

**Full Length Research Paper****Biodiversity of Medicinal Plants used to Control Diabetes by the Rural People of Marcela Village and Surrounding Areas**Lata Satyawana Naik¹, Ananth Nag B² and Puttaiah.E.T³¹Department of Environmental Science, Gulbarga University, Gulbarga-585106²Department of Environmental Science, Kuvempu University, Shankarghatta³Vice-Chancellor, Gulbarga University, Gulbarga-585106**Corresponding Author: Dr. Ananth Nag B****Abstract**

In the present paper work 72 plant taxa were observed for the practical work on diabetes. It is observed that the people in the study area make direct use of these herbal medicines to the human bodies and get complete relief. These herbal treatments carried out by the herbal healers and also by the rural people are cheaper and elixir. While the use of plants as anti-diabetic medicine, entire plants, parts of plants in fresh or dry form or as plant juices are used. The findings of exploratory work of an ethno-botany of medicine plants of Marcela and surrounding areas generated information as mentioned in this article.

Keywords: - Anti-diabetic, herbal healers, traditional use and Medicinal plants, Kulagars.

Introduction

Now a day's diabetes is a growing problem. World over, with the conservative estimate, the members of diabetes patients is expected to be 438 million by 2030. According to WHO(1985) diabetes can be basically categorized into 2 types, namely Diabetes insipidus and Diabetes mellitus. When we talk of diabetes, we normally mean the former that is diabetes mellitus because it is one of those obstinate and other wise in unable diabetes. Modern medicine has made phenomenal progress in the treatment of several diseases. Yet scientist, doctors are unable to find a successful and sure therapy against certain dreadful diseases. Many diseases which are caused by viruses, bacteria, germs, insects are overpowered by modern medicines but some metabolic diseases like diabetes have eluded by efforts. (vaidya Bhagwan Dash, 1986).

Overall if we observe carefully diabetes prevalence is higher in men but because diabetes is more prevalent with increasing age and women live longer than men, there are more women in India with diabetes than men. In Goa too this is observed as there are several factors which cause diabetes. The estimated member of incident cause of diabetes worldwide was 11.6 million cases in 2002 (Dr. U. G. Board, 2011). WHO survey through Multinational Project for childhood Diabetes (Dia MOND) which was started in 1990 gives the data for children those <14 years of age. The annual increase in incidence between 1990 and 1999 was 2.8%. As per the world Health organisation (WHO) India had 31.7 million of people with diabetes and in counting years say about 2030 India will have 79.4 millions of people with diabetes (Dr. U. G. Barard, 2011). But to cater this disease so far only palliative therapies have been discovered by the scientists. Many anti-diabetes drugs have been discovered which are in the forms of injections, tablets to take orally. As per the patient their effect varies and also as per the contents used to prepare their drugs their results are different which are short-lived. Once the effects of the medicine wears out, the patients gets back the original situations with same old complaint. Another factor which notice about these modern drugs is that the patient becomes resistant to certain anti-diabetes drugs, even if they do not show resistant, at times the blood sugar remains normal and there is not a trace of sugar in the urine, but the diabetic process in the body continues as much as the changes in the blood vessels, the retina and the nerves continue unabated. The patient ultimately succumbs to either the complications of their diabetes changes or to the reactions or adverse side effects of the anti-diabetic drugs. Thus it has become essential to look for the remedies from non-conventional sources like herbal medicines which can not only control diabetes successfully but also cure it forever.

From time immemorial diabetes has been observed it is as old as the Vedas. It is known as Madhu-Meha in Sanskrit. "Madhu" means honey and "meha" means to pass out through the urine. Almost similar meaning the term 'Diabetes Mellitus' has which hails its origin from a Greek word "Diabainess" which means "to pass through" and a Latin word "Mellitus" meaning "honey urine" i.e. Urine testing like honey. According to "Ayurveda" this is one of the "Adhya rogas" i.e., disease of the rich which has now reached even to the people of BPL (below poverty level). This disorder is due to metabolic deficiency of insulin production in the body and / or impairment in the action of insulin. Insulin is a hormone which is secreted by the b-cells of the "Islets of Langerhans" in the pancreas. This insulin is actually a soluble protein which regulates the concentration in the blood by increasing the withdrawal of glucose from the body fluids and by decreasing the rate of addition of glucose to the body fluids and by

decreasing the rate of addition of glucose to the body fluids. The number of the people suffering from diabetes has skyrocketed over the past two decades. Today we see more and more people suffering from high blood sugar levels. The prime cause of this disease is the modern civilisation and its life style. Excessively starchy diets, intake of soft drinks, intake of tinned or preserved food, the preservatives used in such food and beverages, and excessive use of food stored in refrigerators, unbearable mental stress and strain to which man is exposed at early age today. All these aspects of modern life style contribute to the occurrence of diabetes. Also with science and technology, luxurious comforts like mixers, washing machines, grinders, lifts, flour machines are provided to the human beings have become a curse in disguise. Also we are blessed with air-conditioning to conquer heat and cold, vehicles to cover long distance and telecommunication as well. Looking at this life style we can say that man has no hard work to do and sweat in his life. He only has to think, but thinking also has been captured by computers and laptop now a days. This unwanted, unnatural rest to the body has invited several diseases including diabetes. Lack of exercise, Lack of proper sleep also cannot be neglected as the factors causing diabetes. Obesity, intake of food at wrong time, hormonal disorders, sedentary habits, hereditary predisposition to diabetes are few causes to consider that causes diabetes. Diabetic patients show symptoms like tendency to urinate frequently, excessive thirst also accompanies this habit of urinating, increase in appetite, weakness, feel of exhaust, loss of weight and strength, older persons complain of tiredness, unusual fatigue and rapidity of physical exhaustion. Also different type of aches and pains in different parts of the body, eyesight is affected, the skin becomes dry and he looks a little shrunken. Also behavioural changes can be observed in him like hot tempered, irritable and worried as the brain cells are being deprived of essential nutrients like sugar,

In the armoury of folk medicines of Goa, there are several plants which are used with considerable success and without any adverse effects in the treatment of diabetic patients. These plants are not only anti-diabetic but are also of therapeutic excellence. The compound preparations from their anti-diabetic plants are used not only to give relief to the manifested signs and symptoms of diabetes but they also produce a salutary effect on the whole body to ultimately root out the disease. All of them have large safety margins and even if they are consumed in high doses by mistake no side effects are observed. This paper presents the detail information collected as a primary data from the rural people of Marcela and surrounding villages.

Objectives of the study:-

- 1) To know the biodiversity of medicinal plants used to control diabetes in the natural way.
- 2) To know the present of anti diabetic plants available in Marcela and surrounding villages.
- 3) To know the details about herbal remedies practiced by herbal practitioners of the study area.
- 4) To learn and formulate the method of using anti-diabetic plants.
- 5) To document the details about the plant diversity under the category of “anti-diabetic drug plants”.

Description of the study Area

Marcela is a village in Ponda Taluka of North District of Goa state, India. It is situated at a distance of about 17km. from the capital city Panaji (Tiswadi) of Goa. The village is famous for several temples and for its scenic beauty. Marcela has the latitude and longitude co-ordinates of 15.5177922 and 73.9560467. Marcela is the name derived from Sanskrit word “Mahashail”. The history of Marcela tells that during the rule of portuges on Goa, Marcela was the village which was not troubled much by the foreign invaders and so the people from the areas which were affected by Portugese rule took shelter in Marcela along with their family Gods and Goddesses and also various communities brought their village Gods and Goddesses to Marcela. Some of the temples to be quoted are Devkikrishna, Rawalnath, Shantadurga, Laxmi-Narayan, Mallinath, Shri Vithal and so on. Marcela caters the people of various religions like hindu, catholic, Muslim and along with these schedule tribes and schedule caste people like Gawada, Velip, Zalmi, etc. Since time immemorial these people have been using herbal medicines to cure various ailments. There were many herbal healers in Marcela among which few are left to continue the herbal therapy. To add up more data to the topic of the present paper the author also visited neighboring villages in the outskirts of Marcela. Following table gives the details of the study area selected along with their Latitude and Longitudes.



Fig: 1. Map of the study Area

Table 1. Details of the study area selected along with their Latitude and Longitudes.

Name of the village	Latitude	Longitude	Approximate distance in kms from Marcela.
Amona	15.5329311	73.977126	6 kms.
Banastarim	15.4923823	73.9572998	3.5 kms
Betki	15.5069062	73.99.3489	3 kms.
Cumbarjuva	15.509545	73.9492078	3 kms.
Madapai	15.2993265	74.123996	1 ½ kms.
Orgao	15.5132582	73.960963	3 kms.
Tivrem	15.4992658	73.963902	2 kms.

The villages mentioned above are in the surrounding areas of main village Marcela. This area is clothed with small semi-evergreen forest patches which are rich in plant diversity. The prominent trees which are found in these villages and in their mini forests are Terminalia arjuna, Pongamia glabra, Hydrocarpus laurifolia (Khashti) Lantana Camera, Parthenium hysterophorus (congress grass), Randia dumetorium (Gello), Mimusops elengi, Mesua ferrea, Garcinia indica, Holarrhena antidysenterica, Thespesia populnea (Bhendi), Eugenia jambolana, Careya arborea (kumbyo), Moringa pterygosperma, zizgphus jujube, cassia fistula, Allophylus cobbe (Ritho), Magnifera indica and many more to list. The area under study is quite rich in medicinal plants. But construction of new buildings, highways, other illegal encroachments is destroying these valuable species. Most of the people from villages like Tivrem, orgao, Banastarim, Betki are from farmer communities where as Amona and cumbharjuva residents have fishing as well as farming as their main occupations. Literate young villagers have tendency to do white colored jobs in cities which are the groups do not make use of herbal remedies.

Materials and Methods

The present study is totally based on the visits with the villagers of Marcela, Tivrem, Madapai, Cumbharjuva, Orgao, Banastarim, Betki and Amona. Also the data is collected based on self observation in the actual field and queries with the villagers and some tribal people residing in very remote and far flung area of the North District of Goa, from the villages mentioned above. The ethno medicinal data on various anti-diabetic plants were gathered from the tribal elderly and experienced people in this field, from knowledgeable and experienced and domestic folk herbal practitioners. These people were interviewed and several visits were done in various seasons so as to collect the data minutely. Data was collected with a view to record all the uses of anti-diabetic plants being in practice among them in different parts of the villages.

During the survey from 2007 onwards till date certain plants were carefully observed which are used to control diabetes. Specimens of these plants were collected, photographs were taken, and plants were properly identified and compared with standard literature and with the herbal practitioners. Separate Literature has been prepared by the author in details about each anti-diabetic plant to highlight about its names in various Indian language. Botanical name, its meaning in English if the plant has some different latin name, its description in detail, type of the leaves, type of the fruits, type of the bark, uses in details, methods practiced by the folk herbal healers to use the herb as a medicines, parts which are used for medicine, quantity of dose to be taken and in which from it is to be taken, its religious or any other miscellaneous information is separately collected. But in the present paper the author furnishes the details only about, vernacular and English name of the plant, scientific or botanical name, family, occurrence, habit, medicinal use, plant part used, method of preparation, status in case of each anti-diabetic plant. Also videos of interviews with the herbal healers have been collected by the author and preserved.

The medicinal uses of some plants is being compiled with the help of earlier publications (Bhagwan Dash, 1997), Nita Mehta (2007), Aziz syed, Shiv charan Sharma (2006), Gulia (2007), Vaidya Shrinivas Jalukar, (1931), prabhakar Ogle.

Results and Discussion

In Goa tribal people, strongly believe in folk medicines and also some religious miracles. The Folk medicines are easily available for them. During the courses of this study, the folk medicines in their native place were studied under the experienced guidance of herbal practitioners. Also lots of data is collected from the local people. Innumerable field trips, spanning over 6 years were undertaken to collect plants and gather knowledge about their medicinal value especially those which are used for diabetes treatment and management. A total of 72 anti-diabetic plant species belonging to 42 families have been recorded. Among which 4 families found to be dominant with 20 species followed by 5 more families which are second dominant. These species are widely used by the local inhabitants / tribal / medicine practitioners in diabetes therapy. Correct botanical name, family, local name, English name, habit, parts used, occurrence of plant, a detailed accounts of the mode of administration and dose(s) also have been provided. In this study Anacardium occidentale, syzygi um etc. found to be dominant species and Asperagus racemosus willd, pterocarpus marsupium, terminalia tomentosa species is appeared as a rare species.

Village Marcela has some herbal healers, who have accrued much useful, ethno medicinal knowledge about the plants of their surroundings by sheer necessity, observation and experimentation in the area. This knowledge has disseminated mainly by memory and voice instead of written words. The knowledge is shared and used within their future generations, even though medicines are applied or patient are treated by these herbal healers, they are not ready to share their knowledge about the folk medicines. It remained within the family. But to the authors good will since the author is born and brought up in Marcela village has very good contacts with the villagers and also with the people in the surrounding vicinity of Marcela, so author could manage to gather lots of data related to folk medicines.

Herbal healers in the selected study area mostly used fresh preparation of herbal medicines in the form of decoction, juice, paste, powder etc. either singly or in combination with other plants. The mode of application, perhaps, enhances the efficacious effects of the claimed drugs. Single therapy is mostly practiced but sometimes multiple therapies are also used. Though earlier diabetes was not very common among the villagers of Marcela due to their simple site style, and was more prevalent in affluent society, it was earlier considered as the disease of rich people. But now the time is changed, environment is changed, Marcela has become one of the developing semi-urban area, lots of developments like big market complex, a huge bus-stand, housing complexes, road constructions, installations of mobile towers has changed the scenario of this tiny evergreen villages in surrounding area of Marcela. This has changed the life style of villagers also. Hard work in fields has taken place the work in shifts in industrial areas like packing, labelling where the manual work is less and no much physical exercise is being done. This has resulted tremendous increase in diabetic patients in the study area. But the treatment taken by most of the people is not folk medicine based; their flow is towards instant curing medicines of allopathy. Very few elderly people go to these herbal for traditional medicines. Also there are few middle aged patients also who believe in herbal healing plants. Following are the details about anti-diabetic drug plants.

Table 2. Anti- diabetic flora of Marcela village and surrounding areas like Amona, Banastarim, Betki, Cumbarjuva, Madapai, Tivrem, orgao with botanical names and families of plants used in Diabetes:-

Sr. No.	Botanical Name	Family	Sr. No.	Botanical Name	Family
1	Acacia Arabica (wild)	Mimo saceae	37	Ficus Race mosa	Moraceae
2	Achyranthus aspera	Amaranthaceae	38	Ficus religiosa	Moraceae
3	Aegle marmeoles	Rutaceae	39	Foeniculum Vulgane Mill	Apiaceae
4	Aza dirachtha indica	Meliaceae	40	Hibiscus rosa – siensis L.	Malvaceae
5	Allium cepa L	Liliaceae	41	Holarrhena antidysenterica	Apocyanaceae
6	Allium Sativum	Liliaceae	42	Lawsonia inermis L.	Lythraceae
7	Aloevera	Agavaceae	43	Mangifera indica	Ancardiaceae
8	Anacardium occidentale	Ancardiaceae	44	Melia azedarach	Meliaceae
9	Annona squamosa	Anonaceae	45	Michelia champaca	Manoliaceae
10	Areca catechu L.	Arecaceae	46	Mimosa pudica	Mimosaceae
11	Asperagus racemosus wild	Liliaceae	47	Momordica charantia	Cucurbitaceae
12	Bacopa monnieri (L) Penn	Scrophulariaceae	48	Morus Nigra Linn	Moraceae
13	Bauhinia purpurea	Leguminoceae	49	Murraya koenigii (L) spreng	Rufaceae
14	Butea monosperma (Lam) Kuntge	Papilionaceae	50	Nelumbo nucifera	Nymphaeaceae
15	Calotropis gigantean R. Br. (white flowered)	Asclepiadaceae	51	Nymphaea rubra Roxb	Nymphaeaceae
16	Calotropis procera (Linn) (purple flowered)	Asclepiadaceae	52	Ocimum Sanctum	Lamiaceae
17	Carica papaya	Caricaceae	53	Oista stratiotes Linn	Araceae
18	Carissa carandus	Apocynaceae	54	Opuntia dillenii Haw	Cactaceae
19	Cassia auriculata linn	Caesalpinaceae	55	Oxalis corniculata L.	Oxalidaceae
20	Cassia fistula	Caesal piniaceae	56	Phaseolous Vulgaris	Fabaceae
21	Catharanthus roseus	Apocyanaceae	57	Phyllanthus fraternus web / Phyllanthus amarus	Euphorbiaceae
22	Ceiba pentandra (linn) Gaerth	Bombacaceae	58	Polyalthia longifolia Thw	Annonaceae
23	Centella asiatica (Linn) urban	Umbelliferae	59	Pongamia pinnata (L) Pierre	Papilionaceae
24	Cinnamomum Sp	Luraceae	60	Psidium guajava Linn	Myrtaceae
25	Citrus limon	Rufaceae	61	Pterocarpus marsupium	Papi lionaceae
26	Coccinia indica W & A	Cucurbitaceae	62	Punica granatum L.	Puni caceae
27	Cocos nucifera L.	Arecaceae	63	Ricinus communis Linn	Ephorbiaceae
28	Coriandrum sativum Linn	Apiaceae	64	Santalum album	Santalaceae
29	Cassia tora L.	Caesalpinaceae	65	Sida cordifolia L.	Malvaceae

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30	Cuminum cyminum Linn	Umbelliferae	66	Tamarindus indica Linn	Caesalpiniaceae	
31	Cynodon dactylon (L.) Pers	Poaceae	67	Tectona grandis L.F.	Verbenaceae	
32	Cyperus rotundus Linn.	Cyperaceae	68	Terminalia fomentosa	Combretaceae	
33	Emblica officinalis / Phyllanthus emblica linn	Euphorbiaceae	69	Terminalia paniculata Roth	Combretaceae	
34	Eugenia jambolana / or sygygium juminii	Myrtaceae	70	Tinospora cordifolia	Menispermaceae	
35	Euphorbia hirta linn.	Euphorbiaceae	71	Trigonella foenum – graecum Linn	Fabaceae	
36	Ficus bengalensis	Moraceae	72	Zingiber officinale Rose	Zingiberaceae	

- ❖ Acacia Arabica (Babool) ie. Black Babool is not found in the study area but a few herbal healers borrow it from neighbouring state Karnataka ie. From Belgaum or they buy from Hindu Pharmacy (Ayurvedic Pharmacy) of panaji – Goa.
- ❖ Azadirchtha indica (koddunimb) because of its very bitter taste is taken on empty stomach, in some patients it may cause nausea or lose motions. So care should be taken and accordingly dose should be reduced. To overcome nausea chew the seeds of cardamom.
- ❖ Butea monosperma (pallas) has become extinct from the study area. But is abundantly found in western ghats on the borders of Goa state and also found in the nearby forest of Valpoi, Sattari, from where it is borrowed to use as a medicine for diabetes in the study area.
- ❖ Kulagar :-There are the plantation areas in which trees like areca nut, coconut, jack fruit, bread fruit, Garcinia indica, Michelia Champaca, pepper, betel nuts etc are grown. The areas are to be watered regularly. And these are very cool, sensitive patches found in many parts of Goa which are called Kulagars.
- ❖ Ceiba pentandra (Linn) Gaerth (Dhavi Savar) is not found in the study area at all, earlier also it was not available in this area so some of the herbal heaters in Marcela even they know the use of ceiba petitandra (Linn) Gaerth .But they do not administer it for any patient due to its unavailability.
- ❖ Pterocarpus marsupium (Biblo) has almost become extinct from the study area. It was earlier famous for its black strong wood which was used to make furnitures earlier. But still some of the herbal healers make the use of it for diabetes.
- ❖ Terminalia fomentosa (Aasan) also is not available in the study area but herbal healers make it available from other sources for the treatment.
- ❖ In Ayurvedic Medicine Pterocarpus marsupium and Terminalia tomentosa are considered as synonyms

Table 3. List of families and number of anti-diabetic drugs falling under the respective families:-

Sr. No.	Name of the family	Number of anti-diabetic plants from this family	Sr. No	Name of the family	Number of anti-diabetic plants from this family
1	Agavaceae	1	21	Leguminoceae	1
2	Amaranthaceae	1	22	Liliaceae	3
3	Ancardiaceae	2	23	Malvaceae	1
4	Anonaceae	2	24	Manoliaceae	1
5	Apiaceae	1	25	Meliaceae	2
6	Apocyanaceae	3	26	Menispermaceae	1
7	Araceae	3	27	Mimosaceae	1
8	Asclepiadaceae	2	28	Moraceae	4
9	Bombacaceae	1	29	Mymphaeaceae	2
10	Cactaceae	1	30	Myrtaceae	2
11	Caesalpinia ceae	4	31	Oxalidaceae	1
12	Caricaceae	1	32	Papilionaceae	3
13	Combretaceae	2	33	Poaceae	1
14	Cucurbitaceae	2	34	Punicaceae	1
15	Cyperaceae	1	35	Rutaceae	3
16	Euphorbiaceae	4	36	Santalaceae	1
17	Eythraceae	1	37	Scrophulariaceae	1
18	Fabaceae	2	38	Umbelliferae	2
19	Lamiaceae	1	39	Verbenaceae	1
20	Lauraceae	1	40	Zingiberaceae	1

From above table one can conclude that, species belonging to the families like, Apiacea, caesalpiniacea, Euphorbiace and Moracea have highest number, of plants to be used as anti-diabetic drugs. Whereas looking at the table we can make out that there are many families of which only one species are used as anti-diabetic drugs.



Fig 2. Some interviews of herbal healers

Table 4. Taxonomic Enumeration of some anti-diabetic plants of Marcela village and surrounding villages:-

Botanical Name	English Name	Vernacular Name	Habit	Habit or occurrence of the plant	Parts used	Mode of administration	Dose (s)
Acacia arabica, wild	Babool, Black babool	Babhall	Thorny medium sized tree	Not available in study area	Gum	It is eaten as a betel nut, which also strengthens the gums of teeth and gives strength to body along with the treatment for diabetes.	2 to 3 gms per day
Achy rantha us aspera	Prickly chaff flower	Agadho	Shrub	Found along roadsides and in open areas.	Whole plant	Decoction of a whole plant is taken by the patient twice a day with empty stomach.	1 glass at a time
Aegle Marmeoles	Bael tree, Bengal Quince	Bael	Deciduous Thorny Medium sized tree	Found near the temples	Leaves	Three leaves should be chewed and eaten twice daily	6 leaves per day

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Azadirachta indica	Margosa tree, Neemtree	Koddunee m	Big tree	Rarely found in the study area, also cultivated for medicine.	Leaves, flowers	Leaves dried in shade, powdered and used in diabetes. Flowers are eaten as a vegetable.	30 ml twice daily life decoction of powder is prepared.
Allium Sativum	Garlic	Lossunn	Herb	Not cultivated but is always used in the kitchen	Garlic cloves	It is used regularly through diet	As per the taste required.
Allium sepa	Onion	Kando, Pion	Bulbous herb.	Cultivated in some fields in the villages of study area.	Bulb	Decoction of tender bulb with turmeric powder	½ cup on empty stomach
Alove vera	Indian Aloe	Katekor	Rhizomatous herb	Cultivated	Whole plant	Leaf is roasted and is consumed, the jelly like mucilage by mixing it with turmeric powder	2-3 gms of jelly per day on empty stomach
Ancardium occidentale	Cashew nut	Caju	Medium sized tree	Cultivated as cash crop and also found wild and in open spaces.	Bark	Decoction of the bark of the tree is given till cure	1 glass on empty stomach
Annona squamosa	Custard-Apple, Sugar Apple, sweet sop	Sitaphal	medium sized tree	Found in open spaces and also cultivated in backyards	Leaves, bark of the tree	Decoction of leaves and bark is very effective. To be consumed on empty stomach	1 glass per day
Areca catechu L.	Betel nut	Supari beddo	Erect, strong tall tree	Cultivated in kulagars, in backyards	Nuts	Decoction of nut with old jaggery is given for 10-20 days to treat the nervous and urinary disorders caused due to diabetes.	5 g nut powder with 5 gm old jaggery.
Bacopa monnieri (Linn) penn	Thyme leaved Gratiola or water Hyssop	Ghooe (Gholee)	Evergreen delicate herb	Found in wet, marshy area, also in kulagars. Also in vegetables crops	Whole plant	Aqueous leaf juice twice a day for 1 month. 2. 5ml leaf juice +15ml of bael leaf juice for 1 month to reduce blood sugar	1. one glass on empty stomach 2. as indicated
Calotropis gigantean R.Br. (white flowered)	Crown plant, Madar, Giant Milk weed	Rui, Rhui, Dhavi Rui.	Medium sized herb which grows about 3 meter high	It grows wild anywhere in the study area.	Flower	Decoction of flower with rhizome juice of Haridra curcuma longa) is given twice a for 15 days	10 ml of decoction of flowers+ 3 ml of Haridra juice.
Carrisa carandas	Bengal currants	Kanna, carandam	Strong woody shrub with a number of spines	It grows in the hilly, forest regions of study area	Fruits	5 gm fruit paste is given for 1 month to take care of nervous disorders due to diabetes	As indicated
Cassia tora L.	Sickle senna, Ringworm plant	Taikhillio	Small herb	Grows on roadside, waste areas.	Seeds, leaves	1.5gm of seeds powdered with 2 pepper seeds. Given daily once for month 2. vegetable of leaves	As indicated

Catharanthus Roseaus G. Bom	Vinca Periwinkle	Sadaphuli	Herbaceous Perennial erect	Founding the gardens of study area	Leaves , roots	is eaten The infusion of the leaves is given	4 to 5 cups a day for adults
Ceiba pentandra (linn) Gaerth	White silk cotton tree, True kapok tree	Dhavi sanvor	Medium sized tree with thorns	Not available in study area.	Roots	Juice obtained from roots, most valuable cure for diabetes	2tsp. Of juice, everyday in the morning.
Centerla asiatica	Indian Pennywort	Braamhi	Common creeping rooting herbs	Found in most wet areas, also found in kulagars and in field areas	Leaves or whole plats	1) juice of leaves is extracted and given till cure 2) Whole plant is used to prepare decoction till cure	1) 2 tsp full every day 2) 4 cups a day
Citrus limon	Lemon	Limbu	Short size tree	Grown for medicinal purpose in backyard	The fruit juice	Drink lemon juice with little salt or without salt in a lukewarm water	As per the need
Cocas nucifera L.	Coconut	Naall	Tall erect palm tree	Cultivated on large scale	Kernel , flowers	1. flower juice taken twice a day for 30 days. 2. Fresh coconut milk of a very young fruit is given every alternate day for 1 month to restore potency	1.2 spoon ful 2. As indicated 1 glass of milk
Coccinia indica W.& A.	Ivy gourd	Tendalim	Climbing or prostrate perennial herb	Cultivated as well as wild.	Leaves , fruits, roots	Juice of thick tuberous root is given to treat diabetes mellitus.	1 tsp. Every day on empty stomach
Calotropis procera R. Br. (purple flowered)	Swallow wart, milk weed, king's crown	Rui, Jhamballi Rui.	An evergreen shrub	It grows wild anywhere in the study area	Roots	Roots are pound with the leaves of androgaphis paniculata (creat) and paste is made into pills. And pills are taken twice a day for 21 days	As indicated
Cumincim Cuminum	Cumin	Jeerein	Herbaceous plats	Not cultivated in the study area but is used by all people in kitchen for culinary purposes.	Seeds	It has volatite oil which is effective in diabetes .-Decoction of seeds everyday lowers down the sugar level .	4 to 5 cups a day
Cynodon dactylon (L)pers	Bermuda Grass, Bahama Grass, couch Grass.	Duurvaa, Hariyaali	Delicate Grass	Found on the roadside, also near the temples.	Whole plant	Decoction of whole plant is given 2 times a day for 15 days	1 glass on empty stomach
Cyperus rotundas Linn	Nut grass	Tann, (Nagaarmo)	Delicate Grass	Found in marshy wet	tubers	Tubers are sliced and dried and powdered	1 glass of water to be

		tha)		areas. Also grows in rainy season as a weed.		.This powder is given 5gm with 2 black pepper (Piper nigrum) is taken with water	used
Note:- very less people make use of cyperus rotund as for diabetes.							
Emblica officinalis	Indian Goose berries	Anvaallo	Deciduous monoexious tree	Found in forests, also cultivated near the temples.	Fruits	2 gm of powder of fruits with a glass of luke warm water regularly form 1 month	As indicated should be taken on empty stomach
Eugenia Jambolana	Java plum, Black plum, Jambolan	Jambllan	Big branched tree	Found abundantly in forest and on the roadside	Fruit seeds leaves	1.2gm of dry seed powder once a day for about 2 months 2. Fruit pulp given twice a day for 15 days 3. Tender leaves to be chewed for one month	As indicated
Euphorbia hirta linn	Snake weed	Dourly (weed) (latex is milky so the name)	Procumbent rigid herd	It abounds on grasslands and waste places.	The whole plants	The decoction of whole plant is given	Only 12 to 20 gms of plant material to be used for 1 litre of water
Ficus bengalensis	Banyan tree	Wadd, wadache - zhaad	Spreading, much branched evergreen tree		Bark	Infusion of bark is used till cure	1 glass everyday
Ficus racemosa linn	Cluster fig, country fig.	Audumbar	Big branched tree	Found near the water bodies Also near the temples	Sap of the root	1.Sap of root is collected by cutting the root and collecting sap in earthen pot overnight. In the morning the sap is collected. This is given to the patient 4 to 5 cups per day.	As indicated
Ficus religiosa linn	Bot-tree peepal	Peepall	Large deciduous tree, with no aerial roots	Found in village in open spaces, also near temples.	Bark fruits	1.1tsp of bark extract is taken till cure 2. unripe fruit is boiled and jeera powder is mixed in to this should be taken for 15 days	As indicated
Hibiscus rosasiensis L.	Shoe flower, chin ese hibiscus	Dasant Dasann	Woody tall shrub		Flowers	1.5 to 10 ml of infusion petals given in diabetes to lessen the sugar level.	As indicated
Holarrhena antidysenterica	Easter tree, Ivory tree, Tellicher bark	Kudo, shenta	Woody strong shrub		Stem bark	Decoction of extract of stem bark is given in diabetes	20-30 gm for an adult
Lawsonia mermis L.	Heena	Methi	Thorny medium sized shrub	Grown as a hedge plant or grown in	Flowers and leaves	Decoction of leaves and flowers in same quantity ie. (2-5gms)	1 glass

				backyards individually		each, daily for 15 days to reduce sugar level in urine.	
Mangifera indica	Mango	Aambo	Big tree		Leaves	one leaf is soaked in the water overnight. Next morning the leaf is torn into peaces by slowly separating it from the veins of the leaf. No vein of the the leaf should be taken and then boil the leaf in the water in which it was soaked ,drink on empty	1 glass per day
Melia azedarach	Persian lilac	Phirangi nimb	Short 8 to 12 high tree	Cultivated in gardens found wild in forest	Root bark, leaf and fruit gum stem bark	1.Paste or juice of leaves 1tsp.ful 3 times a day with honey 2. Powder of root bark, stem bark should be gives 1tsp.ful 3 times a day with honey 3. Powder of gum should be given 1tsp.ful 3 times a day 4. Decoction of root bark one ounce 6 tsp. Twice a day.	As Indicated
Michelia champaca	Champa k golden champa	Chaffo, sonnchaffo	Tall tree, bears a spreading crown	Cultivated as ornamental plant in gardens in Kulagars ,near temples	Flower	Decoction of flowers is usefull in urinary problems caused due to diabetes	3 tsp. Every day
Mimosa pudica	Touch me not plant, sensitive plant, Humble plant	Laajji	Prickly prostrate herb	Grows in open spaces. Abundantly found every where	Mimosa pudica Leaves	1 tspful of leag juice given 2 times 2 a day till cure.	10-20ml of juice
Momordica Charantia	Bitter gourd	Karantein	Delicate climber with slender stems	Cultivated in fields and also in backyards for culinary purpose.	Morordica leaves	1.Juice of leaves and fruits to be given 3 times a day. 2 tsp. Ful a powder three times a day	One ounce (6 tsp) Two tsp. Full
Morus nigra	Black mulberry	Tutee / amor	Shrub growing upto 10 meters	Cultivated as ornamental plant in gardens rarely found	Leaves	Infusion of leaves is given to drop in blood sugar, some time in diet.	5 ml everyday
Murraya koenigii (L.) spreng	Curry leaf tree	Karbel	Woody medium sized shrub	Cultivated in backyard mostly for culinary purposes	Murra ya leaves	Eat 7 fresh leaves every morning for 3 months. This will cure diabetes due to hereditary factors and	As indicated

Nelumbo Nucifera	East Indian Lotus, sacred Lotus	Kamall	Aquatic lily	Seeds	Found in ponds	due to obesity 10 gms of seeds are fried in ghee and are mixed with 2 gms of jaggery and consumed everyday before sunrise to check impotency due to this disease.	As indicated
Nymphaea rubra roxb.	Indian red water lily	Tambade kamall	Aquatic rhigomatous herb	Rarely found in study area but available in other parts of Goa	Seeds	Powder of seeds to be consumed with lukewarm water	½ glass per day
Ocimum sanctum	Holy basil, sacred Basil	Tulas	Erect aromatic herb	Cultivated for religious purpose in Tulsi vridavan in front of the every hindu in Goa	Leaves	5 to 6 leaves to be eaten on empty stomach	As indicated
Opntia dillenii low	Prickly pear / opuntica	Kantya Nivali	Cactus with broad leaf like succulent stems called phylloclade's.	Found in dry rock areas mostly in cashew plantation in the study area	The phylloclade, or flattened stem	The flattened stem is roasted on fire and juice extracted from it is given till cure.	1 table spoon everyday
Oxalis orniculata L.	Indian sorrel	Chaangii	Tiny delicate herb	Found near marshy, wet areas near water bodies	Whole plant	Fresh juice of whole plant mixed with cow's butter given once daily for the 15 days to treat thirst caused in diabetes	1 table spoon
Phaseolus vulgaris	French bean, kidney bean	Vaal papadi	Erect herb seeds pod	Not grown in study area available in market.	Seed pod	It is advised to include in the diet as French beans reduces blood glucose level	As per the need.
Phyllanthus traternus web or Phyllanthus amarus	Phyllanthus or seed under leaf plant or egg woman.	Bhuiaanval lo	Tiny fruiting herb	Found growing among weeds in gardens in waste lands and along the roadsides	Whole plant	10 grams of the plant material is used for 1 litre to prepare decoction which is given to me patient.	2 to 3 cups a day.
Pistia stratiotes Linn	Water lettuce Tropical Duckweed	Jalkumbhi (udkatlo) gulab)	Aquatic plant growing in large numbers	It is found floating on lakes, lazy streams and on stagnant water which is rich in lime	Whole plant	Infusion of leaves is given to treat urinary problem in diabetes	1 glass per day in the morning
Polyathia longifolia thw	Mast tree, cemetery tree	Shobhecho ashok	Tall handsome tree	Common ornamental tree found everywhere	The bark	The decoction of the bark is very effective ei. Taken till cure everyday in the	One ounce 16 table spoon

				in study area		morning	
Pongamia pinnata (L) pierre	Pongam oil tree, Indian Beech	Karanj	Big tree	Found in the forest Also cultivated by grampanchayat on the roadside	Flowers, roots	1. Decoction of flowers used to quench thirst in diabetes 2. juice of the roots given along with equal quantity of coconut milk once a day for 3 days to check urination problem due to diabetes	1.3 tsp full of flower decoction to be given till cure. 2. 10 ml juice of roots + 10 ml coconut milk.
Pterocarpus marsupium	The Indian kinotree, The Malabar kino tree	Biblo	Moderate size to large deciduous tree.	Rarely found in the study area	Wood	Powder of wood is kept in the water, in about 12 hours the colour of the water changes this water is strained and taken for about thirty days	One ounce (six teaspoon full) 3 times a day.
Punica granatum Linn	Pomegranate	Dallimb	Medium size tree	Cultivated in gardens for fruits	Root bark, fruit rind	1. to check polyuria in diabetes ie. Excessive urination, equal amount of root bark and fruit rind ground to a paste and given twice a day	10 gms of paste to gather is given
Santalum album	White sandal wood	Chandan	Strong woody medium sized tree	It has become very rare in study area	Wood	5 gm paste of heartwood (chandan) or heartwood oil mixed with 5 gm of fenugreek powder for 7 days to be given	As indicated

Conclusion

Based on the above observations and discussions on the anti-diabetic plant drugs found in the village Marcela and surrounding areas following suggestions can be made as recommendations:-

- In order to preserve and promote positive health and help prevention of disease an individual's remedies should be fully natural remedies and he/she should show faith in the treatment offered to him/her.
- The awareness campaign should be started about this silent killer disease and also about the importance of taking natural herbs and conserving and preserving of these folk medicines should be percolated to the grass root level to the people.
- The knowledge of anti-diabetic medicinal plants and medico ethno botanical culture should be exchanged from the previous generation to the next. It should be encouraged at all the levels.
- This knowledge should be carefully documented, protected from modernization, urbanization and careless use of the same.
- Proper guidance should be given by the herbal healers, botanists, knowledgeable people to identify these medicinal plants correctly which will help to preserve and conserve them.
- Step should be taken to conserve and preserve, protect the endangered species of anti-diabetic importance at large.
- Diabetic patients should be trained properly about how to prepare and consume the drugs in the correct doses.
- The sedentary habits in patients should be removed and encourage the patients to perform good habits with yogic exercise, physical exercise, proper diet, also inform about ill effects of sleep during the day time and allow the patient to live closer to the nature
- Also convince the patient that these herbs produce no adverse effects when used for a prolonged period, there is no fixed course of the treatment of diabetes with patient becomes absolutely free from the disease and even for a few months thereafter to prevent recurrence of the ailment.

Summary

The present paper on the biodiversity of medicinal plants used to control diabetes by the rural people of the study area deals with the traditional knowledge of healing herbs found and available in the study area. This valuable information is collected from the

traditional herbal practitioners, locally known as vaij, vakhadi, has revealed that 72 medicinal plants are being used as anti-diabetic herbs in the form of powder, decoction, juice, extracts, latex, paste for the treatment of the said disease. Botanical name, English name, Vernacular name, habit, Occurrence of the anti-diabetic drug, parts used and mode of administration of the drug along with the doses to be taken is documented systematically and cleanly by using primary data collected by the author.

Acknowledgements

I am thankful to the herbal healers, villagers, students of Marcela, Tivrem, Orgao, Betki, Amona, Cumbarjuva, Banastarim, Madapai – Goa for sharing their valuable knowledge of anti-diabetic drug plants, Also thankful to Dr. E. T. Puttaiah, Vice-chancellor, Gulbarga university for his valuable guidance in this study. Dr. Ananth Nag Dept of Environmental Science Kuvempu University, shimoga, for providing me to prepare this Research Paper.

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