

# Green Leafy Vegetables of Tripura: A Case study

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## ABSTRACT

**Background:** Present study was carried out in Tripura, which is a small hilly state belonging to the north eastern part of India. Tripura is very rich in plant diversity because of its varied climate and optimum rainfall. Leafy vegetables which are found abundantly in the natural habitat have a very important role to provide nutrition and health benefits among the indigenous people. **Aim:** In this study Tribal markets of Tripura were surveyed to explore the wild leafy vegetable plants. **Materials and Methods:** The methods used in this investigation were considered for collecting basic information and to record the on the various wild leafy vegetable plants and their uniformity and handling in the vicinity of the indigenous people of Tripura prior to conduct the study, necessary information was gathered from the claimant. Participants considered during the study were selected by sampling method. **Results:** Wild Leafy plants such as *Typhonium trilobatum* (Kharkon), *Hygrophila auriculata* (Kulekhara), *Ipomoea aquatica* (Kolmi), *Centella asiatica* (Thankuni pata), *Alternanthera philoxeroides* (Joldaroga), *Chenopodium album* (Jilmil Saak), *Amaranthus retroflexus* (Morcha ssak), *Corchorus capsularis* (Paat pata), *Leucas aspera* (Drun), *Enhydra fluctuans* (Helongcha), *Naptunia oleracea* (Moloncha) etc, are very popular leafy vegetable plants found in wild state. I have explored and identified 37 wild leafy vegetable plants which are found in the rural markets of Tripura during the study. Nowadays, though various sophisticated medical instruments and medicines have been invented, many people in rural areas try to use local herbs and creepers for the treatment of minor illnesses. **Conclusion:** The commercial status of these leafy vegetables are very less known and remained unexplored as these plants are only sold in the tribal dominated markets. This study also revealed that most of these plants are also traditionally used as home remedies and in herbal formulations practiced by the folklore practitioners besides providing important food supplements by the indigenous people of Tripura. This study will facilitate the nutritional evaluation and exploration of medicinal properties of these wild leafy vegetable plants in future pharmaceutical research activities.

**Keywords:** Wild leafy vegetables, Indigenous people, Ethnomedicinal plant, Folklore practitioners, Tripura.

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## INTRODUCTION

Most of the underutilized edible plants collected from the forest and neighboring areas are preferably sold in the local tribal markets of Tripura in both forms dried and fresh. Fresh leaves, tender shoots or flowers of these vegetables are consumed as vegetables with some addition of spices. During peak season, a large quantity of these leafy vegetables is harvested and dried by the local indigenous people. The method of household drying involves collection or harvesting of the wild leafy vegetable plants from agricultural fields, household surroundings or forests followed by washing and sorting to remove dirt and other unwanted particles. Leaves are usually spread on a clean cloth in the sunny day for drying. Complete drying normally takes around

2-5 days depending upon the weather and type of leafy vegetables. The dried leaves are then either crushed with hands or ground in a pestle and mortar followed by sieving to produce a fine powder. These powdered and dried leaves are generally used by the local people in making soup with other seasonal vegetables when there is less supply of other vegetables and due to adverse climate, the prices become high. The wild leafy vegetables are very healthy and nutritious as they are good sources of different vitamins and minerals. They are loaded with various minerals like magnesium, calcium, potassium, iron etc. The wild leafy vegetables are also high in fibre and low in fat and simple carbohydrates and are good source of proteins. These wild leafy vegetables play a significant role in reducing deficiency of micronutrient and give food security to the indigenous people of rural Tripura; however, no organized literature is accessible regarding the biometabolites of these lesser-known leafy vegetables. Besides being a very good source of vitamins and micronutrients, the wild leafy vegetables are also considered to be a good source of antioxidants. They be full of various useful biometabolites which helps to protect the



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cells from oxidative damage induced by free radicals and thereby help reduce the oxidative stress,<sup>[1]</sup> and plays a role in healthiness, especially lowering the danger of chronic human ailments such as cardiovascular disease, cancer and other age-related disorders.<sup>[2]</sup>

In Tripura, the leaves of many wild plants are used as vegetables. They are a very nutritious and found abundantly in the forest areas. The wild leafy vegetables are an important part of the nutritional requirement of the indigenous people in inaccessible areas of Tripura. The wild leafy vegetables not only supply food but also help in the fulfillment of nutrition among the indigenous people. The make use of wild leafy vegetables as food is an essential component of the tradition and culture of many communities of indigenous people of Tripura. It constitutes an important part of the food habit and foodstuff security of different indigenous communities particularly people living around the forest areas and these wild leafy vegetable plants are widely consumed in the daily diet. A large section of the rural population meets their nutritional requirement through unconventional means, by consuming various wild plants and animal resources. Wild leafy plants are the essential part in the variation of different traditional recipes and also bring food security of many indigenous communities and sometimes also consider as an income source. However, the recognition of wild leafy vegetable plants has a very little awareness in economic development, research activities, sustainable management and biodiversity conservation. To reduce the gap of traditional knowledge and to explore the unknown wild resources to ensure appropriate utilization and sustainable management of these important species are crucial. Keeping view of these the Tribal markets of Tripura were surveyed and studied to explore the various seasonal wild leafy vegetable plants. The commercial status of these species are very less known and unexplored as these plants are only sold in the tribal dominated markets of Tripura.

## MATERIALS AND METHODS

### Study area

This study was performed in Tripura, the smallest states of Northeast India and the 3<sup>rd</sup> smallest state of India that forms an important part of the rich Indo-Burma biodiversity hotspot. The Latitude and longitude of Tripura coordinates are: 23.745127, 91.746826. Tripura located in the eastern part of India sharing the border with Bangladesh and the states of Mizoram, Manipur and Meghalaya (Figure 1). Tripura is very rich in cultural and biological diversity, having populated by diverse linguistic, ethnic and religious groups and various indigenous tribal communities. The study was conducted among the village markets of Tripura in the areas of Barmura-Devatamura hills and in close proximity areas like Teliamura, Ampinagar, Tetoibari, Gamakupara village,

Taidu, Karvu, Baishamani., Jantranapara etc. The main occupant of these areas are Tripuri, Reang, Molsom, Chakma Lushai tribes, Jamatia, Kaipeng, Halam, Debberma, Kuki, Uchoi and Uchai tribes. Tripura reported a recorded forest area of 6,294 sq km which is 60.02% of its geographical area. The indigenous people collect different varieties of wild leafy vegetables and various kind of wild edible plants from the local forest and surrounding areas. They sell those species in the local markets and in the tribal markets of Agartala.

### Survey and data collection

The methods used in this investigation were considered for collecting basic information and to record the on the various wild leafy vegetable plants and their uniformity and handling in the vicinity of the indigenous people of Tripura prior to conduct the study, necessary information were gathered from the claimant. Participants considered during the study were selected by sampling method. The craterous were to obtain and understand maximum in formations on dietary preference, edibility, medicinal and to explore the market of various wild leafy vegetable plants from different tribal markets. The tribal markets are very important as it provides much information on different wild edible varieties which are popular among the local indigenous societies. The Tribal markets areas were surveyed to gather the information on the presence and profusion of wild leafy vegetable plants. Surveys were performed at 26 tribal market areas of Tripura in different seasons mainly pre monsoon to monsoon and post monsoon period from April 2018 to October 2021. Involvement of local peoples were made while collecting data as the sellers and the collectors were belong to different ethnic communities. However, a majority of them know Kokborok and Bengali as the state language. Important information were gathered using extensive formal, informal and interactions with the edible plant vendors who deals with wild leafy vegetable plants and those collector who harvested the species from their natural habitat and marketing following the methods used by Upetry *et al.*,<sup>[3]</sup> and Jain *et al.*<sup>[4]</sup> The information comprise of their botanical names, families, mode of preparation etc. (Table 1). The collected plant specimens were preserved and identification was performed taking assistance from the relevant literature, experts and Flora.<sup>[5-7]</sup> The herbarium specimens were preserved and deposited in the Botany Laboratory, Assam down town University, Guwahati, Assam. During the study 60 local sellers, folklore practitioners who were associated in making different traditional formulations using many of the recorded wild leafy vegetable plants and local people were interviewed to get more data and all the information were recorded in the tabulated questionnaire form. The collection sites of these plants were visited and interactions were conducted to gather in depth information on these recorded species.

## RESULTS

The study indicates all most all the wild leafy vegetable species which were collected from the adjacent areas of forest, the larger amounts wild leafy vegetable plants were collected from the hilly and rural areas of Tripura. The information were collected during the study reveals that they there was no connection between the social status and income of the people for using these wild edible plants. The different races of indigenous people use different modes of preparation of these species and all the preparations are very popular among them. Though the method of preparation is more or less same for these wild leafy vegetables but sometimes it varies among communities according to their taste of preference and food habit. Gudak, Chakoi, Tak, Pata bata, Sutki, Bhorta are the major traditional cuisines unique to the state that form an important part of daily diet. Use of one or more wild vegetables is a necessary part of a daily recipe. Locally collected wild leafy vegetables are mostly preferred in day meal.

The present investigation recorded 37 wild leafy vegetables distributed under 27 botanical families, sold in different tribal markets of Tripura. Those documented species which were being utilized by the indigenous communities for nutritional and various household purposes like as home base medicines. The plants were collected from terrestrial, aquatic habitats of Tripura. Most of the species are herbaceous in nature, leaves are the mostly edible part including tender shoot and sometime along with young stem, consumed through cooking. The photographs

were taken during the market survey and while identifying these species local names were also collected. The list of plants along with their Botanical name, family, mode of preparation etc are presented in the below mentioned Table 1.

The indigenous people of Tripura mostly use plant-based formulations as a remedy to cure from various diseases. Indigenous drugs are very ancient. It provides information on the traditional uses of wild unexplored plants wealth which can be utilized in the development of medicine, agriculture, health and industry. During the investigation it was observed that some species were also having ethnomedicinal value, the brief information about the recorded wild leafy vegetable plants used by the folklore practitioners of the State are given below:

*Typhonium trilobatum* (L.) (*T. trilobatum*) Schott belongs to the family Araceae, is perennial herb and the size is small to moderate, locally it is known as *Kharkol pata*. Leaves and tubers are cooked as vegetables and also given to the patient suffering from piles and rheumatism.<sup>[8,9]</sup> The uses of this plant as traditional medicine confirm that it may possess some important biological activities.

*Hygrophila auriculata* (K. Schum) Heine belongs to the family Acanthaceae is a wild herb found in the semi aquatic moist places like paddy fields, ditches and on the rivers banks throughout Tripura and is popularly known as Kulekhera (Figure 2). The plant is traditionally used by the folklore practitioners for the treatment of pain, inflammation, edema, urinary infection and also as a diuretic. The plant is also used in preparing rejuvenating



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**Figure 1:** MAP showing the forest cover of Tripura (A) and market places of Tripura (B). (Source: mapsofindia.com)



**Table 1: The description of the method of preparation of traditional dishes.**

Sl. No.	Botanical name	Family	Preparations
1	<i>Typhonium trilobatum</i> L.	<i>Araceae</i>	Cooked as leafy vegetable and as chutney.
2	<i>Hygrophila auriculata</i> (K. Schum) Heine	<i>Acanthaceae</i>	Cooked as leafy vegetable.
3	<i>Ipomoea aquatic</i> Forssk.	<i>Convolvulaceae</i>	Cooked as leafy vegetable Cooked as leafy vegetable.
4	<i>Alternanthera philoxeroides</i> (Mart.) <a href="https://en.wikipedia.org/wiki/August_Heinrich_Rudolf_Grisebach">https://en.wikipedia.org/wiki/August_Heinrich_Rudolf_Grisebach</a>	<i>Amaranthaceae</i>	Cooked as leafy vegetable.
5	<i>Amaranthus viridis</i> L.	<i>Amaranthaceae</i>	Cooked as leafy vegetable.
6	<i>Corchorus capsularis</i> L.	<i>Malvaceae</i>	Cooked as leafy vegetable.
7	<i>Leucas aspera</i> Spreng.	<i>Lamiaceae</i>	Cooked as leafy vegetable.
8	<i>Naptunia oleracea</i> Lour.	<i>Fabaceae</i>	Cooked as leafy vegetable.
9	<i>Enhydra fluctuans</i> Lour.	<i>Asteraceae</i>	Cooked as leafy vegetable.
10	<i>Polygonum barbatum</i> L.	<i>Polygonaceae</i>	Cooked as leafy vegetable.
11	<i>Antidesma diandrum</i> (Roxb.) B.Heyne. ex. Roth.	<i>Euphorbiaceae</i>	Used in the preparation of tak chatnies with olive fruit and sugar.
12	<i>Centella asiatica</i> (L.) Urb.	<i>Apiaceae</i>	Used in the preparation of chatni and in fish curry.
13	<i>Chenopodium album</i> L.	<i>Chenopodiaceae</i>	Cooked eaten with other vegetables.
14	<i>Pogostemon purpurascens</i> Dalzell.	<i>Lamiaceae</i>	Added as spices.
15	<i>Alocasia macrorrhiza</i> L.	<i>Araceae</i>	Tender leaves are eaten in curries after proper cooking.
16	<i>Cardamine ornica</i> L.	<i>Brassicaceae</i>	Additives in cooked curry.
17	<i>Cissus javanica</i> DC.	<i>Vitaceae</i>	Leaves and tender shoots can be consumed as vegetable. Cooked by boiling with potatoes and dry fish.
18	<i>Zanthoxylum acanthopodium</i> DC.	<i>Rutaceae</i>	Eaten raw with chili and fermented fish chutney or additives in snail curry.
19	<i>Eryngium foetidum</i> L.	<i>Apiaceae</i>	Added as spice in all cooked dish; especially in meat curry.
20	<i>Passiflora edulis</i> Sims.	<i>Passifloraceae</i>	Cooked eaten as vegetable; added to meat curry.
21	<i>Piper pedicellatum</i> DC.	<i>Piperaceae</i>	As spices.
22	<i>Diplazium esculentum</i> (Retz.) Sw.	<i>Athyriaceae</i>	Tender coiled leaves are Cooked with other vegetables.
23	<i>Oxalis orniculata</i> L.	<i>Oxalidaceae</i>	Cooked with fishes and preparation of tok (Sour) chatneys.
24	<i>Raphanus sativus</i> L.	<i>Brassicaceae</i>	Cooked as vegetables.
25	<i>Houttuynia cordata</i> Thunb.	<i>Saururaceae</i>	Used in the preparation of chatni.
26	<i>Adhatoda zeylanis</i> Medic.	<i>Acanthaceae</i>	Tender leaves are fried and consumed with rice.
27	<i>Alternanthera sessilis</i> L.	<i>Amaranthaceae</i>	Leaves are eaten as vegetables.
28	<i>Amorphophallus bulbifer</i> Roxb.	<i>Araceae</i>	Tender leaves are eaten as pakoras fried with basan.
29	<i>Basella alba</i> L.	<i>Basellaceae</i>	Leaves along with tender stem are consumed as vegetables.
30	<i>Boerhaavia diffusa</i> L.	<i>Nyctaginaceae</i>	Leaves along with tender stem are also consumed as leafy vegetables.
31	<i>Coccinia grandis</i> L.	<i>Cucurbitaceae</i>	Tender leaves are used in the preparation of saak and also used in the preparation of gudak with dry fish.
32	<i>Colocasia esculenta</i> L. Schott.	<i>Araceae</i>	Young leaves and stalks are cooked and kacchu sag is prepared which is consumed with rice.

Sl. No.	Botanical name	Family	Preparations
33	<i>Momordica charantia</i> L.	<i>Cucurbitaceae</i>	Tender leaves are used in the preparation of Nona Hilcha recipe and eaten with rice.
34	<i>Murraya koenigii</i> L. Spreng.	<i>Rutaceae</i>	Leaves are used as a flavouring agent and in chutney and curries.
35	<i>Paederia foetida</i> L.	<i>Rubiaceae</i>	Young leaves are used in making curries with small fish.
36	<i>Azadirachta indica</i> A. Juss.	<i>Meliaceae</i>	Young leaves are used in making fries with rice powder.
37	<i>Portulaca oleraceae</i> L.	<i>Portulacaceae</i>	Leaves along with tender stem are consumed as vegetables.

tonics. It is classified in the ayurvedic system of medicine as Seethaveryam, mathuravipaka and is used for the treatment of a number of conditions including diabetes and dysentery.<sup>[10]</sup>

***Alternanthera philoxeroides*** (Mart.)[https://en.wikipedia.org/wiki/August\\_Heinrich\\_Rudolf\\_Grisebach](https://en.wikipedia.org/wiki/August_Heinrich_Rudolf_Grisebach) belongs to the family Amaranthaceae is a wildy growing perennial, herbaceous plant having creeping stems that form roots at the nodes and locally known as Joldaroga saak. The plant extract is also used by the folklore practitioners to treat various female diseases and stomach disorders.

***Amaranthus viridis* L.**, member of the family Amaranthaceae is locally known as Data saak is an upright annual herb with light green stem that grows to about 60-80 cm in height (Figure 3). The plant is documented to be used in the treatment of snake bite and scorpion sting by the traditional practitioners of Tripura.

***Leucas aspera*** Spreng. is a very important plant under the botanical family Lamiaceae which is locally known as Dron saak is an annual, branched herb used in the plant-based medicine by the folklore practitioners as an antipyretic and insecticide (Figure 4). The plant extraction is used against worm, wound healing and poison bites.

***Naptunia oleracea* Lour.** is a member of the family Mimosaceae is a perennial herb which is sometimes grown as an annual aquatic, floating or prostrate near water's edge and is locally known as Horai or Panilajuk (Figure 5). The plant is used against burning sensation and helminthiasis by the folklore practitioners of Tripura.

***Enhydra fluctuans* Lour.** belongs to the family Asteraceae which local name is Helencha (Figure 6). It is a semi-aquatic herbaceous plant having serrate leaves and found in different marshy areas of Tripura. The plant is used in skin diseases and also in the treatment of liver ailment and insomnia.<sup>[11]</sup>

***Polygonum barbatum* L.** belongs to the family Polygonaceae is a leafy vegetable which is rich in B Complex Vitamins specially Vitamin B2, B3 & B12, Vitamin E, Vitamin D and minerals such as Calcium, magnesium and potassium. The plant is used by the folklore practitioners of Tripura in the treatment of colic

pain-relieving treatment. The roots are also used as astringent and are used externally in the treatment of scabies. Also consumed as a tonic and useful against headache.

***Antidesma diandrum* (Roxb.) B.Heyne.** ex. Roth belongs to the family Euphorbiaceae is also known as tak pata locally which is very acidic and reported to treat of snake-bites by the folklore practitioners of Tripura. Fruits are also sour.

***Centella asiatica* (L.) Urb.** belongs to the botanical family Apiaceae which is popularly known as Thankuni pata (Figure 7) is used to treat leprosy, epilepsy, asthma, bronchitis and abdomen disorders.

***Chenopodium album* L.** is a member of the botanical family Chenopodiaceae known as Botua saak (Figure 8) is used to treat hepatic disorders and in spleen enlargement by the folklore practitioner of Tripura. The plant extract is useful in dysentery and rheumatism.

***Alocasia macrorrhiza* L.** belongs to the family Araceae is popular among the local people as Fen kacchu which is reported effective to treat of earache, scorpion-string and in urine complaint.

***Cissus javanica* DC** belongs to the family Vitaceae, locally known as Harbhangha gas is a very important ethnomedicinal plants. The folklore practitioners of Tripura used the powdered roots as well as the stem paste to treat bone fractures.

***Eryngium foetidum* L.** belongs to the family Apiaceae which is known as Bilati Dhania is used in the treatment of kidney stone related problems. The plant extracts is also useful as nerve tonic.

***Boerhaavia difusa* L.** is a member of the botanical family Nyctaginaceae which is known as Punarnava is very useful to treat of swelling, stomachic, antihelminthic. It is effective in anaemia as household remedies, heart diseases and folklore practitioners used as an antidote to snake-venom.

***Oxalis corniculata* L.** is a member that belongs to Oxalidaceae family which is locally known as Amrul sak. The plant extraction is considered as a remedy for convulsions and also for healing fractures bones. Ground leaves help purify blood, anemia, piles and scurvy by the folklore practitioners of Tripura.





Figure 2: *Hygrophila auriculata* (K. Schum) Heine.



Figure 5: *Naptunia oleracea* Lour.



Figure 3: *Amaranthus viridis* L.



Figure 6: *Enhydra fluctuans* Lour.



Figure 4: *Leucas aspera* Spreng.



Figure 7: *Centella asiatica* (L.) Urb.

*Houttuynia cordata* Thunb. belongs to the family Saururaceae which is locally known as Maschagandha. The leaves along with the tender stems are used in the treatment of stomach complaint and useful in injuries due to burn.

*Adhatoda zeylanis* Medic belongs to the family Acanthaceae. The plant is known as Basak tita is an important ethnomedicinal plant used by the folklore practitioners, it is prescribed in the form of juice, syrup and decoction of leaves used as expectorant.

Leaf juice is effective in dysentery, diarrhea and to treat various of skin infections.

*Alternanthera sessilis* L. belongs to the botanical family Amaranthaceae, known as Matikanduri is useful in the treatment burning sensation, diarrhea and fever. The plant is also reported to be used in the traditional medicine to treat night blindness and leprosy.





**Figure 8:** *Chenopodium album* L.



**Figure 11:** *Azadirachta indica* A. Juss.



**Figure 9:** *Colocasia esculenta* L. Schott.



**Figure 12:** *Portulaca oleraceae* L.



**Figure 10:** *Murraya koenigii* L. Spreng.



**Figure 13:** *Ipomoea aquatic* Forssk.

*Amorphophallus bulbifer* Roxb is an important member of the family Araceae which is locally known as Bager Doga, a very useful plant used by the folklore practitioners of Tripura. The corn is used to control swelling of throat, enlarged spleen and ear aches. It is also used in the traditional formulations to treat against elephantiasis and tumor.

*Basella alba* L. is known as Pui saak belong to the family Basellaceae is an important medicinal plant used in the treatment of haemorrhages, sleeplessness, ulcer, dysentery and to treat

urinal diseases. The plant is used to get relief from burning sensation, useful to treat leprosy and used as laxative in children and pregnant women.

*Coccinia grandis* L. is belong to the family Cucurbitaceae and locally known as Telakuccha gass. The plant is used as a laxative antihelminthic and also used against asthma, fever, anaemia. Juices of the leaves are used in diabetes and leaf decoction used in chronic ulcers. Stem is useful in bronchial catarrh and bronchitis. The folklore practitioners used the dried stem powder against

**Table 2: Nutritional composition of some leafy vegetables (per 100 g edible portion).**

Vegetables	Minerals			Vitamins	Macronutrients			References
	Calcium	Phosphorous	Iron	Rivoflavin, Niacin, ascorbic acid	Protein	Carbohydrate	Fat	
<i>Chenopodium album</i> L.	150	80	4200	R-140, N-600, AA-35	3.7	2.9	0.4	Gopalan <i>et al.</i> , (2004). <sup>[13]</sup>
<i>Amaranthus viridis</i> L.	397	83	3490	R-30, N-1200, AA-99	4.0	6.1	0.5	Gopalan <i>et al.</i> , (2004). <sup>[13]</sup>
<i>Coccinia grandis</i> L.	250	115	900	Ascorbic acid-25.55	1.4	3.4	0.2	Neetu <i>et al.</i> , (2020). <sup>[14]</sup>
<i>Leucas aspera</i> Spreng.	188		2742	Ascorbic acid-5	7	12.3	0.2	Kripa KG <i>et al.</i> , (2016). <sup>[15]</sup>
<i>Oxalis corniculata</i> L.	563	25	8916	-	28	24.67	23.75	K Arunal <i>et al.</i> , (2014). <sup>[16]</sup>
<i>Centella asiatica</i> (L.) Urb.	0	-	178	Ascorbic acid-13	10	52	0	Chandrika UG at al., 2015. <sup>[17]</sup>

dysuria and its tuber juice of 1-3 teaspoon is taken daily to use in diabetes mellitus.

***Colocasia esculenta* L. Schott** belong to the family Araceae is known as Kacchu saak (Figure 9) is a very important ethnomedicinal plant used to increase appetite and to control blood pressure. The leaf extracts is used against internal haemorrhages and is a stimulant. Corn juice is laxative. The plant is also reported to treat enlarged spleen.

***Momordica charantia* L.** is a member of the family Cucurbitaceae known as Korola is a very important medicinal plant having numerous pharmaceutical properties which is used in the different formulations of folklore medicines to treat against snake bites, leprosy, stomach worm etc. The fruit juice is useful against diabetes.

***Murraya koenigii* L. Spreng** is a member of the botanical family Rutaceae, known as Narasingha gaas (Figure 10), is an important medicinal plant used to treat of diarrhea and dysentery and for checking vomiting. Bark, leaves and roots are useful against hyperdipsia and ulcers. The leaves are also used by the folklore practitioners against of poison bites.

***Paederia foetida* L.** is a member of the botanical family Rubiaceae, known as Gondhopatali is a very important plant used against urinary bladder problem, intestinal disorders and rheumatism. The plant is also used to treat dysentery and different abdomen complaints. Externally it is used as liniment.

***Azadirachta indica* A. Juss** is a member of the family Meliaceae, known as Neem gaas (Figure 11) which is a very important medicinal plant which is reported to treat different fertility issues by the folklore practitioners of Tripura. The plant has antipyretic, antiseptic and antiviral activity.

***Portulaca oleraceae* L.** is a member of the family Portulacaceae, locally popular as Demi or Dimai saak (Figure 12) is an important ethnomedicinal plant which is used in diseases of kidney and bladder, gonorrhoea. The plant is also used to treat haematemesis, hemophilic by the folklore practitioners of Tripura. Externally it is applied in case of burns, scalds ok skins etc.

***Ipomoea aquatic* Forssk.** is locally known as Kolmi saak (Figure 13) is an important medicinal plant which is used to treat piles and stop nosebleeds by the folklore practitioners of Tripura. It is a seasonal leafy vegetable the young leaves and fleshy stems are very popular with dry fish among the local people.

### Nutritional components in wild leafy vegetables

Green leafy veggies supply essential elements for human health and well-being. Green leafy vegetables, which are high in important micronutrients, can be used to supplement nutritionally deficient goods. Dietary fibre, vitamins, vital fatty acids, minerals (calcium, Phosphorus, Iron) and amino acids are examples of these. Green leafy vegetables have long been regarded as excellent providers of nutritional requirements (Table 2). Additionally, fibre has been discovered to lower cholesterol levels by minimising the reabsorption of cholesterol produced by the body to aid in fat digestion. Epidemiological research has demonstrated the value of dietary fibre in preventing a number of diseases, particularly the fibre presents in wild leafy vegetables. Green leafy vegetables are abundant sources for beta-carotene. In the leaves of wild edible plants, vitamin-A is present in the form of provitamin-A carotenoids such as betacarotene (ca. 25-30%), alpha-carotene, beta-cryptoxanthin, gamma-carotene and non-provitamin A carotenoids lutein (ca. 45%), violaxanthin (ca. 15%) and neoxanthin (ca. 15%).<sup>[12]</sup>

Greater, thinner leaves are more nutrient-dense and typically have fewer calories. The body must convert carotenoids, such



as betacarotene, present in plant diets into vitamin A. Plants, particularly green leafy vegetables, are the primary source of foliates for humans. In the Indian diet, *Colocasia* leaves (*Colocasia esculenta*) are a great source of foliate. Green leafy vegetables are the richest and most affordable sources of protein. Protein nutritional quality is determined by the amounts of necessary amino acids, which humans cannot synthesise and must thus be given in the diet. Wild leafy vegetables serve an essential function as a nutritional source in rural settings and they are available all year or in specific seasons.

### Dietary fibres

Green leafy vegetables are good sources of dietary fiber, which is important for preventing diseases and lowering cholesterol levels. Indian green leafy vegetables such as cabbage, spinach, fenugreek, coriander and basella are also good sources of soluble dietary fiber, which can help with constipation, diabetes, diverticulitis and obesity.

### Vitamins

Typhonium is a rich source of vitamins such as Carotene, Folic acid, Thiamine, niacin, etc. Spinach provides 573 mcg of vitamin A, which can lower blood pressure and improve heart health. Fresh, young leaves contain more vitamin C. Carotenoids like beta-carotene are abundant sources of vitamin A. Vitamin-A is present in green leafy vegetables in the form of provitamin-A carotenoids, expressed in retinol equivalents. Green leafy vegetables are abundant sources for beta-carotene. In the leaves of wild edible plants, vitamin-A is present in the form of provitamin-A carotenoids such as betacarotene (ca. 25-30%), alpha-carotene, beta-cryptoxanthin, gamma-carotene and non-provitamin A carotenoids lutein (ca. 45%), violaxanthin (ca. 15%) and neoxanthin (ca. 15%).<sup>[13]</sup>

### Proteins

The nutritional quality of protein is determined by the presence of essential amino acids and its proportions. Greater, thinner leaves a most of the wild life vegetables are more nutrient-dense and typically have less calories. Plants, particularly green leafy vegetables, are the primary source of foliates for humans. In the Indian diet, *Colocasia* leaves (*Colocasia esculenta*) are a great source of foliate. Wild Green leafy vegetables such *Chenopodium album* L. are the richest and most affordable sources of protein

### Essential fatty acids

Omega-3 fatty acids are essential for normal growth and development and have been found in green leafy vegetables with beneficial effects on health. Evidence shows that alpha-linolenic acid is found *Coccina grandis*, spinach, mustard greens, red leaf lettuce and butter crunch lettuce. Spinach helps to improve brain function, memory, lower the risk of heart problems, regulate blood pressure and control diabetes.

### Harvest Period

Collection and harvesting of most green leafy vegetables were done twice during the growing season. The first harvest took place on 15<sup>th</sup> May-25<sup>th</sup> May 2021, cutting the plants to avoid damaging the vegetative top of the plants and to ensure retro-vegetation. The second harvest took place after 20 days, on 5<sup>th</sup> June -15<sup>th</sup> June 2021. Again, the collection of green vegetables took place on 10<sup>th</sup> May- 20<sup>th</sup> May 2022 and 30<sup>th</sup> June-10<sup>th</sup> June 2022 respectively.

### DISCUSSION

The benefits of wild resources to remote rural villages in Tripura cannot be overstated. The positive relationship between the resources i.e., crops, non-timber forest products and livestock indicate their concurrent relevance to livelihoods. The favourable association between non-timber forest products such as wild leafy vegetables and livestock indicates their concurrent value to livelihoods. However, chemical analyses were beyond the scope of this study, this may be carried out in the near future. The favourable association between non-timber forest products such as wild leafy vegetables and livestock indicates their concurrent value to livelihoods. Different varieties of wild leafy vegetables prepared with dry fish (Gudak) is very popular among the ethnic people of Tripura. Vegetable curries and chatnies (grind with garlic, chilies and ginger) are eaten with sticky rice is a very common recipe practiced in most of the households. Wild edible herbs provide important leafy vegetables for many rural households such as *Typhonium trilobatum* L., *Alternanthera philoxeroides* (Mart.) Griseb, *Centella asiatica* (L.) Urb., *Diplazium esculentum* (Retz.) Sw., *Alternanthera sessilis* L., *Basella alba* L., *Colocasia esculenta* L. Schott, *Paederia foetida* L. etc. The abundance of wild leafy vegetables indicated that there were enough herbs available for harvesting during the research year. When locals were asked to compare present availability to the previous decade, the majority agreed that the amount of wild plants had declined. Some of the villagers reported to cultivate some of the wild leafy vegetable plants in their kitchen garden to make those available throughout the year. Based on species popularity and importance, some species have a high economic potential based on nutritional and chemical composition for which separate research study will be conducted.

### CONCLUSION

The findings of the present investigation indicates that the indigenous people of Tripura use most of the wild leafy vegetable plants collected from the local habitats and prepare different ethnic recipes as they are having diversified culture and food. The wild leafy vegetable plants are utilized as common household food and make a considerable contribution to the food security. A large amount of such wild leafy vegetable plants are found abundantly in different seasons sold in the tribal dominated markets to sustain livelihood by the rural people. In this study the

wild leafy vegetables which were collected from natural habitat were documented and also attempted to gather information on ethno-medicinal uses of these plants during the study period. The present investigation of scientific documentation on wild leafy vegetable plants reveals that indigenous people living in rural and remote areas of Tripura practice very less cultivation but they utilize natural resources in every aspect starting from food, medicine and all household activities. As food the indigenous people consume various wild leafy plants as vegetables, the study reveals 37 wild leafy vegetable plant species that belongs to 28 botanical families that were utilized by the indigenous people of Tripura. But increased over-exploitation, forest fires, habitat destruction may threat many species, many of them are already been disappearing from the natural habitats. Therefore, is very much needed to explore and evaluate wild edible species that may be harvested with proper scientific interventions using nondestructive manner. The study showed that a large number of wild plants were used as leafy vegetables which were found very popular among the indigenous people having many health benefits are in threat of extinction if we don't practice scientific harvesting.

## ETHICAL APPROVAL

The Ethical clearance was obtained from the Department of Botany, Assam down town University, Panikhaiti, Guwahati, Assam for conducting the survey.

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## AUTHORS CONTRIBUTION

Dr. Gunamoni Das conceptualized and gathered all the field data and laboratory activities were performed related to the identification of the plants and prepared the manuscript on the basis of original research work.

## CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

## SUMMARY

The plant specimens were collected from different market areas of Tripura and were authenticated and specimen samples were deposited in Botany department of Assam down town University for future reference. Organoleptic characters and macroscopic characters were examined during the study along with its nutritional and ethnomedicinal uses.

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