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Diversity of medicinally important leafy vegetables used by the tribes in Balasore district of Odisha, India

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Abstract

With an increase in the incidence and outbreak of several new diseases, plant-based medications are becoming increasingly popular owing to their low cost and fewer adverse effects. In this context, the leafy vegetables being enriched in nutritional and therapeutic value are in focus in order to uncover their hidden potential for human welfare. In this backdrop, the present study was undertaken in the Balasore district of Odisha, India to document the ethnomedicinally significant leafy vegetables consumed by the local tribes of the region. A total of 72 leafy vegetables belonging to 35 families under 69 genera were reported with ethnomedicinal uses. The data on information related to their uses was collected through scientifically structured questionnaires, interviews and close interactions with 192 informants. The results also included the determination of fidelity level (FL) along with factor informant consensus value (Fic). *Nyctanthes arbor-tristis* L., with a fidelity level of 98.77%, is the most commonly used medicinally potent leafy vegetable. Diabetes had a higher Factor Informant Consensus value (Fic) of 0.994, similar to the common cold and cough disease. The findings of the present study suggested that most of the underutilised leafy vegetables under study possessed curative values and needed further investigation to prove their efficacy against specific diseases reported. Furthermore, these leafy vegetables need immediate attention for their conservation and sustainable utilization and efforts should be made to safeguard the traditional knowledge of tribal communities, which is under threat of extinction.

Keywords

Nutritional, ethnomedicinal, underutilized, conservation, sustainable

Introduction

Due to the global rise in reports of several new diseases, there is an urgent need to explore novel drugs for addressing pathogenic as well as non-pathogenic ailments. However, with synthetic drugs being expensive besides their adverse side effects, the quest to develop new plant-based medicines has increased tremendously over the past few decades. Furthermore, leafy vegetables being enriched with nutrients, antioxidants and bioactive compounds are gaining more attention in research areas currently to explore their hidden potential for the benefit of humankind. They are the most easily accessible sources of carbohydrates, fats, proteins, vitamins, minerals, essential amino acids and fibers (1). Besides, they possess medicinal values that can cure various diseases and can boost our immune systems. Unfortunately, instead of eating leafy green vegetables, the current genera-

tion relies on multivitamin tablets and mineral supplements to meet their nutritional needs. Due to the lack of awareness about their overlapping nutritional and medicinal values, they have become the least important in our daily diet.

Being rich in biodiversity, India bestows a broad array of leafy vegetables growing in their native habitat. For a long time, leafy vegetables have been a staple in our diet. Many wild leafy vegetables are consumed by tribal and rural people that are still unknown to the mainstream population. Usually, the majority of tribal and rural communities still depend on wild edible plants to meet their food requirements. Rural households and tribal people not only collect and grow leafy vegetables but also sell them in the local markets in order to earn their livelihood. Besides fulfilling nutritional needs, leafy vegetables are also used by tribal and rural inhabitants to treat various diseases (2). Traditional medicinal knowledge of plant species used by indigenous people is not only beneficial for conservation of inherited folk medicine, but it can also open research avenues for drug discovery (3).

Several researchers in Odisha State have conducted large-scale studies on the antioxidant, nutritional and floristic studies of leafy vegetables (4-11). The ethobotanical survey (exploration) of leafy vegetables in Odisha, on the other hand, has received little attention. The Balasore district of Odisha, being bestowed with the most favourable climatic conditions, is endowed with a diversity of leafy vegetables, many of which are associated with hidden ethnic knowledge as food and medicine and are still unknown to the scientific community and researchers. As a result, the primary objective of this study is to identify ethnomedicinally potent leafy vegetables by surveying natural resources and to preserve traditional medicinal knowledge for future drug research. The other objective of the investigation aims at identifying the most cited medicinal leafy vegetables by using quantitative ethnobotanical calculation tools.

Materials and Methods

Study area

The present study was carried out in different community development blocks in the coastal district named Balasore in Odisha. The district (21°3' to 21°59' N latitude and 86°20' to 87°29' E longitude) comprises an area of 3806 km² with a population of 2320529 (2011 Census). The district is administratively divided into 2 subdivisions namely Balasore and Nilagiri and 12 C.D. blocks which is surrounded by Midnapur district of West Bengal in its northern side, Bay of Bengal in its east, Bhadrak district in its south and Mayurbhanj and Keonjhar districts lying on its western side. Being situated in the coastal section of Odisha, it is blessed with hot and humid climate, the average summer and winter temperature is 43.1℃ and 10.6 ℃ respectively while the annual average precipitation is approximately 1583 mm. In addition to favourable climate and alluvial soil, presence of perennial rivers promotes the growth of agriculture in Balasore district. The district is dominated by various eth-

nic, linguistic and religious communities including many indigenous tribes. Apart from the local dialect i.e. Baleswari bhasa, other languages spoken in the district include Odia, Bengali, Urdu, Santali, Hindi etc. Santal, Oraon and Bhumij are the predominant tribes of the district under study.

Methodology

Several field trips were undertaken in the interior tribal pockets of different blocks of Balasore district, Odisha during February 2018 to January 2022 to gather information about the diversity of leafy vegetables consumed by the local and tribal people of the district. The ethnomedicinal uses of leafy vegetables were documented through structured questionnaires as well as discussions with the local inhabitants, tribal people and forest dwellers of the district. A total of 192 local informants including 67% males and 33% females were interviewed during the ethnobotanical survey. The ages of the informants were within the range of 25-75 years. The taxonomic data comprised of the scientific names, vernacular name, habit, parts used, diseases treated and mode of utilization.

The plant specimens collected during the course of survey have been critically examined, studied and identified in consultation with the regional floras (12-14), while the up-date nomenclature of the documented plant species was ascertained by referring to "The World Flora Online Site". Digital photographs of the plants were also taken for identification and record. The plant specimens were dried and preserved as voucher specimens using standard herbarium techniques (15) and deposited as herbarium samples in the Department of Botany, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India.

Quantitative Analysis

By using quantitative ethnobotanical tools, the Factor of Informant Consensus (Fic) and Fidelity Level (Fl) were calculated. The Factor of Informant Consensus (Fic) was calculated by using the following equation: Fic = Nur – Ntaxa/ Nur-1, where Nur is the number of use reports in each category, Ntaxa is the number of species in each category (16,17). The Fidelity Level was calculated for the most cited medicinal plant species as: Fl (%) = (Np / N) × 100, where, Np = the number of informants that claimed the use of a plant species to treat a particular disease; N = the number of informants that used the plants as medicine to treat any given disease (18).

Results and Discussion

As a result of extensive floristic exploration and natural resources survey, a total of 72 ethnomedicinally used potent leafy vegetables belonging to 35 families distributed under 69 genera were collected, taxonomically studied, identified and found to be utilised to treat more than 40 diseases as presented in Supplementary Table 1. The information and data relating to the uses of leafy vegetables as ethnomedicines were gathered by conducting interviews with 192 informants of the study area. It was observed that

plants often considered as weeds like *Achyranthes aspera* L., *Aerva lanata* (L.) Juss. ex Schult., *Cleome viscosa* L., *Commelina benghalensis* L., *Dicliptera bupleuroides* Nees., *Euphorbia hirta* L., *Leucas cephalotes* (Roth) Spreng., *Portulaca oleracea* L. and *Rungia pectinata* (L.) Nees. are largely consumed as leafy vegetables by the tribal and forest dwellers of the study area. They were less known and popular as leafy vegetables, and possessed interesting folklore claims with therapeutic values that need further investigation to reveal their efficacy as herbal drugs. Some of the uncommon plant species reported to be used as leafy vegetables in the study area include *Antidesma acidum* Retz., *Bauhinia variegata* L., *Cayratia auriculata* (Roxb.) Gamble, *Erythrina variegata* L., *Ficus religiosa* L. and *Zanthoxylum asiaticum* (L.) Appelhans, Groppo & J.Wen etc.

The data on the parts of the plants utilised as medicines revealed that leaves are the most common plant part utilised as herbal medicine by the tribal people during the present study and the results are shown in Fig. 1, thereby
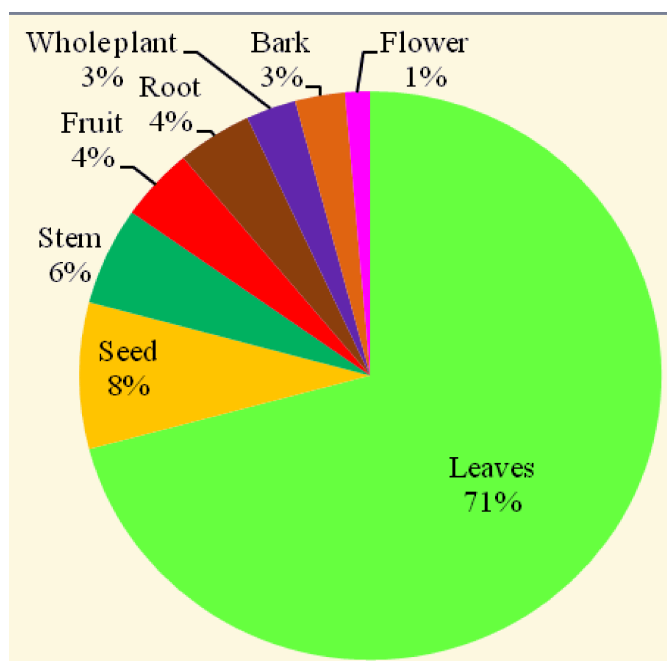

Fig. 1. Recorded plant parts used as medicine.

Fig. 2. Dominant families of potent ethnomedicinal leafy vegetables in the study area.

Fig. 3. Leafy vegetables used to treat various diseases recorded from the study area.

Table 1. Fidelity level (Fl%) of most cited leafy vegetables

Species	Ailments	NP	N	Fl%
Nyctanthes arbor-tristis L.	Intermittent-Fever	161	163	98.77
Justicia adhatoda L.	Cough and Cold	157	161	97.51
Andrographis paniculata (Burm.f.) Nees	Diabetes	148	153	96.73
Marsilea quadrifolia L.	Insomnia	154	161	95.65
Lagenaria siceraria (Molina) Standl	Agalactorrhoea	142	151	94.03
Oxalis corniculata L.	Vomiting & Diarrhoea	137	146	93.83
Amorphophallus paeoniifolius (Dennst.) Nicolson	Internal Piles	91	108	84.25
Achyranthes aspera L.	Stomach ulcer	62	81	76.54

indicating their sustainable management by nature. As regards to family-wise distribution of plant resources, it was seen that Fabaceae is the dominant family, represented by 9 species, followed by Amaranthaceae (7 species), Cucurbitaceae (6 species), Acanthaceae (5 species) and Apiaceae with 4 species (Fig. 2). The use of leafy vegetables as medicines revealed that of all the plants collected, 8 species were reported to be used for curing skin diseases by the tribal people (Fig. 3). The most cited ethnomedicinal plant species are *Nyctanthes arbor-tristis* L., *Justicia adhatoda* L., *Andrographis paniculata* (Burm.f.) Nees, *Marsilea quadrifolia* L., *Lagenaria siceraria* (Molina) Standl. and *Oxalis corniculata* L. Of all the leafy vegetables studied, 7 species showed an above 80% fidelity level (Table 1), while the fidelity level of *Nyctanthes arbor-tristis* L. (98.77%) was found to be the highest among the most used plant species. 2-3 teaspoons of the leaf juice of this plant are consumed orally once a day in the morning on an empty stom-
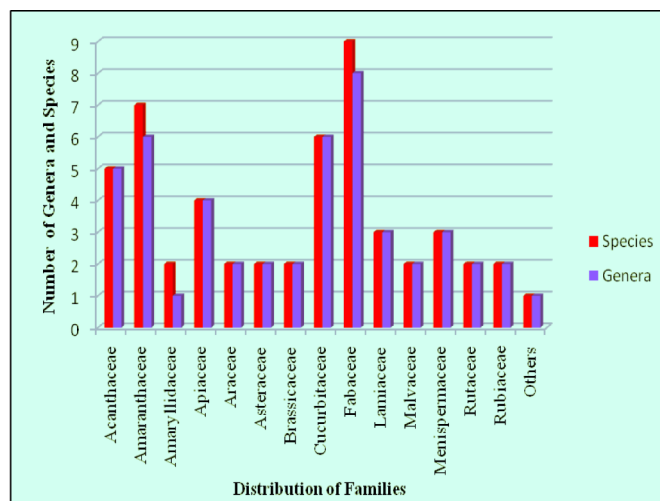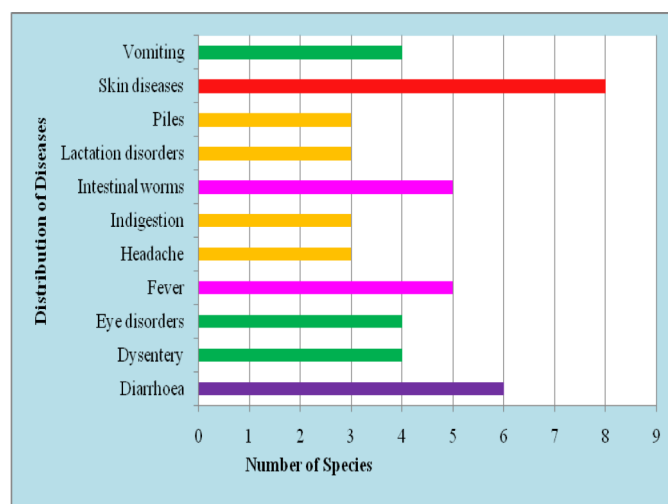
ach for 3 consecutive days for the treatment of intermittent fever caused by malaria, viral fever, or other infectious diseases. Factor of informant consensus (Fic) values of total ailments studied were categorised into 20 groups in order to assess the consensus of tribal people using leafy vegetables as ethno medicines (Table 2). The diseases like "diabetes", "common cold" and "cough" resulted in the highest Fic value of 0.994, while the average Fic value for all diseases reported was 0.974, thereby indicating that the

Table 2. Factor of informant consensus (Fic) value of each disease category

Diseases Categories	Number of taxa	Used report	Fic values
Skin diseases	8	162	0.956
Diarrhoea	6	158	0.968
Fever	5	191	0.978
Deworming	5	141	0.971
Dysentery	4	97	0.968
Eye disorders	4	32	0.903
Vomiting	4	159	0.981
Headache	3	26	0.92
Indigestion	3	87	0.976
Lactation	3	187	0.989
Piles	3	113	0.982
Diabetes	2	178	0.994
Constipation	2	108	0.99
Menstruation	2	88	0.988
Common Cold and Cough	2	177	0.994
Earache	2	158	0.993
Hyperacidity	2	121	0.991
Reproductive disorders	2	68	0.985
Arthritis and Body inflammation	2	94	0.989
Others	10	292	0.969

majority of the tribal population in the study area were well versed in the system of plant-based medicines *vis-a-vis* ethnomedicinal knowledge.

The investigation carried out in the present piece of research work revealed the phytotherapeutic potential of leafy vegetables used by the tribal and rural inhabitants of the Balasore district of Odisha for treating a variety of ailments. Skin diseases being the most prevalent in the study area, it was most interesting to note that the local communities relied on eight different species of leafy vegetables instead of using any synthetic formulation. Similarly, for treatment of intermittent fever, *Nyctanthes arbor-tristis* L. was observed to be the most recommended species with a fidelity level record of 98.77%. The Fic value of 0.994 for diseases such as diabetes and the common cold indicated that a large number of respondents used fewer plant species to treat these diseases, or that the ethno therapeutics of the specific plant remedy was well shared among informants in the study area. In other words, the findings of the current study confirmed that the age-old practise of ethno medicine is still alive in the region under study. However, due to overexploitation of plant resources, habitat fragmentation and invasion of alien species, coupled with the impact of urbanisation and the introduction of modern health care facilities in rural areas, may result in the depletion of potent wild leafy vegetables and the associated ethnomedicinal knowledge behind their use. Thus, sustainable utilisation of such bioresources along with the documentation of their therapeutic potential is the need of the hour before they are permanently lost.

Conclusion

Potent green vegetables with high citation, Fic and Fl values that haven't been studied yet can be evaluated for their phytochemical and pharmacological screening in order to discover new classes of active compounds in view of their uses for the treatment of specific ailments. Moreover, in order to prevent the depletion of those therapeutically potential leafy vegetables, local populations should be recommended for massive cultivation and popularisation of the most extensively utilised ethnomedicinal plant species. Furthermore, ethnobotanical survey, as the first step in the bioprospecting process, should be prioritised not only for uncovering hidden information for the discovery of innovative medications but also for biodiversity conservation.

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Authors contributions

KBS and NN conceived the idea. NN performed the experiments. KBS and NN analyzed the data. Both authors have significant contribution in drafting the manuscript.

Compliance with ethical standards

Conflict of interest: The authors do not have any conflict of interests to declare.

Ethical issues: None

Supplementary data

Supplementary Table 1. Ethnomedicinal uses of leafy vegetables of Balasore district in Odisha.

References

1. Sharma HP, Kumar RA. Health security in ethnic communities through nutraceutical leafy vegetables. *J Environ* Res Develop. 2013;7(4):1423-29. http://www.jerad.org/ppapers/dnload.php?vl=7andis=4andst=1423

2. Noor N, Satapathy KB. Indigenous leafy vegetables: A superfood and a potent drug for future generation. Int J Botany Stud. 2020;5(3):146-53. http://www.botanyjournals.com/archives/2020/vol5/issue3/5-2-79

3. Kantati Y T, Kodjo KM, Dogbeavou KS, Vaudry D, Leprince J, Gbeassor M. Ethno- pharmacological survey of plant species used in folk medicine against central nervous system disorders in Togo. J Ethnopharmacol. 2016;181:214-20. http://dx.doi.org/10.1016/j.jep.2016.02.006

4. Sahu RK, Kar M, Routray R. DPPH free radical scavenging activity of some leafy vegetables used by Tribals of Odisha. India. J Med Plants Stud. 2013;1(4):21-27. https://www.plantsjournal.com/archives/?year=2013&vol=1&issue=4&part=A&ArticleId=29

5. Panda T. Traditional knowledge on wild edible plants as livelihood food in Odisha, India. J Biol Earth Sci. 2014;4(2):144-59.

6. Misra S, Misra MK. Nutritional evaluation of some leafy vegetable used by the tribal and rural people of south Odisha, India. J Nat Prod Plant Resour. 2014;4(1):23-28. http://scholarsresearchlibrary.com/archive.html

7. Tripathy PK, Kumar S, Jena PK. Nutritional and medicinal values of selected wild cucurbits available in Similipal Biosphere Reserve Forest, Odisha. Int J Pharm Sci Res. 2014;5(10):5430-37. http://dx.doi.org/10.13040/IJPSR.0975-8232.5(10).5430-37

8. Panda T, Mishra N, Pradhan BK, Mohanty RB. Diversity of leafy vegetables and its significance to rural households of Bhadrak district, Odisha, India. Sci Agric. 2015;11(3):11423. http://dx.doi.org/10.1016/j.jep.2016.02.00610.15192/PSCP.SA.2015.11.3.114123

9. Pradhan B, Panda D. Wild edible plant diversity and its ethnomedicinal use by indigenous tribes of Koraput, Odisha, India. Res J Agriculture and Forestry Sci. 2015;3(9):1-10. http://www.isca.in/AGRI_FORESTRY/Archive/v3/i9/1.ISCA-RJAFS-2015-041.php

10. Samal D, Rout NC, Biswal AK. Contribution of wild edible plants to the food security, dietary diversity and livelihood of tribal people of Keonjhar district, Odisha. Plant Sci Res. 2019;41(1&2):20-33. http://plantscienceresearch.co.in/admin/uploads/SubArt_937096606.pdf

11. Mallick SN, Sahoo T, Naik SK, Panda PC. Ethnobotanical study of wild edible food plants used by the tribals and rural populations of Odisha, India for food and livelihood security. Plant Arch. 2020;20(1):661-69.http://www.plantarchives.org/20-1/661-669%20(5616).pdf

12. Haines HH. The Botany of Bihar and Orissa. 6 parts London. Botanical Survey of India, Calcutta; 1921-1925.

13. Saxena HO, Brahmam M. The Flora of Orissa. Vol. 1-4. Bhubaneswar (Orissa): Regional Research Laboratory and Forest Development Corporation of Orissa;1994-1996.

14. Mooney HF. Supplement to the Botany of Bihar and Orissa. Ranchi: Catholic Press;1950.

15. Jain SK, Rao RR. A Handbook for field and herbarium methods. New Delhi: Today and Tomorrow Publishers; 1967.

16. Trotter RT, Logan MH. Informant consensus: A new approach identifying effective medicinal plants. In: Etkin NL, Editor. Plants in Indigenous Medicine and DietBehavioural Approaches. Bredfort Hills, New York: Redgrave Publishing Company; 1986. p. 91–112.

17. Heinrich M, Ankli A, Frei B, Weimann C, Sticher O. Medicinal plants in Mexico: Healers' consensus and cultural importance. Soc Sci Med. 1998;47:1859-71 https://doi.org/10.1016/S0277-9536(98)00181-6

18. Friedman J, Yaniv Z, Dafni A, Palewitch D. A preliminary classification of healing plants, based on a rational analysis of an ethno pharmacological field survey among Bedouins in the Negev Desert. J Ethnopharmacol. 1986;16:275-87. https://doi.org/10.1016/0378-8741(86)90094-2

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