



E-ISSN: 2321-2187
P-ISSN: 2394-0514
www.florajournal.com
IJHM 2020; 8(2): 01-06
Received: 01-01-2020
Accepted: 03-02-2020

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Survey of medicinal plants with potential antidiabetic activity used by villagers in lower Assam districts of North-East, India

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Abstract

Diabetes is rapidly emerging as serious and major public health-care problem throughout the world. It is a complex and chronic illness. Apart from currently available different synthetic drugs, many herbal drugs have been recommended for the treatment of diabetic patients. An ethnobotanical study focused on medicinal utility of antidiabetic plants was carried out among the rural village peoples of few lower Assam districts, of North-East, India. A large number of medicinally important plant species are found to be present in the study area. Our survey has reported as many as 41 numbers of medicinal plant species belonging to 31 families. The most cited family was Moraceae, the most widely used plant part was the leaf and the most common mode of administration was juice. All these claims and findings need to be subjected to both phyto- and pharmaco-chemical investigations to assess the claimed activity with the aim of finding new potent antidiabetic drugs.

Keywords: Anti-diabetic, diabetes mellitus, medicinal plants, herbal medicine, herbal treatments, Assam

1. Introduction

Diabetes mellitus is a chronic metabolic disease affecting a large proportion of the population worldwide. It is one of the major degenerative disease in the world [1]. Hyperglycemia is a common symptom of diabetes and ultimately leads to serious irreversible damage to different body's systems [2]. It is characterized by high level of blood glucose level. It is a disease where the body either produces little insulin or cells may become progressively resistant to insulin [3]. In diabetes the body cells are starved of sugar or glucose despite its very high concentration in blood. In Ayurveda diabetes mellitus (DM) is referred to as *Madhumeha*, which literally means excessive urine with sweet taste like honey [4]. There are two types of Diabetes mellitus (DM), viz. Type -1 and Type -2. Type 2 is the more common type of diabetes. Type -2 diabetes mellitus makes up about 90% of the diabetic population in the world.

Diabetic patients increase day by day throughout the world and becoming the second leading cause of death after cancer and heart disease in many developed countries. Diabetes affects almost 5% of the world population [5] and management of diabetes without any side effects is still a challenging job to the medical system. Currently in India the number of diabetic patients is around 41.9 million and it is expected to rise to 69.9 million by 2025. Diabetes is a group of disorder which often leads to complications such as kidney failure, blindness, coronary heart disease, premature death and circulatory problem. Diabetic neuropathy, diabetic retinopathy, diabetic nephropathy, cardiovascular disease, high blood pressure and stroke are the most common complications of diabetes [6].

Regardless of the type, diabetic patients are required to control their blood glucose levels. The common strategy for treatment of diabetes focused mainly on regulating and decreasing blood sugar level to fall within the normal level. Blood sugar monitoring is one of the most essential tasks for diabetic patients. The main mechanisms in antidiabetic medicines involve decrease blood sugar through stimulating pancreatic β -cells; inhibiting other blood sugar elevating hormones; increasing the sensitivity of insulin receptor.

Diabetes is treated with various oral hypoglycemic drugs. Currently available synthetic antidiabetic drugs are found to be associated with various major side effects. Though there are different approaches of the treatment of diabetes and its secondary complications, herbal formulations are always preferred due to their various advantages. Natural medicines are becoming a popular form of healthcare worldwide [7]. A large number of advantages are associated with antidiabetic herbal medicines as opposed to pharmaceutical drugs. Easy availability, low toxicity, raw consumption, easy affordability, least side effects and low cost makes the herbal preparations more popular.

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The Indian healthcare system Ayurvedic medicine has formed an integral and unavoidable part of the Indian tradition^[8]. However, unlike synthetic drugs, herbal products are generally not regulated for purity and potency.

The present work is an effort to explore the therapeutic antidiabetic medicinal plants of the study area, where this illness is found to be the most common. The present survey and review aimed for recording the traditional herbal practices of therapeutic antidiabetic plants of few lower Assam districts of North-East, India, and to assess the viability of various medicinal plant species in light of the literature review.

2. Materials and methods

2.1 Study area

North-eastern region of India (22°-29° N; 89°-97° E) comprises of seven states. This part of India can be categorized into the eastern Himalayas, several Northeast hills and the Brahmaputra and Barak Valley as plains. More than 30% area of North East India is covered by dense forest. Different types of ethnic tribes are inhabited in these seven states of North-East India. Almost 160 major tribal communities are present in this region^[9, 10].

Assam is botanically rich state of North East India. Assam is located in the northeastern region of India. Assam is situated between foothills of Himalayas and the Patkai and Naga Hills. Assam has subtropical climate with a temperature range from 7°C to 40°C and average annual rainfall varying from 1,450 mm to 3,800mm. Heavy rainfall takes place during monsoon. A large area of the state is covered by dense semi-evergreen to evergreen forests. Total forest area in the state is 27,673 sq km which is 35.28% of the total geographical area of Assam. This state is very much rich in medicinal plant wealth. Assam is basically an agricultural-based state and the village areas of Assam are full of large numbers of different kinds of valuable medicinal plants. There are more than seventeen distinctive ethnic tribes in Assam consisting of different ethno-cultural groups. Some of these ethnic groups are Bodos, Dimasha, Mising, Karbi, Koch, Mishimi, Tiwa, Deories, Sonowal Kachari, Ahom, Nagas, Rabhas, Chutia, Motok, Garos and Moran^[11, 12].

The present study and survey work was conducted along some of the selected village areas of Nalbari, Barpeta, Udalguri and Kamrup districts of Assam. These four districts are located in the western most part of Assam. Majority of the rural peoples in these four districts are mainly cultivators and different types of agricultural workers. Lots of different plant species having potential antidiabetic activities are growing wild in this region. The societies of these districts are also ethnically diversified. Majority of rural people in these areas still prefer the traditional herbal medication as their best alternative. People of various communities in these areas have a long history of using plants for their different ailments. Some specific villages were selected for the field study. The selections were done mainly on the basis of economic backgrounds, lack of modern facilities, ethnic diversities of the peoples, dependences on various medicinal plants etc. Plants species form an integral essential part of their culture. Village people of these areas have developed a rich ethnomedical tradition^[13] and they have a very much strong bonding with the herbal medicinal plant species^[14]. Till date, only very few literatures on the traditional herbal uses of antidiabetic plants of these four districts are available but ethnomedical investigation are still lacking.

2.2 Methods

An extensive field survey was carried out in order to collect information about the ethnomedical uses of medicinal plants

in the treatment of diabetes by the local people of the study areas. Several field trips in different seasons were carried out in different village areas of four districts of Lower Assam namely Nalbari, Barpeta, Kamrup and Udalguri. Information was collected from all categories of village people including local herbal practitioners, persons having thorough knowledge of herbal medical practices, village elders, farmers, local vaidya's and traditional healers through normal conversations, personal face-to-face interviews and discussions. Some information was also gathered from few village markets, where some plant parts were sold. The interviewed people were chosen in many cases randomly. During the field visit information was cross verified repeatedly with the data in other places. During the conversations, all the data and information about plants and parts of the plants used, local name of the plants, mode of administrations, methods of preparation or formulation of drugs, frequency of dose, dose quantity, duration of herbal treatments and effectiveness of a particular drug were collected. All the data were collected through various repeated field visits and careful interactions with the concerned people. Only the reliable information was considered and incorporated in the present report. The information collected was also cross verified with the available standard literatures.

2.3 Plant collection and identification

Plant species used by different villagers were collected following standard protocols and norms and then preserved using herbarium techniques. Identification of collected plants specimens was done in the Botany department of Gauhati university and by the experts in Ayurvedic college, Gauhati. Specimens collected from our field study were preserved as herbarium.

3. Result and discussion

Ethnobotany may be defined as the study of the relationship between various plant species and people which usually focuses on the influences of indigenous plants on the local inhabitants^[15]. Traditional herbal medicinal systems are getting considerable attention in global healthcare system. Different natural products from medicinal plants are becoming the basis for treating various human diseases^[16]. Herbal medicines are always cost-effective. For basic health-care approximately 80% of the world population still depends upon therapeutic plants either directly or indirectly. These plants are rich source of bioactive compounds that can be used to develop drug synthesis^[17]. Medicinal plants have a hopeful and promising future. Conservation of traditional knowledge as well as sustainable utilization of local herbal medicinal plants is very much essential^[18].

Diabetes is one of the fastest growing metabolic disease, medicinal plants used in the treatment of diabetes are of considerable interest and a large number of plants have shown a significant amount of hypoglycemic and anti-hyperglycemic activity. Several Ayurvedic herbal formulations have been used in the treatment of diabetes for centuries. Herbalists treat different health problems including diabetes mellitus with the help of medicinal plants^[19]. Indigenous medicinal plants and herbal products have been used in the control and treatment of diabetes from the time of Charaka and Sushruta in India^[20]. Herbal preparations and their doses are generally taken under the guidance of properly trained professional. A systematic scientific investigation of traditional herbal treatment of diabetes may be helpful for the development of alternative drugs and therapeutic strategies. The present research study highlights useful ethno botanical information about the uses of medicinal plants by the local village people and different

tribal's communities of few selected lower Assam districts. This investigation was done with the aim of identifying as well as searching for new herbal plants with anti-diabetic activity which can be efficiently used in the treatment of diabetes mellitus. Free radical induced damage is one of the key factors of diabetic complicacy and antidiabetic compounds with antioxidant properties are of additional advantage and would be more beneficial. Many antidiabetic plant products are found to be rich in their antioxidant properties.

Although lots of people nowadays use herbal medicines as a part of their primary health care system, there are still serious concerns about the efficacy and safety of using these medicinal plants and their various plant products. While herbal medicines have potential contributions towards the advancement of healthcare systems, still many major challenges need to be overcome. Still there are lots of confusions and questions about the safety, accurate dose, exact duration of their treatment, side effects, purity of the products, standardization of herbal products, stability of their compositions and acute and chronic toxicities. These herbal preparations may contain varying amounts of bioactive ingredients and various amounts of impurities. If these different issues are properly resolved, medicinal plants as well as various plant products can be used as a safe, effective, efficient and affordable form of health care.

In the survey it has been found that different types of formulations for the treatment of diabetes were practiced by the indigenous herbalists of the area. In herbal treatment, preparations were made in the form of decoction, soaked, infusion, grounded, juice, powder, cooked, paste and fresh plant parts. Very common media used for preparation of herbal medicines were water, milk, lime water and honey. In majority of the cases these herbal medications were prepared by using water and many of them were consumed during the early hours of the day especially in empty stomach. In

diabetic treatments the mode of herbal drug administration in most of the cases are oral. Plant parts were generally used singly. In many instances, it was found that two or more different plant parts were used in the same patient but usually not administered at the same time. Majority of the cases practitioners prefer fresh plant parts for herbal preparations but in many cases dried plant parts are also used. In many cases honey, milk etc. are used to mask the odor and also improve the adequacy of herbal preparations. The herbal practitioners generally collect the plants from wild sources.

From the current field study it has been found that there is high prospect of antidiabetic medicinal plants in Assam. The survey has indicated that a large number of plant species having potential antidiabetic activities are available in the study area. The results of the present survey are presented in Table-2 and the scientific names are arranged in alphabetical order. The field studies indicate that localities of these areas have sound knowledge of herbal medicines. From this investigation we have ascertained that 41 plant species are widely using in the study area by the local communities and traditional herbal practitioners for the treatment of diabetic patients. These 41 plant species belong to 31 families. The most dominating family is Moraceae with four species followed by Nymphaeaceae and Fabaceae with two species each. Eighteen species (44%) are trees, ten species (24%) are herbs, eight species (20%) are shrubs and five species (12%) are climbers which are presented in Figure-I. The method of herbal preparation falls into various categories. Plant parts are used in the form of juice (24%), decoction (22%), fresh and orally (17%), infusion (9%), powder (7%), cooked (7%), soaked (5%), paste (5%) and grounded (2%) which are presented in Figure-3. Various parts such as leaf, root bark, bulb, flower, fruit, seed, stem bark, rhizome, and tuber are used to develop various herbal medicinal preparations. Leaves are the most used (56%) part.

Table 1: And status of the study Geographical location area

Sl. No.	Status	Assam	Nalbari	Barpeta	Udalguri	Kamrup
1	Latitude	24° 8' N to 28° 2' N	26°N to 27°N latitude	26° 45' N to 26°49' N latitude	26°46'N to 27°77'N latitude	25°46'N to 26°49'N latitude
2	Longitude	89° 42' E to 96° E longitude	91°E and 91°47'E longitude	90°15' E to 90°45' E longitude	92° 08' E to 95° 15' E Longitude	90° 48' E to 91° 50' E longitude
3	Area (Sq. Km)	78,438	2,257	3,245	1,852.16	4,345
4	Forest area (Sq. Km)	26,781,91	170.03	311.25	120.0	211.0
5	Population (2011 census data)	3,12,05576	7,71,693	16,93,622	8,31,668	15,17,542
6	Rainfall (annual average)	2818 mm	2029 mm	1717 mm	1828 mm	1500 to 2600 mm
7	Climate	Tropical monsoon rainforest climate	Sub-tropical climate	Tropical monsoon climate	Humid and congenial	Sub tropical with semi-dry summer & cold winter

Table 2: Medicinal plants used for the treatment of diabetes by the local communities in the study areas.

Sl. No.	Botanical name & family	Local name	Habit	English name	Part used	Mode of utilization of the herbal medicines
1	<i>Adhatoda vasica</i> (Acanthaceae)	Bahaktita	Shrub	Malabar Nut	Leaf	Fresh leaf extracts in empty stomach is used orally
2	<i>Acacia arabica</i> (Fabaceae)	Taruwakadam	Perennial shrub	Indian Gum	bark	Bark powder is used
3	<i>Aloe barbadensis</i> (Xanthorrhoeaceae)	Chal-kunwari	Shrub	Barbados aloe	Leaf	Leaves paste is used
4	<i>Andrographis paniculata</i> (Acanthaceae)	Kalmegh	Herb	King of Bitters	Whole plant	Aqueous extracts of the whole plant at a dose of 2-3 tea spoon in empty stomach
5	<i>Annona reticulata</i> (Annonaceae)	Atlosh, Atephal	Tree	Custard Apple	Leaf	Young Leaf juice
6	<i>Aegle marmelos</i>	Bael, Bilva	Tree	Stone Apple	Leaf, root bark	Fresh leaf extract and dried powder of

	(Rutaceae)					root and bark
7	<i>Catharanthus roseus</i> (Apocynaceae)	Nayantara	Shrub	Tiny Periwinkle	Leaf, flower	Fresh leaf and flower extracts or fresh leaf may be chewed
8	<i>Coccinia indica</i> (Cucurbitaceae)	Kundali	Climber	Little gourd	Fruit	Fruits are used as vegetable
9	<i>Cinnamomum tamala</i> (Lauraceae)	Tez pat	Tree	Indian Bay-leaf, Indian cassia	Leaf	Boiled water extract of the leaf are used orally
10	<i>Cynodon dactylon</i> (Poaceae)	Dubari ban	Herb	Green couch grass	Whole plant	Whole plant extract is consumed
11	<i>Cajanus cajan</i> (Fabaceae)	Rahar-mah	Shrub	Pigeon pea, red gram	Seed, leaf	Fresh leaf extract and boiled seed
12	<i>Citrullus vulgaris</i> (Cucurbitaceae)	Tarmuj	Climber	Watermelon	Fruit, seed	The juice extract of the fresh fruits and seeds are taken
13	<i>Curcuma longa</i> (Zingiberaceae)	Haldhi	Herb	Turmeric	Rhizome	Paste of fresh rhizome is taken orally in empty stomach
14	<i>Dillenia indica</i> (Dilleniaceae)	Ouwtega	Tree	Elephant apple	Flower	Flower juice is used orally
15	<i>Eugenia jambolana</i> (Myrtaceae)	Kala jamu	Tree	Jaman	Fruit, stem bark, seed	Ripe fruits are eaten; seed powder
16	<i>Ficus benghalensis</i> (Moraceae)	Bot, Bor –goch	Tree	Banyan Tree	Aerial root, stem bark	Decoction of root and stem bark are used
17	<i>Ficus racemosa</i> (Moraceae)	Jangyadimoru	Tree	Craddock, Cluster	Fruit	Fruits are used as vegetable
18	<i>Ficus heterophylla</i> (Moraceae)	Dimaru, Dumbaru,	Tree	Limbing stream fig	Fruit	Fruits are used as vegetable
19	<i>Ficus religiosa</i> (Moraceae)	Ahot	Tree	Peepal tree, Sacred tree	Stem bark, root bark	Infusion of stem bark and root bark are used
20	<i>Garcinia pedunculata</i> (Clusiaceae)	Bar thekera	Tree	Garcinia	Fruit pulp	Dried fruit pulp soaked with water
21	<i>Gymnema sylvestre</i> (Asclepiadaceae)	Gurmar	Climber	Gurmar	Leaf	Leaves are eaten once a day
22	<i>Hibiscus syriacus</i> (Malvaceae)	Jobaphool	Shrub	Rose of sharon	Flower, leaf	Water extract of leaf and flowers are consumed orally
23	<i>Ipomoea batatas</i> (Convolvulaceae)	Mithaalu	Climber	Sweet potato	Stem	Boiled stem are eaten; raw stem are also used as vegetable
24	<i>Leucas aspera</i> (Labiatae)	Dron or durum	Herb	White dead nettle	Leaf	Leaf juice is used orally
25	<i>Musa paradisiaca</i> (Plantaginaceae)	Kaskal	Shrub	Banana	Unripe fruit pulp	Fruit juice is used orally
26	<i>Momordica dioica</i> (Cucurbitaceae)	Titakerela	Climber	Small bittergourd, spine gourd	Unripe fruit, leaf, seed	Juice of plant parts are used
27	<i>Moringa oleifera</i> (Moringaceae)	Sajina	Tree	Drumstick tree	Leaf, flower, fruit	Leaf, flower and fruit are used as vegetable
28	<i>Morus alba</i> (Moraceae)	Nuni	Tree	White mulberry	Fruit	Ripe fruits are eaten
29	<i>Nyctanthes arbortristis</i> (Oleaceae)	Sewaliphool	Tree	Night jasmine, Coral jasmine.	Flower, leaf	Leaf, flower juice is used orally
30	<i>Nymphaea rubra</i> (Nymphaeaceae)	Ranga vet	Herb	Red water lily	Root, Rhizome	Rhizome paste taken orally
31	<i>Nymphaea alba</i> (Nymphaeaceae)	Baga vet	Herb	White water lily	Root, rhizome	Roots and rhizomes juice is used orally
32	<i>Nelumbo nucifera</i> (Equisetopsida)	Padumphool	Shrub	Indian lotus, sacred lotus	Rhizome	decoction of rhizome is used
33	<i>Ocimum sanctum</i> (Lamiaceae)	Kala tulsi	Herb	Holy basil	Leaf	Leaf consumed raw
34	<i>Phyllanthus emblica</i> (Phyllanthaceae)	Amlakhi	Tree	Indian gooseberry	Fruit	The juice extract of the fresh fruits
35	<i>Swertia chirayta</i> (Gentianaceae)	Chiratatita	Herb	Bitter stick	Areal part, leaf	Decoction of the Areal part, leaf is used
36	<i>Spondias mangifera</i> (Anacardiaceae)	Amara	Tree	Indian Hog plum	Root	Boiled extract of the root
37	<i>Tinospora cordifolia</i> (Menispermaceae)	Saguni-lota	Climber	Gulanchatinospora	Stem bark, leaf	Dried barks decoction and leaf juice is used
38	<i>Terminalia citrine</i> (Combretaceae)	Silikha, Haritaki	Tree	Black chuglam	Fruit	Fresh as well as dry powdered fruits are used
39	<i>Trigonella foenum</i> (Fabaceae)	Mithi	Herb	Fenugreek seed, Greek Hay-seed	Seed	Powdered seeds are mixed with boiling water and consumed orally in empty stomach;
40	<i>Tabernaemontana ivaricate</i> (Apocynaceae)	Kothanna-phul	Shrub	Crape jasmine	Flower, leaves	Fresh leaves and flowers are consumed
41	<i>Zingiber officinale</i> (Zingiberaceae)	Ada	Herb	Ginger	Rhizome	Boiled rhizome is given

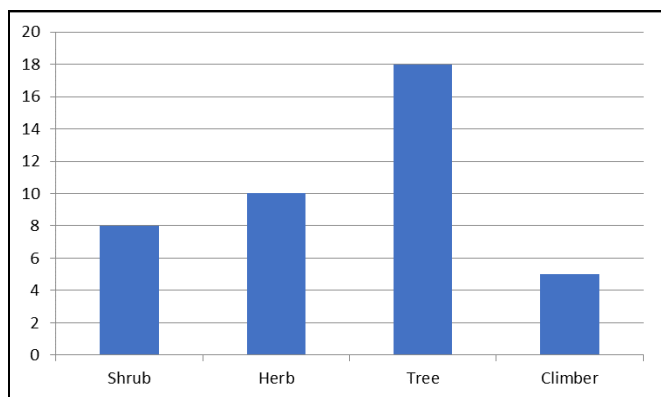


Fig 1: Natural habit wise distribution of antidiabetic plants in the study area

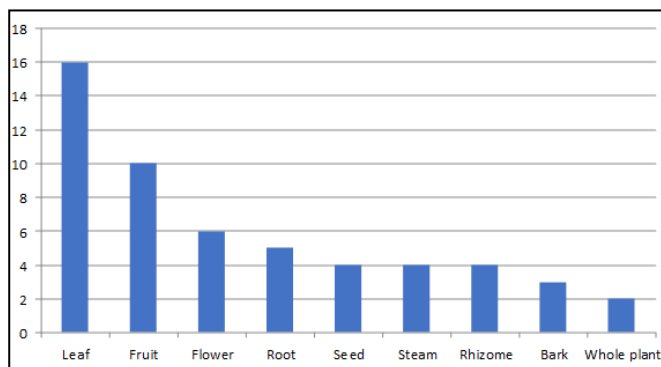


Fig 2: Parts wise used antidiabetic plants in study area

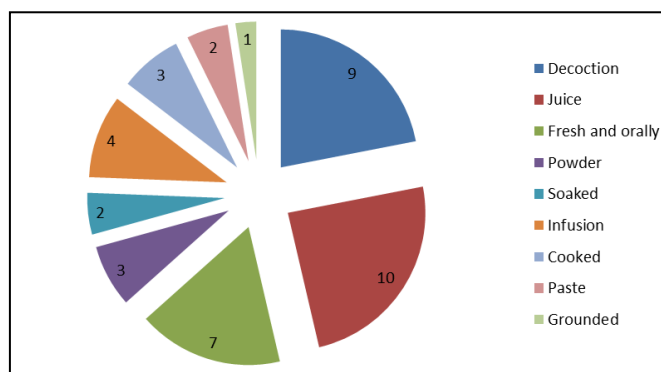


Fig 3: Mode of preparation of antidiabetic plants

4. Conclusion

An attempt was made to characterize the plant species and to do systematic documentation of the information about the plant species available in the study area. Detailed ethnobotanical studies on them are in progress. The knowledge that ethnic people of Assam used for plants gives a clear idea about the crude botanical preparation of traditional sources of medicinal plants. The results of our survey give valuable information on the use of medicinal plants in diabetes treatment. The field study indicated that the study area has a large number of medicinal plants to treat diabetes. The ethnomedicinal investigations conducted in the study areas have shown that 41 species of plants are used for the treatment of diabetes. Many of the investigated plants having potential antidiabetic activities are not still explored scientifically. The outcome and information provided in the paper is significant but limited only. There is always a scope to do more extended ethnomedicobotanical study among the different ethnic communities of Assam to collect information as far as possible. Further attention should be given for

evaluation of exact mode of action of different herbal extracts.

5. Acknowledgement

The author would like to thank the herbal practitioners of the survey areas. The author acknowledges all the contributions from the village people and local residents of the four lower Assam districts in the form of their wisdom, indigenous knowledge and logistics support during the time of field work. The author also thankful to Assam, Forest Department.

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