

TRADITIONAL HERBAL REMEDIES USED FOR THE TREATMENT OF DIABETES IN SOUTH EASTERN REGION OF NEPAL

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ABSTRACT

Traditional knowledge has become recognized worldwide to control many diseases and diabetes is also one of them. In Nepal, remote areas are the root of the indigenous knowledge of medicinal plants. The present study aimed to record traditional medicinal uses of plants to control diabetes. Several times interactions were done with the traditional healers, local knowledgeable old person and other informants like few local people and household visits. A total of 39 plant species of 35 genera belonging to 23 angiosperm families were found to be used in diabetes. About 36 types of herbal remedies were investigated from the rural inhabitants of the area. These traditional recipes include extracts, leaves, powders, flour, seeds, vegetables, fruits and herbal mixtures. Traditional knowledge systems are culturally valued and scientifically important. Strengthening and disseminating the use-value of these plants can save the money and life of poor people.

Key words: medicinal plants - diabetes - herbs - herbal remedies - tribals - Tharu community.

INTRODUCTION

Diabetes is fast gaining the status of a potential epidemic (Joshi *et al.*, 2007 & Kumar *et al.*, 2013). In 2000, India (31.7 million) topped the world with the highest number of people with diabetes mellitus followed by China (20.8 million) with the United States (17.7 million) in second and third place respectively. The prevalence of diabetes is predicted to double globally from 171 million in 2000 to 366 million in 2030 with a maximum increase in India. It is predicted that by 2030 diabetes mellitus may afflict up to 79.4 million individuals in India, while China (42.3 million) and the United

States (30.3 million) will also see significant increases in those affected by the disease (Wild *et al.*, 2004). There were 657200 cases of diabetes in Nepal according to International diabetes federation 2017. The contribution of plant resources to health of rural people is extremely important because more than 80 percent of the population rely on traditional medicinal systems for their health care (WHO, 2002; Shrestha & Dhillion, 2003). The important values of some plants have long been published but a large number of them remain unexplored as yet. So there is a necessity to explore their uses and to conduct pharmacognostic and pharmacological studies to ascertain their therapeutic properties (Baquar, 1989). Approximately 343 plants of the world have been tested for the blood glucose which found the lowering effect in the laboratory experiments. Of them, 158 species are claimed to be used in the Ayurved (Rahman & Zaman, 1989). Due to changing perception of the local people and the ever increasing influence of global commercialization and socio-economic transformation, indigenous knowledge on plant resource use is constantly diminishing (Kunwar & Adhikari, 2005). Furthermore, the indigenous knowledge on the use of lesser known plants is also rapidly declining (Kala, 2005). However, in Nepal the traditional medicinal plants that are used for the treatment of diabetes have not yet been studied in great detail. In past papers published in ethnobotany by various scientists (Manandhar, 1986; Yadav, 1999; IUCN, 2000, 2004; Dhami, 2008; Sankaranarayanan *et al.*, 2010; Singh *et al.*, 2012; Singh, 2015 & 2017 and many more scientists have also mentioned the use of few plants to treat diabetes. In fact diabetes now a day is a global problem. The present study aimed to record the ethnomedicinal uses of indigenous plants to control diabetes mellitus. The recorded traditional phytotherapy will provide the basis for clinical research in order to establish their therapeutic properties of various formulae.

METHODS

Study Area

Parsa District lies in Province 2 of Nepal located between 84° 8' to 85° 27'E longitude and 27° to 27° 26'N latitude. This study was carried out in four villages; Gadi, Madhuban mathwal, Sonbarsa and Shanker Sharaiya of the district which is towards the south eastern part of the district. (Figure

1 a. & Figure 1 b.). The typical vegetation of this area is tropical forest types dominated by *Shorea robusta*, *Acacia catechu* and *Dalbergia sissoo*.



Figure 1 a. Map of study area



Figure 1 b. Map of studied villages

Selection of Participants, Data collection, Identification of plants and Data Analysis

A total of 50 participants (30 men and 20 women) were selected randomly from the representatives. Common participants and knowledgeable traditional medicine practitioners of the district were selected using random and purposive sampling approaches, respectively,

following Martin (1995). Data were collected from March 2018 to February 2019. The standard data collection methods (Martin 1995 & Cotton 1996) were followed to document traditional knowledge of the local community for treating diabetes. The techniques employed for data collection were semi-structured interviews, group discussion, field visits and observations with participants. Most data were collected from primary sources. The secondary sources include a review of literature i.e. journals, articles and books. Most of the plants were identified in the field but verified by cross-checking with the voucher specimens present in the National Herbarium and Plant Laboratory, Godavari, Lalitpur, Nepal. Common names collected during interviews were also verified with Shrestha's dictionary of Nepalese Plant Name (1998) & IUCN report (2000). To compare the efficacy of a particular plant for diabetes, frequency of citation was also done by the participants. Preference analysis was done to analyze the most effective and most commonly used plants to control diabetes by the local inhabitants. In this exercise, 10 participants were selected randomly among the total participants.

Frequency of Citation & Preference index was calculated by the following formulas:- (Amatya, 1996)

$$\text{Frequency of citation (\%)} = \frac{\text{No. of informants who cited the species}}{\text{Total no. of informants interviewed}} \times 100 \quad (1)$$

$$\text{Preference index} = \frac{\text{Preference level} \times \text{No. of respondents}}{\text{Total no. of respondents}} \quad (2)$$

RESULTS

This study revealed 39 plant species belonging to 23 angiosperm families with 35 genera used to treat diabetes mellitus. About 36 types of herbal remedies were notified from the study area to treat diabetes. The plants species used for treating diabetes by rural inhabitants of the study area are arranged alphabetically, followed by their common name, local name, family and habit in Table 1.

The most dominant antidiabetic plant bearing family was Fabaceae having 6 species followed by Poaceae, having 4 species and Liliaceae, having 3 species (Figure 2).

Table 1: Name of plant species with family and habit

S. N.	Botanical name	Common name	Local name	Habit	Family
1	<i>Adhatoda vasica</i> (Nees)	Vasaka	Asuro	Herb	Acanthaceae
2	<i>Aegle marmelos</i> (L.) Correa	Stone apple	Bel	Tree	Rutaceae
3	<i>Allium cepa</i> (L.)	Onion	Piaz	Herb	Liliaceae
4	<i>Allium sativum</i> (L.)	Garlic	lahsun	Herb	Liliaceae
5	<i>Aloe vera</i> (Mill.)	Aloe	Ghiukumari	Herb	Liliaceae
6	<i>Bixa orellana</i> (L.)	Lipstick tree	Sindure	Tree	Euphorbiaceae
7	<i>Boerhaavia diffusa</i> (L.)	Hog weed	Punarnava	Herb	Nyctaginaceae
8	<i>Cajanus cajan</i> (L.)	Pigeon pea	Rahar dal	Shrub	Fabaceae
9	<i>Catharanthus roseus</i> (L.)	Periwinkle	Sada bahar	Herb	Apocynaceae
10	<i>Cicer arietinum</i> (L.)	Gram	Chana	Herb	Fabaceae
11	<i>Cyperus rotundus</i> (L.)	Nutgrass	Motha	Herb	Cyperaceae
12	<i>Daucus carota</i> (L.)	Carrot	Gajar	Herb	Apiaceae
13	<i>Delonix regia</i> (Hook.) Raf.	Flame tree	Gulmohar	Tree	Fabaceae
14	<i>Dillenia pentagyna</i> (Roxb.)	Kamada	Tantari	Tree	Dilleniaceae
15	<i>Ficus bengalensis</i> (L.)	Banyan	Bar	Tree	Moraceae
16	<i>Ficus racemosa</i> (L.)	Fig	Gular	Tree	Moraceae
17	<i>Hibiscus rosa-sinensis</i> (L.)	China rose	orhul	Shrub	Malvaceae
18	<i>Hordeum vulgare</i> (L.)	Barley	Jau	Herb	Poaceae
19	<i>Melia azedarach</i> (L.)	China berry	Bakaino	Tree	Meliaceae
20	<i>Momordica charantia</i> (L.)	Bitter gourd	Karela	Climber	Cucurbitaceae
21	<i>Murraya koenigii</i> (L.)	Curry leaf	Mitho nim	Shrub	Rutaceae
22	<i>Ocimum album</i> (L.)	White basil	Ban Tulsi	Herb	Lamiaceae
23	<i>Ocimum sanctum</i> (L.)	Holy basil	Tulsi	Herb	Lamiaceae
24	<i>Oryza sativa</i> (L.)	Rice	Chawal	Herb	Poaceae
25	<i>Oxalis corniculata</i> (L.)	Indian sorrel	Chari amilo	Herb	Oxalidaceae
26	<i>Phyllanthus emblica</i> (L.)	Goose berry	Amla	Tree	Euphorbiaceae
27	<i>Psidium guajava</i> (L.)	Guava	Amba	Tree	Myrtaceae
28	<i>Rosa alba</i> (L.)	Rose	Gulab	Shrub	Rosaceae
29	<i>Scoparia dulcis</i> (L.)	Goat weed	Mithajhar	Herb	scrophulariaceae
30	<i>Solanum nigrum</i> (L.)	Black nightshade	Kalo bihi	Herb	Solanaceae
31	<i>Syzygium cuminii</i> (Skeels)	Black plum	Jamoon	Tree	Myrtaceae
32	<i>Tinospora cordifolia</i> (L.)	Guduchi	Gurju	Twiner	Menispermaceae
33	<i>Trigonella foenum-graecum</i> (L.)	Fennugreek	Methi	Herb	Fabaceae
34	<i>Triticum aestivum</i> (L.)	Wheat	Gahun	Herb	Poaceae
35	<i>Vigna mungo</i> (Burm. f.)	Green gram	Mung	Herb	Fabaceae
36	<i>Vigna sinensis</i> (Burm. f.)	Cow bean	Bori	Twiner	Fabaceae
37	<i>Withania somnifera</i> (L.)	Wintercherry	Aswagandha	Shrub	Solanaceae
38	<i>Zea mays</i> (L.)	Maize	Makai	Herb	Poaceae
39	<i>Zizyphus jujube</i> (Mill.)	Chinee tree	Bayar	Tree	Rhamnaceae

Source: Field survey, 2018 & IUCN, 2000

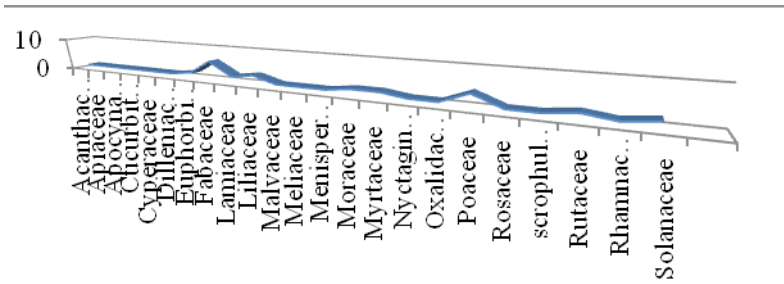


Figure 2: Family wise analysis of the studied plants

Different parts of the plants like, Leaves, seeds, fruits, shoot, bulb, bark, wood, stem and root are used as medicines. But, the most commonly used part of the plants was leaf (Table 2).

Table 2: List of plant parts used for making crude drug

S. N.	Plant parts	No of species used	% of richness
1	Leaf	12	31
2	Seed	10	26
3	Fruit	7	18
4	Shoot	3	8
5	Bulb	2	5
6	Bark	2	5
7	Wood	1	2
8	Stem	1	2
9	Root	1	2

Source: Field survey, 2018

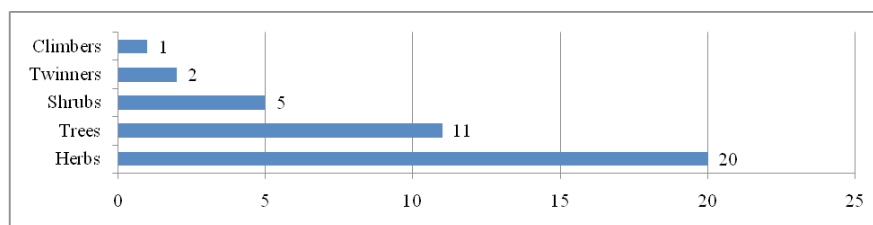
The different parts of the plants used as medicines in different ways which include filtrate, raw leaves, powder, flour, seeds, vegetables, fruits and herbal mixture. Filtrates and powder are a common mode of medicines preparation (Table 3).

Depending upon the habit, among total studied plants; 20 plants (51%) are herbs, 11plants (28%) are trees, 5 plants (13%) are shrubs, 2 plants (5%) are twinnners and 1 plant (3%) is a climber (Figure 3).

Table 3: Mode of preparation of medicines

S.N.	Types of medicines	No of species used	% of richness
1	Filtrate	12	34
2	Powder	7	20
3	Vegetable	4	11
4	Leaf	4	11
5	Fruit	3	9
6	Seed	2	6
7	Latex	2	3
8	Bread	1	3
9	Herbal mixture	1	3

Source: Field survey, 2018

**Figure 3:** Plant species based upon habit used for diabetes

The result showed that the preference index of *Syzygium cumini* is highest followed by *Catharanthus roseus* in the second position and *Tinospora cordifolia* in third position (Table. 4).

Table 4: Preference Analysis of most preferred plants for diabetes

S.N.	Plant Species	No. of Respondents per Preference level			Preference Index	Rating
		1	2	3		
1	<i>Syzygium cumini</i>	4	5	1	1.7	I
2	<i>Catharanthus roseus</i>	4	4	2	1.8	II
3	<i>Tinospora cordifolia</i>	4	0	5	1.9	III
4	<i>Trigonella foenum graecum</i>	3	4	3	2.0	IV
5	<i>Scoparia dulcis</i>	2	3	4	2.2	V

Source: Field survey, 2018

The result of this study showed that plants used for treating diabetes were in nine different categories viz., antidiabetic filtrate, antidiabetic leaves,

antidiabetic powder, antidiabetic bread, antidiabetic seeds, antidiabetic latex, antidiabetic herbs/vegetables, antidiabetic fruits and antidiabetic herbal mixture. In antidiabetic filtrate category; about 10 ml of few fresh leaves filtrate of *Adhatoda vasica* is used thrice a day (Citation %23), the pulp of fresh leaves (2") of *Aloe vera* is taken either directly or mixing with water (Citation %25), hot decoction of dried leaves of *Psidium guajava* is used (Citation % 45), the filtrate of 4-5 leaves of *Aegle marmelos* is taken in the morning in empty stomach (Citation % 60), 3-4 leaves of *Tinospora cordifolia* are ground with water and filtrate is taken in morning in empty stomach (Citation % 73), filtrate of 4-5 leaves of *Hibiscus rosasinensis* is taken in the early morning (Citation % 40), one table spoon of the juice of bulb of *Allium cepa* is taken thrice a day (Citation % 20), Water kept overnight in the tumbler made by the heart wood of *Pterocarpus marsupium* is taken in the morning to cure diabetes (Citation % 35) and decoction of half table spoon bark powder of *Dillenia pentagyna* is taken to cure diabetes (Citation % 25).

In antidiabetic leaves category; 4-5 fresh leaves of *Ziziphus jujube* are chewed daily to lower blood glucose level (Citation % 36), 2-3 Fresh leaves of *Psidium guajava* are masticated and taken twice a day with glass of water (Citation % 35), 4-5 fresh leaves of *Scoparia dulcis* are chewed daily (Citation % 67).

In antidiabetic powder category; 1 tea spoon dry leaf powder of *Delonix regia* is taken in the morning (Citation % 25). 1 gm dry leaves powder of *Ocimum sanctum* is given with water twice a day (Citation % 30), 1 table spoon of dry fruit powder of *Momordica charantia* is taken twice a day to lower blood glucose level (Citation % 45), about half tea spoon fruit powder of *Melia azedarach* is given with water before breakfast daily for a month (Citation % 50), 1 table spoon of seed powder of *Syzygium cumini* is used twice a day with water before meal (Citation % 80), seeds of *Hordeum vulgare* and *Cicer arietinum* in the ratio of 3:1 are roasted and ground and a half table spoon of this powder is taken with water thrice a day to control blood glucose level (Citation % 35), one tea spoon bark powder of *Ficus racemosa* is prescribed (Citation % 67) and about half teaspoon stem powder of *Tinospora cordifolia* is taken with water twice a day before meal (Citation % 75).

In antidiabetic bread category; equal amount of *Cicer arietinum* (Seeds), *Daucus carrota* (Dried root), *Hordeum vulgare* (Seeds), *Oryza sativa* (Seeds), *Triticum aestivum* (Seeds) and *Zea mays* (yellow variety) are ground. The bread is cooked from this mixed flour and taken as breakfast

with fresh butter of cow for 2-month (Citation % 45). This remedy is used as a dietary supplement to control diabetes.

In antidiabetic seeds category; 1 table spoon soaked seeds of *Trigonella foenum-graecum* are given daily before meal once or twice a day (Citation % 65) and 1 tea spoon seeds of *Withania somnifera* are soaked in water in the night and given in the morning before breakfast to the patient (Citation % 45).

In antidiabetic latex category; half tea spoon sap obtained from fruit of *Bixa orellana* is used to control blood glucose level (Citation % 40) and 1 table spoon latex obtained from the young branches of *Ficus benghalensis* is taken with honey (Citation % 35).

In antidiabetic herbs/vegetables category; the fresh aerial parts of *Solanum nigrum* are cooked as a vegetable (Citation % 25), aerial parts of *Boerhaavia diffusa* are cooked as a vegetable (Citation % 20), the pulse obtained from the seeds of *Cajanus cajan* & *Vigna mungo* is recommended (Citation % 27) and three or four bulblets of *Allium sativum* are taken in the morning (Citation % 30).

As antidiabetic fruits; immature pods of *Vigna sinensis* are used (Citation % 15), fresh fruits of *Syzygium cuminii* are taken (Citation % 50) and fresh fruits of *Phyllanthus emblica* are eaten to control blood glucose level (Citation % 45).

As antidiabetic herbal mixture; powder of seeds of *Syzygium cumini* & *Momordica charantia* (2 parts), *Cyperus rotundus* & *Rosa alba* (1 part) is made. This mixture is taken before meal for lowering blood glucose by the inhabitants of the study area (Citation % 25).

DISCUSSION

The old people of the study area treat diabetes through these traditional herbal remedies. They believe that traditional medicines are the better and permanent cure for their diseases. So, the indigenous knowledge continues to provide the building blocks for the development in rural communities (Rahman & Zaman, 1989). Out of total reported plants few plants like ; *Syzygium cumini*, *Catharanthus roseus*, *Tinospora cordifolia*, *Aegle marmelos*, *Momordica charantia*, *Ficus racemosa*, *Trigonella foenum-graecum*, *Scoparia dulcis* and *Melia azedarach* were highly preferred by the Tharu people on the basis of citation %. Similarly, preference index analysis showed that *Syzygium cumini* got the highest position followed by, *Catharanthus roseus* and *Tinospora cordifolia* in second and third position

for treating diabetes. Citation percentage of these three plants was also high. There were many overlapping of the use of plant species for same disease in the studied villages, for example, in the village Madhuban mathwal fruit of *Momordica charantia* was used as powder but in Gadi it was used as fresh fruit filtrate. But in some cases, the use-value in the studied villages was uncommon, for example, in Gadi and Sonbarsa, leaf of *Adhatoda vesica* was used to treat fever and asthma but in Shankar sharaiya it was used in diabetes. In Madhuban mathwal *Aegle marmelos* was used in fever and dysentery but in Gadi and Shankar shraiya it was used in diabetes. This study also disseminated the common use-value of these studied plants among traditional healers of all studied villages. Almost all studied plants are available in an all villages except *Withania somnifera* which was found only in village Gadi. In the study area, herbs are the primary source of herbal remedies, followed by trees, most likely because herbs are more abundant. This is perhaps because herbs leaves are the most frequently utilized part of the plant to treat diabetes. They also have a faster growth rate and may possess bioactive secondary metabolites concerning to the environment (Paul *et al.*, 2015). The uses of plants are well known among the traditional healers of the all studied villages. These healers are considered to be very effective in treating diseases. Medicinal plant resources are an important component of biodiversity with an important source for local livelihood as well as they have cultural significance. Therefore, the conservation of medicinal plants is not only vital for the livelihood of local people but also it has immense cultural significance to them. During the study, it was found that the traditional herbal remedies were more adaptable and acceptable from past to present in this area. Due to widespread use, folk herbal remedies appear to be not only a case of preference but also of a situation without choices due to lack of modern medical facilities. Such a system of medical treatment on which the majority of the population has been relying upon for generations with considerable success should not be overlooked for further medical investigation. This case is valid for those plants which have not been looked at for medical research, although the same has been in use by local inhabitants over hundreds of years.

Identification of new claims and reliability of reported claims

The reported uses of various medicinal plants of the present study were compared with the previously published papers in Nepal and India; Burlakoti *et al.* (2008); Dhama (2008); Joshi (2008); Gurung *et al.* (2008); Sankaranarayanan *et al.* (2010) and Singh *et al.* (2012);. The present study identified many new and different way of uses of these studied plants to

treat diabetes which were not mentioned in the previous papers except about *Momardica charantia*, *Murraya koenigii* and *Trigonella foenum graecum*.

CONCLUSIONS

In present scenario diabetes is a global problem and every year a considerable amount of foreign exchange is involved in the import of antidiabetic drugs. In present study many plants were notified to control diabetes. But few plants like, *Syzygium cumini*, *Catharanthus roseus* and *Tinospora cordifolia* are highly preferred to control diabetes. So, it is strongly recommended to carryout phytochemical and clinical research work on these plants and also reported plant species of this study to prove and substantiate the traditional herbal therapies of the rural people. These plants should be studied for their active compounds responsible for the hypoglycemic activities

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