feb
2	<i>Annona reticulata</i>	Bullock's heart	Ramphal	Annonaceae	Fruit, leaves	T	Seed powdered paste are applied to the head to kill lice and leaves boil juice to reduce high blood pressure	April-May
3	<i>Aphanamixis polystachya</i> (wall)Parker	Pithraj tree	Hei-ranggoi	Meliaceae	Fruit	T	Liver constipation and leucorrhoea	Mar-May
4	<i>Artocarpus lakoocha</i> Roxb.	Monkey jack	Heiri kothong	Moraceae	Fruit	T	Ripe fruit pulp is taken in constipation and in fever and also as anthelmintic	July-Sept
5	<i>Artocarpus heterophyllus</i> Lam.	Jackfruit	Theibong	Moraceae	Root, seed, ripe fruit	T	Treatment of diarrhea from root and seed extract. Ripe fruit as laxative and gum exude from unripe fruit is burnt and the ash powder is applied in skin disease.	May-June
6	<i>Averrhoa carambola</i>	Carambola	Heinoujom	Oxalidaceae	Fruit, root	T	Ripe fruit pulp along with little common salt is eaten against jaundice, bleeding piles and for washing utensil. Besides, the crushed leaves for curing chicken pox, ring worm and scabies and its root extract is used as an antidote for poisoning.	Sept-Oct
7	<i>Baccaurea ramiflora</i> Lour.	Burmese grape	Moktok hei	Euphorbiaceae	Fruit, bark	T	Fruit as a digestive and bark for skin disease	Aug-Sept
8	<i>Calamus tenuis</i>	Rattans (Canes)	Heiri	Arecaceae	Fruit	CP	Highly acidic fruit which use as digestive after mea; stem are used for handicraft and furniture work	Mar – April
9	<i>Celtis timorensis</i>	Stinkwood	Hei- krengh	Cannabinaceae	Leaf	T	Dysentery and jaundice	Mar-April
10	<i>Citrus granata</i>	Pommelo	Nobab	Rutaceae	Fruit juice	T	Fruit juice as febrifuge, seed against dyspepsia and its dry pill to repel the mosquito	Oct – Dec
11	<i>Citrus macroptera</i>	Hatkora	Heiribob	Rutaceae	Fruit, peel	T	Fruit juice is used for stomach ailment, fruit pill as spice and in dyspepsia	Nov-Dec
12	<i>Dillinia indica</i> Linn.	Chulta/ Elephant apple	Heigri	Dilliniaceae	Fruit	T	As a digestive and pickle preparation	Oct-Dec
13	<i>Duchesnea indica</i> Focke	Mock strawberry	Heirong-kak	Rosaceae	Whole plant	H	Against stone formation in urinary tracts and kidney	Mar-April
14	<i>Elaeagnus umbellata</i> Tunb.	Japanese silvery	Heiyai	Eleaegnaceae	Fruit, seed	S	Fruit as a digestive and seed for curing cough	Mar-April

Table 1. Cont.

15	<i>Euphoria longan</i> Steud.	Longan	Nongang hei	Sapindaceae	Fruit	T	Relaxation and stomachic from fresh fruit	Aug-Sept
16	<i>Ficus auriculata</i>	Elephant ear Fig	Heirit	Moraceae	Fruit and Bark	T	Used against dysentery, diabetes and lungs disease	June-July
17	<i>Ficus palmate</i> Linn.	Bedu	Heibala	Moraceae	Fruit	T	Prevent oxidative stress	June-July
18	<i>Ficus glometra</i> Roxb.	Cluster fig tree/Gooler	Heibong	Moraceae	Fruit, root	T	Fruit are used against dysentery, diabetes and lung disease and bark are used on skin having boil or insect bite	May-June
19	<i>Ficus hispida</i> Linn. F	Gobla	Asiheibong	Moraceae	Fruit, bark, leaves	T	Dysentery, ringworm and intestinal worm infection. Leaves are used in preparation of fermented soyabean locally called "hawaizar"	May-June
20	<i>Flacourtia jangomas</i>	Indian plum / Coffee plum	Heitroi	Flacourtiaceae	Fruit	T	Used for bleeding gum and toothache and diabetes	Dec-Jan
21	<i>Gardinia companulata</i> Roxb.	Boilem	Lam-Heibi	Rubiaceae	Young leaves, fruit	T	Leave paste are applied on the skin of boil for removing pus and diabetes	Nov-Dec
22	<i>Garcinia pedunculata</i> Roxb.	Sani	Heibung	Guttiferae	Fruit	T	Fruit as a digestive and stomach disorder	Mar-April
23	<i>Glycosmis arborea</i>	Chauldhua	Yong komla	Rutaceae	Fruit, leaves	S	Fever liver complaints, jaundice and hair lotion	Sept-Oct
24	<i>Juglans regia</i> L.	Walnut	Heijuga	Juglandaceae	Fruit, leaves	T	Fruit use for curing heart diseases and leaves are use as traditional medicine to reduce swell on joint, fever and antidairrhoeal	Aug-Sept
25	<i>Litsea glutinosa</i> Robins.	Medasaka	Thang-hidak	Lauraceae	Leaves and bark	T	Cut and injuries for early blood clotting and muscular sprain	July-Aug
26	<i>Litsea monopetala</i> (Roxb) Pearson	Meda	Tumid-la	Lauraceae	Leaves, bark, seed	T	Diarrhea and rheumatism of body pain	July-Aug
27	<i>Malus bacata</i> Borkh.	Crab apple	Heitup	Rosaceae	Fruit	T	As a digestive but not recommended to eat during cold fever	Oct-Nov
28	<i>Meyna laxiflora</i> Robym.	Moyna	Heibi	Rubiaceae	Young leaves, fruit	T	Intestinal worm and hoarseness	Nov-Dec
29	<i>Musa paradisiaca</i> Linn.	Hill banana	Ching laphu	Musaceae	Pseudostem, male flower	H	Pseudostem for better breast milk for newly born child mother and male flower for blood purification	Throughout the year
30	<i>Olea ferruginea</i>	Indian olive	Chorphon	Oleaceae	Leaves, fruit	T	Leaves are used for pile treatment and fruit as a digestive	Jan-Mar
31	<i>Phyllanthus acidulous</i>	Star gooseberry	Kihori	Euphorbiaceae	Fruit	T	Blood enhancer for the lungs and root as a purgative	Jan-Feb
32	<i>Phyllanthus fraternus</i> Web	Bhumyamalki	Chakpa-heikru	Euphorbiaceae	Whole plant	H	Leucoderma	Mar-April

Table 6. Cont.

33	<i>Prunus domestica</i> ssp. <i>Syrca</i>	Mirabelles plum	Kalen Heikha	Rosaceae	Fruit	T	(Fruit are small, yellow color with excellent flavor, sweet and blue anthocyanin) Laxative property	March-April
34	<i>Prunus domestica</i> ssp. <i>Insititia</i>	Damsons plum	Heikha	Rosaceae	Fruit	T	(Fruit are small, purple color well blended sugar acid ratio and blue anthocyanin) Laxative property	June-July
35	<i>Rhus chinensis</i>	Nutgall tree	Heimang	Anacardiaceae	Young shoot, fruit	T	Antiviral, antibacterial, anti-diarrhea, antioxidant activities and as a digestive	Dec-April
36	<i>Rubus elliptiens</i> Sm.	Yellow Raspberry	Heijampet	Rosaceae	Fruit, leaves & root	S	Fruit against diarrhea and root for dysentery and leaves for abortifacient	Dec-Jan
37	<i>Rubus moluccanus</i> Linn.	Ceylon blackberry	Heijampet amuba	Rosaceae	Fruit, leaves & root	S	Fruit against diarrhea and root for dysentery and leaves for abortifacient	Dec-Jan
38	<i>Spondias pinnata</i>	Indian hog plum	Heining	Mangiferaceae	Fruit, leaves	T	Leaves are used as an ingredient for making herbal hair lotion " <i>Chinghi</i> ", fruit are use against dysentery and dyspepsia	Mar -April
39	<i>Terminalia chebula</i> Retz.	Yellow myrobalan	Manahi	Combretaceae	Fruit	T	Anti-inflammatory, cough and colds, pile, ulcer and mild purgative	Mar-April

## MATERIALS AND METHODS

The survey was carried out in Imphal valley (Manipur) during the year 2011-2012 which is located at 23°45' N to 25°00'N and 93°43'E to 94°15'E covering with an area of 1843sq.km comprising of four districts viz. Imphal East, Imphal West, Thoubal and Bishnupur (excluding Jiribam sub-division, Imphal East). The average altitudes of the valley is about 750m above MSL and represent a typical subtropical zone with cool, dry winter, a warm summer and a moderate monsoon season (Figure 1). The climate of the North-East region of India including Manipur is very salubrious for growth of a wide range flora representing the centre of origin of valuable fruit species like citrus, banana, mango rice, sugarcane and pulses (Hore, 1998). The rainfall ranges from 933 mm in the valley to 2593 mm in the hills. The temperature ranges from a minimum of sub-zero to 36°C. The soil types comprises of red ferruginous in the hilly tracts to alluvium in the plain and are acidic in nature exhibiting a range of pH from 5.4 to 6.8. Of the total geographical area, the hilly terrain occupies 90 per cent and whereas, the valley represents 10 per cent. The natural vegetation accounts for 64 per cent of the total geographical area the

prevailing agro-climatic zones have indeed shelters a rich natural underutilized fruit species scattering in undulated hilly terrain. These fruit species have been the principal source of nutritional food for the local people, besides the locally grown vegetables. However, due to lacking of systematic scientific intervention, these valuable fruit species remained underutilize and its medicinal value are not explore. Routine methods of botanical collection and herbarium technique (Jain and Rao, 1977) have been followed in the study and the plants were identified using relevant floras. Data on medicinal uses of plants were obtained through interview of knowledgeable elderly people (both genders of 30-75 age) inhabiting in the Imphal valley and information on underutilized minor fruit crops, gathered from the medicine men locally known as "*Maibas*" and the medicine women locally known as "*Maibis*", to whom the knowledge was passed on from their ancestors were cross checked. The specimens of the plants are collected and identified on the basis of vernacular name, regional floras and published literatures (Singh *et al.*, 2003). They are enumerated alphabetically with scientific name, common name, local name, family; part used, associated medicinal names and period of available its fruits in the local market.

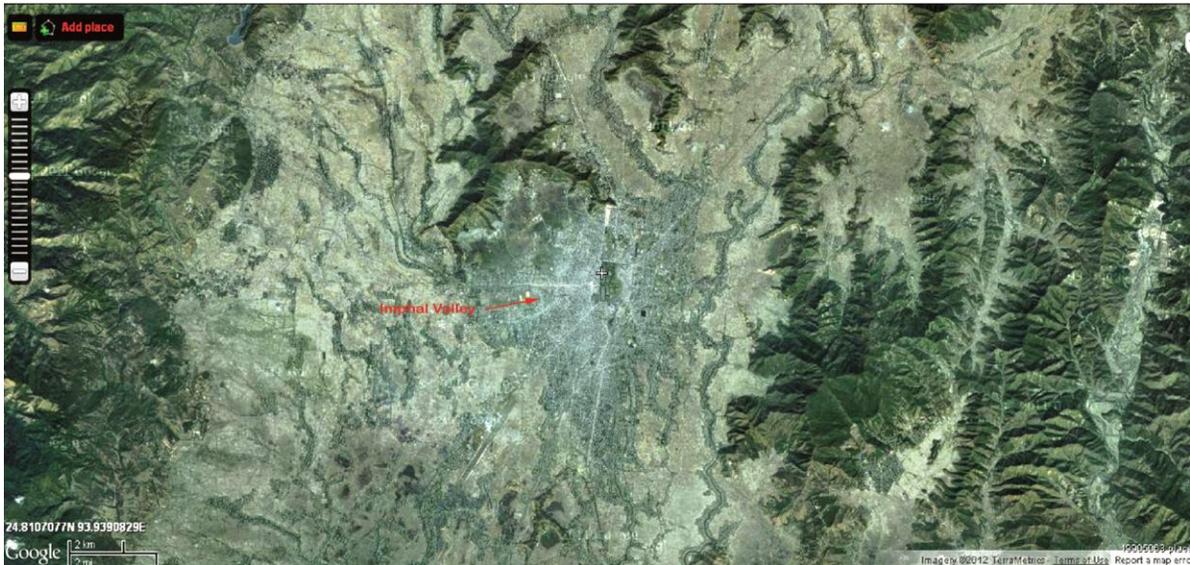


Figure 1. Imphal valley, Manipur (India), location site of the study.

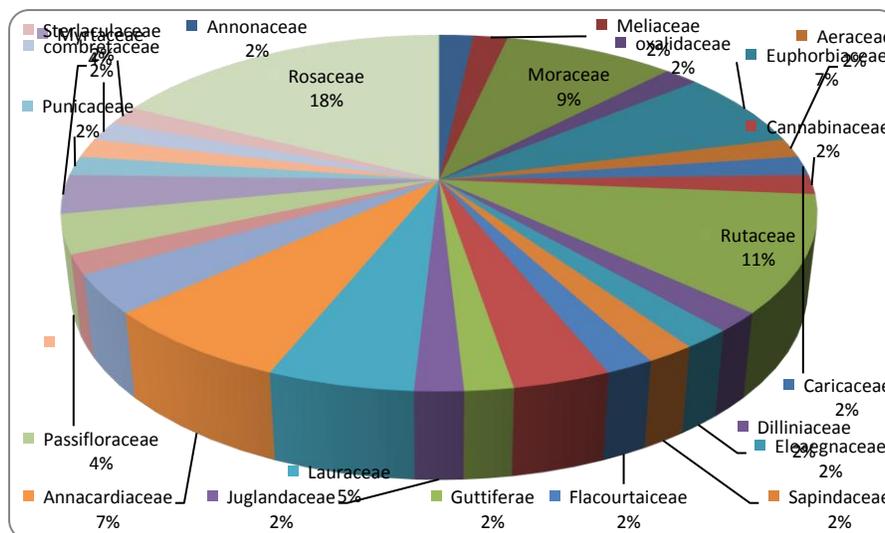


Figure 2. Family dominance of underutilized fruit crops as medicine in Manipur (India).

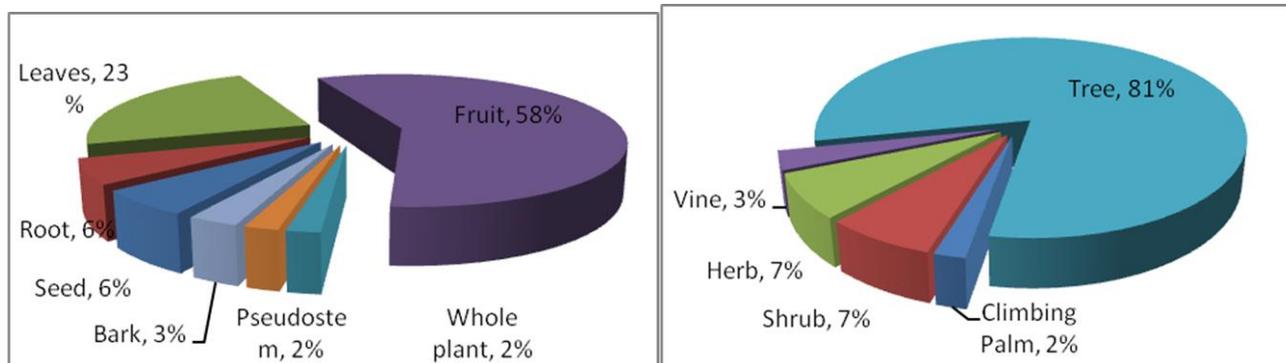
## EXPERIMENTAL RESULT

During the survey, farmers were asked to list the fruits they considered as important underutilized fruit crops based on their potential and actual utilization for its medicinal values including availability in local market in Manipur. Altogether 39 plants belonging to 29 genera and 23 families of underutilized fruit crops were collected which are consumed for medicinal purposes (Table 1). Based on the family dominance Rosaceae and Moraceae (15%) is found to be the most widely used, followed by Rutaceae (10%) and Euphorbiaceae (8%) (Figure 2). Fruits and leaves are the major plant parts used for the preparation of medicine consume having 52 % and 22%

followed by bark and root 8%, seed 5%, whole plant 3% and banana male flower 2%. Tree species contributed in maximum having 76 % while shrubs 10% and herbs recorded 7 % followed by vine 5% and climbing palm 2% of the total underutilized fruits crops as medicine in Manipur (Figure 3).

## DISCUSSION

Many research papers on rich bio-resources of the region have been published by various workers for its medicinal value but so far no tangible research worked on the underutilized fruit crops as medicine. Khumbongmayum,



**Figure 3.** Percentage of (a) Habit of the plant (b) Plant parts of underutilized fruit crops as medicine in Manipur (India).

*et al.*, (2005) also reported that *Meitei* community, the ethnic people of Manipur are quite aware of the uses of plant species having ethno medicinal value. It has been observed that most of the reports are just listing the various plants used by different tribes and most of the underutilized fruit are little known or not known at all to the world. Also, many of the known underutilized fruit crops have not been studied empirically in detailed for the active chemical compounds and its nutritional values of these plants need to be investigated. The state of Manipur, which is located in the corner of North-Eastern part of India, experienced a variety of fruit crops flourishing hitherto in the wild state as its natural home. These underutilized minor or novel fruit crops have been the source of nutrition for the different ethnic groups dwelling throughout the length and breadth of the region (Figure 4a and 4b). The belief behind this mode of eating underutilized fruit crops is good for health and acts as a remedy for various ailments like relief of strain muscle, laxative, sedative, herbal hair lotion shampoo for anti-oxidant, dysentery, diarrhea, jaundice, cough etc. This could be attributed due to the presence of phytochemical in these minor fruit crops that enhance the power of immunity of human body (Benny and Vanitha, 2004). These underutilized fruit crops are rich in vitamin and mineral which are needed in our body. Rickman *et al.*, (2007) reported that cooking result in the partial or total loss of vitamins and nutrients that are present in them. It is now apparent that policy be framed and executed to explore the hidden potential of these novel fruit species to strengthen the security in terms of food and nutrition. These underutilized fruit crops promise to meet vital requirement of the ever increasing demand for nutritional security. The ample presence of these underutilized minor fruit crops and their adaptation in the local climate and thus their expansion in length and breadth of the state can be achieved without much hurdle. Once a systematic scientific intervention is achieved the fullest use of these crops can be launched through value addition. Besides, in the remote and interior place like Manipur in North-East India such fruits played an

important role in curing diseases through the traditional knowledge of its importance in human mankind. Schmidt (2008) also reported that the underutilized fruit crop species have a potential to contribute to food security and poverty alleviation including the value addition. Therefore, it is right time to explore the medicinal value of such underutilized fruit crops which is hidden from mankind and documented in particulars. Besides, the study also advocates coordinated efforts among different agencies such as Government, NGOs, and research institutional for strengthening the biodiversity conservation and health care system together. These efforts may help in improvement of the rural economy as well as long term security of the traditional healthcare system particularly in the remote area where traditional medicine is still followed in curing diseases for mankind.

## CONCLUSION

Apart from meeting the commercial utility of the rural people in remote places like Manipur as traditional medicine, there is lacking of encouraging timely scientific intervention to ensure the ecological aspect of biodiversity conservation thereby opening door for generation of gene bank for the masses. Besides, due to the lacking medicinal value of this underutilized fruit crops and rapid deforestation, the germplasm of such important plants are threaten to be extinct. Thus, if this hidden wealth of novel fruit species and its medicinal compound is explored without further delay, the state like Manipur which is rich source of genetic biodiversity will be in a position to occupy a sizeable share in the National and International Market for herbal medicine.

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## REFERENCES

- Anonymous (2011). All India area and production of fruits and vegetables. Indian Hort. Database, National Horticultural Board, Ministry of Agriculture, Govt. of India, pp. 3-4.
- Benny KH, Vanitha J (2004). Immunomodulatory and Antimicrobial affects of some tradition chinese medicinal herbs: A Review. *Curr. Med. Chem.*, **11**: 1423-1430.
- Hore DK (1998). Diversity in Agricultural plants-an experience with North-East India, In: Agriculture Biodiversity and Climate Change, Souvenir, (North Eastern Hill University, Shillong), pp. 11-13.
- Jain SK, Rao RR (1977). *A handbook of field and herbarium methods*, (Today and Tomorrow's Printers and Publishers, New Delhi).
- Khumbongmayum AD, Khan ML, Tripathi RS (2005). Ethnomedicinal plants in the sacred groves of Manipur. *In. J. Tradt. Knowl.*, **4**: 21-32.
- Kotoky R, Pathak MG, Kanjilal PB (2007). Physiochemical characteristics of seed oils of some *Litsea* species found in the North-East India. *Nat. Prod. Reliance*, **6**: 297-300.
- Moa AA, Hynniewta TM, Sanjappa M (2009). Plant wealth of North-East India with reference to ethnobotany. *In. J. Tradt. Knowl.*, **8**: 96-103.
- Rickman JC, Barrett DM, Bruhn CM (2007). Nutritional comparison of fresh, frozen and canned fruits and vegetables-1, vitamins C and B and phenolic compounds. *J. Sci. Food Agric.*, **87**: 930-944.
- Schmidt M, Wei W, Polthanee A, Lam NT, Chuong S, Qiu L, Banterng P, Dung PT, Glaser S, Gretzmacher R, Hager V, De KE, Li Y, Phuong NT, Ro S, Zhang Z, Zhou H (2008). Ambiguity in a trans-disciplinary stakeholder assessment of neglected and underutilized species in China, Cambodia, Thailand and Vietnam. *Biodivers. Conserv.*, **17**: 1645-1666.
- Sing HB, Singh RS, Sandhu JS (2003). Herbal medicine of Manipur, A colour Encyclopedia, (Daya publishing House, New Delhi).
- Singh JS, Raghubanshi AS, Vurshney CK (1994). Integrated biodiversity research in India, *Curr. Sci.*, **66**: 109.
- Singh LS, Singh PK, Singh EJ (2001). Ethnobotanical uses of some Pteridophytes species in Manipur. *Indian Fern. J.*, **18**: 12-14.
- Swaminathan MS (1999). Enlarging the basis of food security. The role of underutilized species. International workshop held at the M. S. Swaminathan Research Foundation, 17-19, February, Chennai, India.
- Yumnam JY, Tripathi OP (2012). Traditional knowledge of eating raw plants by the Meitei of Manipur as medicine / nutrient supplement in their diet. *In. J. Tradt. Knowl.*, **11**: 45-50.