Original Research Article

Anti-Diabetic Plants Used by *Apatani Tribe* of Arunachal Pradesh, India

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Abstract: *Apatani* community is one of the major ethnic communities of Arunachal Pradesh and known for their rich traditional knowledge of natural resources. They have very efficient traditional management and conservation system of bio-resources around them. During last few decades there have seen exponential growth of scientific investigation on plants of ethno-medicinal importance in search of active principles for validation of folk claims and in the discovery of new drugs and herbal products. With the establishment of scientific knowledge of physiological and chemical factors behind the occurrence of one of the most vexed chronic ailments of the present century, the traditional healers have also initiated the hunts for potent anti-diabetic plants species growing wild and present in and around their vicinity, which are supposed to be efficacious in the treatment and management of diabetes mellitus, thus giving it a traditional touch. During the present study, survey was carried out in the Apatani plateau of Lower Subansiri district of Arunachal Pradesh. First hand information was collected from traditional healers and elderly folk people visiting different villages. A total of 30 plant species having apparently anti-diabetic properties and belonging to 25 families have been recorded from the study site. Flowers, leaves, stem, whole aerial parts, roots, rhizomes are used in different preparations to treat the high blood sugar level among the tribal community. The study reveals that the family Cucurbitaceae with 4 species having anti-diabetic properties top the list of families followed by Amaryllidaceous and Lamiaceae with 2 species each.

Keywords: *Apatani* community, Diabetes, Herbal products, Traditional healthcare

Introduction

With its rich biodiversity India's north eastern (NE) region represents one of the global biodiversity hotspots in the subcontinent (Myers *et al.*, 2000). The region is ecologically represented by the Eastern Himalayan biome and is rich in a number of endemic flora and fauna. The region is consisting by eight Indian states, namely: Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim. The region shares international boundaries with Bhutan, China, Myanmar and Bangladesh. The north-east India is part of both the Eastern Himalaya as well as Indo-Myanmar biodiversity hotspots thus forming a unique bio-geographic province encompassing major biomes recognized in the world. It is the richest reservoir of plant diversity in the country supporting about 50% of India's biodiversity (Mao, 2000).

Since the early 1970's different groups in various Universities and Research Institutions have been working on ethno-botany and traditional knowledge system of the region and published many reports. Most of the publications were concerned with ethno-botany or agricultural operations including shifting cultivation and festivals of the region. During the 1980's Ministry of Environment and Forests (MoEF), Government of India also launched an all India co-ordinated

project to document ethno-botanical uses of plants by indigenous people of India which was participated by many research institutions and Universities of the country. Under the project Botanical Survey of India, Eastern Circle, Shillong, conducted studies in tribal areas of Assam, Nagaland, Tripura and Arunachal Pradesh. From these study, the BSI has recorded 200 plant species from Arunachal Pradesh used by the local communities for treatment of 44 different diseases and ailments, 286 plant species from Assam for treatment of 40 different diseases and ailments, 526 plant species from Nagaland for treatment of 83 different diseases and ailments and 194 plant species from Tripura for treatment of 50 diseases and ailments. Foundation for Revitalization of Local Health Tradition (FRLHT), Bangalore recorded 834 medicinal plants from Meghalaya (FRLHT, 2012). Arunachal Pradesh, the easternmost state of the country, lying in the in the transition zone between the Eastern Himalayan and Indo-Myanmar regions (26°28′ - 29°30′ N and 91° 30′- 97°30′ E) covers an area of 83,743 km^2. The people inhabiting the region predominantly belong to tribal population, which comprises 65% of the total population. There are 26 major tribes and more than 120 sub tribes, each with a specific geographic distribution and distinct linguistic, cultural and social identity. Their main occupation is subsistence agriculture which is characterised by slash and burn technique.

Apatani community is one of the major ethnic communities of Arunachal Pradesh and they are known for the rich traditional knowledge of natural resource management and conservation. They are predominantly found in Lower Subansiri district of Arunachal Pradesh covering an area of 1,317 km^2 (Anonymous, 1992). The district is bounded on the north by China and Upper Subansiri district, on the South by Papum Pare district and Assam, on the east by West Siang and some parts of Upper Subansiri and, on the west by East Kameng district of Arunachal Pradesh.

Traditional system of medicine has been the important source of relief in controlling different diseases afflicting the ethnic communities throughout the globe. It is pertinent to note that majority of the ethno-medicinally important plants await scientific validation. In the last few years there has been upsurge of scientific activities for validation of ethno-medicinally important plants in search of active principles for formulation of herbal drugs. Plant species involved in the treatment and management of diabetes mellitus that have gradually infringed into the traditional healthcare practices in recent years have also been targeted for new drug discovery.

"In the late 1970s both WHO and the National Diabetes Data Group produced new diagnostic criteria and a new classification system for *diabetes mellitus*. This has been able to bring order to the chaotic situation in which nomenclature varied and diagnostic criteria showed enormous variations using different oral glucose loads. In 1985 WHO slightly modified their criteria to coincide more closely with the NDDG values. There are now many data available, and also much more etiological information has appeared. It seemed timely to re–examine the issues and to update and refine both the classification and the criteria, and to include a definition of the "Metabolic Syndrome". An American Diabetes Association (ADA) expert group was involved to address these issues. It published its recommendations in 1997. WHO convened consultation on the same subject in London, United Kingdom, in December 1996. In general, the ADA and WHO groups reached similar conclusions. The provisional report of the WHO Consultation solicited comments which were considered in preparing the present report. Both the provisional and the present reports were prepared by Professor K.G.M.M. Alberti and Professor P. Z. Zimmet on behalf of the members of the Consultation. The meeting was made possible with financial support from Bayer, UK; Bayer, Germany; Novo Nordisk, Copenhagen, Denmark; and The Institute for Diabetes Discovery, New Haven, USA"(Report of a WHO Consultation 1999).

"Diabetes is the condition in which the body does not properly process food for use as energy. Most of the food we eat is turned into glucose, or sugar, for our bodies to use for energy. The pancreas, an organ that lies near the stomach, makes a hormone called insulin to help glucose get

into the cells of our bodies. A diabetic person either doesn't make enough insulin or can't use its own insulin as well as it should. This causes sugars to build up in your blood. This is why many people refer to diabetes as *sugar*" (https://www.cdc.gov/media/presskits/aahd/diabetes.pdf)

In the most severe form diabetes may lead to complications of heart, blindness, kidney failure, and amputations of limbs. The continued negligence of the disease complete breakdown of activities of the vital organs resulting in stupor and comma- a prelude to death if timely and effective measures are not initiated (American Diabetes Association, 2014). There are two types of diabetes viz., type I and type II. The first one occurs in juvenile stage and it is linked to autoimmune, genetic and environmental factors and is not serious nature. However, the second type accounts for 90-95 percent of all diagnosed cases of diabetes.

Gestational diabetes develops in 2 percent to 5 percent of all pregnancies but usually disappears when a pregnancy is over. Gestational diabetes occurs more frequently in African Americans, Hispanic/Latino Americans, American Indians, and people with a family history of diabetes than in other groups. Obesity is also associated with higher risk. Women who have had gestational diabetes are at increased risk for later developing Type 2 diabetes. In some studies, nearly 40 percent of women with a history of gestational diabetes developed diabetes later.

Other specific types of diabetes result from specific genetic syndromes, surgery, drugs, malnutrition, infections, and other illnesses. Such types of diabetes may account for 1 percent to 2 percent of all diagnosed cases of diabetes.

Symptoms of diabetes

If anybody experiences any one of the following conditions he/she is advised to contact a doctor for diagnosis of diabetes:

- Frequent urination
- Excessive thirst
- Unexplained weight loss
- Extreme hunger
- Sudden vision changes
- Tingling or numbness in hands or feet
- Feeling very tired much of the time
- Very dry skin
- Sores that is slow to heal
- More infections than usual

Sometimes, nausea, vomiting, or stomach pains may also accompany some of these signifying onsets of type 1 diabetes.

Materials and method

Study area

The Lower Subansiri district covers approximately an area of 10,135 km^2. The topography of the district is mostly mountainous terrain, where the hill ranges vary approximately from 1000 to 1600 m above sea level. The district headquarter is located at Ziro a small town at about 1564 m above sea level (Fig. 1). The forests of the district are biodiversity rich with wide varieties of wild edible and medicinal plants in forms of herbs, shrubs, climbers and trees characteristics of sub-temperate forest with elements of tropical flora. The present study was conducted in Ziro valley covering four villages viz. Lampia, Hari, Siro and Bamin Michi of the Lower Subansiri district during the year 2016-2017.

Data collection

The data were collected through the informal interview and discussion with the local people particularly with traditional healers from each village. Among the village experts, one knowledgeable person was hired to survey and collect the plant species from wild habitats. Information on the local names, life forms, part(s) used and information relating to the traditional mode of treatment thus gathered was noted in the field note book used for the purpose. Plant specimens used in local pharmacopoeia were collected, processed for making herbarium for authentication of their identity. The aim of the study was to qualitatively establish anti-diabetic potential of plants having ethno-medico-botanical claim among the *Apatani* tribe of Arunachal Pradesh.

Identification of plant species

Identification of species was carried out with the help of taxonomic literature (Wu *et al.,* 2003-2010; Hooker, 1872-1897; Hooker, 1888), Haridasan (1985), Kanjilal *et al.* (1934-40), botanists and authentic herbarium specimens of Botanical Survey of India (ARUN) and SFRI (APFH), Itanagar,

Arunachal Pradesh. The standard methodology of Jain and Rao (1978) and Jain (1991) had been followed during the field study and herbarium preparation.

Different tribes have provided vast information regarding medicines and traditional health care practiced by them. The result of the survey is presented in Table 1, which represents the list of medicinal plants recorded from the tribal communities. The scientific name of the plants is arranged in alphabetical order, followed by its local name, family and part/s used etc. The study comprises 30 species of anti-diabetic plants belonging to 25 families.

Results

Total 30 species of anti-diabetic plants belonging to 25 families have been recorded from the study site. The family Cucurbitaceae represents the highest five species having anti-diabetic properties followed by Amaryllidaceae and Lamiaceae with 2 species each.

The plant part/s used for the purpose depending on the specific plant used is as follows:

Plant parts	Number of species
Fruits	7 species
Leaves	10 species
Whole plant	3 species
Young shoot	3 species
Bark	3 species
Rhizome	1 species
Stem	2 species
Root	4 species
Flower	1 species
Resin	1 species
Berry	1 species and
Aerial part	1 species

Table. 1. List of the *Antidiabetic* plants used by the *Apatani* tribe.

Sl. No	Botanical Name	Family	Vernacular names	Part used
1.	*Allium cepa* L.	Amaryllidaceae	Piyaz	Rhizome
2.	*Allium sativum* L.	Amaryllidaceae	Losun	Whole plant
3.	*Aloe vera* (L.) Burm.f.	*Xanthorrhoeaceae*	Aloe vera	Leaf pulp
4.	*Azadirachtaindica* A. Juss	Meliaceae	Neem	Leaf, Bark
5.	*Maniferaindica* Linn.	Anacardiaceae	Aam ahi	Tender leaves
6.	*Centellaasiatica* (Linn.)	Apiaceae	Ngiilyangakhohamang	Whole plant
7.	*Panaxpseudoginseng* Wall.	Araliaceae	-	Roots and berry
8.	*Crassocephalum crepidioides* (Benth.) S.Moore	Asteraceae	Gendahamang	Leaf
9.	*Diplazium esculentum* (Retz.) Sw.	Athyraceae	Hiikahamang	Young frond
10.	*Begonia roxburghii* A.DC.	Begoniaceae	Bekhoo, Lukhu	Leaf
11.	*Brassica juncea* (L.) Czern.	Brassicaceae	Giiyan	Leaf, seed
12.	*Cannabis sativa* Linn.	Cannabinaceae	Ganja	Leaf, flower, resin
13.	*Catharanthus roseus* (L.) G.Don	Apocynaceae	periwinkle	Leaf
14.	*Callicarpa tomentosa* (L.) L..	Lamiaceae	Tato, yalu, Yahorin	Bark
15.	*Saccharum spontaneum* L.	Poaceae	Tapi	Young shoots
16.	*Solanum viarum* Dunal	Solanaceae	Bengela tang	Fruit
17.	*Momordica charantia* L.	Cucurbitaceae	Karela/kairu	Fruit and seed
18.	*Beta vulgaris* L.	Chenopodiaceae	Beet	Root
19.	*Ipomoea batatas* (L.) Lam.	Convolvulaceae	MithaAloo	Aerial part
20.	*Coccinia grandis* (L.) *Voigt*	Cucurbitaceae	Jojuru	Fruits and root
21.	*Cucumis melo* L.	Cucurbitaceae	Tape	Fruits
22.	*Momordica dioica* Roxb. ex Willd.	Cucurbitaceae	Bhat kerala	Fruits
23.	*Trichosanthes dioica* Roxb.	Cucurbitaceae	Potol	Fruits and roots
24.	*Phyllanthus emblica* L	Euphorbiaceae	Amloki	Tender leaves
25.	*Glycine max* (L.) Merr.	Fabaceae	Ammiiperung	Seed
25.	*Ocimum tenuiflorum* L.	Lamiaceae	Tulsi/Eulochi	Leaf
26.	*Cinnamomum tamala* (Buch.-Ham.) T.Nees &Eberm.	Lauraceae	Tej pat	Stem, bark, root.
27.	*Mimosa pudica* L.	Leguminosae	Haniang	Whole plant
28.	*Psidium guajava* L.	Myrtaceae	Muduri	Leaves
29.	*Plantago major* L.	Plantaginaceae	Mepihamang	Root, leaves stem
30.	*Zanthoxylum armatum DC.*	Rutaceae	Yorkhung	Fruit / leaves

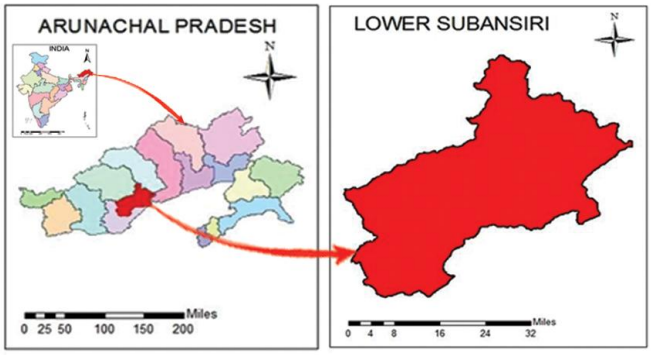

Fig. 1. Location maps of study area.

The plants reported in this study are mostly adminstered orally to cure diabetes and other ailments. For example, fruits of *Zanthoxylum acanthopodium* are prescribed for dysentery and stomach ache; leaves of *Centella asiatica* are used for gastric, abdominal pain and relief in constipation; boiled leaves of *Plantago erosa* are used to get relief from constipation.

Discussion

The existing 30 plants species known to have anti-diabetic properties used by the *Apatani* tribe of Ziro, Lower Subansiri district Arunachal Pradesh have been collected and details of preparation of effective doses are given. The *Apatani* community have a rich traditional knowledge on herbal medicines to combat different kind of diseases which have been associated with them since time immemorial.

In the present study it has been found that the herbal formulations are mostly utilised by the priests and the local elders of the community and the younger generation have least knowledge about the traditional system as they have shown more inclination to the easily available modern medicine in recent years.

Diabetes mellitus is a metabolic disorder initially characterised by a loss of glucose homeostasis with disturbances

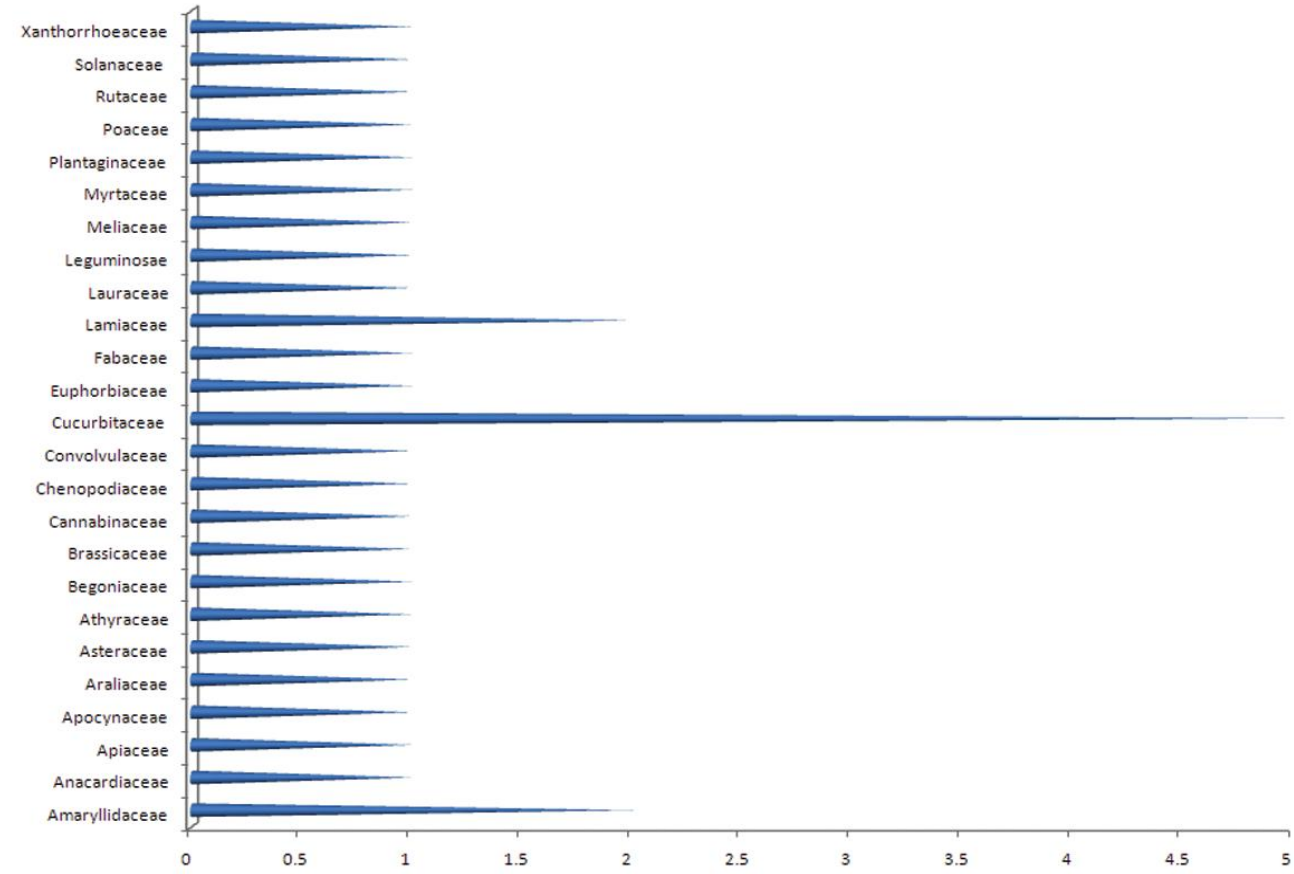

Fig. 2. Distributions of species among family.

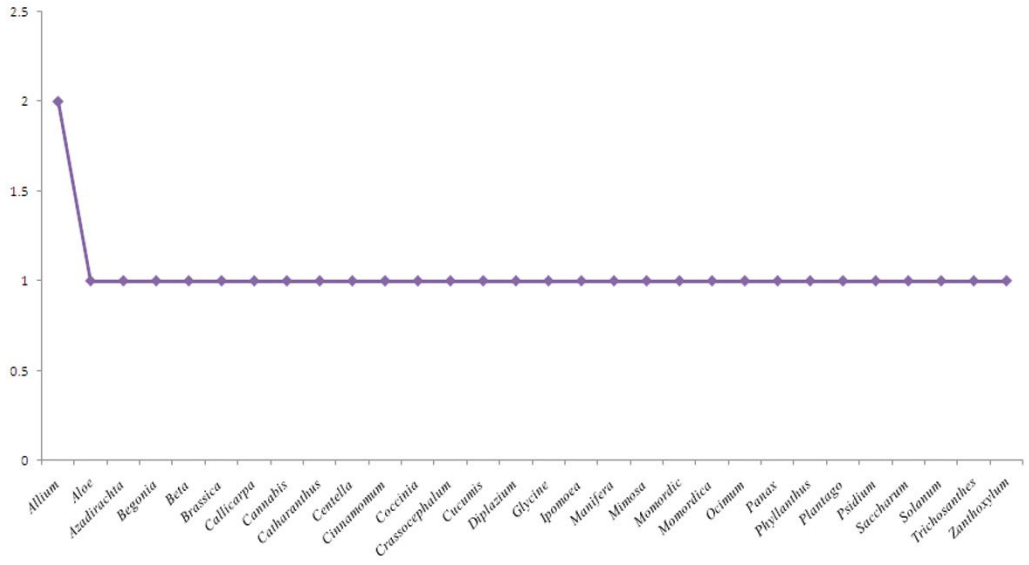

Fig. 3. Number of *anti-diabetic* plants under respective genera recorded from study area.

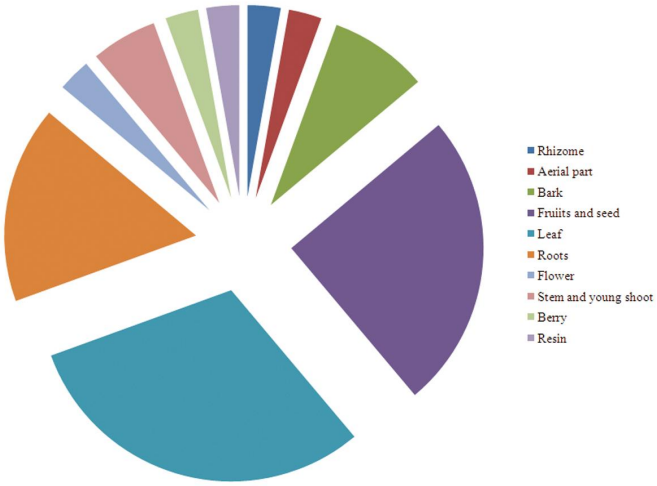

Fig. 4. Distribution of parts used among species

of carbohydrate, fats and protein metabolism resulting from defects in insulin secretion, insulin action, or both (Barcelo and Rajpathak, 2001). Without enough insulin, the cells of the body cannot absorb sufficient glucose from the blood; hence the blood glucose level increase, which is termed as hyperglycemia. If the glucose level in the blood remains high over a long period of time, this can result in long term damage to organs such as the kidneys, liver, eyes, nerves, hear and blood vessel. Complication in some of these organs can lead to death (Pari and Saravanan, 2004). Diabetes can be classified in three major categories: type 1 diabetes, type 2 diabetes (WHO, 1985; Velho and Froguel, 2002).

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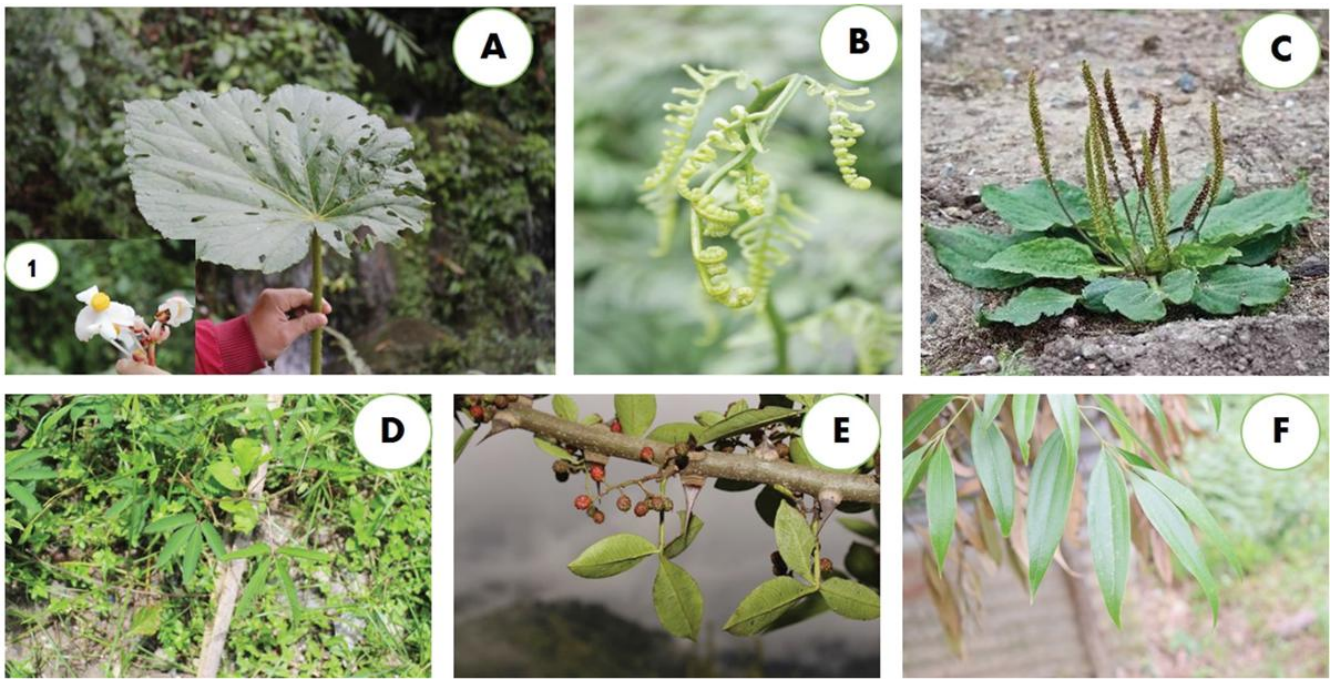

Fig. 5. Commonly occurring Anti-diabetic Plants of Lower Subansiri District of Arunachal Pradesh.
A. Begonia roxburghii A.DC.; *B. Diplazium esculentum* (Retz.) Sw.; *C. Plantago major* L.; *D. Mimosa pudica* L.; *E. Zanthoxylum armatum DC.; F. Cinnamomum tamala* (Buch.-Ham.) T. Nees & Eberm.

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