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Documentation on ethnomedicinal usages of different *Dioscorea* species (Yams) amongst the people of Bodoland Territorial Region, Assam, India

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Abstract

Since the beginning of time, people have been using plants as a food source and as a medicine to treat various ailments. The current study aimed to explore and document the medicinal uses of *Dioscorea* (yams) in Bodoland Territorial Region (BTR), Assam. A survey was conducted among the people residing in four districts of BTR viz., Chirang, Kokrajhar, Baksa and Udalguri. The study shows that nine different species of *Dioscorea* namely, *Dioscorea alata* L., *Dioscorea bulbifera* L., *Dioscorea deltoidea* Wall. ex Griseb, *Dioscorea esculenta* (Lour.) Burkill., *Dioscorea hamiltonii* Hook.f., *Dioscorea hispida* Dennst., *Dioscorea pentaphylla* L., *Dioscorea pubera* Blume. and *Dioscorea villosa* L. occurring in this region have been used as a food source as well as for the treatment of various health ailments by different ethnic communities residing in this region. The relative abundance of individual *Dioscorea* species was also calculated and the result revealed that *Dioscorea alata* has the highest relative abundance in Kokrajhar, Chirang and Udalguri district, while in Baksa District; *Dioscorea bulbifera* has the maximum relative abundance.

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Introduction

NE region of India is a great treasurer of both flora and fauna biodiversity. Among the floral diversity, medicinal and aromatic plants occupy important position in the field of biological research especially in medical field for the treatment of various human disorders. Different tribes living in this region have their own traditional knowledge for treating various health disorders using different medicinal plants found in their region. Bodoland Territorial Region (BTR) is an autonomous region in Assam, Northeast India. BTR lies between $26^{\circ}07'12''$ N to $26^{\circ}47'50''$ N Latitude and $89^{\circ}47'40''$ E to $92^{\circ}18'30''$ E Longitude. It constitutes of 4 districts namely, Chirang, Kokrajhar, Baksa and Udaguri, situated on the north bank of the Brahmaputra River below the foothills of Bhutan and Arunachal Pradesh. The Bodo tribes represent the majority of the population in the region. The other communities residing in this area are Assamese, Bengalis, Rabhas, Garos, Adivasis, Nepalis, Rajbonshis. People of BTR, Assam, especially the tribal communities have been using various plants as medicine for curing health related issues or various health disorder. But proper documentation of these plants is yet to be done and therefore this knowledge is confined to themselves as it is only transferred via mouth from one generation to next.

A variety of *Dioscorea* species, commonly known as yams, are one of such plants used enormously by people of BTR. These are locally known as Kath alu (in Assamese) or Tha (in Boro language). It is an herbaceous plant with creeping and climbing vines belonging to monocotyledonous Dioscoreaceae family under order Dioscoreales (Burkill, 1960). About 600 different species of *Dioscorea* are reported throughout the world (Amanze *et al.*, 2011). It was reported that about 50 different *Dioscorea* species occurred in India (Prain and Burkill, 1936) and 28 species in North Eastern region (Sharma and Hore, 1995). Whereas Dutta (2015) reported that 16 species of *Dioscorea* are found in Assam, India. Globally, yams are regarded as the fourth most important and widely used root and tuber crop after potatoes, cassava and sweet potatoes (Lev and Shriver, 1998, Viruel *et al.*, 2016).

Different ethnic groups residing in BTR have been using yams as a food as well as for treating various health ailments. Yams are either cultivated in their home or harvested from wild by the village people of this area. Various reports showed that the tubers of *Dioscorea* are used in treating number of health problems such as fever, headache, dysentery (Srivastava, 2010), stomach disorders, abdominal pain, wounds, cough (Dutta, 2015), etc. Reports revealed that yams contain bioactive compounds such as flavonoids, alkaloids, phenols, polyphenols, saponins, tannins (Okwu *et al.*, 2006) and minerals such as Ca, K, Mg, Na, Mn, P, Cu, Zn, Fe (Shajeela *et al.*, 2011, Polycarp *et al.*, 2012, Afiukwa *et al.*, 2013). It was also reported that yams possess antioxidant (Padhan *et al.*, 2020), anti-inflammatory (Olayemi *et al.*, 2007, Park *et al.*, 2013), anti-microbial, anti-fungal, and immunomodulatory (Kumar *et al.*, 2017) activities. In addition, Diosgenin, a bioactive principle of yam has hypocholesterolemic, gastro- and hepatoprotective, anti-oxidant, anti-diabetic, anti-inflammatory, and anti-cancer properties (Sethi *et al.*, 2018) and used commercially in pharmaceutical industry. It is useful in metabolic diseases (diabetes, obesity and dyslipidemia), inflammatory diseases and cancer (Dey *et al.*, 2020). However, there is very little documentation regarding the uses of *Dioscorea* spp as food and medicine among the people of this region.

Therefore, owing to possess a number of beneficial properties as well as its extensive uses by the people of BTR, this survey work was undertaken to document the traditional knowledge of usages of yams in treating various health ailments among the ethnic groups of BTR, Assam, India.

Material and methods

Study Area

The present survey was carried out among the people inhabiting in four districts of BTR, Assam namely, Kokrajhar, Chirang, Baksa and Udaguri (Fig 1). Six places from each district viz., Amguri, Halowadol, Siljan, Dotma, Daloabari and Debargaon from Kokrajhar district; Gundamara, Bagargaon, Dhaligaon, Kakragaon,

Hatimara and Panbari from Chirang district; Kaljar, Nikashi, Doomni, Naosali, Badulipara and Rupohi from Baksa district; Barnagaon,

Batabari No. 1, Belguri, Bhairabkhunda, Bhergaon and Borigaon from Udalguri district were selected for the present study.

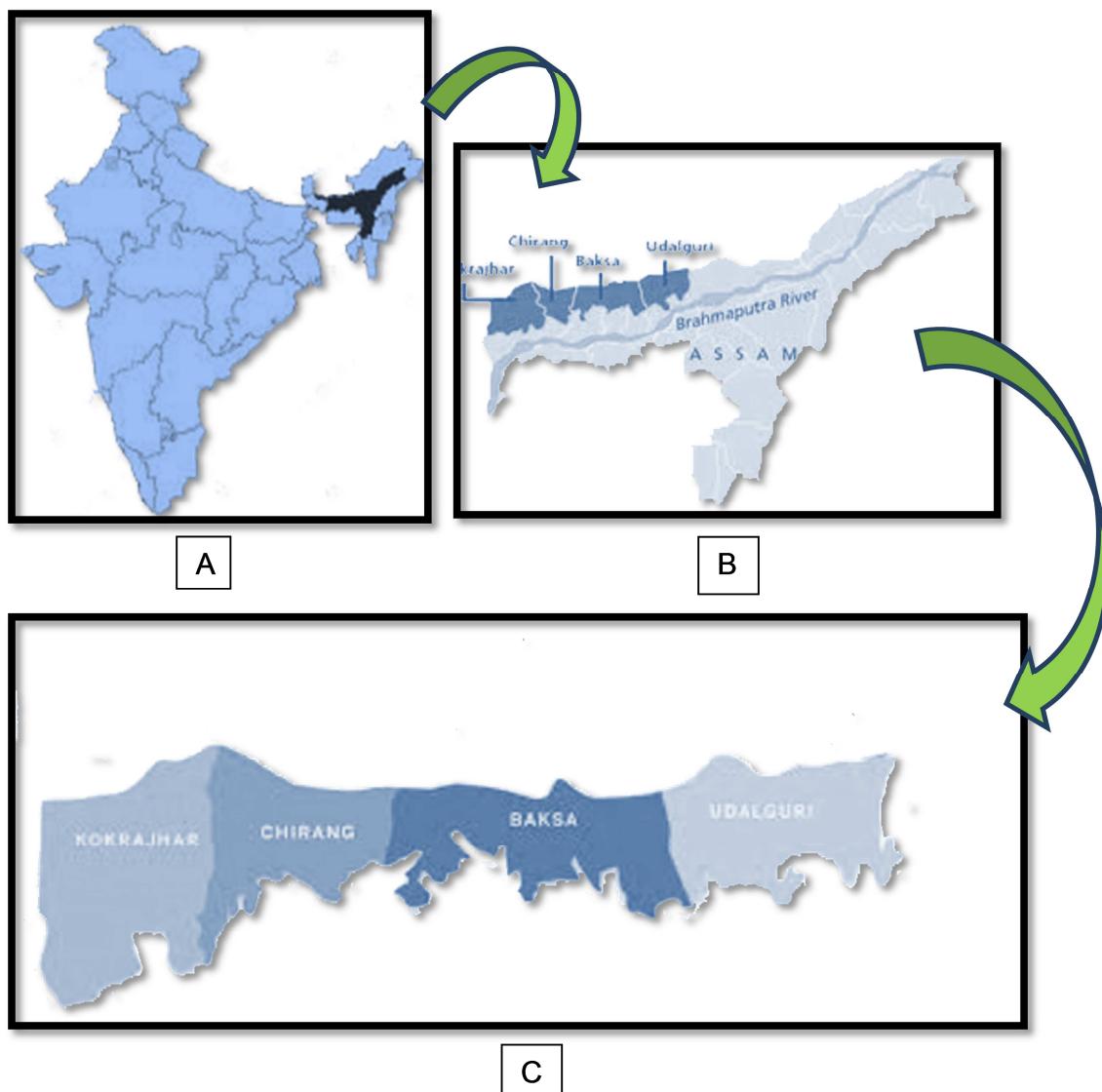


Fig. 1. Geographical map of (A) India (B) Assam (C) studied districts of BTR.

Data Collection

The study was conducted from Oct' 2019 to December' 2021. A total number of 430 families consisting of about 910 people of different age groups including heads of villages were studied. Data was collected from the local people who have voluntarily participated in the study via questionnaire and then followed by personal interview. Information was also collected from local healers (Ojha) who have knowledge of medicinal plants. The aim, need of the study and the details of questionnaire were explained

to the people prior to the investigation. The questionnaire used in this study contains a set of questions enquiring about parts of plants used, mode of consumption, methods of dose preparation and types of physical ailments for which it is used.

Collection and Identification of plants

The plants were collected during the field visits and herbarium specimen prepared following the standard technique of Jain and Rao (1997) and identified at Department of Botany, Cotton University, Guwahati, Assam.

Relative abundance

The relative abundance of *Dioscorea* species in each of the surveyed district is also calculated using the formula-

$$\text{Species relative abundance} = \frac{\text{Species abundance}}{\text{Total abundance}} \times 100$$

Result

A total of 430 families were studied during the survey, out of which 318 families belonged to tribes and 112 families were non tribes, the details of

which are shown in table 1. From the survey it was found that yam is quite popular as food as well as in treatment of various health ailments among the people of BTR. During the survey, it was recorded that nine species of *Dioscorea* viz., *Dioscorea alata*, *Dioscorea bulbifera*, *Dioscorea deltoidea*, *Dioscorea esculenta*, *Dioscorea hamiltonii*, *Dioscorea hispida*, *Dioscorea pentaphylla*, *Dioscorea pubera* and *Dioscorea villosa* are generally used by the people of this region.

Table 1. Showing percentage of families studied (tribes and non-tribes) of BTR, Assam.

Districts surveyed	Total no. of families studied	% Of families studied	Total no. of tribal families studied	% Of tribal families studied	Total no. of non-tribal families studied	% Of non- tribal families studied
Kokrajhar	110	25.58	94	85.45	16	14.55
Chirang	112	26.04	90	80.36	22	19.64
Baksa	106	24.65	66	62.26	40	37.74
Udalguri	102	23.72	68	66.67	34	33.33

The result suggested that yams are mostly consumed by the local people in form of curry. Tribal people frequently use yam tubers in preparation of curry with meat (pork, chicken) or dried fish, whereas the non- tribes prepare it occasionally with meat. They were found to consume boiled or roasted tuber or cooked with other vegetables in preparation of

curries. Sometimes, tubers also prepared with soya chunks in absence of meat. It was also found that the tubers are cut into thin slices, fried and consumed as chips by the local people. Boiled and mashed bulbils are found to be popular among the tribal peoples. Bulbils are also roasted, cooked as vegetable with potatoes and tomatoes (Table 2).

Table 2. Showing the mode of consumption of yam among tribes and non-tribes of districts of BTR.

Surveyed district	Studied cases (Tribe/ Non-Tribe)	Mode of consumption of yam
Kokrajhar	Tribes (Boro, Rabha, Santhal, Garo)	Tubers are made curry with meat or dried fish. Bulbils are boiled and smashed as chutney or cooked as vegetable.
	Non tribes	Tuber boiled and eaten with salt, curry with other vegetables or meat.
	Tribes (Boro, Rabha Santhal)	Tuber made curry with meat, fish or soya chunks. Tuber fried as chips Bulbils roasted, cooked as vegetable.
Chirang	Non tribes	Tuber boiled, roasted or cooked with potatoes, tomatoes.
	Tribes (Boro, Rabha, Adivasi)	Tubers are used to prepare curry with meat or fish. Bulbils boiled and prepare curry.
Baksa	Non tribes	Tubers cooked with mixed vegetables.
	Tribes (Boro, Garo, Rabha, Santhal)	Tubers are prepared with meat or fish, bulbils boiled or roasted.
	Non tribes	Bulbils are boiled and cooked as vegetable. Tubers are used in preparing curry with tomatoes, potatoes or meat.
Udalguri		

The survey also revealed that yams are widely used by the rural people of BTR for treating various health ailments such as cold, cough, digestive problems, skin problems, menstrual problems, etc (Table 3 & 4). It was recorded that local people of this region use yams to treat weakness and improve immunity. Powder of raw tuber is eaten to cure piles and reduce blood pressure, boiled or roasted tuber of different *Dioscorea* species are consumed by the locals to treat cough, cold, indigestion, acidity, dysentery, abdominal pain, insect bite, skin related problems, to reduce body heat. Powder of *D. bulbifera* tuber mixed with milk is taken to treat cough, cold, tuberculosis, whereas tuber decoction is used to cure insect bite and worm infestations. Water of soaked tuber of *D. hispida* is applied on eyes to treat eye related problems such as weak eyesight, smoky vision, night blindness, cataract. Moreover, paste of the tuber is used to cure peeling of feet's skin. Paste of yam leaves are used for

treating wounds, cuts, burns, injuries and other skin infections. Local people of this region apply leaf paste on infected areas and tied with cloth. Juice of leaf mixed with warm water is given to diabetic patients. Also, bulbils of yam have medicinal use among the people of BTR. Bulbils of *D. pubera* is boiled or cooked as vegetable and consumed to cure colic pain. During the survey, it was also recorded that yam tubers are very useful among the rural women in treating gynaecological related problems. Tubers of *D. villosa* is extensively used by the young girls to treat menstrual problems viz., irregular menstrual cycle, heavy bleeding, painful cramps. It is also used for treating menopause and post-menopausal symptoms, nausea experienced during pregnancy and to relieve the pain of child birth. In addition, the paste of tuber is also used to treat rheumatism. The parts and mode of use of different *Dioscorea* species in various health ailments are shown in table 3 & 4.

Table 3. Showing medicinal uses of certain *Dioscorea* species available in BTR, Assam.

<i>Dioscorea</i> species	Plant's part	Types of ailments for which plant is used
<i>Dioscorea alata</i> L.	Tuber	Piles, gonorrhea, leprosy, blood pressure, diabetes, general weakness, headache, wounds, cuts, skin diseases.
	Leaf	Fever
<i>Dioscorea bulbifera</i> L.	Tubers	Improve appetite, dysentery, indigestion, boils, cuts, wounds, cold, cough, sore throat, fever, asthma, ulcer, piles, abdominal pain, insect bite, ringworm, goiter, reduce body heat, tuberculosis, menopausal problems.
	Bulbils	Cure typhoid in children
<i>Dioscorea deltoidea</i> Wall. ex Griseb.	Leaf	Skin diseases.
	Tuber	Wounds, burns, indigestion, constipation, abdominal pain, sore throat, diarrhea
<i>Dioscorea esculenta</i> (Lour.) Burkill.	Tuber	General weakness, weight loss, nervous disorders, chest pain, boils, swellings.
<i>Dioscorea hamiltonii</i> Hook.f.	Tuber	Enhance appetite, Stomach ache, diarrhea.
<i>Dioscorea hispida</i> Dennst.	Tuber	Eye related problems, vomiting, indigestion, wounds, insect bites, peeling of skin of feet.
<i>Dioscorea pentaphylla</i> L.	Tuber	Improve immunity and treat weakness, fever, cough and cold, stomachache, abdominal discomfort, constipation, indigestion, joint swelling, skin infections
<i>Dioscorea pubera</i> Blume.	Tuber	Weakness
	Bulbil	Colic pain
<i>Dioscorea villosa</i> L.	Tuber	Muscular spasms, gas, cramps, digestive disorders, rheumatism, menstrual problems, menopausal and post menopause symptoms, labor pain.

Table 4. Showing the mode of use and ailments in which yams are used.

<i>Dioscorea</i> species	Mode of use	Ailments in which it is used
<i>D. alata</i>	Powder of tuber or tubers eaten raw	To cure piles, weakness, reduce blood pressure
	Tuber paste	Cut, wounds, skin diseases
	Juice of tuber or leaf mixed with warm water	Headache, fever, diabetes
<i>D. bulbifera</i>	Leaf paste	Skin diseases
	Tuber powder mixed with milk	Cold, cough, asthma, tuberculosis
	Boiled tuber	To reduce body heat, acidity, indigestion, dysentery, menopausal problems, abdominal pain
	Raw tuber	To improve appetite, fever
<i>D. deltoidea</i>	Tuber decoction	To cure insect bite, worm infestations, goiter
	Boiled or roasted tuber taken with salt	To treat digestive problems, abdominal pain
	Paste of tuber tied on infected areas	To cure wounds, burns
<i>D. esculenta</i>	Tuber boiled, roasted or cooked as a vegetable	To increase low weight and treat general weakness, chest pain
<i>D. hamiltonii</i>	Tuber paste	To treat boils, swellings
	Tuber boiled or roasted and mixed with rice	To enhance appetite, for treating stomach ache, diarrhea
<i>D. hispida</i>	Water of soaked tuber applied on Eye related problems eyes	
	Paste of tuber	To cure wounds, insect's bites and peeling of feet's skin
	Tuber boiled, roasted or cooked with vegetables	To treat vomiting, indigestion
<i>D. pentaphylla</i>	Tuber cooked with vegetable or meat	To treat weakness and improve immunity
	Tuber powder mixed with warm water	To cure stomach pain, indigestion, constipation, abdominal discomfort
	Tuber paste	To cure skin wounds, boils, cuts, sunburns, swelling of joints
	Boiled or roasted tuber	To treat cough, cold, fever
<i>D. pubera</i>	Tuber boiled and mashed or prepare curry with meat or fish	To treat weakness
<i>D. villosa</i>	Bulbil boiled or cooked as vegetable	To cure colic pain
	Tuber boiled, roasted	To treat gas, cramps, muscular spasms, menstrual problems, menopause and post-menopausal symptoms,
	Tuber paste	To treat rheumatism
	Root decoction	Helps to relieve pain of child birth

The relative abundance of *Dioscorea* species in each district are presented in Table 5. The result shows that *D. alata* had the highest relative abundance in both Kokrajhar (16.70%) and Chirang (18%) district, while *D. deltoidea* (6.37%) and *D. pubera* (5.49%) had the lowest

relative abundance in Kokrajhar and Chirang district respectively. In Baksa district, *D. bulbifera* showed the maximum relative abundance (17.33%), while *D. pubera* has minimum relative abundance (6%). Furthermore, it was revealed that *D. alata* had the highest relative

abundance (17.01%), while *D. hamiltonii* had the lowest

relative abundance (5.29%) in Udalguri district.

Table 5. Relative Abundance of *Dioscorea* species in surveyed districts.

Dioscorea species	Kokrajhar		Chirang		Baksa		Udalguri	
	A	R.A (%)	A	R.A (%)	A	R.A (%)	A	R.A (%)
<i>D. alata</i>	152	16.70	164	18	110	12.22	148	17.01
<i>D. bulbifera</i>	120	13.19	118	12.95	156	17.33	114	13.10
<i>D. deltoidea</i>	58	6.37	60	6.59	67	7.44	58	6.67
<i>D. esculenta</i>	108	11.87	120	13.17	115	12.78	102	11.72
<i>D. hamiltonii</i>	60	6.59	65	7.14	58	6.44	46	5.29
<i>D. hispida</i>	102	11.21	100	10.98	106	11.78	112	12.87
<i>D. pentaphylla</i>	110	12.09	114	12.51	116	12.89	108	12.41
<i>D. pubera</i>	72	7.91	50	5.49	54	6	60	6.90
<i>D. villosa</i>	128	14.07	120	13.17	118	13.11	122	14.02

A= Abundance; R. A= Relative Abundance



Fig. 2. A, B, C- *D. alata* from different site. D, E, F- Tubers of *D. alata*. G- *D. pentaphylla*. H- Tuber of *D. pentaphylla*. I- Bulbils of *D. pentaphylla*. J- *D. bulbifera*. K- *D. bulbifera* leaf with bulbil. L- Tuber of *D. villosa*.

Discussion

In this present study it was explored about different species of *Dioscorea* available in this region, its mode of consumption and usages in treatment of various health ailments by people of districts of BTR, Assam. The survey revealed that this plant is highly consumed by the people of this region. Tubers are mainly used for preparing curry with meat, fish, soya chunks or simply boiled and eaten by the tribal people. Sometimes, thin slices of tubers are fried as chips and taken as a snack. Whereas the non-tribal people mostly consume boiled or roasted tuber or cooked it with tomatoes, potatoes or other vegetables to prepare curry. They occasionally cook the tuber with meat. Boro *et al.*, 2011 reported the use of tubers of *D. bulbifera* and *D. pentaphylla* in preparation of curry among the Bodo tribes of Udaguri district, Assam. Similarly, tubers of *D. alata* and *D. bulbifera* were also reported to be consumed after cooked as vegetable by the people of Baksa District (Baro *et al.*, 2015). Bulbils are roasted or cooked as vegetable with potatoes or tomatoes. Also boiled bulbils are smashed and prepare chutney with onion, chilly. It is also revealed that this plant is very popular as traditional medicine in treating various functional disorders of the body among different tribes and non tribes residing in BTR. Local people use yam for treating stomach related disorders such as indigestion, constipation, gas, diarrhea, dysentery. This might be as a result of yams containing dietary fiber, which promotes regular bowel movement, fecal bulkiness and reduced intestinal transit.

Traditional healers in the rural areas of this region recommend yam in addition to other medicinal plants for treating common health issues like fever, cough, headache, weakness, stomachache, etc. Powder of *D. bulbifera* tuber mixed with milk is commonly used for treating cold, cough and asthma among the people of BTR. Paste of *D. bulbifera* leaves are used for treatment of skin diseases. Also, tuber paste of *D. alata*, *D. deltoidea* and *D. pentaphylla* are applied externally on wound, cuts, scars, boils, burns and other skin related problems. This may be due to anti-inflammatory, anti-oxidant activity of *Dioscorea*

which contribute to wound healing process (Chaniad, 2020). Catechin, a major active compound responsible for wound healing process is reported in *D. bulbifera* by Chaniad, 2020. Tribals of Hoshangabad district, Madhya Pradesh are also reported to use tuber paste of *D. alata* and *D. pentaphylla* to treat skin diseases (Abhyankar and Upadhyay, 2011). Local people of this region consume raw or boiled or roasted tuber with rice and salt in order to enhance appetite and increase low weight. Tubers are also cooked with meat or other vegetables and consumed by the people for treating weakness and to improve immunity. It has been documented that one boiled tuber of *D. esculenta* is taken every morning and evening by the tribals of Hoshangabad district for 15 days to increase low weight (Abhyankar and Upadhyay, 2011) which is similar to that of present findings. Kamble *et al.*, 2010 also reported the use of *D. alata* to overcome weakness.

Also, *Dioscorea* is widely used by village women for treating various gynecological related problems such as irregularity in menstrual cycle, menstrual cramps, excessive bleeding, etc. Boiled or roasted tubers of *D. villosa* are consumed to treat menopause and post-menopausal syndromes. Paste of tuber is also used to treat rheumatism. Moreover, root decoction helps in relieving the pain experienced at child birth. These findings are in agreement with study by Dutta, 2015.

The study revealed that water of soaked tuber of *D. hispida* is applied on eyes to treat weak eyesight, smoky vision, night blindness, and cataract. This may be due to presence of vitamins and beta-carotene in yams as reported earlier by Padhan and Panda (2020), which aid to improving eyesight. Tuber of *D. alata* are found to be consumed by tribal people of this region to reduce blood pressure, thus indicating that yams are helpful in maintaining blood pressure which may be due to rich dietary fibers and minerals such as potassium, sodium, phosphorous, calcium, manganese, copper, zinc (Obidiegwu *et al.*, 2020). The result of relative abundance revealed that *D. alata* and *D. bulbifera* are most abundantly found in this region, followed by *D. villosa* and *D. pentaphylla*

whereas *D. deltoidea*, *D. pubera* and *D. hamiltonii* are found to have low relative abundance among the *Dioscorea* species available in this region.

During this study, it was also observed that village people collect *Dioscorea* tubers in large amount from wild and sell them in local markets of their area or also in the urban areas, which help them to earn money. While collecting the tuber, they make sure to leave a piece of tuber in the soil from collection site so that it will be available for the next season.

Analysis of this survey work reveals that *Dioscorea* spp (Yams) has been extensively used as food and also in treatment of various health ailments by tribes and non-tribes of BTR. Therefore, more detailed studies on bioactive components of *Dioscorea* species and its mechanism of action are needed which may help in utilization of yams in discovery of effective drug.

Conclusion

From the present investigation, it can be concluded that nine different species of *Dioscorea* are found to be occurred in this region. The data obtained from the study suggests that different parts of the plants i.e., tubers, leaves, bulbils are used as food as well as for treating various health disorders by the people of BTR. During the survey, it was observed that younger generations lack knowledge about traditional uses of these plants due to modernization and are more inclined towards allopathic medicines. Therefore, it is extremely essential to document the traditional knowledge of using these plants for curing various health disorders by different communities of BTR. It is also essentially important to cultivate and conserve these plants for both human benefit and maintenance of plant biodiversity. In addition, further research on the various bioactive components present and their mechanisms of action is needed, which can contribute in the development of novel drugs with minimal or no side effects.

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Conflict of interest

Authors declare that they have no conflict of interest.

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