



RESEARCH ARTICLE

# Traditional Ethno-Medicinal Plants Used for Treatment of Diabetes by Bhuyan Tribes in Sundargarh District of Odisha, India- An Ethnobotanical Survey

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## Abstract

Diabetes mellitus is the most common disease which has conveyed significant well-being intimidation around the world. The accessible synthetic drugs for the fix of Diabetes mellitus are related to significant expense, different incidental effects and a few constraints. Medicinal plants are the storehouse of the phytochemicals which can be helpful for the therapy of various ailments. Medicinal and aromatic plants are the better option in contrast to compound medications with little or no side effects. Ethnomedicinal studies carried out among the Bhuyan tribal groups in the Sundargarh region, Odisha for the investigation of antidiabetic treatments. The Bhuyan tribal group has a rich knowledge of plants which are used in the treatment of different disease causes. The ethnomedicinal data was gathered from interviews and field studies with nearby healers and townspeople. Restorative plants were gathered and related to help from native healers. These kind medicines have been displayed to have huge mending power, either in their normal state or as the wellspring of new items handled by them. Our study is mainly concentrated on plants used by Bhuyan tribal groups in relation to the cure of diabetes. An extensive field survey of different parts of the district was made with the local tribal villagers and ethnomedicinal or ayurvedic drug practitioner's perusal of published literature and herbarium specimen of different herbaria of the district was done. A sum of 25 plants having a place with 18 unique families used to treat diabetes utilized by Bhuyans of Sundargarh district has been reported. In this report we have prepared detailed notes on the method of preparation of precise doses, the part/parts of plants used and the method of application of doses with scientific names, vernacular names and family names of collected plants are also given. Further, it emphasizes strongly in this regard the optional and rational uses of traditional and natural indigenous medicine. The results of this study showed that these tribal people still depend on medicinal plants in Sundargarh district forest areas. The study thus underlines the potential of ethnobotanical research and the need for the documentation of traditional ecological knowledge pertaining to medicinal plant utilization for the greater benefit of mankind.

## Keywords

Bhuyan tribals; Medicinal plants; Diabetes; Ethnomedicine; Conservation; Sundargarh

## Introduction

Since ancient times, plants have been an exemplary source of medicine as the ancient people had very good and sufficient knowledge about the use of plants from the past. According to the World Health Organization (WHO) report, in developing countries due to poverty and lack of access to modern medicine, about 65-80% of the world's population depends directly on plants for their primary healthcare (1). The traditional systems of medicine like Chinese, Ayurvedic, Unani and Siddha are very effective, particularly in rural areas for the treatment of various ailments. In spite the presence of modern medicines, tribal populations are still depending on plants as herbal medicine. Ethnobotany must have been the first knowledge acquired by man to satisfy his hunger, heal his wounds and cure various ailments (2). The knowledge of the use of plants as a source of medicine is as old as humanity. Ethnomedicine deals with medicines derived from plants, animals, minerals etc. and their use in the treatment of various diseases and ailments, based on indigenous pharmacopoeia, folklore and herbal charms (3). Tribals constitute an important segment of the Indian Population. Odisha state has the second largest tribal population i.e. 6.82 million in the country with 62 different tribal groups including 13 primitive tribal groups (PTGs) which have their own ethnomedicinal practices that have been gone on since the days of yore. The study on traditional knowledge about ethnomedicine, and its social impacts in Odisha is rare.

Diabetes mellitus is a metabolic endocrine disease characterized by chronic elevation of blood glucose concentration, which anomaly is due to inadequacy or poor insulin utilization by the body (4, 5). It is one of the major endocrine diseases which affect around 5% of the total population in the world (6). This disease causes 100 million individuals yearly and is perceived as the seventh reason for death on the planet (7), and the management of diabetes with no side effects is yet a challenge which needs a test to the clinical framework (8). It has been assessed that the number of diabetic individuals will increase from 371 million in 2012 to a new gauge of up to 552 million individuals by 2030 (9). The natural medicinal plant having anti-diabetic properties are yet to be economically produced as present-day drugs, while these medicinal plants have been used for their remedial properties in the traditional medicinal system practiced by tribal groups (10). Traditional medicine has been used for the treatment of diabetes in developing nations to date where the price of modern medicine is expensive to the local people (11). In this paper various native Indian herbal plants have been investigated and found the result that they are helpful in effectively reducing diabetes. One of the incredible benefits of restorative plants is that they are promptly accessible and make exceptionally low side impacts. Plants have forever been a model wellspring of medications, and a significant number of the as-of-now-accessible medications have been gotten straightforwardly or in a roundabout way from them. The connection between plants and human societies isn't restricted to the

utilization of plants for food, dress, and sanctuary yet additionally incorporates their utilization for strict services, ornamentation, and medical care. The medicinal plants used to treat hypoglycemic or hyperglycemic conditions are of extensive interest for ethnomedicinal of local areas as they are perceived to contain important therapeutic properties in various parts of the plant, and various plants have shown fluctuating levels of hypoglycemic and antihyperglycemic action. Individuals utilize wild plants in various ways to meet their fundamental requirements, like food, sanctuary, and attire. This is an essential need of people (12). More than 85,000 of these plant species are with medicinal properties. Natural drugs have been utilized for the treatment of diabetic patients for quite a while, and they are at present acknowledged as an elective treatment for diabetic treatment. Nonetheless, in the native Indian arrangement of medication, a lot of plants were referenced for the fix of diabetes, and some of them have been tentatively assessed and dynamic standards were secluded. WHO has additionally suggested the assessment of the viability of plants in conditions where there are no protected current medications. The ethnobotanical data reports around 800 plants that might have the antidiabetic potential (13). Medicinal plants used to treat diabetic circumstances are of extensive interest and various plants have shown changing levels of hypoglycemic and hostile to hyperglycemic action (14). An enormous number of plants and plant parts have been researched for their gainful job and are hostile to diabetic properties (15, 16).

Tribals residing in the remote places of forest areas depend on the forest to meet their livelihood and healthcare needs (17). Since ancient times, herbal medicines have been used by them since antiquity in treating diseases. The indigenous people of the study area in Sundargarh district are called Bhuyan/Bhuiyan. The Bhuyans are one of the most primitive tribal groups of Odisha living at Bonai sub-division of Sundargarh district. The name "Bhuyan" has been gotten from the Sanskrit word "bhoomi", importance land or earth those has been differently called Bhuiya, Bhuiyan, and Bhuiya. Bhuyan villages are arranged either on the plateau land at the peak or on the slope of the hilly areas. Individuals of the study regions are as yet reliant upon conventional medication for medical care and therapy of illnesses, whereas modern medication makes no side impacts and it is likewise high to fix a limit. The ancestral individuals for the most part rely upon home grown items as medications. The viability of numerous natural prescriptions utilized by Bhuyan tribals has not been recorded because of an absence of proper documentation. The indigenous traditional knowledge associated with the tribal groups transferred from one generation to another generation orally for ages which is quickly vanishing because of the approach of present-day innovation and the change of conventional culture herbal science during the time spent urbanization (18). Traditional medicinal systems have been created through the experience of numerous ages and have been principally reliant upon locally accessible plants. Indigenous people group all through our nation save their

conventional information for themselves which might be helpful to common individuals for better normal medical care. In this research study, we tried to study and document for recognition of medicinal plants which are traditionally utilized by Bhuyan groups for the control and treatment of diabetes in the Sundargarh area of Odisha and conserve indigenous knowledge.

## Materials and Methods

### Ethnobotanical survey

The Sundargarh district lies with the GPS coordinates between 22° 7' 26.4072" N and 84° 2' 35.43" E. An intensive and extensive ethnobotanical field surveys were conducted during the period from September 2015 to July 2020 in different tribal landscapes like Panposh, Hemgiri, Sundargarh, Bonaigarh, Lahunipada, Rajgangpur, Lathikata and Kuarmunda (Fig. 1.) Areas in the Sundargarh district of Odisha to collect the ethnomedicinal data regarding antidiabetic plants utilized by the Bhuyan public and to collect herbarium plants utilized by the Bhuyan public and to collect herbarium samples. During the field study, the data were collected from the tribal people through Participatory Rural Appraisal (PRA) questionnaire methods. To collect ethnobotanical information from informants, a structured interview using the predetermined questionnaire was used to collect information on medicinal plants used for antidiabetic action by Bhuyan tribals. The assistance of the socio-social associations of each gathering was taken to approach and build compatibility with the conventional healers of every local area. The knowledgeable elder persons, medicine men called Kabirajs as well as housewives were contacted to collect data on the uses of medicinal plants. During the collection of information about the plants used against diabetes by Bhuyans, the structured forms in local languages were filled in with the information received from both healers and patients in the study areas. The first-hand information like local names, plant parts used, and methods of dose preparation was gathered from them with regard to each plant in the field (19-22).

### Plant Collection

The medicinal plants used by the tribal people were collected following standard protocols and preserved using herbarium techniques (23, 24). The detail information about the plants and part used in the treatment of diabetes with the detail mode of the preparation of the precise dose was also collected. Specimen collected from the field were tagged and taken to lab. Subsequently, the collected plants were identified with the help of local floras (25, 26) and the voucher numbers has been given to the herbarium specimens of the antidiabetic plants and deposited in the herbarium of the PG. Dept. of Botany, Govt Autonomous College, Rourkela, Odisha.

### Presentation of Data

The data reported on the questionnaire was sorted using Microsoft spreadsheet for further analysis to determine the

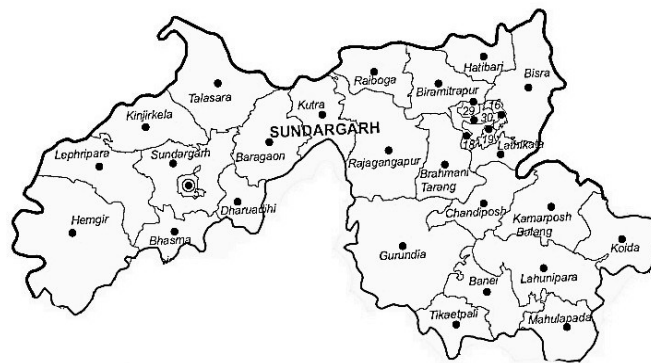


Fig. 1. Map of Sundargarh district showing study sites.

proportions of different variables such as plant parts used, and preparation methods. These results were analyzed descriptively and comparatively. In addition, ethnobotanical data was analyzed using Use Value (UV). The relative importance of each plant species known locally to be used as herbal remedy is reported as use value (UV) calculated using the following formula:

$$UV = \Sigma U/n$$

Where UV is the use value of a species, U is the number of use reports cited by each informant for a given plant species and n is the total number of informants interviewed for a given plant (27).

## Result

The list and information of ethnobotanical remedies for diabetes treatment mentioned by Bhuyan people and traditional healers are presented (Table 1). In the present study, the interview data indicate that a total of 25 species of plant belonging to 18 different families are utilized as antidiabetic agents by Bhuyan tribes in the Sundargarh district (Table 1). The families with the most antidiabetic plants included Apocynaceae (4 species), Fabaceae (3 species), and other families with single plant species (Fig. 2). Among the plant parts used, leaf with 11 species (38%) is highly used followed by bark 7 species (24%), fruit 8 species (10%), seeds, roots, flowers with 3 species each (7%) whereas rhizome and stem with 1 species each (4%) (Fig. 3). It was found that the most utilized source of medicines is trees (64%) followed by climbers (16%), herbs (12%) and shrubs (8%) (Fig. 4). The most commonly used method of preparation for medicines were decoction form followed by powder and juice. The most commonly used plant species was *Azadirachta indica* with 49 use reports giving the highest use value of 0.96. Another important plant with high value use was *Momordica charantia*, 1.24 use values with 48 use reports by 51 informants. The least used plant was *Cajanus cajan* with 9 use reports showing low use value of 0.17 (Table 1). The study was also reported on different types of biological growth forms of the antidiabetic plants. Phanerophytes with 17 plant species were reported from the present study followed by Thereophytes with 6 species, while Hemicryptophytes and Cryptophytes each with single species (Fig. 5).

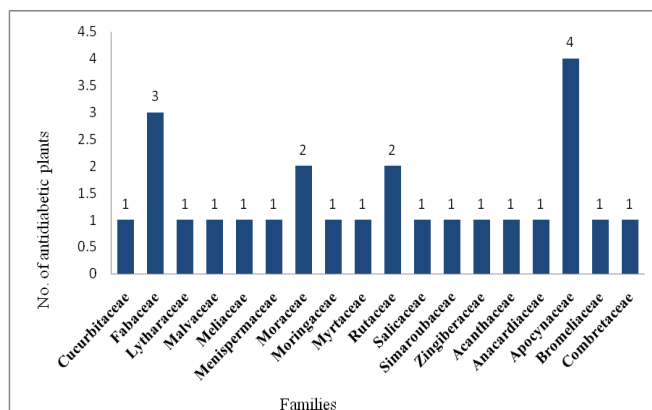
**Table 1.** Ethnomedicinal Plants Used for the Treatment of Diabetes by the Bhuyan Tribe in Sundargarh district, Odisha

Sl. No	Sp. Name	Local name	Family	Habit	Biological Life Forms	Parts used	Dose	Use Value (UV)	Voucher No.
1	<i>Aegle marmelos</i> (L.) Corrêa	Bela	Rutaceae	T	P	L	15-20gm fresh leaves crushed with 7-8 black pepper and consumed in empty stomach effectively helps in control of diabetes. 10 ml leaf extract if taken in empty stomach also helps in control of diabetes. Tablets prepared from grinded leaves of <i>Azadirachta indica</i> , <i>Aegle marmelos</i> , <i>Ocimum sanctum</i> and taking of 1 tablet everyday helps in control of diabetes.	27 (0.52)	SNM/ GACR/01 5
2	<i>Ailanthus excelsa</i> Roxb.	Mahanim	Simarou baceae	T	P	B	Take 2 tsp bark powder twice daily on empty stomach for 1-2 months regularly lowers the blood sugar level.	11 (0.21)	SNM/ GACR/10 9
3	<i>Ananas comosus</i> (L.) Merr	Sapuri	Bromelia ceae	T	H	Fr.	100 gm pineapple juice is mixed with 10 ml <i>Sesamum</i> seeds, with triphala powder (dry fruit powders of <i>Phyllanthus emblica</i> , <i>Terminalia bellirica</i> , <i>Terminalia chebula</i> ) and dry seed powder of <i>Syzgium cumini</i> to make fine powder. Intake of 3gm of this mixed powder is taken every morning and evening helps in lower of diabetes.	10 (0.19)	JD/ GACR/18 5
4	<i>Andrographis paniculata</i> (Burm.f.) Nees	Chireita	Acanthac eae	H	T	L	2-3 fresh tender leaves are chewed in morning in empty stomach to lower the diabetes level.	43 (0.84)	SNM/ GACR/09 9
5	<i>Artocarpus heterophyllus</i> Lam.	Panas	Moracea e	T	P	L	The leaves are boiled without leaf petioles with a glass of water till it is reduced to half. The strained leaf juice taken in empty stomach twice a day for two month helps in control of diabetes.	19 (0.37)	JD/ GACR/21 3
6	<i>Azadirachta indica</i> A.Juss.	Neem	Meliacea e	T	P	L	A table spoon of dry leaves powder taken with water in empty stomach once a day during morning helps in diabetic activity. In winter fresh tender leaves are also fried to eat for control over the sugar level.	49 (0.96)	JD/ GACR/76
7	<i>Cajanus cajan</i> (L.) Millsp.	Harad	Fabacea e	S	P	L	One teaspoon sundried leaf powder if taken in empty stomach controls the diabetes.	09 (0.17)	JD/ GACR/10 2
8	<i>Casearia tomentosa</i> Roxb.	Khokra	Salicacea e	St	P	B	Infusion of bark is a remedy for treating diabetes. Dry the bark under sun for 2-3 days and then soak it in water for 2 days, finally boil it in the same water till it is reduced to half the quantity. Store the liquid in a bottle and take 14 cup daily. It controls diabetes.	11 (0.21)	SNM/ GACR/18 6
9	<i>Catharanthus roseus</i> (L.) G.Don	Sadabiha ri	Apocyna ceae	H	T	L	Seven fresh tender leaves chewed in the early morning in empty stomach controls diabetes.	46 (0.90)	JD/ GACR/53
10	<i>Curcuma longa</i> L.	Haladi	Zingiber aceae	R.H	C	Rh.	Intake of half spoon of haldi powder taken on an empty stomach for long period of time controls diabetes.	42 (0.82)	JD/ GACR/92

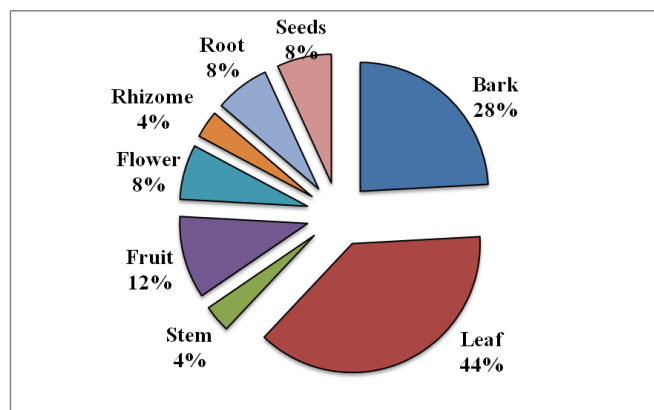
11	<i>Ficus benghalensis</i> L.	Bara	Moraceae	T	P	B	20gm of crushed dry powder prepared from bark of stem and aerial roots are boiled in 1 litre of water till 1/8th, the boiled mixture is strained and drink for a month helps in control of diabetes.	21 (0.41)	JD/GACR/14
12	<i>Gymnema sylvestre</i> (Retz.) R.Br. ex Sm.	Gudmar	Apocynaceae	C	T	L	4-5 leaves are chewed daily which changes the taste of mouth helps in lower of sugar level in body.	45 (0.88)	SNM/ GACR/057
13	<i>Hemidesmus indicus</i> (L.) R. Br. ex Schult.	Antamul a, Sugand hilai	Apocynaceae	C	T	R	An amount of 4-5 gm of <i>Hemidesmus indicus</i> root powder added with 4-5 gm dry leaf powder of <i>Justicia adhatoda</i> taken with warm milk for twice a day helps in control of sugar in the body.	25 (0.49)	SNM/ GACR/101
14	<i>Holarrhena pubescens</i> Wall. ex G.Don	Indrajau	Apocynaceae	T	P	Fl.	3 gm dried flowers given to patient to control over the diabetes. The decoction of boiled flower after strained also given to patient to limit the sugar level.	19 (0.37)	SNM/ GACR/089
15	<i>Limonia acidissima</i> Groff	Kaintha	Rutaceae	T	P	L	The pounded tender leaves extract taken twice during morning and evening in empty stomach helps in control the sugar level.	15 (0.29)	SNM/ GACR/26
16	<i>Mangifera indica</i> L.	Aam	Anacardiaceae	T	P	L	10 gms of shade dried leaves boiled in 1 litre till 1/4th water left strained and taken twice daily in empty stomach controls diabetes.	26 (50.98)	JD/GACR/23
17	<i>Momordica charantia</i> L.	Kalara	Cucurbitaceae	C	T	Fr.	10-15 gm leave juice or fruit juice taken with a glass of water in early morning in empty stomach daily controls sugar level. A weight of 3-5gm shade dried fruit powder is given daily to patient with water to limit the sugar level constant.	48 (0.94)	JD/GACR/004
18	<i>Moringa oleifera</i> Lam.	Munga	Moringaceae	T	P	L, B	10gm leaf powder given to diabetic patient daily for 6 month in morning helps to get relief from sugar level.	46 (0.90)	SNM/ GACR/025
19	<i>Pongamia pinnata</i> (L.) Pierre	Karanj	Fabaceae	T	P	Fl.	The fresh 20 gm flowers are boiled with 1 glass of water till half of the glass and after strained the boiled water is taken to control diabetes.	29 (0.56)	SNM/ GACR/123

20	<i>Punica granatum</i> L.	Dalimb	Lytharaceae	St	P	Se.	A mixture of 100 gm dry seeds of pomegranate and 50gm dried ginger are make powdered by adding with black peppers, Ficus religiosa dry leaves, Cinnamon, Cardamon and Bay leaves 50 gm each mixed and equal amount of sugar added to the dry mixture. The patient is administrated to take 3 gms of powder twice a day to control its sugar level.	33 (0.37)	SNM/ GACR/069
21	<i>Saraca asoca</i> (Roxb.) Willd.	Asoka	Fabaceae	T	P	L,B	A handful tender <i>Saraca</i> leaves with a handful of <i>Mangifera</i> leaves boiled with 3 glass of water till 1 glass of water cooled, strained and taken by patient only in empty stomach in morning for 2 months helps in sugar level.	19 (0.37)	SNM/ GACR/119
22	<i>Sida cordifolia</i> L.	Bajramuli	Malvaceae	S	T	R	20 gms of roots boiled with 2 glass of water till 1 glass is strained and given to patient for 1 month twice a day lowers the diabetes level.	20 (0.39)	SNM/ GACR/073
23	<i>Syzygium cumini</i> (L.) Skeels	Jamun	Myrtaceae	T	P	Se., B, Fr.	100gm of root is pounded with 20gm of sugar and taken with 250 ml of water thrice a day to get relief from sugar problem. A mixture of one part of dry <i>Syzygium</i> seeds and one part of dry ginger with 2 parts of dry leaves of <i>Gymnema sylvestre</i> made small tablets by adding <i>Aloe vera</i> juice. A single tablet is given thrice a day to cure sugar level. A weight of 2gm ash of dry bark with water is given thrice a day to control sugar in urine. 20gm of well sundried seed powder is taken thrice in a day for a month, gives a proved result in effective control of diabetes.	46 (0.90)	SNM/ GACR/147
24	<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Arjuna	Combretaceae	T	P	B	The half tablespoon of <i>Terminalia arjuna</i> bark powder is mixed with <i>Santalum album</i> powder and water taken regularly in empty stomach during morning for six months controls the sugar level.	39 (0.76)	SNM/ GACR/131
25	<i>Tinospora sinensis</i> (Lour.) Merr.	Duluchi. Guduchi	Menispermaceae	C	P	S	Sundried woody stems are made powder and mixed with <i>Curcuma longa</i> powder which is taken in empty stomach twice a day for 3 months regularly for control of sugar level.	41 (0.80)	JD/ GACR/002

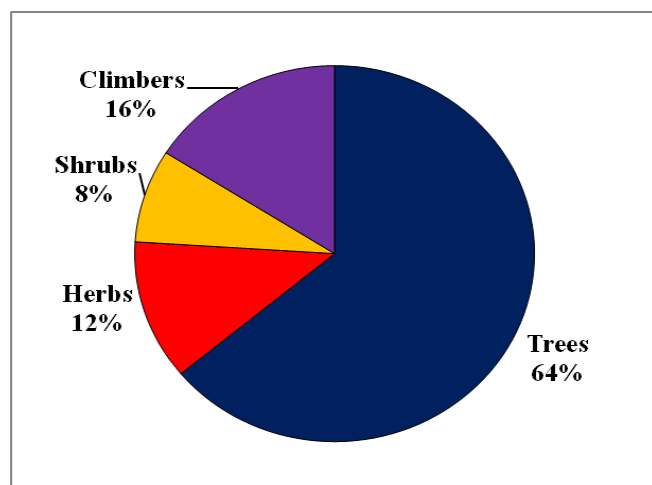
**Note:** P- Phanerophyte, H- Hemicryptophyte, T- Therophyte, C-Cryptophyte, T- Tree, C- Climber, H-Herbs, R.H-Rhizomatic herb, St- Small tree, S- Shrub; B- Bark, L-Leaf, Fr.-Fruit, FL.-Flower, R-Root, S-Stem, Se-Seeds, Rh-Rhizome, SNM-Samarendra Narayan Mallick, JD-Julie Das



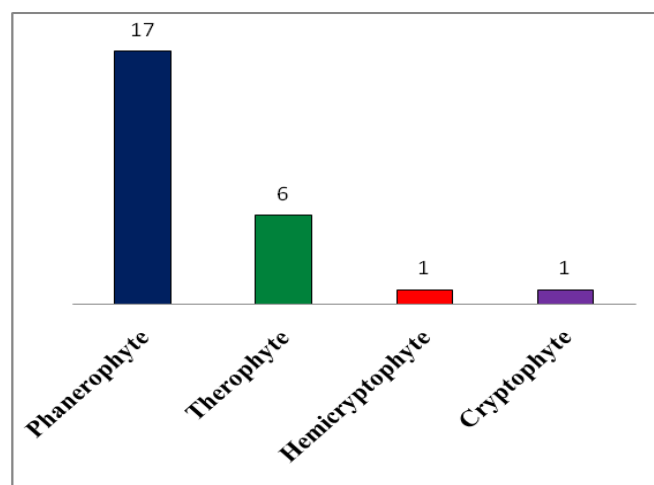
**Fig. 2.** The families with numbers of plants with antidiabetic activity used by Bhuyan people



**Fig. 3.** The percentage of different plant parts used against diabetes by Bhuyan clans.



**Fig. 4.** Habit wise plant groups used against diabetes by Bhuyan tribes



**Fig. 5.** Biological life form of plants studied against diabetes used by Bhuyan people

## Discussion

Current discoveries show many utilizing medicinal species by Bhuyan tribals have anti-diabetic effects. The study portrays that asset people are constantly old individuals and the more youthful age is hesitant to take up the protection of native information from elder ones. Consequently, documentation of customary information is the main way a mission to safeguard the information base ratio of the plant assets endemic to this area. At present, there is no information on natural plants used to treat diabetes in the Sundargarh area of Odisha. While a very few reports have been published about the anti-diabetic plant uses in Khordha and Gajapati districts (28, 29). The most frequently paid attention plants were *Aegle marmelos*, *Andrographis paniculata*, *Azadirachta indica*, *Clerodendrum philippinum*, *Curcuma longa*, *Gymnema sylvestre*, *Catharanthus roseus*, *Syzygium cumini* are found as the most common species used by traditional healers which is also mentioned by other workers (28, 29, 30). In the recent study, trees are predominantly used for anti-diabetic purposes which are also similar used in Khurda while in Gajapati district tribals are more rely on herbs to use against diabetes. Biological growth form denotes about how the plants are developed from one group to another growth form. In the present paper, Phanerophytes growth form showed the highest number while Hemicryptophyte and Cryptophytes were used very less in number. Regarding all identified plants used against

diabetes by Bhuyans, the bark and leaves were the major plant parts used, which is in agreement with other studies (29, 31). Accordingly, these discoveries are so significant in the administration of diabetes and the preservation of native information related to the plants. Different workers (32) performed phytochemicals examination of plants which are additionally considered during study work in Bhuyan towns showed the presence of a high measure of polyphenols which may be having antidiabetic and anti-peroxidase impacts. The study has revealed in detail antidiabetic action and the presence of pharmacological dynamic fixings in various plants against diabetes were phytochemically dissected from different regions. Many workers discussed the antidiabetic and hypoglycemic movement though portrayed about increment take up of glucose and improved glycogenesis (34,35). The adequacy of these ethnomedicinal establishes should be exposed to pharmacological approval. Some antidiabetic plants might apply their activity by invigorating the capacity or number of cells and subsequently expanding insulin discharge (36). The *Momordica charantia* extricates when controlled to langurs and people showed huge hypoglycemic impact because of the presence of popyptide P in entire piece of the severe gourd. *Catharanthus roseus* Linn. (Apocynaceae) is usually utilized as an anticancer specialist while in subtropical and tropical regions of the world boiling water fluid; concentrate is utilized for the therapy of diabetes. The entire plant of *Syzygium cumini* has been involved all through Asian nations in the treatment of diabetics as the plant shows anti-hyperglycemic and antidiabetic impacts yet it has not been at this point known any blood glucose impact

(37). Various specialists additionally announced similar purposes of *S. cumini* by tribals of Manipur and Southern Assam of India (38, 39) while in Madagascar, Southern Brazil, (40) and different areas of the planet (41) against diabetes. The bark concentrates of *Ficus racemosa* when treated with type 2 diabetic patients brought about fundamentally decreased glucose levels in the blood and expanded serum insulin levels (42).

The recorded plants are utilized for diabetic purposes as well as utilized for various purposes. It is important that these plants because of their cell reinforcement exercises and different components can diminish the poisonous impacts of harmful specialists or different medications (43). The products of *Aegle marmelos*, *Ananas comosus*, *Artocarpus heterophyllus*, *Ficus benghalensis*, *Limonia acidissima*, *Mangifera indica*, *Punica granatum*, *Syzygium cumini* are eaten as occasional natural products as well as wild food plants, while the products of the soil of *Moringa oleifera* are cooked for vegetable purposes. Traditionally, *M. oleifera* is utilized for different restorative purposes. The plant is utilized as an antispasmodic, energizer, expectorant and diuretic. The cases are utilized to be as anthelmintic, antipyretic, and furthermore utilized in diabetes. Normal utilization of *M. oleifera* leaves helps control pulse level. The leaf extract of *C. serratum* (L.) Moon is resulted with blood sugar lowering potential when it is treated with both normal and diabetic rats (44).

## Conclusion

Among the Bhuyan people of the Sundargarh district of Odisha, medicinal plants play a significant part in the treatment of diabetes. Natural medicines used by the indigenous people are either based on a solitary plant or a mix of a few plant parts. The plant materials arranged as a decoction, imbue, and fluid concentrate in milk or honey were utilized for the treatment of diabetes. Sharing strategies for the utilization of old restorative plants, starting with one age and then onto the next, is jeopardized these days (45). Indigenous knowledge of medicinal plants is under threat of extinction with the ongoing pace of modernization. Accordingly, accumulation and documentation of ethnomedicinal uses are vital before the total loss of this significant orally communicated information sooner rather than later. Different minerals found in a few medicinal plants have been accounted for to be cofactors that signal middle-class insulin activity and key catalysts of glucose digestion (46, 47). Conservation of these valuable medicinal plants is fundamental as it guarantees the accessibility of plants for customary healers; conventional botanists, and spice merchants. Phytochemical examination of the referenced plants should be finished to lay out the well-being and adequacy of the revealed plant species, which will likewise build awareness among the more youthful age about the need to safeguard this significant vegetation, which any other way will be lost on account of deforestation. The harmful impact of these medicinal plants should also be studied. The recent study has unveiled the vital roles of medicinal plants in the primary health care of the people of this study area. In the Sundargarh district, conventional healers play a significant part in primary health care.

However, further studies are required to isolate active principle from the crude extract for proper drug improvement from the plants utilized by the Bhuyan clans against diabetes.

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## Authors contributions

JD carried out the field study, herbarium preparation, participated in the data typing and drafted the manuscript. SNM carried out the field study, herbarium preparation, design the draft and performed the statistical analysis. BCA participated in the design of the study and overall correction of the manuscript.

## Compliance with ethical standards

**Conflict of interest:** Authors declare that there is no conflict of interest.

**Ethical issues:** None .

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