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PLANTS USED IN THE TREATMENT OF DIABETES BY THE MEITEI COMMUNITY IN IMPHAL EAST DISTRICT OF MANIPUR (INDIA)

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ABSTRACT: Globally, an estimated 422 million adults were living with diabetes in 2014, compared to 108 million in 1980. Diabetes caused 1.5 million deaths in 2012. Higher-than-optimal blood glucose caused an additional 2.2 million deaths, by increasing the risks of cardiovascular and other diseases. It has recently broken age barriers and appears even in younger people. Diabetes is known to the Meitei community of Manipur (India) since ancient times by the name "ISHING PUKCHATPA" and has been using plants for the treatment and control of this disease. The present paper deals with folklore botanical remedies for diabetes used by the Meitei Community of Imphal East District, Manipur (India). The present study reveals that 79 plant species were found to be used by the Meitei Community of Imphal East District, Manipur in the treatment of diabetes. These 79 plant species (61 dicots, 17 monocots and 1 gymnosperm) belong to 74 genera (56 dicots, 17 monocots and 1 gymnosperm) which are distributed over 50 families (38 dicotyledons, 11 monocotyledons and 1 gymnosperm). Some of the species used in diabetes treatment are *Ananas comosus* (L.) Merr., *Barleria albostellata* C.B. Clarke, *Coix lacryma-jobi* L., *Drymaria cordata* subsp. *diandra* (Blume) J.A. Duke, *Ficus hispida* L.f., *Kigelia africana* (Lam.) Benth., *Nelumbo nucifera* Gaertn., *Oreocnide integrifolia* (Gaudich) Miq., *Oroxylum indicum* (L.) Kurz, *Phyllanthus fraternus* G.L. Webster, *Tinospora sinensis* (Lour.) Merr. and *Vallisneria spiralis* L. The correct botanical names, local names (in Manipuri), family, plant parts used and mode of application are also discussed.

KEYWORDS: Diabetes, Ishing Pukchatpa, Imphal East, Manipur.

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1. INTRODUCTION

The word diabetes has been derived from a Greek word "dia" meaning through; "bêtes" meaning pass. It is a metabolic disorder and arises due to insufficient production of insulin by the pancreas. There are two main categories of this disease. Diabetes mellitus is characterized by an initial loss of glucose homeostasis resulting from defects in insulin secretion and/or insulin action or leading to impaired metabolism of glucose and other energy-yielding metabolites [1]. Type 1 diabetes mellitus also called insulin dependent diabetes mellitus (IDDM) and Type 2, the non-insulin dependent diabetes mellitus (NIDDM). Type 1 diabetes accounts for only 5 to 10% all cases whereas Type 2 accounts for 90 to 95% of all diabetic patients [2]. According to World Health Organization (WHO), an estimated 422 million adults were living with diabetes in 2014, compared to 108 million in 1980. It is predicted that by 2035 the number will be almost 600 million [3]. The global prevalence (age-standardized) of diabetes has nearly doubled since 1980, rising from 4.7% to 8.5% in the adult population. The global prevalence (age-standardized) of diabetes has nearly doubled since 1980, rising from 4.7% to 8.5% in the adult population. This reflects an increase in associated risk factors such as being overweight or obese. Over the past decade, diabetes prevalence has risen faster in low- and middle-income countries than in high-income countries. This reflects an increase in associated risk factors such as being overweight or obese. Over the past decade, diabetes prevalence has risen faster in low- and middle-income countries than in high-income countries. Based on cost estimates from a recent systematic review, it has been estimated that the direct annual cost of diabetes to the world is more than US$ 827 billion. The International Diabetes Federation (IDF) estimates that total global health-care spending on diabetes more than tripled over the period 2003 to 2013 – the result of increases in the number of people with diabetes and increases in per capita diabetes spending. Diabetes caused 1.5 million deaths in 2012. Higher-than-optimal blood glucose caused an additional 2.2 million deaths, by increasing the risks of cardiovascular and other diseases [4]. Large increase will occur in countries like India, China and United States of America, especially in people aged between 45 to 64 years. Moreover, the management of diabetes is a global problem until now and successful treatment is not yet discovered. It has also been estimated that there are approximately 33 million adults with diabetes in India which is likely to increase to 57.2 million by 2025 [5]. There are many synthetic medicines has been developed for patients. However, the traditional medicines have demonstrated a bright future in therapy of diabetes and to understand the importance of traditional herbs. Several plants are used by different ethnic communities all over the world for the control of this disease. Diabetes is known to the Meitei community of Manipur (India) since ancient times by the name "ISHING PUKCHATPA" (Ishing = Water/Urine; Pukchatpa= Excessive passing) and has been using plants for the treatment and control of this disease since time immemorial. The present attempt is therefore a thorough survey for information on the traditional use of medicinal plants in the treatment of diabetes by the Meitei community of Imphal East District, Manipur (India).

2. MATERIALS AND METHODS

2.1. Study Area

Imphal East District is one the sixteen districts of Manipur. It covers an area of 709 sq.km. The total population of the district is 456,113 which are roughly 17.74% of the state population. There are 226,094 males and 230,019 females in the district. The population density is 643 persons km^{-2}. As per 2011 census, 59.83 % population of Imphal East districts lives in rural areas of villages. The total Imphal East district population living in rural areas is 272,906 of which males and females are 136,789 and 136,117 respectively. Average literacy rate of Imphal East in 2011 were 81.95 compared to 75.50 of 2001. There are four Revenue Sub-Divisions in the district namely: (1) Porompat Sub-Division; (2) Sawombung Sub-Division; (3) Keirao Bitra Sub-Division and (4) Jiribam Sub-Division. There are 237 Revenue villages in the district

2.2. Ethnomedicinal study of plant species

The present paper is based on the data collected on ethnomedicinal practices among the people of Imphal East District, Manipur during July 2017 to December, 2019. For the present study 15 villages inhabited by the Meitei Community in Porompat Sub-division in Imphal East District (Manipur) have been selected. Standard methods are used while collecting information from the local people, medical practitioners (Maiba = Male and Maibi = Female in Manipuri) and village market place [6,7,8]. The suggestion and advice of the local people are also taken in account. Elderly persons, heads of the settlements and persons having thorough knowledge of medicinal plants and their utilization in day-to-day life were also consulted. All the information was taken by visiting their respective houses and asking structured question regarding the plants which they used for different aspects. The authenticity of uses was repeatedly verified by asking to different individuals by oral contact. In the field, the characteristics of the plants like habitat, habit, morphological character etc. were noted down. Colour photographs of most of the plants were also taken for easier identification. Plants are collected for Herbarium specimen and one copy of it is deposited with Botany Department, Thoubal College, Manipur (India) for future use or record. Efforts have also been made to find out the correct botanical names in accordance with the latest International Code of Nomenclature (ICN) 2012. For nomenclatural updates names in author citation www.theplantlist.org and www.ipni.org was used all the time. The correct authors' names have also been given as per *Authors of Plant Names* of Royal Botanic Garden, Kew [9]. Prior Informed Consent (PIC) was obtained from the people of Imphal East District Manipur.

3. RESULTS AND DISCUSSION

In the following enumeration the species are arranged alphabetically followed by the family names, common English names, local names (Manipuri) if any, part or parts used in the preparation and method of preparation and administering the prepared medication. Commonly used synonyms have also been given for some of the species.

***Abelmoschus esculentus* (L.) Moench**

Syn. *Hibiscus esculentus* L. Family: Malvaceae.

Common name: Lady's finger. Local name: Bhelendri.

Parts used: Young fruits.

Mode of use: The young fruits are cut into halves and the juice is extracted and the same is taken on an empty stomach early in the morning until cured.

***Aegle marmelos* (L.) Correa**

Syn. *Belou marmelos* (L.) Lyons Family: Rutaceae.

Common name: Stone apple. Local name: Harikhagok.

Parts used: Tender leaves and root bark.

Mode of use: The tender leaves are boiled with kabok aphaba (roasted paddy) (*Oryza sativa* L. Family: Poaceae; Local name: Phou/Cheng) and about one yaum (approximately equal to 5 or 6 teaspoon) of the decoction is taken internally early in the morning. Sometimes the boiled extract of the root bark is also taken internally. Raw leaves are eaten by diabetic patients either with Ametpa or Iromba (a local delicacy prepared with chilies and fermented small fishes called Ngari). Sometimes the tender leaves are also consumed along with milk. Boiled extract of the root bark is also taken orally.

***Allium ascalonicum* L.** Family: Amaryllidaceae.

Common name: Welsh onion. Local name: Meitei tilhou.

Parts used: Bulbs.

Mode of use: The bulbs along with pieces of heartwood of *Pinus kesiya* Royle ex Gordon (Family: Pinaceae; Local name: Uchan) and roots of *Smilax lanceifolia* Roxb. (Family: Smilacaceae; Local name: Kwa manbi) are boiled together and the decoction is taken internally twice a day. Pieces of the bulbs are boiled using water along with the fruits of *Rhus succedanea* Murray (Family: Anacardiaceae; Local name: Heimang) and sugar candy and the decoction is orally taken twice daily.

***Amaranthus spinosus* L.**

Common name: Prickly amaranth. Local name: Chengkruk tingkhang panba.

Parts used: Tender leaves.

Mode of use: The tender leaves and used as vegetable for lowering blood sugar level.

***Ananas comosus* (L.) Merr.**

Syn. *Ananas acostae* C. Commelijn Family: Bromeliaceae.

Common name: Pine apple. Local name: Kihom.

Parts used: Tender leaves.

Mode of use: The fresh juice of young tender leaves is given for internal consumption in diabetes to lower blood sugar level. The fresh juice of young tender leaves along with the powdered seeds of *Piper nigrum* L. (Family: Piperaceae; Local name: Gun moroksi) are also used in the same manner.

***Antidesma acidum* Retz.**

Syn. *Antidesma diandrum* (Roxb.) Spreng. Family: Phyllanthaceae.

Common name: Rohitaka. Local name: Ching yensil.

Parts used: Tender leaves.

Mode of use: The boiled extract of the leaves is taken internally for treatment of diabetes.

***Areca catechu* L.**

Syn. *Areca macrocarpa* Becc. Family: Arecaceae.

Common name: Betel nut. Local name: Kwa.

Parts used: Seeds.

Mode of use: The boiled extract of the nuts is taken orally.

***Artemisia nilagirica* (C.B. Clarke) Pamp.**

Syn. *Artemisia vulgaris* var. *nilagirica* C.B. Clarke Family: Compositae.

Common name: Mugwort. Local name: Laibakngou.

Parts used: Tender leaves.

Mode of use: The decoction of the leaves is given in diabetes.

***Arundo donax* L.**

Syn. *Arundo sativa* Lam. Family: Poaceae.

Common name: Giant reed. Local name: Yengthou.

Parts used: Tender rhizomes.

Mode of use: The fresh juice extracted from the tender rhizomes is taken orally twice daily in little amounts in diabetes. The tender rhizomes are boiled along with the whole aerial plant of *Mimosa pudica* L. (Family: Leguminosae; Local name: Kangphal ekaithabi), leaves of *Cinnamomum tamala* (Buch.-Ham.) T. Nees & Eberm. (Family: Lauraceae; Local name: Tejpat), and whole aerial plant of *Zehneria scabra* (L.f) Sond. (Family: Cucurbitaceae; Local name: Lam thabi) and the decoction is consumed orally in diabetes.

***Averhhoea carambola* L.**

Syn. *Averrhoa acutangula* Stokes Family: Oxalidaceae.

Common name: Cucumber tree. Local name: Heinoujom.

Parts used: Leaves and stem bark.

Mode of use: A handful leaves plucked on Saturday is boiled in water until the volume is reduced to 2/3rd. The decoction is given 3 or 4 times a day. Boil extract of the stem bark is also used for lowering sugar level.

***Barleria albostellata* C.B. Clarke** Family: Acanthaceae.

Common name: Grey barleria. Local name: Hanu khutlam.

Parts used: Fresh leaves.

Mode of use: Fresh leaves boiled in water till volume is halved and the decoction is given to diabetic

patients twice daily.

***Benincasa hispida* (Thunb.) Cogn.**

Syn.*Benincasa cerifera* Savi Family: Cucurbitaceae.

Common name: Ash gourd. Local name: Torbot.

Parts used: Fruits.

Mode of use: Pieces of the fruit along with jaggery are boiled together and taken orally at the dosage of half a glass for 15 days.

***Bryophyllum pinnatum* (Lam.) Oken**

Syn. *B. calycinum* Salisb.

Kalanchoe pinnata (Lam.) Pers. Family: Crassulaceae.

Common name: Sprout leaf plant. Local name: Mana hidak.

Parts used: Leaves.

Mode of use: Fresh juice of the leaves is taken orally in diabetes.

***Centella asiatica* (L.) Urb.**

Syn. *Hydrocotyle asiatica* L. Family: Apiaceae.

Common name: Indian pennywort. Local name: Peruk.

Parts used: Whole aerial plan

Mode of use: The fresh extract of the whole aerial plant is given to diabetic patients in the morning before breakfast. The whole aerial plant is boiled along with stem bark of *Parkia timoriana* (DC.) Merr. (Family: Leguminosae; Local name: Yongchak) and fruits of *Ficus racemosa* L. (Family: Moraceae; Local name: Heibong) and the decoction is taken twice a day.

***Clerodendrum infortunatum* L.**

Syn. *Clerodendrum calycinum* Turcz. Family: Lamiaceae.

Common name: Tree clerodendron. Local name: Kuthap ukabi.

Parts used: Tender leaves

Mode of use: Decoction of the tender leaves is given to diabetic patients in little amounts on an empty stomach in the morning.

***Coccinia grandis* (L.) Voigt**

Syn. *Bryonia grandis* L.

Cephalendra indica Naud.

Coccinia cordifolia Cogn. Family: Cucurbitaceae.

Common name: Scarlet gourd. Local name: Warak tayal.

Parts used: Fruits.

Mode of use: Decoction of the fruits is consumed orally to lower blood sugar level in diabetes. Boiled extract of leaves are also used for the same purpose.

***Coix lacryma-jobi* L.**

Syn. *Coix gigantea* J. Jacq. Family: Poaceae.

Common name: Job's tear. Local name: Chaning.

Parts used: Roots.

Mode of use: The fresh extract of the roots is said to be a good remedy for diabetes.

***Commelina benghalensis* L.**

Syn. *C. turbinata* Vahl Family: Commelinaceae.

Common name: Day flower. Local name: Wangden khoibi.

Parts used: Whole aerial part.

Mode of use: The fresh juice extracted from the whole aerial part is consumed in diabetes.

***Curcuma angustifolia* Roxb**. Family: Zingiberaceae.

Common name: East Indian arrowroot. Local name: Yaipal.

Parts used: Rhizomes.

Mode of use: The boiled extract of rhizome is used for the treatment of diabetes.

***Cuscuta reflexa* Roxb.**

Syn. *Cuscuta macrantha* G. Don Family: Convolvulaceae.

Common name: Dodder / Love vine. Local name: Uri sanamachu.

Parts used: Whole plant.

Mode of use: Decoction or boiled extract of the whole plant is given orally to patients suffering from diabetes in a proper dose twice daily.

***Cynodon dactylon* (L.) Pers.**

Syn. *Panicum dactylon* L. Family: Poaceae.

Common name: Bermuda grass. Local name: Tingthou.

Parts used: Whole aerial plant.

Mode of use: The fresh juice of the whole aerial portion along with a little honey is prescribed in diabetes.

***Cyperus dubius* Rottb.**

Syn. *Kyllinga triceps* Rottb. Family: Cyperaceae.

Common Name: Soft sedge. Local name: Chumthang namthibi.

Parts used: Whole aerial plant.

Mode of use: The fresh juice of the whole aerial portion along with a little honey is prescribed in diabetes.

***Datura stramonium* L.**

Syn. *Datura wallichii* Dunal Family: Solanaceae.

Common name: Jimson weed. Local name: Sangoidak amuba.

Parts used: Seeds.

Mode of use: A little amount of powdered seeds along with an equal amount of dried powdered seeds of *Piper nigrum* L. (Family: Piperaceae; Local name: Gun moroksi) are added to milk and given to diabetic patients.

***Drymaria cordata* subsp. *diandra* (Blume) J.A. Duke**

Syn. *Drymaria cordata var. indica* Miq. Family: Caryophyllaceae.

Common name: West Indian chickweed. Local name: Tandan mana.

Parts used: Whole aerial plant.

Mode of use: Whole aerial plants cooked with lata fish (*Channa orientalis* Bloch & Schneider) when consumed during meals helps in lowering blood sugar level.

***Eclipta prostrata* (L.) L.**

Syn. *Eclipta alba* (L.) Hassk. Family: Compositae.

Common name: Trailing eclipta. Local name: Uchi sumbal.

Parts used: Whole aerial plant.

Mode of use: Fresh juice extracted from the whole aerial plant is useful in diabetes.

***Enydra fluctuans* DC.** Family: Compositae.

Common name: Water cress. Local name: Komprek tujombi.

Parts used: Whole aerial plant.

Mode of use: Fresh extract of whole aerial plants is a good remedy for lowering blood sugar level. It can also be used as vegetable for the same purpose.

***Eupatorium cannabinum* L.**

Syn. *Eupatorium birmanicum* DC. Family: Compositae.

Common name: Burma agrimony. Local name: Langthrei.

Parts used: Leaves.

Mode of use: Decoction of leaves is when consumed in little amounts said to be useful in diabetes by lowering the blood sugar level.

***Euryale ferox* Salisb.**

Syn. *Euryale indica* Planch. Family: Nymphaeaceae.

Common name: Prickly water lily. Local name: Thangjing.

Parts used: Tender petioles, fruits and seeds.

Mode of use: Eating of the raw fruits, seeds and young petioles are said to lower the blood sugar level.

***Fagopyrum esculentum* Moench**

Syn. *Fagopyrum emarginatum* Moench Family: Polygonaceae.

Common name: Common buck wheat. Local name: Wakha Yendem.

Parts used: Tender leaves.

Mode of use: Cooked tender leaves when used as vegetable is said to help in controlling blood sugar

level.

***Ficus benghalensis* L.**

Syn. *Ficus banyana* Oken Family: Moraceae.

Common name: Banyan tree. Local name: Sana khongnang.

Parts used: Bark of roots and Stem bark

Mode of use: Decoction of root barks is useful lowering blood sugar level. Boiled extract of the stem bark is also used for the same purpose.

***Ficus hispida* L.f.**

Syn. *Ficus simphytifolia* Lam. Family: Moraceae.

Common name: Hairy Fig. Local name: Ashi heibong/Perel hei.

Parts used: Fruits, stem bark and leaves.

Mode of use: The crushed fresh fruits or boiled leaves along with common salt when consumed in little amounts are helpful in controlling blood sugar level. Boil extract of the leaves are also used for the same purpose. The stem bark is peeled out upward from the bottom of the plant and boiled. Consumption of the decoction is effective in the treatment of the diabetes.

***Ficus palmata* Forssk.**

Syn. *Ficus malabarica* Miq. Family: Moraceae.

Common name: Punjab Fig. Local name: Heiban mana.

Parts used: Fruits.

Mode of use: The juice extracted from fresh fruits with a little common salt is useful in managing blood sugar level.

***Ficus racemosa* L.**

Syn. *Ficus glomerata* Roxb. Family: Moraceae.

Common name: Fig. Local name: Heibong.

Parts used: Roots and fruits.

Mode of use: Decoction of roots or juice extracted from fresh fruits is taken orally in little amounts by diabetic persons in managing blood sugar level.

***Flacourtia jangomas* (Lour.) Raeusch.**

Syn. *Flacourtia cataphracta* Roxb. ex Willd. Family: Salicaceae.

Common name: Governor's plum. Local name: Heitroi.

Parts used: Fresh fruits.

Mode of use: The juice extracted from fresh fruits when taken internally is useful in managing blood sugar level.

***Hedychium coronarium* J. Koenig**

Syn. *H. spicatum* Lodd. Family: Zingiberaceae.

Common name: Ginger lily. Local name: Takhellei.

Parts used: Rhizomes.

Mode of use: The fresh extract of the rhizomes is given to diabetic persons with a little honey in the morning.

***Hygrophila ringens* (L.) R.Br. ex Spreng.** Family: Acanthaceae.

Common name: Erect hygrophila. Local name: Ishing langthrei.

Parts used: Whole aerial portion.

Mode of use: Boiled extract of the whole plant is prescribed daily in the morning in diabetic patients for a long period.

***Kaempferia rotunda* Wall. ex Baker**

Syn. *Kaempferia longa* Jacq. Family: Zingiberaceae.

Common name: Peacock ginger. Local name: Leibaklei.

Parts used: Rhizomes.

Mode of use: Consumption of boiled extract of the rhizomes is useful for the treatment of diabetes.

***Kigelia africana* (Lam.) Benth.**

Syn. *Kigelia pinnata* (Jacq.) DC.

Bignonia africana Lam. Family: Bignoniaceae.

Common name: Sausage tree. Local name: U-sebot/U-khongdrum.

Parts used: Fruits.

Mode of use: The juice extracted from fresh fruits when taken internally is useful in controlling blood sugar level.

***Leucaena leucocephala* (Lam.) de Wit**

Syn. *Leucaena glauca* Benth. Family: Leguminosae.

Common name: White popinae. Local name: Chigonglei angouba.

Parts used: Leaves.

Mode of use: Decoction of leaves is used in diabetes. It can also be used as vegetable with the same result.

***Magnolia campbellii* Hook. f. & Thomson**

Syn. *Magnolia mollicomata* W.W.Sm. Family: Magnoliaceae.

Common name: Pink tulip tree. Local name: Uthambal.

Parts used: Leaves.

Mode of use: 7/9 leaves cut into small pieces boiled in 2.5litre of water till the volume is reduced to about 750ml. It is consumed 4 times a day in little amounts.

***Meyna spinosa* Roxb. ex Link**

Syn. *Vangueria spinosa* (Roxb. ex Link) Roxb. Family: Rubiaceae.

Common name: Muyna. Local name: Heibi.

Parts used: Fruits.

Mode of use: The fruits are cooked together with lata fish (*Chana orientalis* Bloch & Schneider) and consumed at the rate of ½ glass 3times a day.

***Momordica charantia* L.**

Syn. *Momordica indica* L. Family: Cucurbitaceae.

Common name: Bitter gourd. Local name: Karot akhabi.

Parts used: Fruits

Mode of use: About 20ml of the fresh juice extract of the fruits is consumed in little amounts in diabetes.

***Musa balbisiana* Colla**

Syn. *Musa rosacea* Jacq. Family: Musaceae.

Common name: Wild banana. Local name: Changbi laphu.

Parts used: Inflorescence.

Mode of use: The inflorescence is cut into small pieces and are soaked in water for a few hours and filtered. The fresh extract is consumed in little amounts along with a little common salt.

***Nelumbo nucifera* Gaertn.**

Syn. *Nelumbium speciosum* Willd. Family: Nelumbonaceae.

Common name: Lotus. Local name: Thambal.

Parts used: Flowers and leaves.

Mode of use: The fresh leaves are consumed along with kabok aphaba (roasted paddy) (*Oryza sativa* L.; Family: Poaceae; Local name: Phou/Cheng) and dry prawn. In another way, the leaves are cooked along with the leaf petioles of *Colocasia gigantea* (Blume) Hook.f. (Family: Araceae; Local name: Yendem) and dry fish. The tender leaves are boiled along with the whole aerial plant of *Phyllanthus fraternus* G.L. Webster (Family: Phyllanthaceae; Local name: Chakpa heikru) with a pinch of common salt and the decoction is taken internally. A handful of flower petals of *Nelumbo nucifera* Gaertn**.** and leaves of *Jasminum multiflorum* (Burm.f.) Andrews (Family: Oleaceae; Local name: Kundo) are boiled in water and about 40ml of the decoction is taken daily till cured.

***Oreocnide integrifolia* (Gaudich) Miq.** Family: Urticaceae.

Common name: Wild rhea. Local name: U-khajing.

Parts used: Leaves.

Mode of use: Hot decoction of the leaves is mixed with honey and is given to diabetic patients in a right proportion and small doses for a long period.

***Oroxylum indicum* (L.) Kurz**

Syn. *Bignonia indica* L. Family: Bignoniaceae.

Common name: Indian trumpet flower. Local name: Samba.

Parts used: Fruits.

Mode of use: Juice extracted from the fresh fruits is taken orally in diabetes.

***Osbeckia nepalensis* Hook.f.**

Syn. *O. nepalensis* var. *nepalensis* Family: Melastomataceae.

Common name: Nepalese osbeckia. Local name: Yachubi.

Parts used: Tender leaves.

Mode of use: The extract of tender leaves after boiling along with the leaves of *Emilia sonchifolia* (L.) DC. ex DC. (Family: Compositae; Local name: Tera paibi macha) is taken orally in the treatment of diabetes.

***Phlogacanthus thyrsiformis* (Roxb. ex. Hardw.) Mabb.**

Syn. *Justicia thyrsiformis* Hardw.

Family: Acanthaceae. Local name: Nongmangkha.

Parts used: Leaves.

Mode of use: Fresh leaf juice is consumed in small amounts 2 to 3 times a day. Consumption of the decoction of the leaves also give the same result. Leaves are boiled along with the rhizomes of *Zingiber officinale* Roscoe (Family: Zingiberaceae; Local name: Shing) and the decoction is taken orally in diabetes.

***Phyllanthus emblica* L.**

Syn. *Emblica officinalis* Gaertn. Family: Phyllanthaceae.

Common name: Gooseberry. Local name: Heikru/Heigru.

Parts used: Fruits.

Mode of use: The fruits along with dried fruits of *Piper longum* L. (Family: Piperaceae; Local name: Uchithi) and fruits of *Plumeria rubra* L. (Family: Apocynaceae; Local name: Khagi leihao angangba) are boiled together and the decoction is taken orally in small amounts in diabetes.

***Phyllanthus fraternus* G.L. Webster**

Syn. *Phyllanthus lonphali* Wall. Family: Phyllanthaceae.

Common name: Stone breaker. Local name: Chakpa heikru.

Parts used: Whole aerial plants.

Mode of use: Consumption of the boiled extract of the whole aerial plant is said to be useful in diabetes.

***Portulaca oleracea* L.**

Syn. *Portulaca consanguinea* Schltdl. Family: Portulacaceae.

Common name: Purslane. Local name: Leibak kundo.

Parts used: whole aerial plant.

Mode of use: Consumption of the whole plant as curry or soup is useful to diabetic patients.

***Punica granatum* L.**

Syn. *Punica nana* L. Family: Lythraceae.

Common name: Pomegranate. Local name: Kaphoi.

Parts used: Seeds

Mode of use: Decoction of the seeds with honey.

***Pyrus lindleyi* Rehder**

Syn. *Pyrus sinensis* Lindley Family: Rosaceae.

Common name: Pear. Local name: Naspati.

Parts used: Fruits.

Mode of use: Consumption of the fresh fruits is recommended to patients suffering from diabetes.

***Quercus acutissima* Carruth.**

Syn. *Quercus serrata* var. *attenuata* Blume Family: Fagaceae.

Common name: Oak. Local name: Chakpa uyung.

Mode of use: Consumption of boil extract of leaves is found useful for the treatment of diabetes.

***Rumex maritimus* L.**

Syn. *Rumex aureus* Mill. Family: Polygonaceae.

Common name: Yellow dock. Local name: Torongkhongchak.

Parts used: Leaves.

Mode of use: Fresh juice of leaves and young shoots with honey is said to be useful in diabetes.

***Schima wallichii* Choisy** Family: Theaceae.

Common name: Needle wood. Local name: Ushoi.

Parts used: Leaves.

Mode of use: The fresh juice extracted from the tender leaves and young shoots is taken orally in diabetes.

***Scoparia dulcis* L.**

Syn. *S. grandiflora* Nash Family: Plantaginaceae.

Common name: Sweet broom weed. Local name: Yangli manbi.

Parts used: Whole aerial plant.

Mode of use: Decoction of the aerial plant parts.

***Scutellaria discolor* Colebr.** Family: Lamiaceae.

Common name: Bicolor Skullcap. Local name: Yenakhat.

Parts used: Whole aerial plant.

Mode of use: Decoction of the aerial plant parts is taken orally in diabetes.

***Senna bicapsularis* L.**

Syn. *Cassia bicapsularis* L. Family: Leguminosae.

Common name: Yellow candlewood. Local name: Thaonam nashangbi.

Parts used: Tender leaves.

Mode of use: Decoction of tender leaves is given in little amounts twice daily to diabetic persons. Dried powdered leaves are soaked in water and taken orally.

***Strobilanthes cusia* (Nees) Kuntze**

Syn. *Strobilanthes flaccidifolia* Nees Family: Acanthaceae.

Common name: Assam indigo. Local name: Kum pambi.

Parts used: Leaves.

Mode of use: A handful of leaves are boiled in about one litre of water till the volume is reduced to half. About 50ml of the decoction is taken 3times a day in diabetes.

***Syzygium cumini* (L.) Skeels**

Syn. *Eugenia jambolana* Lam. Family: Myrtaceae.

Common name: Black plum. Local name: Jam.

Parts used: Seeds and stem bark.

Mode of use: Powdered seeds or powdered bark powder are consumed in little amounts along with water. Seeds are boiled along with the whole aerial plant parts of *Zehneria scabra* (L.f) Sond. (Family: Cucurbitaceae; Local name: Lam thabi) and about 1 teaspoonful is consumed three times a day in diabetes.

***Tinospora sinensis* (Lour.) Merr.**

Syn. *Tinospora cordifolia* (Willd.) Miers Family: Menispermaceae.

Common name: Tinospora. Local name: Ningthou khongli.

Parts used: Stem.

Mode of use: Fresh pieces of the stem are boiled in water until the volume is reduced to half. About 10 ml of the decoction is given to diabetic patients 2 to 3 times a day.

***Trigonella foenum-graecum* L.**

Syn. *Trigonella tibetana* (Alef.) Vassilcz. Family: Leguminosae.

Common name: Fenugreek. Local name: Methi.

Parts used: Seeds.

Mode of use: Seeds are soaked overnight in water and filtered the about 50 ml of the filtrate is given in the morning.

***Vallisneria spiralis* L.**

Syn. *Vallisneria pusilla* Barbieri ex Bertol. Family: Hydrocharitaceae.

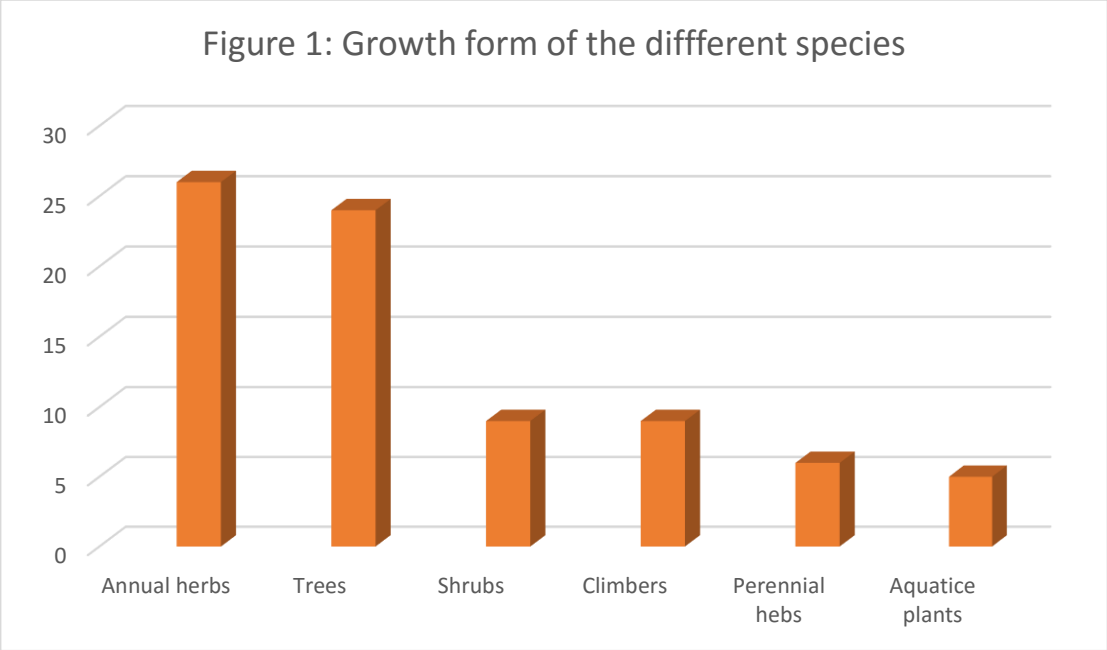
Common name: Eel grass. Local name: Ishing yensum/Lairenchak.

Parts used: Whole plant.

Mode of use: A handful of the whole plant is boiled with sugar candy. About 20 ml of the decoction is taken daily in managing diabetes.

DISCUSSION

The present study reveals that 79 plant species were found to be used by the Meitei Community of Imphal East District, Manipur in the treatment of diabetes. These 79 plant species belongs to 74 genera which are distributed over 50 families (38 dicotyledons, 11 monocotyledons and 1 gymnosperm). Out of these 79 species 61 are dicots, 17 are monocots and 1 species belong to gymnosperms. The families Compositae and Leguminosae contributed maximum number of species in the treatment of diabetes with 5 species each. Five families namely Acanthaceae, Cucurbitaceae, Moraceae, Poaceae and Zingiberaceae have equally contributed four species each. The family Phyllanthaceae contributed 3 species. Four other families Bignoniaceae, Lamiaceae, Piperaceae and Polygonaceae have equally contributed two species each. The remaining 38 families have equally contributed only 1 species each used in diabetes treatment.



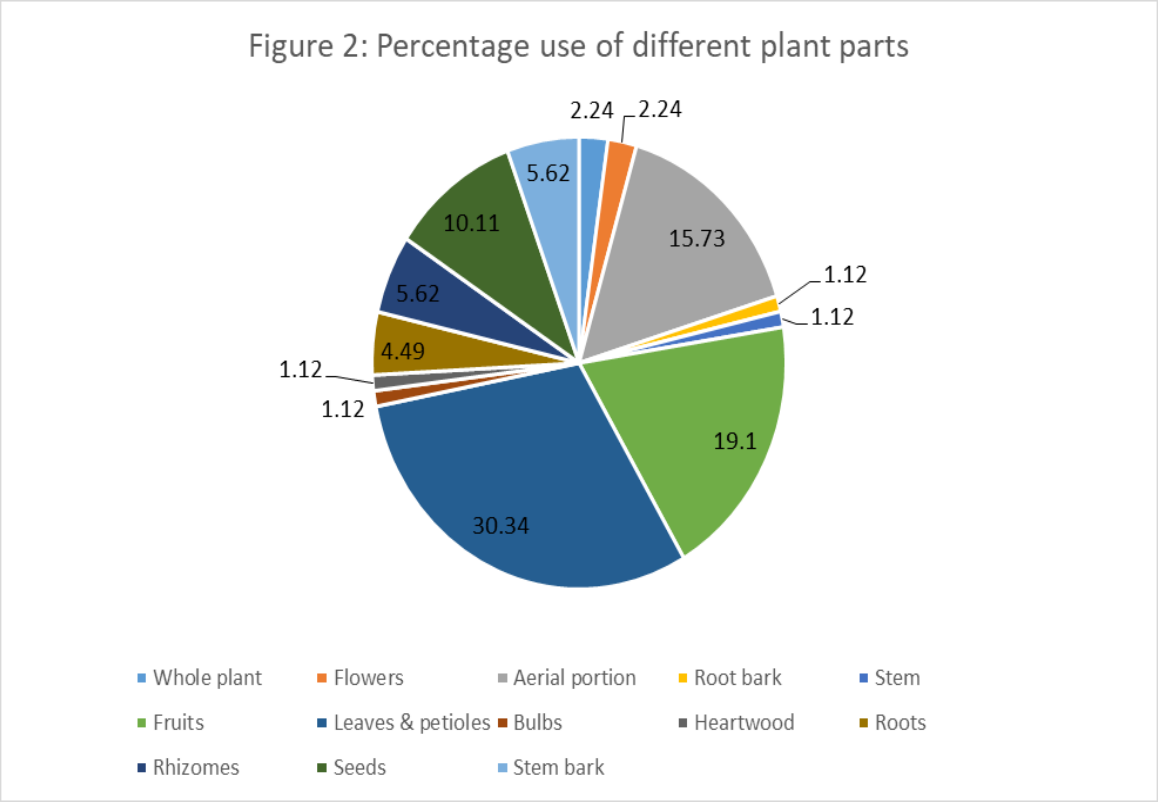


Table 1: Comparative study of anti-diabetic plants used in different parts of the world.

Region/Country	No of Species	No of Genera	No of Families	Source
Imphal East, Manipur (India)	79	74	50	Present study
Cauvery Delta of Tamil Nadu (India)	30	27	26	[10]
Midnapore District, West Bengal (India)	55	45	29	[11]
Thoubal District, Manipur (India)	55	48	31	[12]
Thoubal District, Manipur (India)	50	47	35	[13]
Arunachal Pradesh (India)	30	29	25	[14]
Kamrup District, Assam (India)	56	52	38	[15]
Mizoram (India)	53	49	32	[16]
Bangladesh	37	34	25	[17]
Eastern Ghats (India)	29	28	22	[18]
Urmia, North West Iran	30	26	17	[19]
South Western Nigeria	31	30	24	[20]
Tamil Nadu (India)	105	94	64	[21]

Out of the 79 species recorded, there are 26 annual herbs, 6 perennial herbs, 24 trees, 9 shrubs, 9 climbers and 5 aquatic plants (Figure 1). For the treatment of diabetes, the use of above ground plant

parts was higher (85.71%) than the underground parts (14.28%). Leaves were used in the majority of the cases (30.34%), followed by fruits (19.10%), whole aerial portion (15.73%), seeds (10.11%), rhizomes and stem bark (6.6%), roots and stem barks (5.62% each) and so on as shown in Figure 2. Comparative analysis of this study with other ethnobotanical surveys of plants used traditionally in treating diabetes mellitus (Table 1) in different parts of India as well as in different regions of the world shows that Imphal East District (present study) with a population of 456,113 uses a very good number of species in the treatment of diabetes. The present study is comparable with those reported from Bangladesh [17], South Western Nigeria [20], South eastern Nigeria [22], Morocco [23], Eastern Cape Province of South Africa [24], Tanzania [25], Mali [23], Trinidad and Tobago [26], North West Iran [27], Jordan [28], Israel [29], Egypt [30] and Mexico [31].

4. CONCLUSION

The present study reveals the people of Imphal East District (Manipur) still extensively used plants in the management and treatment of diabetes. It also revealed some similarities in the plants cited in these surveys with those reported from different parts of the world. Further research is necessary to ascertain the exact number of plants and their methods of preparation being used by this community.

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CONFLICT OF INTEREST

The authors declared that they have no conflicting interest.

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