



Botanical solutions for gastrointestinal disorders: a quantitative ethnobotanical approach in the Balasore district of Odisha, India

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Research

Abstract

Background: The world faces evolving challenges related to gastrointestinal (GI) diseases in the present scenario. In this context, the study highlighted a quantitative ethnomedicinal assessment of plants used to treat gastrointestinal disorders in the Balasore district of Odisha.

Methods: The information was collected through semi-structured interviews with 48 informants to gather the ethnomedicinal data for the treatment of gastrointestinal disorders. Quantitative indices such as Use Value (UV), Family Use Value (FUV) and Relative Frequency of Citation (RFC) were calculated to determine the most useful plant species and plant family.

Results: The present study documented a total of 104 plant species across 52 families used by indigenous communities to treat various GI diseases. Among the reported plant families, the family Fabaceae is the dominant, with 13 species, followed by the families Rubiaceae and Apocynaceae. Trees are the most dominant growth habit, followed by shrubs and herbs, whereas leaves are frequently used in disease treatment. The UV ranges from 0.12 to 0.93, whereas the RFC values range from 0.77 to 0.04. The UV and RFC are both highest in *Aegle marmelos*, whereas the FUV indicates that the family Zingiberaceae (0.89) is the most useful.

Conclusions: The findings of this research offer detailed data regarding the diversity of medicinal plant species, their useful parts, mode of preparation, application and medicinal utility of the ethnic communities. Further studies regarding the scientific validation of obtained ethnomedicinal information by phytochemical analysis and detection of pharmacological activities are necessary for scientific authenticity.

Keywords: Gastrointestinal diseases, Ethnomedicine, Use Value, conservation, coastal Odisha, Indigenous Knowledge, Kuldiha Wildlife Sanctuary

Background

Plants primarily contributed to human life by providing four essential needs like food, clothing, shelter, and medicine. With fulfilling all our basic needs, they provide wide therapeutic biomolecules that have been used for curing various diseases and are an important contributor to our health (Yarrappagaari *et al.* 2022; Zothantluanga *et al.* 2019). Throughout ancient times, people have utilised plant-based medicines to treat diseases (Singh *et al.* 2017). In India, the utilisation of medicinal flora has a rich historical tradition within its conventional healthcare practices, encompassing systems such as Ayurveda, Unani, and Siddha, alongside various local folk traditions (Samy & Ignacimuthu 2000). One of the earliest known repositories of human knowledge, the Veda, is considered the earliest literature to document the utilisation of plants as medicines.

Plants are always regarded as the primary source of medications in a variety of forms, including crude extracts, juice, decoction, and crude form in both conventional and alternative medicine (Singh *et al.* 2017). Approximately 80% of the total population of the world still uses traditional healthcare resources. The Indian subcontinent is well known for its plant-associated culture (Patra & Nayak 2024). These indigenous people have access to a wealth of unpublished ethno-pharmacological and ethnomedicinal knowledge about the local flora, which could be extremely beneficial in rural communities. Due to changes in lifestyles, inadvertent development initiatives, and the rise of modern society, unreported ethno-pharmacological data and tribal traditions have declined at an alarming rate. In this context, traditional knowledge is also impacted by youth negligence (Poonam & Singh 2007; Pandey & Shukla 2003).

Among the different organs, the gastrointestinal tract is considered the most sensitive organ vulnerable to different kinds of diseases such as constipation, diarrhoea, bloating, gastroenteritis and reflux, parasitic and other infectious ailments (Khoja *et al.* 2022). Disordered eating patterns, including irregular eating behaviours, restricted food type, fasting and binge eating, are the main reasons behind the diet-dependent gastrointestinal disorder (Grilo 2006). Likewise, Dysentery, stomach pain, diarrhoea, constipation, indigestion, abdominal pain, intestinal worms, and acidity are the major gastrointestinal problems in the present time (Mir *et al.* 2021). Herbal medicines are the earliest forms of healthcare that humans have ever known. Before the creation of modern medicine, many societies depended on it. They also have preserved a wealth of traditional knowledge that serves as the foundation for herbal remedies (Chakraborty, 2018). The rural population of our nation is more likely to use medicinal flora and traditional methods of therapy over the last several decades, as medicinal herbs are easily accessible and more affordable (Sahu *et al.* 2010).

India is widely recognised as a global hub for medicinal flora, earning a reputation because it holds approximately 8% of the planet's total estimated biodiversity, which is concentrated in its 12 mega-biodiversity centres and 4 biodiversity hotspots. Plants are important bioresources that play a vital role in human welfare. In the agriculturally dependent state of Odisha, many farmers prefer traditional remedies due to their high costs, adverse effects of modern medicine, social norms and limitations in access to essential pharmaceuticals. Balasore district is famous for its biocultural heritage and well-known traditional medicine practices, as evidenced by previous ethnobotanical studies. The indigenous communities, including Santal, Ho, Munda, Bathudi, Shabar, Bhumij and Kolha of the district, depend upon the botanical resources of their surrounding regions for the treatment of different diseases (Behera & Nayak 2023). Although several ethnobotanical studies were previously conducted in the Balasore district of Odisha, particularly a quantitative ethnomedicinal study based on gastrointestinal disorders in this region remains insufficient. The present study aims to document the plants with gastrointestinal disorder curative properties, followed by the determination of the use value and the relative frequency of citation. The quantitative ethnobotanical analysis result will help to select the potential medicinal plant, which can be used for the sustainable management and conservation of botanical resources of the district.

Materials and Methods

Study area

The present study was conducted in the Balasore district, which is a coastal district situated in the northern part of Odisha with an area of 3634 square kilometres. The district is situated within a Latitude of 20.48° to 21.59° N and a longitude of 86.16° to 87.29° E (Figure 1). The total population of the district is 2,320, 529 (Census 2011). The district is characterized by diverse dense flora with different forest areas, including Kuldiha wildlife sanctuary, Dhobashila hill, Panchulingeswar hill and Nilgiri hill. The indigenous communities of this region possess a deep understanding of local flora and traditional knowledge.

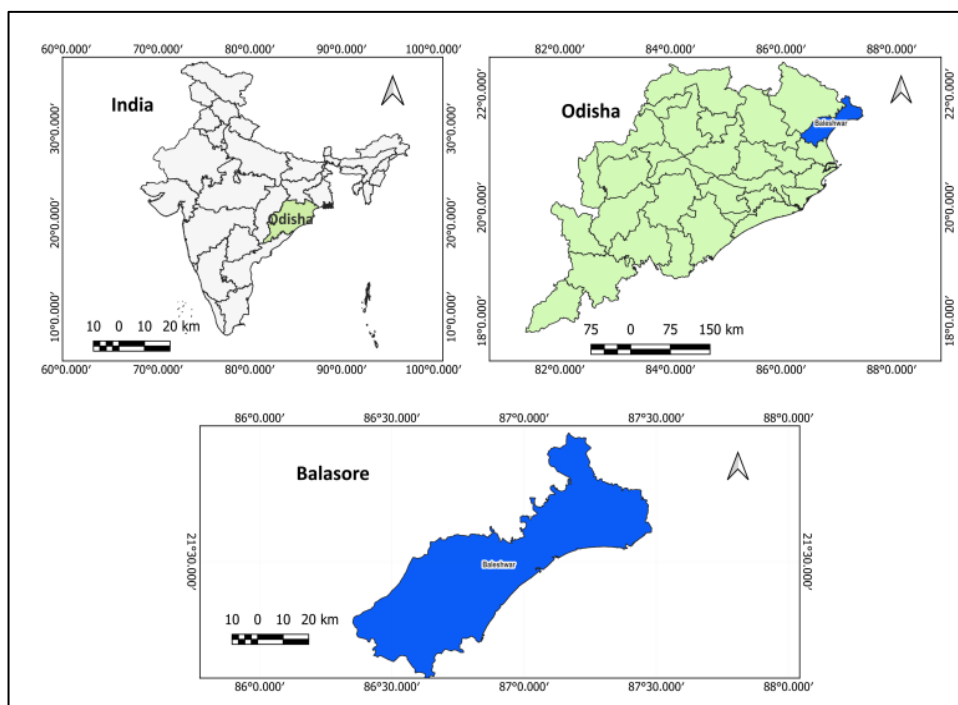


Figure 1. Map of the study area

Demographic feature of informants

A total of 48 individuals were investigated, consisting of 35 males and 13 females of different age groups ranging from 18 to 89 years (Table 1). Before the collection of ethnomedicinal data, oral informed consent was taken from the individuals participating in the interview. To verify the authenticity of collected ethnomedicinal information, a consistent relation was kept with the indigenous communities. The maximum number of informants were illiterate, whereas only a few of them received education up to higher secondary. The informants mainly belong to the Santala, Ho, Ganda, Kudumi, Vumij and Bathudi communities. The interview was conducted in the local vernacular language, Odia.

Ethnomedicinal survey and data collection

Field surveys were conducted multiple times in different seasons at different parts of Balasore district during the years 2019-2024 for gathering ethnomedicinal information associated with the treatment of gastrointestinal disorders (Fig 2).

Ethical approval and Sampling strategies

The Department of Environmental Science, Fakir Mohan University, was approved for carrying out these ethnomedicinal investigations in the different areas of Balasore district. Before the collection of ethnobotanical information, oral informant consent was taken from each informant.

Selection of Informants

Informants were selected using Snowball sampling methods. Purposive sampling was adopted to select traditional healers who are actively engaged in different ethnomedicinal practices. The informants were selected according to their experience and availability.

Ethnobotanical Information documentation

The investigation was conducted through an ethnobotanical survey as well as standard questionnaires in group discussions (Martin 1995). To ensure the accuracy of the obtained ethnomedicinal information, a consistent relationship was kept with the informants. Multiple interviews with individuals of diverse ages, sexes, socioeconomic backgrounds, and ethnicities (Table 1) were conducted to gather a comprehensive account of plants used for the treatment of GI diseases. Data collection focused on local names, part used, mode of use, preparation process and mode of application. The collected information in the local vernacular language is later translated into English.

Validation of Ethnobotanical Claims:

To maintain uniformity and to avoid referral bias, multiple interviews were conducted. To validate the ethnobotanical claims for a particular plant by particular informants, the ethnomedicinal claims from one informant were cross-checked with those of others.

Table 1. Demographic features of the informants participating in the study

| ç | Frequency | Percentage (%) |
|------------------|-----------|----------------|
| Male | 35 | 72.91 |
| Female | 13 | 27.08 |
| 15- 20 Age | 01 | 2.08 |
| 21 - 30 Age | 05 | 10.41 |
| 31 - 40 Age | 08 | 16.67 |
| 41 - 50 Age | 07 | 14.59 |
| 51 - 60 Age | 16 | 33.33 |
| More than 60 age | 11 | 22.92 |

Plant sample collection and identifications

The identification of plant specimens was conducted on-site, utilising a comprehensive evaluation that involved direct observations and in-depth investigation of their defining traits, including morphology and eco-physiological responses. Taxonomic identification of the collected plant specimen was based on two regional works: The Botany of Bihar and Orissa (Haines 1921-25) and The Flora of Orissa (Saxena & Brahmam, 1994-1996). The updated nomenclature of the taxon was assigned, referring to the online available database Plant of the World Online (POWO 2025) and International Plant Name Index (IPNI 2025). During the study, the plant specimens were collected in the field in their flowering or fruiting stages to ensure proper identification. The collected specimens were assigned a unique field number for preparation of the herbarium. The prepared herbarium specimens were deposited in the herbarium of the P.G. Department of Environmental Science, Fakir Mohan University, Balasore.



Figure 2. Photographs representing collection of ethnomedicinal information and plant sample collection for herbarium preparation

Quantitative Ethnobotanical Analysis

Use Value (UV): In this study, the UV was determined by referring to Phillips and Gentry (1993). This index aimed to evaluate the significance of each medicinal plant species used by the local community. The UV value of a plant is directly proportional to the number of uses.

$$UV = \sum U_i / N$$

Where, U_i : Total number of usage reports provided by each informant and N : Total number of informants involved in the study.

Family Use Value (FUV)

This FUV index determines the use value associated with a particular family. This is calculated by referring to the formula of Phillips and Gentry (1993).

$$FUV = \sum UV / N$$

Where ' $\sum UV$ ' represents the summation of the total use value from all species of a particular family, and ' N ' represents the total number of species that belong to that family.

Relative Frequency Citation (RFC)

The RFC is calculated by using the formula described by Barkatullah et al. (2018). The value of RCF ranges from 0 to 1.

$$RFC = FC / N$$

Where ' FC ' represents the Number of informants who reported the plant's use and ' N ' represents the total number of informants investigated.

Statistical analysis

The obtained ethnobotanical information was arranged in a tabulated form, followed by indicating its numerical values for " U_i ", " FC " and " N ". These values for individual plants were presented in MS Excel-2019 to calculate the UV, FUV, and RFC by using the above-mentioned formulas.

Results

This research indicates that diverse ethnic groups utilise a variety of plants and plant parts for the treatment of different kinds of gastrointestinal disorders. The findings of this research offer detailed data regarding the diversity of medicinal plant species, their useful plant part, and mode of application and medicinal utility of the ethnic communities (Table 2).

Diversity

The present investigation documented a total of 104 plant species belonging to 52 families used in the treatment of different kinds of gastrointestinal disorders in the Balasore district. Among the documented plant species trees represents the dominant growth habit with 48 species followed by shrub, herb and climber with 27, 23 and 6 species respectively (Table 2, Fig. 3). Similarly, the family Fabaceae represents the dominant plant family with 13 species followed by family Apocynaceae (6), Rubiaceae (6), Euphorbiaceae (5), Phyllanthaceae (5), Combretaceae (5) and Malvaceae (4) (Fig. 4)

Ethnomedicinal use

All the documented plant species and their corresponding ethnomedicinal data obtained from this study are compiled and presented in the accompanying Table 2. Leaves are mainly used for the treatment of gastrointestinal disorder in the study area as leaf of 27 plants are used in treatment of the gastrointestinal disease followed by bark, root and fruit as useful part in 24, 21 and 14 species respectively (Fig. 5). In the study the plants are mainly used for the treatment of major gastrointestinal disorders like constipation, vomiting, diarrhoea, abdominal pain and acidity.

Use Value

From the quantitative ethnomedicinal data analysis, it was recorded that the use value of plant species of Balasore district for the treatment of gastrointestinal disorders ranges from 0.12 to 0.93 (Table 2). The highest UV 0.93 was recorded in *Aegle marmelos*, whereas *Agave angustifolia* and *Triumfetta rhomboidea* represent the lowest UV, with a numerical value of 0.12. Similarly, the UV of plant species like *Zingiber officinale*, *Nyctanthes arbor-tristis*, *Lawsonia inermis* and *Holarrhena pubescens* also indicates the multiple medicinal utility of these plant species in the study area.

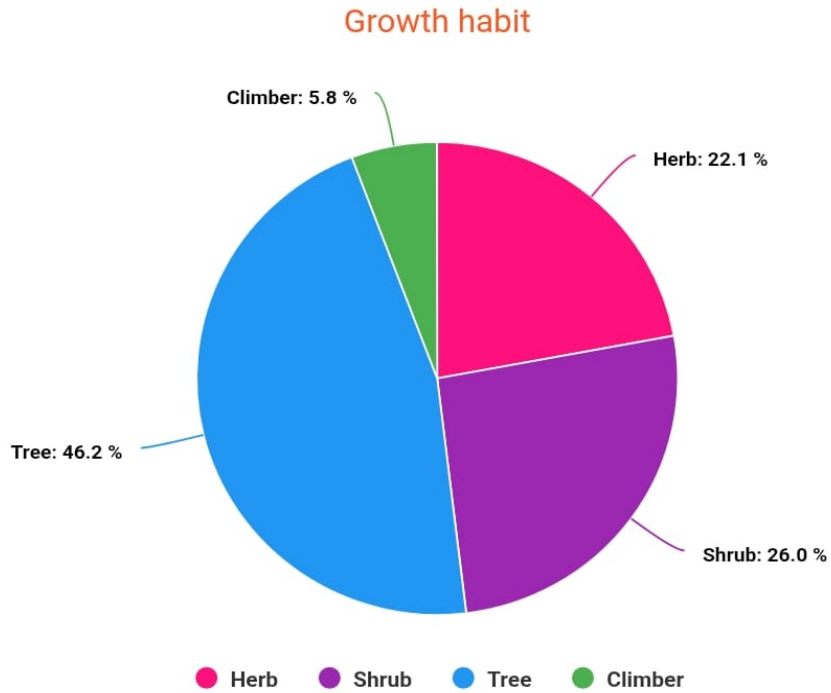


Figure 3. Growth habit of the plant species of Balasore district used for the treatment of gastrointestinal disorders

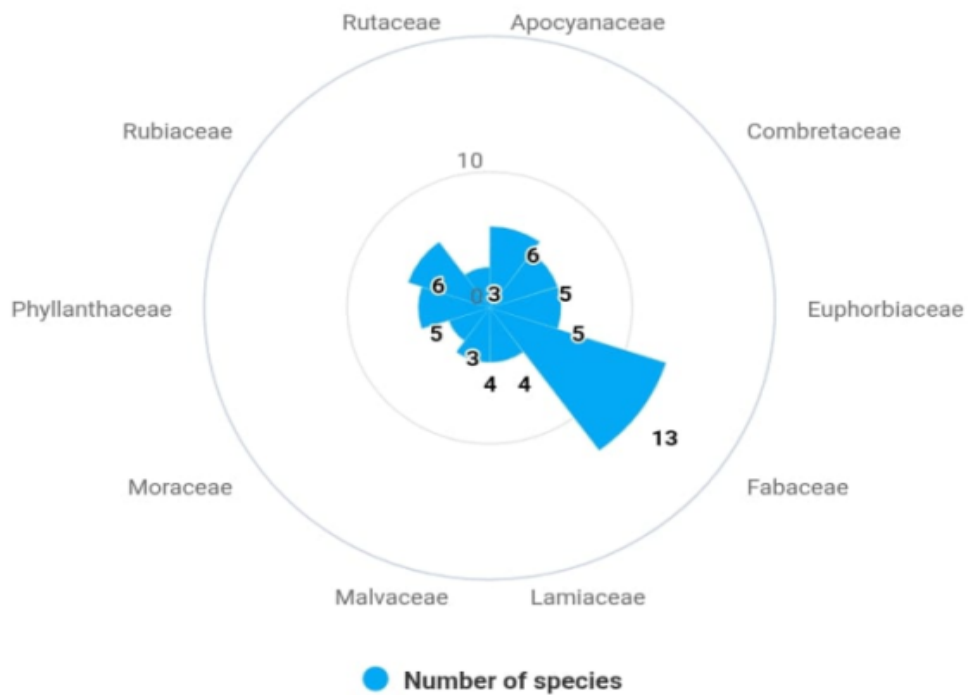


Figure 4. Dominant plant families responsible for the treatment of gastrointestinal diseases in Balasore district, Odisha.

Family Use Value

Among the 52 plant families documented, the FUV (Table 3) indicates that the family Zingiberaceae possesses the highest family use value (0.89) with a single species, which is widely used for the treatment of gastrointestinal disorders in the study area. Other prominent families included Oleaceae (0.87) and Lythraceae (0.83), which also showed diverse medicinal properties to cure different types of gastrointestinal disorders. The lowest FUV was reported in the families Annonaceae and Boraginaceae, with a score of FUV 0.14.

Relative frequency of citation

The study revealed that the Relative Frequency of Citation (RFC) of ethnomedicinal usage ranged from 0.04 to 0.77 (Table 2), with the highest RFC (0.77) in *Aegle marmelos*, followed by *Zingiber officinale* (0.64), *Citrus medica* (0.62) and *Phyllanthus emblica* (52). The *Artabotrys hexapetalus* and *Litsea glutinosa* had the lowest RFC value (0.04).

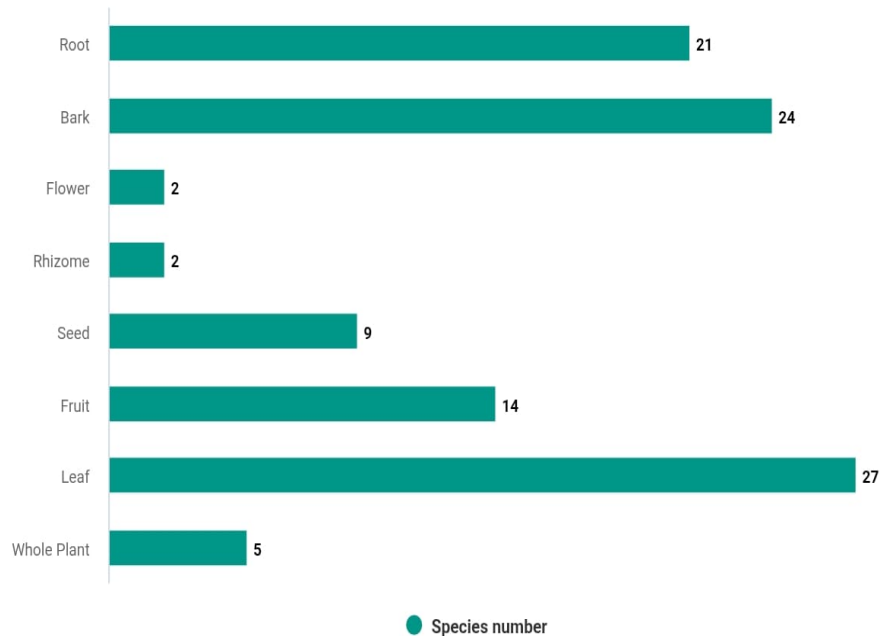


Figure 5. The graph shows the plant parts used for the treatment of gastrointestinal disorders in Balasore district, Odisha.

Discussion

The present study highlighted the medicinal importance of plants in Balasore district for the treatment of various gastrointestinal disorders among ethnic communities. The study documented 104 plant species under 52 families, with the leaf as the most useful part. The result of the present study is well comparable with the findings of Saravanan and Sujana (2025), who conducted the ethnobotanical study in Kuldiha Wildlife Sanctuary of Balasore. The findings of Saravanan and Sujana (2025) documented that 47 plant species were used for the treatment of gastrointestinal disorders in the Kuldiha WLS, whereas current research describes 104 plant species in the whole Balasore district. Interestingly, the species recorded in their study are also reported in the present data. However, their study was restricted to the determination of RFC, whereas the present study focuses on the determination of UV, RFC and FUV. In their study, the value of RFC for the treatment of gastrointestinal disorders ranges from 0.42 to 0.92, but in the present study, it ranges from 0.04 to 0.75. The deviation in the number of medicinal plant species may be due to the difference in data collection, selection of potential informants, mode of interview, time period of study like factors. Apart from that, their study aims to prepare the ethnomedicinal data for several kinds of disease, whereas the present study is restricted to the gastrointestinal disorder only, which may be another reason behind the difference in the number of plant species.

The study of Shende (2024) on ethnomedicinal plants used for gastrointestinal disorder treatment in Maharashtra state documented 61 plant species under 39 families, with the dominant family being Solanaceae. In their study, the leaf is the most useful part, which aligns with the present study. Likewise, Mir *et al.* (2021) documented the 56 plant species belonging to the 24 families, with the dominant family Asteraceae in their study, whereas the whole plant part is mostly used for disease treatment in the study conducted in Budgam of Jammu and Kashmir. Apart from that, the highest UV is noticed in *Artemisia absinthium* (0.74), and the highest UV in the present study is 0.93 reported in *Aegle marmelos*. The most useful species recorded in their study is not documented in the present study, which may be due to the variation in the geographical location of the study area. Likewise, in the Northern part of the Kashmir Himalaya, the study conducted by Khoj *et al.* (2022) documented 67 plant species under 31 families with a dominant growth habit of herb and frequently used part leaf. The Use value ranges from 0.17 to 0.96. The highest UV is reported in *Acotinum heterophyllum*, whereas the lowest UV is in *Verbena officinalis*.

Table 2. Ethnomedicinal applications in gastrointestinal disorders of some flora found in the Balasore district, Odisha

| Family name | Plant name | Voucher No. | Vernacular name (Odia) | Growt h Habit | Parts Used | Ethnomedicinal Uses | ΣUI | FC | UV | RFC |
|---------------|---|--------------|------------------------|---------------|-------------|--|-----|----|------|------|
| Acanthaceae | <i>Andrographis paniculata</i> (Burm.f.) Wall. ex Nees. | ENVFMU -0520 | Bhuinimba/ Chiraeta | Herb | Whole plant | Traditionally, plants are employed to treat diarrhoea resulting from various infectious origins | 36 | 9 | 0.75 | 0.18 |
| | <i>Justicia adhatoda</i> L. | ENVFMU -0508 | Basanga | Shrub | Leaf | Decoction of leaves is consumed with honey to address constipation. | 17 | 4 | 0.35 | 0.08 |
| Amaranthaceae | <i>Alternanthera sessilis</i> (L.) DC. | ENVFMU -0517 | Madaranga | Herb | Leaf | Leaf is boiled, and the decoction is consumed orally for treating indigestion. | 13 | 3 | 0.27 | 0.06 |
| Anacardiaceae | <i>Mangifera indica</i> L. | ENVFMU -0648 | Amba | Tree | Seed | Seeds have unique therapeutic applications, including intestinal disorders and vomiting. | 22 | 8 | 0.45 | 0.16 |
| Annonaceae | <i>Artabotrys hexapetalus</i> (L.f.) Bhandari | ENVFMU -0530 | Chini Champa | Shrub | Leaf | A liquid extract of boiling leaves is employed to combat cholera. | 7 | 2 | 0.14 | 0.04 |
| Apiaceae | <i>Foeniculum vulgare</i> Mill. | ENVFMU -0608 | Panmadhuri | Herb | Seed | The seeds are used to promote digestion due to eating spicy food. | 29 | 11 | 0.60 | 0.22 |
| Apocynaceae | <i>Alstonia scholaris</i> (L.) R.Br. | ENVFMU -0516 | Chhatian | Tree | Bark | Bark and leaf are effective in treating stomachaches due to acidity. It is implemented to check intestinal parasites. | 36 | 8 | 0.75 | 0.16 |
| | <i>Calotropis gigantea</i> (L.) W.T. Aiton | ENVFMU -0553 | Arakha | Shrub | Root | Powdered root is mixed with coconut oil and applied to the dermal region of the belly twice daily to cure dysentery. | 9 | 3 | 0.18 | 0.06 |
| | <i>Hemidesmus indicus</i> (L.) R.Br. | ENVFMU -0770 | Anantamula | Shrub | Root | Root and pepper paste is used for stomach pain and diarrhoea. | 33 | 7 | 0.68 | 0.14 |
| | <i>Holarrhena pubescens</i> Wall. ex G.Don | ENVFMU -0752 | Pita Keruan | Tree | Root | Root paste is taken for stomach pain. Decoction of root extracts is used to treat dysentery. | 40 | 14 | 0.83 | 0.29 |
| | <i>Plumeria alba</i> L. | ENVFMU -0684 | Katha Champa | Tree | Flower | A brew made from blossoms is used to relieve constipation, dysentery and acute enteritis. | 13 | 4 | 0.27 | 0.08 |
| | <i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz | ENVFMU -0698 | Patal Goruda | Shrub | Root | Roots are used to treat diarrhoea, dysentery, cholera, and to expel intestinal worms. | 30 | 8 | 0.62 | 0.16 |
| Arecaceae | <i>Areca catechu</i> L. | ENVFMU -0527 | Gua | Tree | Seed | The seed is beneficial to promote digestion. It is also capable of reducing burning sensations in the GI tract due to acidity. | 8 | 3 | 0.16 | 0.06 |
| Asparagaceae | <i>Agave angustifolia</i> Haw. | ENVFMU -0510 | Baramasi | Shrub | Leaf | The sap is used for digestive troubles and to prevent bacterial infections in the stomach. Root infusions are used to treat dysentery. | 6 | 2 | 0.12 | 0.04 |

| | | | | | | | | | | |
|----------------|--|-----------------|--------------|---------|-------------|---|----|----|------|------|
| | <i>Asparagus racemosus</i> Willd. | ENVFMU -0532 | Satabari | Shrub | Root | Root extract is used for stomach pain, vomiting and loose motion. | 18 | 4 | 0.37 | 0.08 |
| Asphodelaceae | <i>Aloe vera</i> (L.) Burm.f. | ENVFMU -0515 | Gheekuanri | Herb | Leaf | Gel is beneficial for easing constipation. The gel is applied to the belly to neutralise the body temperature to check for fever due to indigestion. | 12 | 3 | 0.25 | 0.06 |
| Asteraceae | <i>Ageratum conyzoides</i> L. | ENVFMU -0511 | Pokasunga | Herb | Leaf | Tea made from the leaves is administered to treat both dysentery and diarrhoea. | 19 | 6 | 0.39 | 0.12 |
| Basellaceae | <i>Basella alba</i> L. | ENVFMU -0538 | Poi | Climber | Leaf | Leaves have been used to check stomach ulcers due to acidity. | 33 | 12 | 0.68 | 0.25 |
| Boraginaceae | <i>Trichodesma indicum</i> (L.) Sm. | ENVFMU -0769 | Hatisundha | Herb | Whole plant | Plant paste is given to cure a stomachache caused by a lack of appetite. | 7 | 3 | 0.14 | 0.06 |
| Brassicaceae | <i>Brassarda juncea</i> (L.) Su Liu & Z.H. Feng | ENVFMU -0548 | Rai Sorisha | Herb | Seed | The seeds are useful for the treatment of nausea caused by indigestion. The oil is applied to the forehead to get relief from a headache caused by indigestion. | 16 | 8 | 0.33 | 0.16 |
| Bromeliaceae | <i>Ananas comosus</i> var. <i>comosus</i> | ENVFMU -0519 | Sapuri | Herb | Root | The root is used to treat cholera. It is also used to stimulate appetite. | 11 | 5 | 0.22 | 0.10 |
| Cannaceae | <i>Canna indica</i> L. | ENVFMU -0555 | Sarbajaya | Herb | Root | The root powder is utilised against dysentery caused by food poisoning. | 24 | 10 | 0.5 | 0.20 |
| Capparaceae | <i>Capparis zeylanica</i> L. | ENVFMU -0556 | Asadua | Shrub | Root | The decoction of the root is effective against vomiting and helps improve appetite. | 18 | 6 | 0.37 | 0.12 |
| Combretaceae | <i>Combretum indicum</i> (L.) DeFilipps | ENVFMU -0697 | Madhu Malati | Climber | Seed, | A brew made from the seeds is administered to expel parasitic worms and to provide relief from diarrhoea. Leaf liquid is consumed to reduce flatulence. | 9 | 2 | 0.18 | 0.04 |
| | <i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn. | ENVFMU -0723 | Arjuna | Tree | Bark | Bark is used as medicine for dysentery and bloody diarrhoea. | 37 | 13 | 0.77 | 0.27 |
| | <i>Terminalia bellirica</i> (Gaertn.) Roxb. | ENVFMU -0724 | Bahada | Tree | Fruit | Fruit powder is used to treat stomach pain. It promotes digestion. It acts as an ingredient in Triphala, which is used to cure all types of gastrointestinal disorders. | 33 | 10 | 0.68 | 0.20 |
| | <i>Terminalia catappa</i> L. | ENVFMU -0725 | Katha Badam | Tree | Bark | The bark infusion improves stomach problems and serves as an emetic for babies. | 14 | 4 | 0.29 | 0.08 |
| | <i>Terminalia chebula</i> Retz. | ENVFMU -0726 | Harida | Tree | Fruit | Dried fruit is used to treat constipation. It acts as an ingredient in Triphala, which is used to cure all types of gastrointestinal disorders. | 33 | 11 | 0.68 | 0.22 |
| Convolvulaceae | <i>Evolvulus alsinoides</i> (L.) L. | ENVFMU -0601 | Bichhamalia | Herb | Whole plant | Herb infusion is used to cure dysentery and check vomiting. | 10 | 7 | 0.20 | 0.14 |

| | | | | | | | | | | |
|------------------|---------------------------------------|-------------|--------------|---------|---------|--|----|----|------|------|
| Cyperaceae | <i>Cyperus rotundus</i> L. | ENVFMU-0580 | Mutha | Herb | Rhizome | Rhizomes or tubers are used to treat stomach disorders and digestive ailments. | 19 | 5 | 0.39 | 0.10 |
| Dipterocarpaceae | <i>Shorea robusta</i> C.F.Gaertn. | ENVFMU-0709 | Sal | Tree | Leaf | Leaf extract is given to check dysentery in both humans and animals. | 21 | 5 | 0.43 | 0.10 |
| Ebenaceae | <i>Diospyros melanoxylon</i> Roxb. | ENVFMU-0590 | Kendu | Tree | Fruit | The fruit helps treat stomach ailments, check loose motion and dehydration. | 34 | 9 | 0.7 | 0.18 |
| Euphorbiaceae | <i>Acalypha indica</i> L. | ENVFMU-0505 | Indramaricha | Herb | Root | The root decoction is used as a purgative, for stomach aches, and to relieve constipation, and burning sensation in the GI tract. | 23 | 8 | 0.47 | 0.16 |
| | <i>Croton bonplandianus</i> Baill. | ENVFMU-0575 | Ban maricha | Herb | Leaf | A brewed preparation produced from the leaves has been used for relieving intestinal parasites and other gastrointestinal ailments. | 8 | 3 | 0.16 | 0.06 |
| | <i>Jatropha curcas</i> L. | ENVFMU-0629 | Baigaba | Shrub | Leaf | The plant provides a remedy for diarrhoea and dysentery in Childs by the dermal mode of application. | 7 | 4 | 0.14 | 0.08 |
| | <i>Jatropha gossypifolia</i> L. | ENVFMU-0630 | Baigabo | Shrub | Bark | Bark paste is taken orally to cure dysentery caused by excess eating of nonveg. | 11 | 3 | 0.22 | 0.06 |
| | <i>Ricinus communis</i> L. | ENVFMU-0700 | Joda | Shrub | Seed | Oil is applied to the toe area to resolve constipation. | 15 | 5 | 0.31 | 0.10 |
| Fabaceae | <i>Butea monosperma</i> (Lam.) Kuntze | ENVFMU-0551 | Palasha | Tree | Bark | The bark is used to treat diarrhoea, dysentery, and intestinal spasms. | 28 | 12 | 0.58 | 0.25 |
| | <i>Cassia fistula</i> L. | ENVFMU-0560 | Sunari | Tree | Fruit | Its fruit pulp is used to treat stomach problems such as acid reflux. Fruit paste with water is applied to the dermal area for stomach pain. | 23 | 10 | 0.47 | 0.20 |
| | <i>Crotalaria retusa</i> L. | ENVFMU-0753 | Jhunjunia | Shrub | Seed | Seeds are used in treatments for stomach ulcers, dyspepsia and constipation. | 17 | 7 | 0.35 | 0.14 |
| | <i>Dalbergia latifolia</i> Roxb. | ENVFMU-0582 | Jadimari | Tree | Bark | The bark is employed to check blood dysentery and diarrhoea, and serves as a deworming agent. | 9 | 6 | 0.18 | 0.12 |
| | <i>Dalbergia volubilis</i> Roxb. | ENVFMU-0754 | Nubardi | Shrub | Bark | Bark juice is prescribed for an ulcer in the stomach and dyspepsia. | 12 | 7 | 0.25 | 0.14 |
| | <i>Entada rheedei</i> Spreng. | ENVFMU-0758 | Badagilo | Climber | Bark | Bark powder is taken to cure a burning sensation in the stomach and GI tract. | 19 | 7 | 0.39 | 0.14 |
| | <i>Guilandina bonduc</i> L. | ENVFMU-0768 | Gilo | Shrub | Seed | Seed paste is given for stomach ulcer and deworming agent. | 22 | 9 | 0.45 | 0.18 |

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|---------------|---|--------------|---------------|-------|-------|--|----|----|------|------|
| | <i>Indigofera cassioides</i> Rottler ex DC. | ENVFMU -0621 | Giliri | Shrub | Root | Root powder is mixed with water to treat diarrhoea and gastroparesis. It is also used to treat stomach aches and dyspepsia. | 16 | 6 | 0.33 | 0.12 |
| | <i>Pithecellobium dulce</i> (Roxb.) Benth. | ENVFMU -0681 | Bilati Kaina | Tree | Leaf | Bark extracts alleviate a variety of chronic disorders, such as constipation, diarrhoea, and dysentery. The leaf extract mixed with cold water is employed against indigestion and to treat gall bladder issues. | 16 | 5 | 0.33 | 0.10 |
| | <i>Saraca asoca</i> (Roxb.) W.J.de Wilde | ENVFMU -0756 | Ashok | Tree | Bark | Bark decoction is an efficacious remedy for dysentery. | 31 | 13 | 0.64 | 0.27 |
| | <i>Senegalia pennata</i> (L.) Maslin | ENVFMU -0707 | Dantari | Shrub | Leaf | The leaf is consumed to hinder both indigestion and vomiting. | 24 | 11 | 0.5 | 0.22 |
| | <i>Tamarindus indica</i> L. | ENVFMU -0721 | Tentuli | Tree | Fruit | The fruit pulp is ingested to alleviate excess stomach acid and fevers. Seed powder is administered as a remedy for diarrhoea and dysentery. | 18 | 12 | 0.37 | 0.25 |
| | <i>Xylia xylocarpa</i> (Roxb.) W.Theob. | ENVFMU -0757 | Tangini | Tree | Fruit | Fruits are used for digestion and to check constipation. | 8 | 3 | 0.16 | 0.06 |
| Lamiaceae | <i>Gmelina arborea</i> Roxb. ex Sm. | ENVFMU -0611 | Gambhari | Tree | Root | Roots are utilised to combat a wide array of illnesses due to stomach distress, piles, and abdominal pain. | 13 | 3 | 0.27 | 0.06 |
| | <i>Mentha spicata</i> L. | ENVFMU -0651 | Pudina | Herb | Leaf | Leaves are used to treat flatulence, bloating, nausea, and indigestion. It acts as a carminative, relaxing the stomach muscles to relieve cramping. | 32 | 19 | 0.66 | 0.39 |
| | <i>Ocimum basilicum</i> L. | ENVFMU -0668 | Dayana Tulasi | Herb | Leaf | Fresh leaf juice is used to treat stomach cramps, flatulence, and dysentery. Seeds act as a natural laxative to relieve constipation and are used to treat acidity and heartburn. | 15 | 10 | 0.31 | 0.20 |
| | <i>Tectona grandis</i> L.f. | ENVFMU -0722 | Saguan | Tree | Bark | To aid digestion and minimise bilious headaches, a wood tar paste is consumed by mixing with hot water to check for loose motion. | 12 | 4 | 0.25 | 0.08 |
| Lauraceae | <i>Litsea glutinosa</i> (Lour.) C.B.Rob. | ENVFMU -0641 | Jaysandha | Tree | Bark | It is a conventional therapy for several kinds of gastrointestinal maladies, including indigestion, abdominal pain, gastroenteritis, and diarrhoea. | 9 | 2 | 0.18 | 0.04 |
| Lecythidaceae | <i>Barringtonia acutangula</i> (L.) Gaertn. | ENVFMU -0759 | Hingala | Tree | Leaf | Leaf juice is given for diarrhoea, dysentery and blood loss orally. | 17 | 6 | 0.35 | 0.12 |
| | <i>Careya arborea</i> Roxb. | ENVFMU -0557 | Kumbhi | Tree | Bark | Bark layer is used for the treatment of peptic ulcer. | 14 | 5 | 0.29 | 0.10 |

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|----------------|--|-----------------|-------------|---------|-------|--|----|----|------|------|
| Lythraceae | <i>Lawsonia inermis</i> L. | ENVFMU -0634 | Mehendi | Shrub | Leaf | Leaf paste is given with water to cool the stomach during acidity. | 41 | 22 | 0.85 | 0.45 |
| | <i>Punica granatum</i> L. | ENVFMU -0760 | Dalimba | Tree | Fruit | The pulp of the fruit is utilised to stimulate digestive health. | 39 | 18 | 0.81 | 0.37 |
| Malvaceae | <i>Abutilon indicum</i> (L.) Sweet | ENVFMU -0695 | Pedipedika | Shrub | Root | Root paste is given once a day for 3 days to treat blood dysentery. | 23 | 7 | 0.47 | 0.14 |
| | <i>Gossypium hirsutum</i> L. | ENVFMU -0612 | Kapa | Shrub | Leaf | A decoction of the leaves is taken to get rid of intestinal pain and constipation. | 11 | 4 | 0.22 | 0.08 |
| | <i>Hibiscus rosa-sinensis</i> L. | ENVFMU -0617 | Mandar | Shrub | Leaf | Leaf paste is given to cool the stomach. | 14 | 5 | 0.29 | 0.10 |
| | <i>Triumfetta rhomboidea</i> Jacq. | ENVFMU -0761 | Tatatatia | Shrub | Root | Powder of dry roots is given for 3 days to treat dysentery and swelling in the GI tract. | 6 | 2 | 0.12 | 0.04 |
| Meliaceae | <i>Azadirachta indica</i> A.Juss. | ENVFMU -0535 | Limba | Tree | Bark | The bark is employed against gastrointestinal ulcers and pain. | 15 | 10 | 0.31 | 0.20 |
| Menispermaceae | <i>Tinospora cordifolia</i> (Willd.) Hook.f. & Thomson | ENVFMU -0729 | Guluchilata | Climber | Root | The roots are used as a powerful emetic and for treating intestinal obstructions. | 21 | 13 | 0.43 | 0.27 |
| Moraceae | <i>Artocarpus heterophyllus</i> Lam. | ENVFMU -0531 | Panasa | Tree | Root | Liquid prepared by boiling roots to treat conditions like diarrhoea. | 12 | 5 | 0.25 | 0.10 |
| | <i>Ficus religiosa</i> L. | ENVFMU -0605 | Aswastta | Tree | Leaf | The leaves possess mild laxative properties. The juice or a decoction of the leaves is often used for bowel regulation. | 17 | 8 | 0.35 | 0.16 |
| | <i>Streblus asper</i> Lour. | ENVFMU -0716 | Sahada | Tree | Bark | The bark is used for constipation. | 26 | 16 | 0.54 | 0.33 |
| Musaceae | <i>Musa balbisiana</i> Colla | ENVFMU -0661 | Kadali | Tree | Fruit | Fruits are used to cure diabetes and diarrhoea. | 29 | 19 | 0.6 | 0.39 |
| Myrtaceae | <i>Syzygium cumini</i> (L.) Skeels | ENVFMU -0718 | Jamu | Tree | Bark | Bark powder mixed with milk is taken orally to cure dysentery. | 23 | 19 | 0.47 | 0.39 |
| Oleaceae | <i>Nyctanthes arbor-tristis</i> L. | ENVFMU -0666 | Gangasiuli | Tree | Leaf | The fresh juice of leaves, administered with a pinch of salt or honey, acts as a powerful anthelmintic (especially for children). | 42 | 24 | 0.87 | 0.5 |
| Oxalidaceae | <i>Oxalis corniculata</i> L. | ENVFMU -0673 | Ambiliti | Herb | Leaf | The fresh juice of the leaves is frequently used to manage chronic diarrhoea and dysentery. It is known to improve appetite and aid in digestion, often used to treat dyspepsia. | 20 | 9 | 0.41 | 0.18 |

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|----------------|---|-------------|--------------|---------|-------------|--|----|----|------|------|
| Pandanaceae | <i>Pandanus odorifer</i> (Forssk.) Kuntze | ENVFMU-0674 | Kia | Shrub | Bark | The boiling of bark is utilised to alleviate dysentery and diarrhoea. | 14 | 8 | 0.29 | 0.16 |
| Plantaginaceae | <i>Plantago ovata</i> Forssk. | ENVFMU-0682 | Isabagul | Herb | Seed | The seeds are utilised for curing constipation, diarrhoea, haemorrhoids, and high blood loss in piles. | 9 | 5 | 0.18 | 0.10 |
| Piperaceae | <i>Peperomia pellucida</i> (L.) Kunth | ENVFMU-0676 | Ghusuri Pan | Herb | Leaf | Leaf sap is utilised to combat stomach problems. | 11 | 3 | 0.22 | 0.06 |
| | <i>Piper nigrum</i> L. | ENVFMU-0679 | Gola Maricha | Climber | Fruit | The dried berries help in improving digestion by stimulating saliva secretion. | 17 | 7 | 0.35 | 0.14 |
| Poaceae | <i>Bambusa tulda</i> Roxb. | ENVFMU-0537 | Baunsa | Tree | Bark | The young shoots are very useful in reducing fat in the stomach and digestive disorders. | 10 | 4 | 0.2 | 0.08 |
| | <i>Chrysopogon aciculatus</i> (Retz.) Trin. | ENVFMU-0762 | Guguchia | Herb | Root | The root is used to alleviate excess loose motion. | 13 | 4 | 0.27 | 0.08 |
| Phyllanthaceae | <i>Antidesma acidum</i> Retz. | ENVFMU-0525 | Nunnunia | Tree | Leaf | The leaves are utilised in traditional healing practices for pediatric stomach issues. | 12 | 5 | 0.25 | 0.10 |
| | <i>Bridelia retusa</i> (L.) A.Juss. | ENVFMU-0549 | Kasi | Tree | Bark | Bark is used in the treatment of indigestion. | 8 | 3 | 0.16 | 0.06 |
| | <i>Phyllanthus emblica</i> L. | ENVFMU-0763 | Anla | Tree | Fruit | Amla is widely used to treat gastritis and peptic ulcers. The dried fruit is used to treat chronic constipation and to regulate bowel movements. | 43 | 25 | 0.89 | 0.52 |
| | <i>Phyllanthus lanceolarius</i> (Roxb.) Müll.Arg. | ENVFMU-0774 | Kalachua | Shrub | Bark | Bark powder, along with rice wash water, is taken to cure diarrhoea. | 13 | 5 | 0.27 | 0.10 |
| | <i>Phyllanthus urinaria</i> L. | ENVFMU-0777 | Bhuin anla | Herb | Whole plant | Plant decoction is given twice a day for 3 days in dysentery. | 30 | 17 | 0.62 | 0.35 |
| Polygonaceae | <i>Persicaria hydropiper</i> (L.) Delarbre | ENVFMU-0772 | Panimaricha | Herb | Whole plant | Whole plant paste is taken orally for stomach pain. | 11 | 5 | 0.22 | 0.10 |
| Pontederiaceae | <i>Pontederia vaginalis</i> Burm.f. | ENVFMU-0779 | Mirmira | Herb | Leaf | Leaf paste is given for constipation and piles. | 16 | 5 | 0.33 | 0.10 |
| Rhamnaceae | <i>Ziziphus nummularia</i> (Burm.f.) Wight & Arn. | ENVFMU-0750 | Jaguli Koli | Tree | Bark | The boiled liquid form of bark has been ingested to combat dysentery. | 19 | 9 | 0.39 | 0.18 |
| | <i>Ziziphus oenopolia</i> (L.) Mill. | ENVFMU-0751 | Kantei Koli | Shrub | Bark | The bark serves as an effective mouthwash for sore throats and is administered to combat diarrhoea and uterine discomfort. | 18 | 11 | 0.37 | 0.22 |

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|--------------|--|-------------|-------------|-------|--------|---|----|----|------|------|
| Rubiaceae | <i>Adina cordifolia</i> (Roxb.) Hook.f. & Benth. | ENVFMU-0765 | Kuruma | Tree | Root | The roots are boiled with goat milk and consumed to prevent dysentery. | 11 | 7 | 0.22 | 0.14 |
| | <i>Neolamarckia cadamba</i> (Roxb.) Bosser | ENVFMU-0524 | Kadamba | Tree | Flower | The flowers are utilised to treat dysentery, stomach cramps, and acidity. | 19 | 13 | 0.39 | 0.27 |
| | <i>Catunaregam spinosa</i> (Thunb.) Tirveng. | ENVFMU-0764 | Palova | Tree | Bark | Bark paste is taken for diarrhoea and dysentery. | 10 | 6 | 0.20 | 0.12 |
| | <i>Morinda pubescens</i> Sm. | ENVFMU-0658 | Achhu | Tree | Fruit | The fruit extract is used to treat various ailments, including gastric ulcers, arthritis, cancer, and other heart diseases. | 33 | 19 | 0.68 | 0.39 |
| | <i>Pavetta indica</i> L. | ENVFMU-0773 | Machharanka | Shrub | Root | Roots are soaked in water and given for 2 days in the treatment of blood dysentery. | 12 | 10 | 0.25 | 0.20 |
| | <i>Psychotria adenophylla</i> Wall. | ENVFMU-0692 | Chelianthua | Shrub | Leaf | Leaves are frequently employed in folk medicines to treat several kinds of digestive tract problems, including stomachache and ulcers. | 9 | 7 | 0.18 | 0.14 |
| Rutaceae | <i>Aegle marmelos</i> (L.) Corrêa | ENVFMU-0509 | Bela | Tree | Leaf | Powdered leaf is used to treat chronic diarrhoea and irritation of the alimentary canal. It helps in cleaning and toning the intestines. An infusion of the leaves is traditionally used to treat gastric ulcers. | 45 | 37 | 0.93 | 0.77 |
| | <i>Citrus medica</i> L. | ENVFMU-0568 | Lembu | Tree | Fruit | The fruit treats gastrointestinal problems like acidity. It also checks vomiting. | 37 | 30 | 0.77 | 0.62 |
| | <i>Limonia acidissima</i> L. | ENVFMU-0775 | Kaitha | Tree | Fruit | The ripened fruits give relief from vomiting. The dried fruit has been employed to alleviate digestive problems and excess bile in adolescents. | 15 | 9 | 0.31 | 0.18 |
| Salicaceae | <i>Homalium napaulense</i> (DC.) Benth. | ENVFMU-0766 | Kuphre | Tree | Bark | Bark paste is given for stomachaches and to reduce appetite. | 9 | 6 | 0.18 | 0.12 |
| Sapotaceae | <i>Mimusops elengi</i> L. | ENVFMU-0655 | Baula | Tree | Fruit | The fruit pulp decoctions are used to treat chronic diarrhoea and irritation of the bowels. | 34 | 20 | 0.70 | 0.41 |
| Smilacaceae | <i>Smilax zeylanica</i> L. | ENVFMU-0711 | Muturi | Shrub | Root | The roots are occasionally used to treat severe stomach pain and dysentery. It also checks the irritation due to stomach pain. | 13 | 4 | 0.27 | 0.08 |
| Symplocaceae | <i>Symplocos cochinchinensis</i> (Lour.) S.Moore | ENVFMU-0776 | Ledha | Tree | Leaf | Leaves decoction is taken for stomach pain. It is also used to check indigestion due to consuming milk products. | 17 | 4 | 0.35 | 0.08 |

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|---------------|--|-----------------|-------------|---------|---------|--|----|----|------|------|
| | <i>Symplocos racemosa</i> Roxb. | ENVFMU -0778 | Ledha | Tree | Root | Root is powdered with water and given to treat stomach pain. | 14 | 6 | 0.29 | 0.12 |
| Ulmaceae | <i>Holoptelea integrifolia</i> (Roxb.) Planch. | ENVFMU -0767 | Dhauranga | Tree | Bark | Bark is warmed and kept on the dermal regions near the stomach for pain relief. | 9 | 4 | 0.18 | 0.08 |
| Vitaceae | <i>Cyphostemma auriculatum</i> (Roxb.) P.Singh & B.V.Shetty | ENVFMU -0755 | Kanjikanjia | Climber | Root | The root is used in decoctions against constipation and blood dysentery. | 11 | 5 | 0.22 | 0.10 |
| Zingiberaceae | <i>Zingiber officinale</i> Roscoe | ENVFMU -0747 | Ada | Herb | Rhizome | The rhizome has been utilised to check acidity, painful stomach cramps, promote digestion, and prevent stomach ulcers. | 43 | 31 | 0.89 | 0.64 |

Table 3. Family use value of different plant families

| Family Name | Number of Species | ΣUV | FUV |
|------------------|-------------------|-------------|------|
| Acanthaceae | 2 | 1.1 | 0.55 |
| Amaranthaceae | 1 | 0.27 | 0.27 |
| Anacardiaceae | 1 | 0.45 | 0.45 |
| Annonaceae | 1 | 0.14 | 0.14 |
| Apiaceae | 1 | 0.6 | 0.6 |
| Apocynaceae | 6 | 3.33 | 0.56 |
| Arecaceae | 1 | 0.16 | 0.16 |
| Asparagaceae | 2 | 0.49 | 0.25 |
| Asphodelaceae | 1 | 0.25 | 0.25 |
| Asteraceae | 1 | 0.39 | 0.39 |
| Basellaceae | 1 | 0.68 | 0.68 |
| Boraginaceae | 1 | 0.14 | 0.14 |
| Brassicaceae | 1 | 0.33 | 0.33 |
| Bromeliaceae | 1 | 0.22 | 0.22 |
| Cannaceae | 1 | 0.5 | 0.5 |
| Capparaceae | 1 | 0.37 | 0.37 |
| Combretaceae | 5 | 2.6 | 0.52 |
| Convolvulaceae | 1 | 0.2 | 0.2 |
| Cyperaceae | 1 | 0.39 | 0.39 |
| Dipterocarpaceae | 1 | 0.43 | 0.43 |
| Ebenaceae | 1 | 0.7 | 0.7 |
| Euphorbiaceae | 5 | 1.3 | 0.26 |
| Fabaceae | 13 | 5 | 0.38 |
| Lamiaceae | 4 | 1.49 | 0.37 |
| Lauraceae | 1 | 0.18 | 0.18 |
| Lecythidaceae | 2 | 0.64 | 0.32 |
| Lythraceae | 2 | 1.66 | 0.83 |
| Malvaceae | 4 | 1.1 | 0.28 |
| Meliaceae | 1 | 0.31 | 0.31 |
| Menispermaceae | 1 | 0.43 | 0.43 |
| Moraceae | 3 | 1.14 | 0.38 |
| Musaceae | 1 | 0.6 | 0.6 |
| Myrtaceae | 1 | 0.47 | 0.47 |
| Oleaceae | 1 | 0.87 | 0.87 |
| Oxalidaceae | 1 | 0.41 | 0.41 |
| Pandanaceae | 1 | 0.29 | 0.29 |
| Plantaginaceae | 1 | 0.18 | 0.18 |
| Piperaceae | 2 | 0.57 | 0.29 |
| Poaceae | 2 | 0.47 | 0.24 |
| Phyllanthaceae | 5 | 2.19 | 0.44 |
| Polygonaceae | 1 | 0.22 | 0.22 |
| Pontederiaceae | 1 | 0.33 | 0.33 |
| Rhamnaceae | 2 | 0.76 | 0.38 |
| Rubiaceae | 6 | 1.92 | 0.32 |
| Rutaceae | 3 | 2.01 | 0.67 |
| Salicaceae | 1 | 0.18 | 0.18 |
| Sapotaceae | 1 | 0.7 | 0.7 |
| Smilacaceae | 1 | 0.27 | 0.27 |
| Symplocaceae | 2 | 0.64 | 0.32 |
| Ulmaceae | 1 | 0.18 | 0.18 |
| Vitaceae | 1 | 0.22 | 0.22 |
| Zingiberaceae | 1 | 0.89 | 0.89 |

The deviation observed in the findings of Shende (2024), Mir *et al.* (2021) and Khoja *et al.* (2022) in comparison with the findings of the present study may be not only due to the difference in the geographical location and climatic condition, but also due to the different approach of collection of ethnomedicinal information, difference sampling strategy and difference in the time period of investigation.

While comparing the findings of the present investigation with the similar studies in the global scenario, in the neighbouring country Nepal, Thapa *et al.* (2013) reported 43 plant species belonging to the 40 genera and 29 families for the treatment of gastrointestinal diseases by the Raji ethnic community of Nepal. However, their study was based on data collection from 32 households with semi-structured questionnaires and group discussion, but in the present, purposive sampling methods were adopted to select traditional healers and investigate 48 informants, who are actively engaged in different ethnomedicinal practices. Apart from that, the ethnobotanical surveys were conducted through standard questionnaires in group discussions.

The study of Kacholi *et al.* (2024) in the Tabora region of Tanzania provides ethnomedicinal information about 64 traditional medicinal plants belonging to the 33 families for the treatment of gastrointestinal diseases from 108 traditional health practitioners. Interestingly, the findings of both studies confirm that the family Fabaceae is the predominant family in their studies. The FUV of Zinziberaceae is highest (0.89) in the Balasore district, whereas 1.016 in their observation, although both studies documented a single species under the family Zinziberaceae, i.e., *Zingiber officinale*. Similarly, 25 species belonging to 16 families were found to be used against gastrointestinal complaints by the Kaili Ledo ethnic group in Central Sulawesi, Indonesia, by Pitopang *et al.* (2024), with the most dominant family, Lamiaceae, with 3 species. But in the present observation, the family Lamiaceae is represented by 4 species.

In the present study, both UV and RFC are highest in the case of *Aegle marmelos*, with a score of 0.93 and 0.77 for UV and RFC, respectively. Scientifically, it was proven that the *Aegle marmelos* is capable of treating inflammatory bowel diseases (IBD) by Shah and Solanki (2025). Their studies are based on the in-silico approach, molecular docking, and enrichment analysis to uncover the potential multicomponent synergistic effect as well as its molecular mechanism for the treatment of Inflammatory bowel diseases. Through CytoHubba, they identified AKT1, SRC, MAPK3, MAPK1, EGFR, IL6, TNF, HSP90AA1 and CASP3 as the top 10 hub targets, which may contribute to the mechanistic role of *Aegle marmelos* for the treatment of IBD. Likewise, Joshi *et al.* (2024) observed that the Hexane fraction of the leaf extract of *Aegle marmelos* was found to possess volatile oils, polyphenols, and tannins, while other fractions were found to have alkaloids, terpenoids, coumarins, flavonoids, glycosides, saponins, and reducing sugars. Further analysis of the hexane fraction identified 21 compounds with over 90 % accuracy. Although their studies show the antidiabetic, antibacterial and antioxidant activities, further studies are necessary to investigate its gastrointestinal disease-curing properties.

Some other important plants reported in the present study are *Azadirachta indica*, *Phyllanthus emblica* (Previously known as *Embllica officinalis*) and *Tinospora Cordifolia* for the treatment of gastrointestinal diseases, the ethnomedicinal utilities followed by Phytochemical analysis of these plants were performed by Behera & Nayak (2023) and noticed that the extract of these plants contains Alkaloids, Flavonoid, Terpenoids, Glycoside and Tannins in the fractions prepared from different solvents. These diverse groups of bioactive compounds may have some potency for disease treatment, which needs further pharmacological validation.

In the current study, several lesser-known plants are documented, which are frequently used by the ethnic community and local forest dwellers. These should be given immediate attention for conservation by various methods, such as in situ and ex situ conservation, tissue culture, and other biotechnological methods. Rare, Endangered, and Vulnerable plant species, such as *Rauvolfia serpentina* and *Saraca asoca*, are also reported in the present study area, which is why they require special conservation efforts from policymakers and conservation biologists regarding biodiversity conservation.

Apart from that, during the field study, it was noticed that many rural and indigenous populations use some of the plants mentioned in the above dataset in their daily life. Widespread selling of such plant materials acts as a source of income for the persons involved in its commercialisation. The major tribal population believes that supernatural powers are the primary cause of ailments and seeks treatments through magico-religious acts in addition to employing plant medicines. Some lesser-known beliefs include wearing the root of a plant on one arm to relieve diseases, worshipping plants for better health, and carrying the roots to increase immune powers against diseases, which shows the ritual significance of plants along with their medicinal utilities. The result obtained in the study may be used by the pharmaceutical industry to carry out further research and to identify some important leads for modern drug development programs. These ethnic communities incorporate the plants into their medical practices, which are reinforced by profound spiritual conviction.

Conclusion

Ethnobotanical investigation with special reference to the plants used in the treatment of gastrointestinal disorders in the different regions of Balasore district reveals that people of various tribal groups have a repository of rich indigenous

knowledge, utilising various plants as medicine to cure a wide spectrum of gastrointestinal diseases. Documentation of the rich indigenous knowledge in proper form should be done for their use in the modern system of medicine. Constipation, vomiting, loose motion, diarrhoea, nausea, burning sensation in the GI tract, and stomachache were the most common illnesses reported in this region. Various plant-based remedies are used by the local population for the treatment of these diseases. The most commonly utilised plant parts were leaves, followed by the bark and root. This area is endowed with rich medicinal plant diversity. Due to urbanisation and deforestation, the flora of this region, particularly its valuable medicinal plants, is facing severe threats from biotic pressures. Instead of valuable information, the present study lacks the detection of bioactive compounds as well as pharmacological validations. Hence, further studies regarding the scientific validation of this ethnomedicinal information by phytochemical screening and detection of bioactive compounds are necessary for the sustainable management of plant-based medicinal resources of Balasore district. Biotechnological approaches like tissue culture and mass propagation are necessary for the conservation of the rare and endangered medicinal plant documented in the study area, which will be beneficial for human society.

Declarations

Ethics approval and consents to participate: Before conducting the ethnobotanical study in Balasore district, oral informed consent was taken from each informant.

Consent for publication: All people shown in images gave their consent to have their image published.

Availability of data and material: Not applicable

Funding: Not applicable

Conflict of interest: The authors declare that there are no conflicts of interest.

Author Contribution: Sanjay Kumar Behera: Conception of the work, carried out the survey and collected the data. Abinash Sahoo: Drafting of the manuscript, analysis, referencing, and interpretation of the data. Keshari Prasad Mohanty: Data interpretation, Quantitative data analysis, Manuscript formatting and editing, Review editing. Adarsha Pradhan: Reference validation and interpretation of data. Debasish Patra: Drafting of the manuscript and figure preparation. Ranindra Kumar Nayak: Study conception, design and supervision of the work, formal analysis, Manuscript editing and Review editing. All authors read and approved the final manuscript.

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