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The importance of wild edible plant and macrofungi diversity to attain food security for the tribes of eastern India—a quantitative study

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Background: Inventorization and promotion of traditionally used local flora can be a better option to gain a wide range of alternative edible resources and multiple nutritional benefits. A perusal of literature highlighted the poor nutritional status of the tribal community living in eastern India and pointed out the potential lack of information regarding locally available wild edible resources.

Objective: Present study aimed to document detailed information on wild edibles of eastern India, evaluate their cultural significance, and understand their role in achieving food security for the local tribes.

Materials and methodology: Traditional knowledge of wild edibles was collected using a semi-structured questionnaire. Standard protocols were followed for collecting data. The collected data were analyzed using specific statistical tools like Relative frequency of citation (RFC), and Cultural food significance index (CFSI) to identify the most cited and culturally significant species. Jaccard similarity index (JI) was used to check the similarity of food plant use in different localities and adjoining areas of the laterite region in eastern India.

Results: A total of 2,603 citations were made by the 153 participants for 83 types of wild edibles spread across 48 families. Among the 83 species, 65 species were angiosperms, three species were pteridophytes and the rest 15 were from fungal groups. The RFC value ranged from 0.04 to 0.76, and *Madhuca longifolia* (L.) J.F.Macbr. was identified as the most frequently cited species (FC = 116; RFC = 0.76). The Cultural food significance index (CFSI) value varied from 0.2 to 844, and thirteen wild edibles like *Colocasia esculenta* (L.) Schott, *Enydra fluctuans* Lour., *Marsilea vestita* Hook. & Grev., *Termitomyces heimii* Natarajan, etc. were identified as culturally most important in the locality.

Conclusion: Present study concludes that the local flora and macrofungi diversity is a treasure trove for fulfilling human hunger and gaining enough nutritional benefit. Scientific and sustainable utilization of these wild edibles can be a wise step to attain multiple health benefits and food security for the tribal community of eastern India. Moreover, culturally accepted species can be opted as a good source for bioprospecting nutraceuticals.

KEYWORDS

wild edibles, ethnogastronomy, relative frequency of citation (RFC), cultural food significance index (CFSI), food security, *Santal* tribe, eastern India

Introduction

In the twenty-first century world, approximately 870 million individuals are anticipated to lack desired calories, and additional two billion individuals are micronutrient deficient (FAO, 2009). Such an undesirable phenomenon is very much linked to the fact that we have nearly 20,000 edible plant species, yet only a few (~20 species) supply 90% of our food today. Monotonous diets lacking in food diversity and proper diet planning resulted in malnourished conditions, which is regarded as one of the top 10 risk factors contributing to the burden of chronic health issues worldwide (GBD 2019 Risk Factors Collaborators, 2020). This challenge can be overcome by a food-based strategy incorporating wild edibles into daily diets (Chadha and Oluoch, 2003). Wild edible plants grow in the wild or semi-wild areas and are not domesticated, cultivated, or consumed as a regular food (Tardío et al., 2006). The contribution of wild edible plants to man's food heritage is as old as human civilization itself (Flyman and Afolayan, 2006). They are not only the store house of a wide range of essential nutrients (Duguma, 2020; Åhlberg, 2021; Mishra et al., 2021) but also the crucial source of genetic diversity for breeding and improving today's domesticated crops (Bharucha and Pretty, 2010; Ulian et al., 2020).

The World is now witnessing rapid changes in socio-economic and environmental conditions as well as rapid loss of biodiversity globally, which reduces the possibilities for finding new food and crop genetic resources. Realizing such alarming facts, scientists from every corner of the world have started documenting local food heritage and associated biodiversity components (Cruz-Garcia and Price, 2011; Ahmad and Pieroni, 2016; Garekae and Shackleton, 2020; Opazo-Navarrete et al., 2021; Cheng et al., 2022; Khalid et al., 2023). Many researchers have enlisted several emergency food consumed during famine, war, pandemic, or prolonged natural disasters (Reyes-García, et al., 2015; Zhang et al., 2016; Bhushi, 2021). Apart from the plant groups, wild edible fungi and animal resources have also been documented from different parts of the world (Christensen et al., 2008; Redžić et al., 2010; Łuczaj and Nieroda, 2011; Alves et al., 2013; Guyu and Muluneh, 2015; Adi et al., 2020; Łuczaj et al., 2021). Since last two decades researches on wild edibles have gained momentum in the Asian continent also. Series of articles have been published from different parts of Southeast Asia (Erskine et al., 2015; Sujarwo et al., 2016; Bernadas and Peralta, 2017; Ong and Kim, 2017; Shin et al., 2018; Pawera et al., 2020; Punchay et al., 2020; Seav et al., 2021; Tharmabalan, 2023) and South Asia, particularly from China (Kang et al., 2013; Sachula et al., 2020; Cheng et al., 2022, 2023), Pakistan (Ahmad and Pieroni, 2016; Ijaz et al., 2022; Khalid et al., 2023), and India (Mallick et al., 2020; Harisha et al., 2021; Angmo et al., 2022).

India is a land of diversified topography, climate, and ecology, providing a strong foundation for its wide range of phytodiversity. This rich phytodiversity has historically played a significant role in the religious, cultural, social and health spheres of Indians' rural and ethnic lives. To explore such domain of interrelationship between man and nature across India, scientists have prioritized the documentation of medicinally important plants over the edible ones. But later, realizing the importance of conserving the local food heritage and knowledge associated with the local biodiversity, Indian scholars have also engaged themselves in this domain of food science, and ample numbers of articles on ethnobotany of wild edible food plants and their nutritional contribution have been reported so far (Singh and Singh, 2007; Vishwakarma and Dubey, 2011; Misra et al., 2013; Kumar and Shiddamallayya, 2021; Talang et al., 2023).

In the state of West Bengal, perusal of literature published in last two decades indicates an opposite scenario which results in scanty and diffuse research on wild edibles (Chowdhury and Mukherjee, 2012; Majumder and Mukherjee, 2015; Panda, 2015; Chakraborty, 2017; Ghosh et al., 2020). Laterite region of West Bengal is uniquely characterized by its topography, biodiversity and ethnicity. This region extends over five districts like Bankura, Medinipur, Purulia, Burdwan and Birbhum. Till date a few works have been carried out from this region except Birbhum district where no ethnogastronomic exploration ever conducted before (Banerjee et al., 2013; Dey and Mukherjee, 2015; Bouri and Ganguly, 2016; Banerjee, 2018; Chatterjee et al., 2022). All these works are based on simple enumeration of collected data without any quantitative analysis. Use of quantitative ethnobotanical tools for analyzing collected data is becoming very much crucial now a day to add more objectivity to this field of research (Leonti et al., 2002; Hoffman and Gallaher, 2007; Rahaman, 2017). Perusal of literature revealed that a large portion of the tribal community including *Santals* living in the laterite region of West Bengal uses wild edibles in their daily diet (Bandyopadhyay and Mukherjee, 2009; Roy et al., 2015) but still suffer from malnutrition mainly due to lack of optimum amount of food intake and other socio-cultural limitations (Bisai, 2014; Stiller et al., 2020; Chandra et al., 2021). On the other hand, with ongoing anthropogenic activity in the forest, shifting cultivation, reliance on the limited number of high-yielding crop varieties, climate change, and changes in socio-economic conditions of the ethnic people, the traditional societies are silently losing their traditional food heritage along with the related phyto-resources (Łuczaj et al., 2012; Downs et al., 2020; Ghosh-Jerath et al., 2021). Long-term inattention towards such a treasure trove of wild edibles raises the risk of overlooking the provisioning of biodiversity and supportive local knowledge systems that may make these food resources fade away from the society in near future. So there is an urgent need to document persisting knowledge on wild edibles available in the laterite region of west Bengal.

In this context, present work is aimed to document detailed information on wild edibles available in the laterite region of West Bengal, determine the importance of local flora to attain the food security of the local tribes and identify culturally significant wild edible species using quantitative data analysis techniques.

Materials and methods

Study area

For the present study, we have focused mainly on the district Birbhum, the land of varied topography, dry deciduous *Saal* forest, and diverse tribal groups resides in remote villages as well as urban and semi-urban areas of this district. The study area is located in between 23°32′30″ and 24°35′00″ North latitudes and 87°5′25″ and 88°1′40″ East longitudes, and occupies an area of 4,545 sq. km (Figure 1). In Birbhum, 15,927 hectares of land is covered by forest; out of which 2,849 hectares of land is under the reserved forest areas, 6,242 hectares is protected forest areas and 6,835 hectares of land is unclassified state forest land. Some of the main forests in the district are Ballavpur forest, Gonpur forest, Chaupahari forest, Chorchor

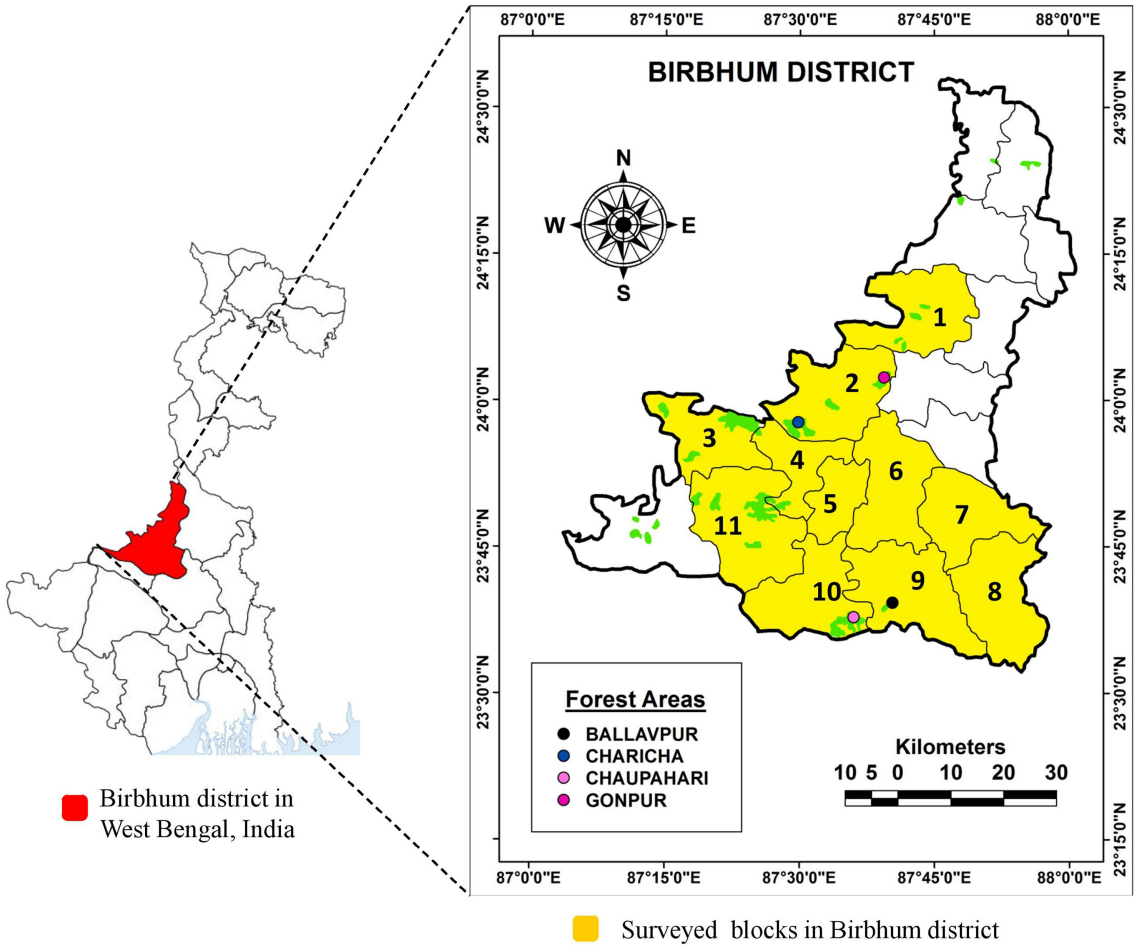

FIGURE 1
Study area showing 11 surveyed blocks (1. Rampurhat-I, 2. Mohammad Bazar, 3. Rajnagar, 4. Suri-I, 5. Suri-II, 6. Sainthia, 7. Labpur, 8. Nanoor, 9. Bolpur-Sriniketan, 10. Illambazar, and 11. Dubrajpur) and four major forest areas in Birbhum district.

forest, forest of Chinpai and Bhandibon. All these natural forests are rich in varieties of medicinal and edible species of diverse plant groups which are gathered mainly by the tribal people for partial fulfillment of their daily diet and primary healthcare needs. Apart from the *Santals*, ethnic communities like *Konra, Mahali, Sardar, Dhangar*, etc. also reside here (Mandal and Rahaman, 2022).

Santals' ethnicity, socio-economic status, food heritage, and health burden

The *Santals* are the third largest ethnic group in India having unique cultural heritage. They are the descendants of pre-Dravidian people who migrated to eastern India nearly three centuries ago (Sarkar and Singha, 2019). Greater portion of the *Santal* reside in the Indian states namely West Bengal, Odisha, Jharkhand and Bihar. In West Bengal, population of the *Santal* tribe is 5.5% of the state population. In this state, majority of the *Santals* reside in the districts of Purulia, Bankura, Birbhum, and Midnapore that comprise the greater part of the laterite region in West Bengal.

Once the *Santals* were purely a nomadic tribe but later they embraced a settled livelihood. Nowadays, they have adopted multidimensional strategies for income generation. Small-scale agriculture and cattle rearing are the primary means of earning their sustenance. *Santals* are also engaged in making musical equipment, mats, baskets, crafts, ornaments, brooms, leaf plates and cups out of the plants and supplement their income by selling these items in the nearby markets. A large section of *Santal* people acts as daily labourers in the neighboring agricultural field, industrial setups, mining and urban areas. They are occasionally engaged in hunting and fishing also. In spite of all these means of revenue generation, till date *Santal* people in the area face certain hardships of life such as poverty, social and economic backwardness, low level of education and poor health status.

Poor economic condition reflects in their food and feed culture. Plain rice is the main staple food. Frequently this rice is taken in a unique way after soaking it in water overnight. Some common vegetables like brinjal, pumpkin, papaya, sweet potato, chili, etc. are mostly grown in their home garden and cultivated field for daily use. Apart from that, *Santals* use several wild and semi-wild fruits and vegetables most frequently in cooking to fill the stomach as well as to enhance the flavor of their food or for preservation purposes. Rice beer or "*daka-handi*" is a traditional drink and remains very popular among the after from *Santals*. They also like to drink "*mahua*" liquor, a drink made from the fermented dried flower of *Madhuca longifolia* (J.Koenig ex L.) J.F.Macbr.

In West Bengal, the researchers evidenced the poor growth rate and high prevalence of undernutritional condition among the *Santal* people of all ages (Das and Bose, 2012; Stiller et al., 2020). They also highlighted several factors like poverty, low educational level, poor knowledge of health care, insufficient intake of nutritional food, social taboos and belief in supernatural powers. All these factors become vital obstacles to the tribal people in achieving the desired health status (Sarkar and Singha, 2019).

Data collection

For ethnogastronomical data collection, field surveys were conducted for a period of 1 year (July, 2021 – June, 2022) in purposefully selected 11 Blocks of Birbhum district in West Bengal, India where approximately 80% of district's tribal population resides at present. "Block" represents one of many administrative units under a Subdivision of a district usually consisting of several villages. We have randomly selected 10 localities from villages and cities from each of the studied blocks like Rampurhat-I, Mohammad Bazar, Rajnagar, Suri-I, Suri-II, Sainthia, Labpur, Nanoor, Bolpur-Sriniketan, Illambazar, and Dubrajpur. At first, 528 inhabitants of the studied area have randomly been asked whether they use wild edibles as vegetables or for medicinal purposes. Among them, 153 inhabitants have responded positively. From them, data were collected through informal interviews, group discussion, and using semi-structured questionnaire (Supplementary File S1). Plants were identified and collected as voucher specimens during *in loco* interaction and use of visual stimuli. Knowledge holding capacity of each of the key participants has been estimated as follows-

$$\text{Knowledge holding capacity} = \frac{\text{the numbers of wild edibles known to the individual}}{\text{total numbers of wild edibles recorded}} \times 100$$

The data on local name of the wild edible species, its traditional uses, cooking methods, season of availability, frequency of use in a week, side effects if any, and market value have been recorded. Free and Prior Informed Consent (FPIC) was requested from each of the participants before starting the interviews as their participation was voluntary. Participating children under the age of 15 years were requested to provide the FPIC of their own and their parents. At the time of field survey we have strictly followed the best field practice as proposed earlier by the scientists (Heinrich and Verpoorte, 2014; Heinrich et al., 2018), and the Code of Ethics recommended by International Society of Ethnobiology (2008). The collected data have been compared with the available literature on ethnobotany of wild edibles from Laterite region in West Bengal (Banerjee et al., 2013; Bouri and Ganguly, 2016; Banerjee, 2018; Chatterjee et al., 2022).

Plant specimen collection, identification, preparation of herbarium, and nomenclature update

Sample specimens have been collected following the national guidelines (NMPB, 2015) and preserved as herbarium specimens following conventional techniques (Jain and Rao, 1977). These specimens have been kept in the Departmental Herbarium, Department of Botany, Krishna Chandra College, Hetampur, India for future references. For identification of the collected wild edibles, both consultation of different Floras and expert opinions have been considered (Dixit, 1984; Guha Bakshi, 1984; Purkayastha and Chandra, 1985; Bilgrami et al., 1991; Sanyal, 1994; Fraser-Jenkins, 2008; Ranjan et al., 2016; Deb et al., 2018). The updated scientific names are used here following the standard websites like Plants of the World Online,[1] and Germplasm Resources Information Network.[2]

Data analysis

The collected data have been analyzed using specific statistical tools like Relative frequency of citation (RFC), and Cultural food significance index (CFSI) to identify the most popular and culturally accepted species in the area. Jaccard similarity index (JI) is used to draw a comparative account among the recent studies conducted in and around the surveyed area.

Relative frequency of citation

The RFC was used to quantify the frequency of use of certain species, which was determined using the following formula- $RFC = \frac{FC}{N}$, where FC is the total number of participants who cited a particular species as wild edible and N indicates the total number of participants involved in the study. The value of RFC varies from 0 to 1; the value close to 1 signifies the higher importance or popularity of the plant in the study area (Tardío and Pardo-de-Santayana, 2008).

Cultural food significance index

The cultural food significance index was effectively framed to assess the overall acceptability and importance of edible plants in a culture (Pieroni, 2001). It was formulated as-

$$CFSI = QI \times AI \times FUI \times PUI \times MFFI \times TSAI \times FMRI \times 10^{-2}.$$

The CFSI is the product of seven indices that include frequency of quotation (QI), availability (AI), frequency of use (FUI), plant parts used (PUI), multi-functional food use (MFFI), taste score appreciation (TSAI), and the food-medicinal role (FMRI).

Jaccard similarity index

The similarity of documented food plant knowledge from different parts of the laterite region and adjoining states is assessed by the Jaccard index (JI)= $\frac{c}{(a+b)-c} \times 100$, where a and b are the number of edible species documented from the areas A and B respectively, and c is common to both A and B (Hamers, 1989).

1 https://powo.science.kew.org/

2 http://www.ars-grin.gov

Venn diagram

Venn diagram is a popular and extensively used illustration style that points out the logical relationship between multiple sets of data. To draw a logical comparison among different ethnogastronomic works conducted in eastern India, an Area-Proportional Venn diagram was drawn (Heberle et al., 2015).

Results and discussion

Key informant's socio-demography and knowledge-holding capacity

Among the 153 key participants, age ranged from 10 to 87 years which included 87 women, 37 men, 21 girls and 8 boys from 132 households scattered in the remote rural areas, semi-urban and urban settlements in Birbhum district (Table 1). Among the participants 17 were traditional healers having versatile knowledge of plants and well-recognized in the respective localities for their healing skills. In the folk culture of eastern India, the knowledge of locally available wild edibles was found to be extensive among the female informants those who are mainly attached with household activity and working as daily labourers. Attachment of female individuals with the local food plants have also been observed in other parts of the world also (Tbatou et al., 2016; Ghanimi et al., 2022). Participants aged above 50 years collectively can able to identify, recalling local names and ethnogastronomic uses of 77 wild edible species. Greater knowledge-holding capacity of the aged participants is quite common in most of the ethnobotanical studies (Beltrán-Rodríguez et al., 2014; Ghanimi et al., 2022). Aging is accompanied by learning that helps one individual to gather knowledge and experiences throughout his/her life. Gathering of wild edibles is independent of education and literacy level of the participants but mostly dependent on their socio-economical conditions, type of settlements, social recognition and faith in local biodiversity. Few young participants have expressed their fondness toward urbanized lifestyle and commercially available, cultivated fruits and vegetables which is a matter of concern.

Taxonomical information of wild edibles

A total of 83 wild edible species (WES) were documented that spread across 48 families. Among the 83 species, 65 species were angiosperms, 3 species were pteridophytes and the rest 15 were from

TABLE 1 Socio-demographic profile of the participants ($n = 153$).

Variables	Categories	Numbers	Percentage (%)	Nos. of wild edible known	Knowledge holding capacity (%)
Gender	Male	45	29.41	43	51.8
	Female	108	70.59	61	73.49
Ethnic identity	*Santal*	79	51.63	72	86.75
	Mahali	45	29.41	58	69.88
	Dhangar	11	7.19	47	56.63
	Konra	18	11.76	46	55.42
Age group (years)	10–30	29	18.95	24	28.92
	31–49	32	20.92	38	45.78
	50–69	53	34.64	67	80.72
	70–90	39	25.49	59	71.08
Education	Without formal education	89	58.17	64	77.11
	Primary level	44	28.76	43	51.81
	Secondary level	13	8.5	23	27.71
	Higher education (University/college, Govt. job)	7	4.6	25	30.12
Residence	Rural	96	62.75	75	90.36
	Semi-urban	41	26.8	44	53.01
	Urban	16	10.46	19	22.89
Principal occupation	Daily labourer	68	44.44	52	62.65
	Farmer	11	7.19	47	56.63
	Shepherd	8	5.23	49	59.04
	House wife/household activity	27	17.65	68	81.93
	"*Vaidya*" or traditional herbalist	17	11.11	38	45.78
	Others	22	14.38	33	39.76

fungal groups. Among the 15 edible mushrooms, 12 were soil fungi, 2 wood fungi, and one grew on paddy straw. Among the reported 46 families, Amaranthaceae was represented by the highest number of WES (6 species) followed by Fabaceae and Rubiaceae (5 species). This data was in contrast with the observation made earlier from India where Leguminosae and Compositae represent highest number of edible species (Ray et al., 2020). Families like Asteraceae, Lyophyllaceae, and Malvaceae were represented by four species each. Three species were recorded under Dioscoreaceae and Araceae. Nine families, Agaricaceae, Amanitaceae, Boletaceae, Apocynaceae, Commelinaceae, Convolvulaceae, Cucurbitaceae, Moraceae, and Rhamnaceae were represented by two species each. Only one species represented rest of the 31 families.

In the present study, maximum number of edible species recorded under the family Amaranthaceae, which may be due to their ease availability in the studied area, herbaceous nature, and preference as leafy vegetables. Potentiality of Amaranthaceae members as food items endowed with nutritional value has already been established (Preetha et al., 2018; Nuñez-Estevez et al., 2021; Ruth et al., 2021). So, diverse nature of this plant family in relation to accessibility, palatability and food value can contribute a lot toward achieving food security.

Habitual categories of the recorded WES

According to the habits, most of the recorded WES were found herbaceous in nature (40%) followed by mushroom (18%), tree (19%), climber (15%), and shrubs (8%). Uses of the herbaceous species in greater number are a characteristic of many folk cultures. It is a fact that humans would prefer to search for food and medicine, which are very easy to access, most abundantly growing, and have long span of availability (Albuquerque et al., 2005). For these reasons, herbaceous plants have played a significant role in folk people's food and medicinal heritage (Cheng et al., 2022; Khalid et al., 2023).

Diversity of edible parts

Local inhabitants of the study area collect various edible parts like flower, calyx, fruit, fruiting body, leaf, petiole, young coiled fronds, seed, stem, shoot, underground parts like root, tuber, and corm. Leaves were the mostly collected plant parts (28.41%) that are mainly used as leafy vegetables followed by fruit (22.73%), fruiting body (17.05%), shoot and stem (17.05%), underground parts (7.95%), flower and calyx (4.55%), and seed (2.27%). In the present study most frequently cited leafy vegetables were *Ipomoea aquatica*, *Azadirachta indica*, *Enydra fluctuans*, *Colocasia esculenta*, *Marsilea vestita*, *Centella asiatica*, and *Hygrophila auriculata*. These observations are in line with the previous work conducted in eastern India (Sinha and Lakra, 2005; Banerjee et al., 2013; Bouri and Ganguly, 2016; Banerjee, 2018; Das, 2018; Kumar and Saikia, 2020). On the other hand, fruits of *Ficus racemosa*, *Madhuca longifolia*, *Coccinia grandis*, *Neolamarckia cadamba*, *Ziziphus nummularia*, and *Artocarpus lacucha* were informed as popular choices for the local people. Both the plant parts (leaves and fruits) were mostly utilized by the local tribes and in agreement with the current study, those edible parts were found as the main source of wild food in other areas of the Asian continent including India (Khan et al., 2015; Bhatia et al., 2018; Mallick et al., 2020; Cheng et al., 2022; Amin et al., 2023).

Traditional knowledge of wild edible species, their gathering pattern, postharvest processing, and preservation techniques

A total of 2,603 citations were made by the 153 participants for 83 types of different wild edible species. In the present study, among the 83 WES, 60 species were collected solely for edible purposes. On the other hand, 23 edible species were attached with both ethnomedicine and local food heritage. Local people have deep understanding and knowledge of the therapeutic properties of those wild edible species. As for example- butter fried leaves of *Centella asiatica* and *Bacopa monnieri* are consumed for their brain boostering properties, *Hygrophila auriculata* is mainly taken for its anti-anemic capacity, soup of *Termitomyces heimii* is taken as cure for dysentery, tuber of *Dioscorea alata* is attached with its anthelmintic potentialities, etc. Local people consciously consumed those species as medicinal food in spite of their low test appreciation score. It is an establish fact that those herbs can provide both high nutritional inputs and medicinal effectiveness.

Documented wild edibles were mostly gathered from late monsoon to mid-winter. Maximum collection rates were informed during March–April and September–November. The highest collection of wild mushrooms occurs in the month of October. Participants informed that most of the leafy vegetables were collected during the period of May–July. Edible leafy vegetables were mostly collected from marshy land (e.g., *Alternanthera philoxeroides*), agricultural fields (e.g., *Centipeda minuta*), water bodies (e.g., *Ipomoea aquatica*), fallow lands (e.g., *Ouret lanata*), and road sides (e.g., *Amaranthus viridis*). Herbaceous leafy greens which are easily accessible were mostly collected by women and children. In the contrary, male members of the community harvest edible underground parts and fruits which need extra physical strength and the support of mechanical tools. Some participants pointed out sustainable harvesting practice followed by folk taboos and beliefs attached with ethno-conservation practices (Kala, 2006; Oka, 2018). As for example, during collection of root vegetables (e.g., *Asparagus* sp.) some parts were left behind which will hopefully help in reviving the plant and sprouting occurs from the remains under favorable condition.

In 17 cases plant parts were eaten raw and mostly they were the ripe fruits. Rest of the cases edible parts were taken in the form of boiled and cooked vegetables, curry, chutney, pakora, pickles, traditional drinks, and recreational tea (Figures 2A–C). Plant like *Pandanus amaryllifolius* is used as flavoring agent only.

Despite the potential for wild edibles as food in the future, some people are concerned about their alleged toxicity because of pesticide residues, heavy metals, chemical additives, microorganisms, and/or the synthesis of hazardous chemical compounds (Xu et al., 2016; Sai Latha et al., 2018; Urugo and Tringo, 2023). The scientific community is deeply divided on this issue. The non-toxic character of naturally occurring wild foods is defended by one group, while the existence of heavy metals, oxalic acids, cyanogenic glycosides, lectins, pyrrolizidine alkaloids, and several other poisonous chemicals is warned of by the

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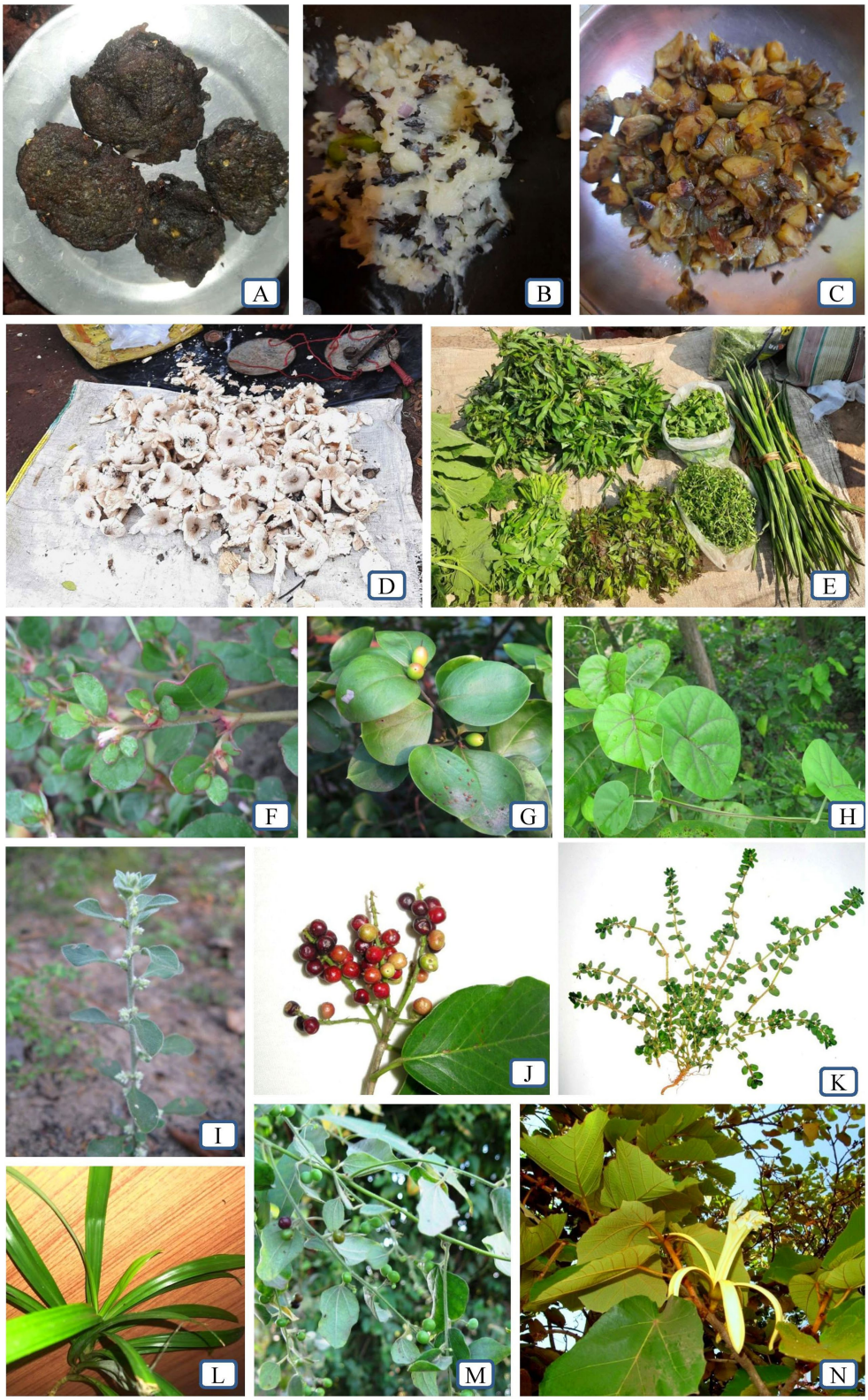

FIGURE 2
Wild edibles of eastern India and their utilization: **(A)** "*Pakora*" made from leaves of *Typhonium trilobatum* (L.) Schott; **(B)** fried leaves of *Cocculus hirsutus* (L.) W.Theob. is mixed in smashed potato; **(C)** traditional ethnic dish made with *Amanita vaginata* (Bull. ex. Fr.) Vitt.; **(D)** *Amanita vaginata* var. *alba* (De Seynes) Gillet in a semi-urban market; **(E)** several wild edible green leafy vegetables are sold in a urban market; **(F)** *Trianthema portulacastrum* L.; **(G)** *Carissa spinarum* L.; **(H)** *Rivea hypocrateriformis* (Desr.) Choisy; **(I)** *Ouret lanata* (L.) Kuntze; **(J)** *Antidesma ghaesembilla* Gaertn.; **(K)** *Euphorbia thymifolia* L.; **(L)** *Pandanus amaryllifolius* Roxb. ex Lindl.; **(M)** *Cocculus hirsutus* (L.) W.Theob.; **(N)** *Pterospermum acerifolium* (L.) Willd.

opposing party (Liu et al., 2015; Buenavista et al., 2021; Saha et al., 2023). Tribes in the studied area have an inherent knowledge of how to treat wild foods after gathering, which aids them in avoiding such harmful dangers. Before consumption in fresh form, washing with clean water is a very common practice that helps in removal of dirt, putrid residue, or other unwanted things from surface (Ruan-Soto et al., 2017). In few cases specialized treatment were given to the edible parts before cooking. In case of wild edible mushrooms, after thorough washing with water, boiling once or twice in plain water or saline water or lime water or with tamarind juice were done according to the local tribe's *emic* perception of collected mushroom's habit, external features and palatability (Sharma, 2015). It was informed that the cuticle of the pileus and stipe was peeled off in case of species like *Amanita vaginata*, *Russula emetic*, *Boletus edulis*, *Amanita vaginata* var. *alba*, and *Astraeus hygrometricus* to reduce their bitterness and to enhance softness. Hot water treatment and boiling are the best possible pre-cooking methods for reducing soluble oxalate content and pyrrolizidine alkaloids in some wild leafy vegetables and underground parts (Chai and Liebman, 2005; Savage and Dubois, 2006; Hajšlová et al., 2018; Takenaka et al., 2022). Local tribes of eastern India followed this method for processing the leaves and petioles of *Colocasia esculenta*, leaves of *Typhonium trilobatum*, tuber of *Dioscorea* spp., and corm of *Amorphophallus sylvaticus*. The use of organic acids, such as lime or tamarind juice, as part of local custom greatly reduces the concentration of insoluble oxalate crystals in food items. Regular usage of ginger, garlic, and turmeric while cooking may potentially serve as effective detoxifiers (El-Barbary, 2016; Ajanaku et al., 2022).

Most of the wild edibles are seasonal and only harvested during their time of availability. For future use, long-term storage is required without compromising their nutritional quality. Recorded wild edible mushrooms like *Termitomyces heimii*, *Amanita vaginata* var. *alba*, *Russula emetic*, and *Termitomyces clypeatus* were first thoroughly cleaned with lukewarm saline water, made sun-dried completely, and then stored in airtight containers for future uses. Local tribes of Himachal Pradesh in India preserved *Morchella* sp. in the same way (Kumari et al., 2022). Most of the time, ripe fruits were consumed fresh, while pickles were preferred for storage. In the present study, tribes of eastern India preserved fruits of *Artocarpus lacucha*, *Grewia asiatica*, *Carissa spinarum*, and *Ziziphus nummularia* in the form of pickle. Traditional pickling methods for preserving perishable fruits and vegetables have long history and have been opted universally (Behera et al., 2020). In few cases leafy vegetables like *Hibiscus sabdariffa*, *Trigonella stellata*, *Cocculus hirsutus*, *Cajanus scarabaeoides*, and *Sonchus oleraceus* were made shade dried for long-term use.

Wild edibles as livelihood support

Many of the recorded wild edibles are gradually finding their place beside the cultivated ones and becoming a source of income generation for the local tribes. As for example, it has been reported that from August to October, in this duration of 3 months a huge income (nearly Rs. 35,000/household) is generated by selling the wild edible mushrooms like, *Agaricus campestris*, *Amanita vaginata*, *Termitomyces heimii*, *Volvariella volvacea*, and *Astraeus hygrometricus* (Figure 2D). Similar observations were made by the earlier workers also (Pradhan et al., 2010; Singha et al., 2020). Not only that, presence of highly demanding, nutritious, non-cultivated edibles parts like leaves of *Marsilea vestita, Azadirachta indica, Enydra fluctuans, Ipomoea aquatica, Alternanthera sessilis,* and *Typhonium trilobatum;* leaves, petioles and corms of *Colocasia esculenta;* tubers of *Amorphophallus sylvaticus,* and *Dioscorea alata;* petioles of *Nymphaea nouchali;* fruits of *Ficus racemosa,* and *Artocarpus lacucha;* medicinal food like *Hygrophila auriculata, Centella asiatica, Mollugo spergula,* and *Bacopa Monnier* are very common in the vegetable markets of rural, urban and semi-urban areas and sold in an average price of Rs.100-150/Kg (Figure 2E). So, there are strong reasons for domesticating some of these economically beneficial wild edibles which can strengthen the arena of food security as well as supply steady nutritional inputs and opens up new avenue for income generation to the local people (N'Danikou and Tchokponhoue, 2020). Collaborative efforts from the government, social activist, ecologist, agriculture and food scientists, local tribes can achieve the sustainable development goals by employing the strategies of food sovereignty, food security or a mixed method approach (Charoenratana et al., 2021).

Enumeration and quantitative analysis of the recorded wild edibles

Recorded wild edibles are presented in Table 2 describing their local names, updated taxonomic information, habits, duration of availability, edible parts, mode of eating or cooking, and traditional uses. Side by side, numbers of quotation (FC), value of relative frequency of citation (RFC) and CFSI score are also tabulated here. RFC value for the recorded species varied from 0.04 to 0.76. In the present study, *Madhuca longifolia* was identified as mostly cited edible species with maximum number of food use mentions (FC-116; RFC-0.76). Higher RFC value (i.e., close to 1) indicates greater importance of the species in the locality. Some other wild edibles like *Colocasia esculenta* (FC-72; RFC-0.47), *Azadirachta indica* (FC-83; RFC-0.54), *Volvariella volvacea* (FC-64; RFC-0.44), etc. were cited frequently also by the local tribes.

Ethnogastronomical data of 83 WES were analyzed using the most effective quantitative index like CFSI and the value ranged from 844 to 0.2. Plants like *Colocasia esculenta*, *Hibiscus sabdariffa*, *Madhuca longifolia* which have multiple edible parts, to them CFSI is calculated separately for each of the edible parts and then combined score is given to the edible species. All the wild edibles are arranged in a descending order according to their CFSI score along with detail calculations in Supplementary File S2. The enlisted wild edibles are then classified into six groups (Pieroni, 2001); species with very high cultural significance (CFSI $\geq$ 300), species with high significance (CFSI ranges from 100 to 299), moderate significance (CFSI varies from 20 to 99), low significance (CFSI ranges from 5 to 19), species with very low significance (CFSI ranges from 1 to 4) and species with negligible cultural significance (CFSI $<$ 1).

Thirteen wild edibles were found very highly significant (CFSI value ranges from 315 to 844) and highest CFSI value was estimated for *Colocasia esculenta* (CFSI = 844) followed by *Enydra fluctuans*, *Ipomoea aquatica*, *Mollugo spergula*, *Azadirachta indica*, *Bacopa monnieri*, *Volvariella volvacea*, *Madhuca longifolia*, *Amaranthus viridis*, *Hygrophila auriculata*, *Centella asiatica*, *Marsilea vestita*, and *Termitomyces heimii*. In this group most of the plants are wild edible

TABLE 2 Enumeration of the wild edible species and projection of their cultural significance.

Family	Wild edible species and voucher specimen numbers	Local name	Habit	Duration of availability	Traditional uses	Edible parts and way of eating	(FC*)	(RFC**)	(CFSI***)	Referred work from laterite zone of WB
Pluteaceae	*Volvariella volvacea* (Bull.) Singer SS-13	*Poal Chhatu/Basub Onthe*	Mushroom	May–December	Edible	Fruiting body; boiled mushroom is cooked with mustard oil and spices and taken with rice	67	0.44	482	Manna et al. (2014) and Singha et al. (2020)
Lyophyllaceae	*Termitomyces heimii* Natarajan SKM-09	*Durga Chhatu*	Mushroom	June–October	Edible and ethnomedicinal	Fruiting body; boiled mushroom is cooked with mustard oil and spices and taken with rice or taken as a soup	56	0.37	315	Manna et al. (2014) and Singha et al. (2020)
Sclerodermataceae	*Astraeus hygrometricus* (Pers.) Morgan SKM-14	*Kurkure Chhatu/ Putko Onthe*	Mushroom	June–September	Edible	Fruiting body; boiled twice and then cooked with mustard oil and spices and taken with rice	48	0.31	75	Manna et al. (2014) and Ganguly et al. (2021)
Amanitaceae	*Amanita vaginata* (Bull. ex. Fr.) Vitt. SS-18	*Sal Chhatu/Budhi Onthe*	Mushroom	July–October	Edible	Fruiting body; boiled mushroom is cooked with tamarind and garlic; taken with rice	42	0.27	123	Pradhan et al. (2010) and Dutta and Acharya (2014)
Agaricaceae	*Agaricus campestris* L. SKM-20	*Sal Chhatu*	Mushroom	August–October	Edible and ethnomedicinal	Fruiting body; boiled mushroom is cooked with mustard oil, onion and spices and taken with rice	27	0.18	194	Singha et al. (2020) and Ganguly et al. (2021)
Agaricaceae	*Apioperdon pyriforme* (Schaeff.) Vizzini SKM-93	*Shib Chhatu*	Mushroom	July–September	Edible	Fruiting body; immature fruiting body is boiled twice with tamarind juice and cooked with mustard oil and spices; taken with rice	19	0.12	67	Ganguly et al. (2021)
Auriculariaceae	*Auricularia auricular* (Bull.) J. Schröt. SKM-87	*Lutur Onthe*	Mushroom	May–September	Edible and ethnomedicinal	Fruiting body; soaked in hot saline water for 30 min then boiled with coriander leaf, garlic and cinnamon; taken as a soup	17	0.11	45	Singha et al. (2020)
Amanitaceae	*Amanita vaginata* var. *alba* (De Seynes) Gillet SKM-26	*Tarmal Onthe*	Mushroom	June–October	Edible	Fruiting body; boiled mushroom is cooked with tamarind and garlic; taken with rice	16	0.1	108	Pradhan et al. (2010) and Dutta and Acharya (2014)
Cantharellaceae	*Cantharellus* sp. SKM-32	*Hinde Onthe*	Mushroom	July–October	Edible	Fruiting body; boiled twice and cooked with mustard oil and spices and taken with rice	13	0.085	30	Singha et al. (2020)

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TABLE 2 (Continued)

Family	Wild edible species and voucher specimen numbers	Local name	Habit	Duration of availability	Traditional uses	Edible parts and way of eating	(FC*)	(RFC**)	(CFSI***)	Referred work from laterite zone of WB
Lyophyllaceae	*Termitomyces microcarpus* (Berk. & Broome) R. Heim SKM-81	*Bulung Onthe*	Mushroom	June–October	Edible	Fruiting body; boiled once for 15 min and then fried with onion and mustard oil; taken with rice	11	0.07	37	Pradhan et al. (2010) and Manna et al. (2014)
Pleurotaceae	*Pleurotus ostreatus* (Jacq.) P. Kumm. SKM-75	*Lutur Onthe*	Mushroom	May–October	Edible	Fruiting body; boiled mushroom is cooked with mustard oil and spices and taken with rice	11	0.07	27	Manna et al. (2014) and Singha et al. (2020)
Lyophyllaceae	*Russula emetic* (Schaeff.) Pers. SKM-38	*Murgi Onthe*	Mushroom	June–November	Edible	Fruiting body; boiled in lime water for 15 min; after discarding the water cooked with black pepper, garlic and black cumin; taken with rice.	9	0.06	16	Pradhan et al. (2010) and Manna et al. (2014)
Boletaceae	*Tylophilus* sp. SKM-44	*Rahet Onthe*	Mushroom	June–October	Edible	Fruiting body; boiled with tamarind juice for 30 min then cooked with coriander leaf, garlic and cinnamon; taken as a soup	8	0.052	23	Ganguly et al. (2021)
Boletaceae	*Boletus edulis* Bull. SKM-50	*Timbe Onthe*	Mushroom	July–September	Edible	Fruiting body; boiled mushroom is used as an ingredient of snacks like "*Pakora*."	7	0.05	14	Singha et al. (2020)
Lyophyllaceae	*Termitomyces clypeatus* R. Heim SKM-56	*Bali Chhatu/Orto Onthe*	Mushroom	July–October	Edible	Fruiting body; boiled in water, after discarding the water fried with onion and mustard oil; taken with rice.	7	0.05	14	Pradhan et al. (2010), Manna et al. (2014), and Singha et al. (2020)
Aspleniaceae	*Thelypteris prolifera* (Retz.) C.F.Reed SKM-61	*Dheki shak*	Herb	March–July	Edible and ethnomedicinal	Young coiled frond (leaf); cooked with garlic and mustard oil; taken with rice	19	0.12	17	
Marsileaceae	*Marsilea vestita* Hook. & Grev. SS-82	*Sushni shak*	Herb	May–August	Edible	Leaf; fried with garlic and mustard oil; taken with rice	92	0.6	331	Chowdhury et al. (2014)

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TABLE 2 (Continued)

Family	Wild edible species and voucher specimen numbers	Local name	Habit	Duration of availability	Traditional uses	Edible parts and way of eating	(FC*)	(RFC**)	(CFSI***)	Referred work from laterite zone of WB
Pteridaceae	*Ceratopteris thalictroides* (L.) Brongn. SKM-69	*Pani shak*	Herb	March–July	Edible	Young frond; cooked with garlic and mustard oil; taken with rice	8	0.05	4	Chowdhury et al. (2014)
Sapotaceae	*Madhuca longifolia* (L.) J.F.Macbr. SS-03, SKM-62	*Mole dari*	Tree	March–July	Edible and ethnomedicinal	(i) Flower; fresh fleshy flowers are eaten raw, used to make "*chutney*," and dried flowers are used to make traditional drink called "*mahua*" (ii) Fruit; unripe fruits are used as an ingredient in vegetable curry; (iii) Seed; seed oil is used as an edible oil in cooking	116	0.76	464	Banerjee et al. (2013) and Bouri and Ganguly (2016)
Meliaceae	*Azadirachta indica* A.Juss. SKM-84	*Neem*	Tree	January–March	Edible and ethnomedicinal	Leaf; young tender leaves are fried with seasonal vegetables like brinjal and/or potato; taken with rice	83	0.54	672	
Araceae	*Colocasia esculenta* (L.) Schott SS-58	*Alati kachu/Anja*	Herb	Throughout the year	Edible	(i) Leaf; before cooking fresh leaves are boiled in water for some time and then cooked with spices, condiments and mustard oil; taken with rice (ii) Petiole; peeled and sliced mature petioles are boiled in water for some time and then cooked with spices, condiments and mustard oil; taken with rice or "*roti*" (iii) Corm; peeled and sliced thin pieces are boiled in water for few minutes and then cooked with black cumin, condiments and mustard oil; taken with rice	72	0.47	844	Banerjee et al. (2013)

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TABLE 2 (Continued)

Family	Wild edible species and voucher specimen numbers	Local name	Habit	Duration of availability	Traditional uses	Edible parts and way of eating	(FC*)	(RFC**)	(CFSI***)	Referred work from laterite zone of WB
Asteraceae	*Enydra fluctuans* Lour. SKM-78	*Jal-helencha*	Herb	September–November	Edible and ethnomedicinal	Shoot; cooked with black cumin, garlic and mustard oil; taken with rice	58	0.38	835	Bouri and Ganguly (2016)
Convolvulaceae	*Ipomoea aquatica* Forssk. SKM-103	*Kalmi shak*	Herb	Throughout the year	Edible	Leaf; tender leaves are cooked with garlic and "*ghee*" (clarified butter); taken with rice	51	0.33	826	Banerjee et al. (2013) and Bouri and Ganguly (2016)
Acanthaceae	*Hygrophila auriculata* (Schumach.) Heine SKM-105	*Kulekhara/ Gokhura janum ara*	Herb	Throughout the year	Edible and ethnomedicinal	Leaf; tender leaves are cooked with garlic and "*ghee*" (clarified butter); taken with rice	47	0.31	349	Banerjee et al. (2013), Bouri and Ganguly (2016), and Banerjee (2018)
Apiaceae	*Centella asiatica* (L.) Urb. SKM-97	*Thankuni*	Herb	April–August	Edible and ethnomedicinal	Leaf; cooked with black cumin and butter; taken with rice	47	0.31	338	Banerjee et al. (2013), Bouri and Ganguly (2016), and Banerjee (2018)
Molluginaceae	*Mollugo spergula* L. SS-71	*Gime-shak*	Herb	Throughout the year	Edible	Shoot; tender shoots are first boiled and then mixed with boiled or fried potato; taken with rice.	47	0.31	571	Banerjee et al. (2013)
Rubiaceae	*Paederia foetida* L. SKM-91	*Gandhavaduli*	Climber	Throughout the year	Edible and ethnomedicinal	Leaf; freshly collected leaves are made into paste along with lentil and garlic, mixed with black cumin and salt, fried to cook in mustard oil; taken with rice	47	0.31	165	Banerjee et al. (2013) and Bhattacharyya and Mandal (2015)
Apocynaceae	*Carissa spinarum* L. SS-92	*Bir karamcha/ Baghjata*	Shrub	August–October	Edible	Fruit; mature fruits are eaten raw and used as an ingredients of mixed pickle.	48	0.31	23	
Rhamnaceae	*Ziziphus nummularia* (Burm.f.) Wight & Arn. SKM-108	*Bhuin kul*	Tree	November–March	Edible	Fruit; (i) ripe fruits are eaten raw, (ii) mature fruits are used to make sweet pickle	45	0.29	171	
Plantaginaceae	*Bacopa monnieri* (L.) Wettst. SS-101	*Bramhi*	Herb	Throughout the year	Edible and ethnomedicinal	Shoot; cooked with black cumin garlic, and butter; taken solely or with rice	42	0.275	491	Banerjee et al. (2013) and Banerjee (2018)

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TABLE 2 (Continued)

Family	Wild edible species and voucher specimen numbers	Local name	Habit	Duration of availability	Traditional uses	Edible parts and way of eating	(FC*)	(RFC**)	(CFSI***)	Referred work from laterite zone of WB
Dioscoreaceae	*Dioscorea bulbifera* L. SS-98	*Methe-alu*	Climber	October–January	Edible and ethnomedicinal	Tuber; peeled and sliced tubers are boiled in water for few minutes and cooked with mustard oil, onion and spices; taken with rice	41	0.27	96	Bouri and Ganguly (2016)
Fabaceae	*Pithecellobium dulce* (Roxb.) Benth. SKM-114	*Jilipi gachh*	Tree	June–July	Edible	Fruit; fleshy seed arils are eaten raw	39	0.255	30	
Rhamnaceae	*Ziziphus oenopolia* (L.) Mill. SKM-119	*Shia kul*	Shrub	December–February	Edible	Fruit; ripe fruits are eaten raw	39	0.255	19	Bouri and Ganguly (2016)
Rubiaceae	*Meyna spinosa* Roxb. ex Link SS-66	*Bainchi kul/Loto*	Shrub	June–August	Edible	Fruit; ripe fruit is eaten raw	38	0.25	15	Bouri and Ganguly (2016)
Amaranthaceae	*Amaranthus viridis* L. SKM-123	*Bon-notey-shak*	Herb	Throughout the year	Edible	Shoot; tender shoots are cooked with black cumin and mustard oil; taken with rice	37	0.24	400	Banerjee et al. (2013)
Malvaceae	*Hibiscus sabdariffa* L. SKM-99	*Mesta/takdhanros*	Shrub	May–November	Edible	(i) Leaf; tender leaves are cooked with black cumin, garlic, ginger flecks, and mustard oil; taken with rice. (ii) Calyx; Fleshy mature calyx is used to prepare chutney	37	0.24	209	
Aizoaceae	*Trianthema portulacastrum* L. SS-70	*Kulpha-shak/Swet purundi*	Herb	August–December	Edible	Leaf; cooked with garlic and mustard oil; taken with rice	34	0.22	90	
Amaranthaceae	*Alternanthera sessilis* (L.) R.Br. ex DC. SKM-90	*Sanchi-shak*	Herb	June–January	Edible	Shoot; tender shoots are cooked with black cumin and mustard oil; taken with rice	34	0.22	274	Banerjee et al. (2013)
Rubiaceae	*Randia aculeata* L. SKM-49	*Maina-kanta*	Shrub	June–August	Edible	Fruit; ripe fruit is eaten raw and sometimes "*chutney*" is made from it	34	0.22	13	Bouri and Ganguly (2016)

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TABLE 2 (Continued)

Family	Wild edible species and voucher specimen numbers	Local name	Habit	Duration of availability	Traditional uses	Edible parts and way of eating	(FC*)	(RFC**)	(CFSI***)	Referred work from laterite zone of WB
Araceae	*Typhonium trilobatum* (L.) Schott SS-88	*Kharkan*	Herb	Throughout the year	Edible	Leaf; freshly collected leaves are first boiled into water for few minutes, then a paste is made from the boiled leaves, mixed with lime juice and "*Pakora*" is made with black cumin, garlic, finely chopped onion, and fried in mustard oil; taken as snacks or with rice.	33	0.22	97	Banerjee et al. (2013)
Amaranthaceae	*Alternanthera philoxeroides* (Mart.) Griseb. SS-25	*Shalunche*	Herb	May–October	Edible	Shoot; tender shoots are cooked with black cumin and mustard oil; taken with rice	32	0.21	259	
Cucurbitaceae	*Coccinia grandis* (L.) Voigt SKM-41	*Kundri/Telakucha*	Climber	Throughout the year	Edible	Fruit; mature unripe fruits are fried in mustard oil with black cumin and onion; taken with rice, *chapati* or *roti*.	31	0.2	92	Banerjee et al. (2013) and Banerjee (2018)
Amaranthaceae	*Amaranthus spinosus* L. SS-26	*Kanta-notey-shak*	Herb	June–September	Edible and ethnomedicinal	Leaf; tender leaves are cooked with black cumin, garlic and mustard oil; taken with rice	29	0.19	235	Banerjee et al. (2013)
Asteraceae	*Centipeda minuta* (G.Forst.) C.B.Clarke SKM-33	*Mecheta shak*	Herb	May–August	Edible	Shoot; cooked with garlic and mustard oil; taken with rice	29	0.19	102	
Dioscoreaceae	*Dioscorea pentaphylla* L. SKM-28	*Kanta alu*	Climber	October–December	Edible	Tuber; after peeling sliced tubers are soaked in water overnight then used as an ingredient of mixed vegetable curry; taken with rice	29	0.19	147	
Malvaceae	*Melochia corchorifolia* L. SKM-21	*Tikiok-ara*	Herb	June–September	Edible	Leaf; tender leaves are first made shade dried and then boiled with pulses, black cumin, garlic and mustard oil; taken with rice	29	0.19	51	Bouri and Ganguly (2016)

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TABLE 2 (Continued)

Family	Wild edible species and voucher specimen numbers	Local name	Habit	Duration of availability	Traditional uses	Edible parts and way of eating	(FC*)	(RFC**)	(CFSI***)	Referred work from laterite zone of WB
Araceae	*Amorphophallus sylvaticus* (Roxb.) Kunth SKM-16	*Bir Shuran*	Herb	January–April	Edible	Corm; sliced and boiled in water with salt and a pinch of turmeric till fully cooked; boiled sliced pieces are then smashed and mixed with black mustard seed paste; served with rice	27	0.18	73	
Convolvulaceae	*Rivea hypocrateriformis* (Desr.) Choisy SKM-129	*Ban pui*	Climber	June–September	Edible and ethnomedicinal	Shoot; tender shoots are first boiled in water for few minutes then fried with black cumin and mustard oil; taken with rice	27	0.18	243	
Rubiaceae	*Neolamarckia cadamba* (Roxb.) Bosser SKM-131	*Kadam*	Tree	October–December	Edible	Fruit; ripe fruits are eaten raw and used to prepare "*chutney.*"	27	0.18	55	
Anacardiaceae	*Buchanania lanzan* Spreng. SKM-7	*Piyal*	Tree	April–June	Edible	Fruit; ripe fruits are eaten raw	26	0.17	15	Bouri and Ganguly (2016)
Malvaceae	*Grewia asiatica* L. SKM-11	*Falsa*	Tree	May–July	Edible	Fruit; ripe fruits are eaten raw; used to make chutney and pickle.	25	0.16	12	Banerjee et al. (2013), Bhattacharyya and Mandal (2015), and Bouri and Ganguly, 2016
Fabaceae	*Melilotus albus* Medik. SS-102	*Ban methi/Senji shak*	Herb	November–January	Edible	Shoot; tender shoots are cooked with garlic and butter; taken with rice	24	0.16	65	
Moraceae	*Artocarpus lacucha* Buch.-Ham. SS-17	*Baral/Deuphal*	Tree	May–July	Edible	Fruit; mature fruits are used as an ingredients of mixed vegetable curry, chutney and to make pickle.	24	0.16	122	Bouri and Ganguly (2016)
Cornaceae	*Alangium salviifolium* (L.f.) Wangerin SKM-55	*Ankar/Dela*	Tree	May–July	Edible	Fruit; ripe fruits are eaten raw	23	0.15	11	Bouri and Ganguly (2016)

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TABLE 2 (Continued)

Family	Wild edible species and voucher specimen numbers	Local name	Habit	Duration of availability	Traditional uses	Edible parts and way of eating	(FC*)	(RFC**)	(CFSI***)	Referred work from laterite zone of WB
Dioscoreaceae	*Dioscorea alata* L. SKM-59	*Kham alu/Chupri alu*	Climber	October–December	Edible and ethnomedicinal	Tuber; after peeling sliced tubers are soaked in water overnight then used as an ingredient of mixed vegetable curry; taken with rice	23	0.15	155	Banerjee et al. (2013) and Bouri and Ganguly (2016)
Fabaceae	*Trigonella stellata* Forssk. SKM-64	*Ban paring*	Herb	June–December	Edible	Leaf; leaves are first made shade dried and then boiled with pulses, garlic and mustard oil; taken with rice	23	0.15	40	Banerjee et al. (2013)
Arecaceae	*Phoenix acaulis* Roxb. SKM-68	*Bir-khejari*	Shrub	June–July	Edible	Fruit; ripe fruit is eaten raw	23	0.15	2	Bouri and Ganguly (2016)
Menispermaceae	*Cocculus hirsutus* (L.) W.Theob. SKM-153	*Aarak-aan-ara*	Climber	September–December	Edible and ethnomedicinal	Leaf; tender leaves are first made parboiled, shade dried and then cooked with black cumin and mustard oil; taken with rice. Fat fried leaves are taken with smashed boiled potato.	22	0.144	98	
Polygonaceae	*Polygonum plebeium* R.Br. SKM-150	*Chimti shak/Tak shak*	Herb	January–March	Edible	Shoot; tender shoots are fried with black cumin and mustard oil; taken with rice	21	0.14	33	
Talinaceae	*Talinum portulacifolium* (Forssk.) Asch. ex Schweinf. SKM-131	*Tak palang/Bilati pui*	Herb	May–August	Edible	Leaf; cooked with garlic and mustard oil; taken with rice	19	0.12	87	
Amaranthaceae	*Ouret lanata* (L.) Kuntze SKM-136	*Chhai-shak/ Lupani-ara*	Herb	January–May	Edible and ethnomedicinal	Shoot; tender shoots are cooked with garlic and "*ghee*" (clarified butter); taken with rice	18	0.12	225	
Euphorbiaceae	*Euphorbia thymifolia* L. SS-148	*Nanha pushi toa*	Herb	Throughout the year	Edible and ethnomedicinal	Shoot; cooked with black cumin and mustard oil; taken with rice.	18	0.12	169	
Commelinaceae	*Commelina diffusa* Burm.f. SS-146	*Bans-kenduri*	Herb	June–September	Edible	Shoot; tender shoots are cooked with black cumin and mustard oil; taken with rice	17	0.11	22	

(Continued)

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TABLE 2 (Continued)

Family	Wild edible species and voucher specimen numbers	Local name	Habit	Duration of availability	Traditional uses	Edible parts and way of eating	(FC*)	(RFC**)	(CFSI***)	Referred work from laterite zone of WB
Ebenaceae	*Diospyros ebenum* J.Koenig ex Retz. SKM-147	*Kend dari*	Tree	April–June	Edible	Fruit; mature ripe fruits are eaten raw.	17	0.11	10	Banerjee et al. (2013) and Bouri and Ganguly (2016)
Ulmaceae	*Holoptelea integrifolia* (Roxb.)Planch. SKM-144	*Pata-badam*	Tree	April–July	Edible	Seed; seed is eaten raw	17	0.11	7	Bouri and Ganguly (2016)
Commelinaceae	*Commelina benghalensis* L. SS-45	*Kansira*	Herb	April–September	Edible	Leaf; tender leaves are cooked with garlic and "*ghee*" (clarified butter); taken with rice	16	0.105	28	Banerjee et al. (2013) and Bouri and Ganguly (2016)
Cucurbitaceae	*Luffa cylindrica* (L.) M.Roem. SS-83	*Dhundul*	Climber	June–August	Edible	Fruit; (i) used as an ingredient of mixed vegetable curry, (ii) fried to cook with black cumin and onion; taken with rice	16	0.105	43	Banerjee et al. (2013)
Fabaceae	*Cajanus scarabaeoides* (L.) Thouars SS-41	*Birhore*	Climber	July–October	Edible and ethnomedicinal	Leaf; tender leaves are first made parboiled, shade dried and then cooked with black cumin and mustard oil; taken with rice	15	0.1	89	Bouri and Ganguly (2016)
Rubiaceae	*Tamilnadia uliginosa* (Retz.) Tirveng. & Sastre SKM-140	*Piralo dari*	Tree	September–November	Edible	Fruit; ripe fruit is eaten raw	14	0.09	1	
Asparagaceae	*Asparagus racemosus* Willd. SKM-142	*Sadmul*	Climber	November–January	Edible and ethnomedicinal	Root; mature tuberous roots are eaten raw	14	0.092	16	Bouri and Ganguly (2016)
Apocynaceae	*Hemidesmus indicus* (L.) R.Br. SS-37	*Anantamul*	Climber	Throughout the year	Edible and ethnomedicinal	Root; dried root powder is used to make recreational tea	13	0.085	23	Bouri and Ganguly (2016)
Malvaceae	*Pterospermum acerifolium* (L.) Willd. SS-20	*Muchkunda*	Tree	April–July	Edible	Calyx; fleshy part of the calyx is made into fine paste and mixed thoroughly in water along with black salt, sugar candy and lemon juice; it is taken as a recreational drink	13	0.085	5	

(Continued)

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TABLE 2 (Continued)

Family	Wild edible species and voucher specimen numbers	Local name	Habit	Duration of availability	Traditional uses	Edible parts and way of eating	(FC*)	(RFC**)	(CFSI***)	Referred work from laterite zone of WB
Nymphaeaceae	*Nymphaea nouchali* Burm.f. SS-9	*Shaluk*	Herb	June–October	Edible	Petiole; freshly collected petioles are cooked with mustard oil, cumin seed, turmeric, and black mustard seed paste; taken with rice	13	0.085	35	
Phyllanthaceae	*Antidesma ghaesembilla* Gaertn. SKM-111	*Suramatha*	Shrub	August–November	Edible	Fruit; ripe fruits are eaten raw	12	0.078	6	
Amaranthaceae	*Achyranthes aspera* L. SS-53	*Chorchore shak*	Herb	Throughout the year	Edible and ethnomedicinal	Leaf; tender leaves are cooked with black cumin and mustard oil; taken with rice	11	0.07	77	Bouri and Ganguly (2016)
Dilleniaceae	*Dillenia pentagyna* Roxb. SS-33	*Bon-chalta*	Tree	May–July	Edible	Fruit; ripe fruits are eaten raw as well as used in preparing "*chutney*"	11	0.072	0.2	
Moraceae	*Ficus racemosa* L. SKM-9	*Dumur*	Tree	December–April	Edible	Fruit; a delicious curry is made from immature fruits when cooked with condiment and spices; it is taken with rice, and "*roti.*"	11	0.072	54	Bouri and Ganguly (2016)
Asteraceae	*Emilia sonchifolia* (L.) DC. SS-25	*Sanchimodi/Kalai-lutur-ara*	Herb	March–July	Edible and ethnomedicinal	Shoot; tender shoots are cooked alone with black cumin and mustard oil and sometimes with other seasonal vegetables; taken with rice. It is also used occasionally as a garnishing agent which add extra aroma to the cooked food.	10	0.065	122	
Asteraceae	*Sonchus oleraceus* L. SS-94	*Titalea shak*	Herb	September–March	Edible	Leaf; tender leaves are cooked with black cumin, garlic and mustard oil; taken with rice	9	0.06	14	
Pandanaceae	*Pandanus amaryllifolius* Roxb. ex Lindl. SKM-19	*Payes gachh*	Herb	Throughout the year	Edible	Leaf; leaves are used as flavoring agent in cooking items	9	0.059	1	

(Continued)

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TABLE 2 (Continued)

Family	Wild edible species and voucher specimen numbers	Local name	Habit	Duration of availability	Traditional uses	Edible parts and way of eating	(FC*)	(RFC**)	(CFSI***)	Referred work from laterite zone of WB
Fabaceae	*Clitoria ternatea* L. SS-29	*Aparajita*	Climber	Throughout the year	Edible	Flower; dried flowers are used to make recreational tea	8	0.05	6	
Boraginaceae	*Cordia dichotoma* G.Forst. SS-49	*Bouri*	Tree	Throughout the year	Edible	Leaf; tender leaves are first made shade dried and then boiled with pulses, black cumin, garlic and mustard oil; taken with rice	6	0.04	6	Bouri and Ganguly (2016)
Poaceae	*Tripidium bengalense* (Retz.) H.Scholz SKM-15	*Sar gachh*	Herb	June–September	Edible	Stem; jiggery made from the stem juice is used as a sweetener in cooking occasionally and mainly used in different ethnomedicinal preparations	6	0.04	2	

*FC, Frequency of Citation; **RFC, Relative Frequency of Citation; ***CFSI, Cultural Food Significance Index.

greens that are easily accessible, mostly available, and mainly used as leafy vegetables by the local inhabitants. The plant with multiple edible parts has high plant parts used score (PUI) as well as multi-functional food use score (MFFI). Every food plant is designated with the identity "edible" due to its edible plant parts that are very much attached with the local food heritage (Sujarwo and Caneva, 2015). For this reason we first calculated CFSI value separately for each of the edible parts like, corm, petiole and leaf of *C. esculenta* and then considering the cultural significance of that plant as a whole we combined the CFSI values of corm, petiole and leaf (corm − 147 + petiole − 308 + leaf – 389 = CFSI value of *C. esculenta* − 844) which make the plant most culturally significant species in the surveyed area with maximum CFSI value. Interestingly two edible mushrooms like *V. volvacea*, and *T. heimii* also took a significant place in this group. It may be due to their huge acceptance as a healthy food, high test appreciation score and quotation number. Seventeen species were designated as highly significant as their CFSI score ranged from102 to 274. CFSI score of 29 moderately significant species varied from 22 to 98. Eighteen WES having low significance as their CFSI value ranged from 5 to 19. Very low significance (CFSI = 1–4) was attached with 5 WES like *Ceratopteris thalictroides*, *Phoenix acaulis*, *Tripidium bengalense*, *Tamilnadia uliginosa*, and *Pandanus amaryllifolius*. One species like *Dillenia pentagyna* was found having negligible significance (CFSI = 0.2) due to its rare occurrence in the locality and very poor utilization frequency.

The wild edibles recorded from Birbhum district is compared with the data published earlier from other districts of laterite region in West Bengal as well as adjoining states like Jharkhand and Odisha where ethnic composition and biodiversity is very much alike (Sinha and Lakra, 2005; Banerjee et al., 2013; Bouri and Ganguly, 2016; Banerjee, 2018; Das, 2018; Kumar and Saikia, 2020). Results of Jaccard similarity index (JI) revealed that for all the cases JI score is very low (varies from 0.11 to 0.21) which means there is a huge knowledge dissimilarity among the inhabitants of different parts of laterite region (Table 3). It is interesting to note that being a part of the similar type of phytodiversity, every region has some unique knowledge on food plant utilization. The scenario is supported by the Venn diagram analysis where it has been found that knowledge about 47 plants is unique among the inhabitants of the studied area (Birbhum district) in eastern India (Figure 3).

Some new observations from the laterite region of West Bengal

Perusal of ethnobotanical, and ethnogastronomical literature published earlier from laterite region of West Bengal revealed that out of 83 wild edibles, 29 species as a whole or its edible parts are the new addition to the existing inventory of the wild edibles (Figures 2F–N) of this area (Banerjee et al., 2013; Bouri and Ganguly, 2016; Banerjee, 2018; Biswas, 2021). Plants like *Alternanthera philoxeroides*, *Antidesma ghaesembilla*, *Carissa spinarum*, *Commelina diffusa*, *Emilia sonchifolia*, *Hibiscus sabdariffa*, *Rivea hypocrateriformis*, *Tamilnadia uliginosa*, *Sonchus oleraceus*, *Ziziphus nummularia*, *Tripidium bengalense*, and *Pandanus amaryllifolius* have been recorded first time as wild edibles from the studied region. Moreover in few cases some plant parts and few species have been documented here as wild edibles that differ from

the previous work of Bouri and Ganguly (2016). In the present study *Polygonum plebeium* is documented instead of *Polygonum barbatum* and *Nymphaea nouchali* is reported as an alternative for *Nymphaea pubescens* (Bouri and Ganguly, 2016). Similarly earlier workers have documented the plants *Cajanus scarabaeoides* and *Cordia dichotoma* for their edible fruits but here in both the cases only tender leaves of those plants have been enlisted (Bouri and Ganguly, 2016). This observation may have some impact on the local food heritage as it expands the list of wild edibles as well as provide the opportunity to opt alternative food sources in absence of one another.

Interlinking wild edibles with food security

The majority of research found a link between food insecurity and micronutrient insufficiency in consumers (Kirkpatrick and Tarasuk, 2008; Lowe, 2021; Lopes et al., 2023). Micronutrient deficit or "hidden hunger" is considerably one bigger problem than hunger, demonstrating the need of integrating food and nutrition security (Shetty, 2009). The phrase "food security" generally refers to a circumstance in which members of the population under consideration have access to enough food to meet their nutritional needs and to provide an adequate intake of calories. Dietary variety is one of the sustainable food-based ways for ensuring optimal micronutrient consumption and gaining calories. Many of the recorded wild edible fruits, roots, tubers, herbs, and mushrooms are high in micronutrients and they may help improve food security by addressing concerns like hidden hunger. Present study documented 83 wild edible species, different parts of which are collected by the local inhabitants throughout the year. They are consumed with relish mainly as to accompany the main cereal based staple dishes. Most of the recorded wild edibles are good source of food and are mostly rich in micronutrients (Ghosh-Jerath et al., 2016). For example- previous researchers have already explored that *Colocasia* leaf characterized by rich dietary fiber, micronutrients, proteins, and very low in calories (Mitharwal et al., 2022). It contains significant amount of β-carotene, ascorbic acid, folic acid, riboflavin, B vitamins, vitamin A, iron, calcium, potassium, phosphorus, and magnesium. Corms of this culturally most valuable species are also a rich source of carbohydrates, proteins, minerals and vitamins (Rashmi et al., 2018). It can be utilized as an additional tuber vegetable next to potato, and sweet potato which can be a great contribution toward achieving food security. It can also be processed as a food ingredient in nutraceutical industry also.

The plant *Madhuca longifolia* has been inextricably linked to the tribal culture of eastern India and remains as a cultural touchstone species for ages both for its food value and holiness. Flower, unripe fruit and seeds of this plant were recorded as edible items, among which flower was the mostly used plant part. Among the ethnic people of eastern India, utilization of *Madhuca* flower to make a traditional beverage called "mahua" or "mahuli daaru" is very common. *Madhuca* flower contains high amount of reducing sugars, Ca, P, Vitamin C, and Carotene (Pinakin et al., 2018). Regular use of this food item in its dried, fresh or processed form will be an advantage to combat malnutrition. Not only that, seed of *Madhuca* contain 50–61% oil which is edible and having lucrative fatty acid profile includes palmitic acid, stearic acid, and oleic acid. Nutritionists prefer vegetable oils with high oleic acid content because it lowers blood cholesterol, which in turn lowers the risk of coronary heart disease (Ramadan et al., 2016).

In rural and semi-urban vegetable market, presence of *Marsilea vestita* or "Sushni shak" is very common which indicate its wider use. Fondness for this edible leafy green mostly attached with its sleep boosting and antidepressant activity (Bhattamisra et al., 2008). Additionally, *Marsilea* contains high amount of essential vitamins like Thiamine (394 mg/100 g), Riboflavin (2.5 mg/100 g), and Vitamin C (240 mg/100 g) which provide added advantage of gaining required micronutrients in consumer's daily diets (Jadhao and Wadekar, 2010).

Human beings have been consuming mushrooms as an important food source for centuries due to their attractive and multiple functional attributes (Bhambri et al., 2022). Local tribes of the laterite region of West Bengal preferably consumed wide array of wild macro-fungi which are nutritious and medicinally important (Dutta and Acharya, 2014; Das et al., 2015). Edible fungi like *Volvariella volvacea, Termitomyces heimii,* and *Astraeus hygrometricus* possess lots of essential minerals, amino acids, bioactive compounds, and vitamins (Paloi and Acharya, 2014; Roy et al., 2014; Pavithra et al., 2016). On the other hand *Amanita vaginata, Agaricus campestris,* and *Amanita vaginata* var. *alba* are also well recognized in the studied area for their deliciousness but their nutritional profiling is still not scientifically validated thoroughly.

Many of these locally growing nutritious wild edibles can be a potent substitute for commercially available costly marketed vegetables and fruits. Earlier workers from different parts of the world have experienced the same (Bvenura and Sivakumar, 2017; Duguma, 2020). Larger parts of the recorded species belong to the herbaceous group and can easily be accessed and raised in home gardens simultaneously which will help in maintaining a continuous food supply chain in the local tribe's kitchen. Besides, 23 wild edibles having several medicinal properties which can provide additional advantage of health benefit along with food security. So the recorded species have high possibilities of providing the desired food security and micronutrient sufficiency if they are included in regular dishes.

Threats, sustainable harvesting, and conservation practice

Biodiversity loss due to anthropogenic activity, ecological factors and natural causes are a matter of ongoing discussion worldwide. Threats for wild edible resources are not bereft out of it (Oluoch et al., 2023). In the present study, during group discussion some threats for the local WES have been identified. Habitat destruction was identified as a most potential threat to the wild edibles of laterite region in West Bengal. Forest lands of this region have currently been encroached rapidly mostly for developmental activities and less for expansion of agricultural lands. Secondly, a competitive unsustainable harvest practice for species with good market value received substantial attention among the informants and was pointed out as a cause of population decline of species like *Amorphophallus sylvaticus*, *Asparagus racemosus*, and *Dioscorea alata* in the locality. So, habitat preservation and sustainable harvesting of wild edibles are very much crucial for the protection of these important wild crop genetic resources. Day by day socio-economic status of the rural tribals is changing rapidly which directly influence their consumeristic attitude

TABLE 3 Comparative account of data similarity among the six ethnogastronomic studies conducted in different parts of the laterite region in eastern India with the present study.

Previous work and study site	Similar plant species recorded earlier (N)	JI coefficient
Banerjee et al. (2013) (Bankura)	*N* = 15 *Alternanthera sessilis, Amaranthus spinosus, Amaranthus viridis, Azadirachta indica, Bacopa monnieri, Centella asiatica, Coccinia grandis, Commelina benghalensis, Dioscorea alata, Enydra fluctuans, Grewia asiatica, Hygrophila auriculata, Madhuca longifolia, Paederia foetida, Typhonium trilobatum*	0.13
Bouri and Ganguly (2016) (Burdwan)	*N* = 27 *Achyranthes aspera, Alangium salviifolium, Amaranthus spinosus, Artocarpus lacucha, Asparagus racemosus, Azadirachta indica, Buchanania lanzan, Cajanus scarabaeoides, Centella asiatica, Commelina benghalensis, Cordia dichotoma, Dillenia pentagyna, Dioscorea alata, Dioscorea bulbifera, Diospyros ebenum, Enydra fluctuans, Ficus racemosa, Grewia asiatica, Hemidesmus indicus, Holoptelea integrifolia, Hygrophila auriculata, Ipomoea aquatic, Madhuca longifolia, Melochia corchorifolia, Meyna spinosa, Phoenix acaulis, Ziziphus oenopolia*	0.21
Banerjee (2018) (Purulia)	*N* = 14 *Alternanthera sessilis, Amaranthus spinosus, Amaranthus viridis, Asparagus racemosus, Bacopa monnieri, Centella asiatica, Coccinia grandis, Colocasia esculenta, Commelina benghalensis, Dioscorea alata, Enydra fluctuans, Hygrophila auriculata, Paederia foetida, Typhonium trilobatum*	0.11
Das (2018) (Jharkhand)	*N* = 11 *Alangium salviifolium, Artocarpus lacucha, Buchanania lanzan, Carissa spinarum, Cordia dichotoma, Ficus racemosa, Holoptelea integrifolia, Madhuca longifolia, Neolamarckia cadamba, Pithecellobium dulce, Ziziphus oenopolia*	0.11
Sinha and Lakra (2005) (Odisha)	*N* = 9 *Antidesma ghaesembilla, Buchanania lanzan, Dillenia pentagyna, Dioscorea bulbifera, Dioscorea pentaphylla, Ficus racemosa, Grewia asiatica, Madhuca longifolia, Tamilnadia uliginosa*	0.07
Kumar and Saikia (2020) (Jharkhand)	*N* = 14 *Amaranthus spinosus, Amaranthus viridis, Antidesma ghaesembilla, Buchanania lanzan, Commelina benghalensis, Dillenia pentagyna, Ficus racemosa, Grewia asiatica, Hygrophila auriculata, Madhuca longifolia, Ouret lanata, Polygonum plebeium, Tamilnadia uliginosa, Trianthema portulacastrum*	0.11

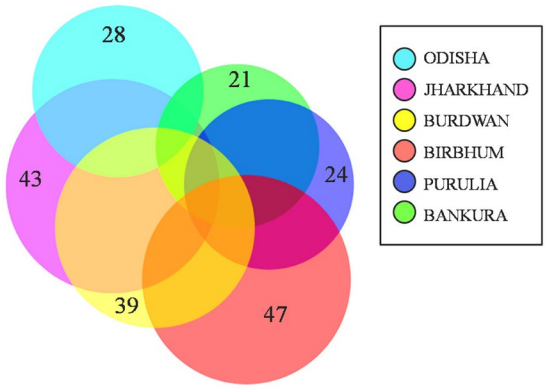

FIGURE 3
Area-Proportional Venn diagram showing the overlap of the commonly used wild edibles recorded from different areas of the laterite region in West Bengal and adjoining areas. Numbers presented within each circle are the unique numbers of wild edibles recorded from the respective areas.

toward urbanized culture. This may be a possible cause of reduced consumption of wild edibles and fading away associated traditional knowledge. Raising awareness among the community members is a long-term effective solution for sustenance of wild edibles in their natural habitat. Additionally collection of germplasm, raising them *in situ* or *ex situ* and formation of gene-bank are also crucial for conserving such treasure trove of our mother nature. Environmental conservationist, social activist, agriculturist, economist and other entrepreneurs can collaboratively step forward in this direction abide by the government laws and policies to protect the population of wild edibles and make fruitful utilization in benefit of the local tribes.

Conclusion

Phytodiversity, agricultural or harvesting practices, wild food gathering, ethnomedicine, nutrition and population health are inextricably linked with one another. Plants with food-medicinal importance play the central role in it. The formation of an inventory of 83 locally accessible wild edibles (WES) is an important step toward preventing malnutrition and ensuring food security for local inhabitants, especially the marginalized. It can also contribute to the eradication of poverty by generating alternate income sources through gathering and marketing popular wild vegetables, fruits and mushrooms. It probably helps with agricultural diversification as well by preserving some excellent traits of WES which can be exploited for developing new cross-breeding varieties.

The present study witnessed that the traditional knowledge of wild edibles still diffusely exists in the *Santal* community of that region. Conservation of this traditional knowledge and its associated natural resources is the best possible sustainable way to keep alive the persisting food heritage. For this, the foremost step should be taken to raise awareness among the wider consumers especially

the younger generation of the tribal community in the studied area regarding the utility of consuming wild edibles. Simultaneously to strengthen the local food use knowledge base, uniformity of ethnogastronomic knowledge should be maintained by creating an oblique knowledge transfer network among the stakeholders of the local food heritage through repetitive group discussions, workshops, and seminars. Additionally, sustainable collection, and use of local flora and macrofungi should be encouraged. As most of the traditional knowledge is related to the local natural resources, associated traditional knowledge will be sustained once the local biodiversity is conserved. Most of the cases culinary uses of wild edibles are very much localized which need proper promotion for diet diversification and intensification. Like other developing countries, India is also facing the conflicts between the population boom and the food availability. This challenge can be overcome through sustainable utilization of recorded inexpensive wild edibles. These wild edibles are lucrative natural source of essential minerals, phytochemicals, vitamins, and many other health benefits. They can be true alternative raw materials for food and nutraceutical industries and thus contribute in reducing the gap between food production and demand. Moreover, further research is needed to go beyond just their nutritional composition information; information on their functional properties is needed to include them in industrial processes. Toxicological studies are also needed to determine their acceptance as a food material. So, newly reported plants as well as plants with high CFSI value should be opted for their detail nutritional analysis, chemical profiling, toxicological studies, and bio-assay to start developing commercial products as well as promoting them as healthy food to overcome hidden hunger.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical review and approval was not required for the ethnobiological study on human participants in accordance with the local legislation and institutional requirements. Written as well as oral informed consent to participate in this study was provided by the elder participants and minor participants' legal guardian/next of kin.

Author contributions

SKM and SatS designed the work, conducted the field survey, collected food-medicinal data, analyzed the data, and wrote the first draft of the manuscript. SarS created Venn diagram, and modified methodology, results and discussion accordingly. Finally, all authors critically revised the manuscript and finalized the draft.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2023.1198187/full#supplementary-material

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