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Ethnobotanical survey of medicinal plants used for the treatment of diarrhoea and dysentery by the tribals of Similipal forest, Mayurbhanj, Odisha, India

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A B S T R A C T

Traditional uses of medicinal plants in healthcare practices are providing clues to new areas of research; hence their importance is now well recognized. However, information on the uses of indigenous plants for medicine is not well documented from many rural pockets of Mayurbhanj district, Odisha, India including Similipal forest. The study focuses on presenting the therapeutic effects of selected plants that are used by the local people in relation to diarrhea and dysentery. Questionnaire surveys, participatory observations and field visits are made to elicit information on the uses of various plants. About 47 plant species belonging 45 genera and 33 families are used by the tribals of Similipal forest for diarrhoea and dysentery. The most cited species for the management of diarrhoea and dysentery are Acorus calamus L., Aegle marmelos (L.) Correa., Centella asiatica (L.) Urb., Curculigo orchioides Gaertn., Emblica officinalis Gaertn., Oroxylum indicum (L.)Vent., Syzygium cumini (L.) Skeels. and Terminalia bellerica (Gaertn.) Roxb. Research is needed to meet the challenges of identifying the active compounds in the plants, and there should be research-based evidence on whether whole herbs or extracted compounds are better. The potent antimicrobial activity on these medicinally important species is warranted.

Key words: *Folk medicine, , Diarrhoea, Dysentery, Primary health care*

Introduction

Diarrhea is said to be an endemic disease in many of developing Asian countries, considered one of the major public health concern that leads epidemic cause of high degree of morbidity and mortality in rural communities (Synder and Merson, 1982). It is one of the most common diseases for all age groups with a symptom of having three or more loose or liquid bowel movements per day or more frequently than normal for the individual and a decrease in the absorption of fluid and thus a loss of electrolytes particularly Na^+ and water (Rang et al. 2003).Acute diarrheal diseases rank second among all infectious diseases, as a killer in 0 to 5 years age group (Dalal et al. 2011).Diarrhea is a condition of gastrointestinal infection, which can be caused by a variety of bacterial, viral and parasitic organisms and infection spreads through contaminated food or drinking water, or from person to person as a result of poor hygiene (WHO 2015). But, dysentery is an intestinal inflammation causing frequent passage of faces with mucus and blood. Vomiting and fever may accompany it; there may be abdominal cramps and pain on defecation. There is increasing recognition of wide array of enteric pathogens associated with dysentery namely, Shigella sp., Salmonella sp., Vibrio parahaemolyticus, Campylobacter, Yersinia and Entamoeba histolytica. Shigella sp. (bacillary dysentery) and Entamoeba histolytica (amoebic dysentery) are most often cause for dysentery in which the loose or watery stools contain visible red blood. Amoebic dysentery is more severe than bacillary dysentery (Kar and Borthakur 2008).

The available antimicrobial synthetic drugs are often ineffective as the causative organisms are increasingly turning resistant. So, a search for new and safe drug is on. One potential source for the development of new drug is plants. The history of the use of botanicals in medicines is as old as humans have inhabited this planet. In search of rescue from various diseases,

the people explored the nature by trial and error to find medications to alleviate pain and cure from different illnesses. Medicine men or "Vaidya" in primitive societies learned the art of medicinal plant selection. There are many different systems of traditional medicine and the philosophy and practices of each are influenced by the prevailing conditions, environment, and geographic area within which it first evolved (WHO 2005).Some of these, such as Tibetan traditional medicine, remain relatively localised in their country of origin; while others such as Ayurvedic and Chinese traditional medicines are increasingly used in many different areas of the world. In every period, every successive century from the development of humankind and advanced civilizations, the healing properties of certain medicinal plants are identified, noted, and conveyed to the successive generations. The benefits of one society are passed on to another, which upgraded the old properties, discovered new ones, till present days. Over the past 100 years, the development and mass production of chemically synthesized drugs have revolutionized health care in most parts of the word. However, in most of the world countries, especially those in the African continent, Asia and South and Central America, large sections of the population (roughly 80%) still relies to a great extent on herbal and natural products of folk medicine for their primary health care. The use of traditional medicine is not limited to developing countries, and during the past two decades public interest in natural therapies has increased greatly in industrialized countries, with expanding use of ethnobotanicals. The most common reasons for using traditional medicine are that it is more affordable, more closely corresponds to the patient's ideology, allays concerns about the adverse effects of chemical (synthetic) medicines, satisfies a desire for more personalized health care, and allows greater public access to health information.

Plants are rich in a variety of compounds. About 200 years ago, the first pharmacologically active pure compound, morphine, is produced from opium extracted from seeds pods of the poppy Papaver somniferum. This discovery showed that drugs from plants can be purified and administered in precise dosages regardless of the source or age of the material (Rousseaux and Schachter 2003; Hartmann 2007). This approach is enhanced by the discovery of cardiac stimulant digoxin from foxglove (Digitalis purpurea); salicylic acid, a precursor of aspirin, derived from willow bark (Salix spp.); reserpine, an antipsychotic and antihypertensive drug from Rauwolfia spp.; and antimalarials such as quinine from Cinchona bark and lipid-lowering agents (e.g., lovastatin) from a fungus (Rishton 2008; Schmidt et al. 2008; Li and Vederas 2009). It is also estimated that about 25% of the drugs prescribed worldwide are derived from plants, and 121 such active compounds are in use (Sahoo et al. 2010). More than 100 natural product–based drugs are in clinical studies (Li and Vederas 2009), and of the total 252 drugs in the World Health Organization's (WHO) essential medicine list, 11% are exclusively of plant origin (Sahoo et al. 2010). Recently, the available global information on the ethnomedicinal has been compiled (Johnson 1999), and the ethinomedicinal plant for the treatment of dysentery and diarrheoa are studied in different parts of India (Sharma et al. 2010; Laloo and Hemalatha 2011; Shanmugam et al. 2011; Sarin and Bafna 2012; Gangte et al. 2013; Johnsy et al. 2013). Although, some studies have served to document ethnomedicinal plants used to treat various ailments in Mayurbhanj district of Odisha, India (Sarkar et al. 1999; Behera 2006; Kumar et al. 2006; Behera et al. 2008; Rout et al. 2010; Panda et al. 2011), not much information on ethnomedicinal study on antidysenteric/antidiarrhoeal exists. The present study investigates the therapeutic use of potential medicinal plants to treat diarrhoea and dysentery in the forest areas of Similipal Biosphere reserve of Mayurbhanj district, Odisha, India. Documentation of traditional ethnomedicinal knowledge, indigenous herbal preparation for diarrhoea and dysentery could help in preserving the knowledge and creating awareness regarding the need for conservation of biological resources.

Materials and Methods

Study area

The study was conducted for collection of ethnomedicinal information against diarrhoea and dysentery from the Similipal forest of Mayurbhanj district, Odisha, India. Similipal is a virgin subtropical forest with a mixture of South Indian, North Indian and Andaman species, because it experiences a tropical climate appropriate to support evergreen forest**.** The study area concentrates in and around the deep forest pockets of tribal villages which comes under Similipal Biosphere Reserve (20° 17' to 22° 34' North latitude and 85° 40' to 87° 10' East longitude) located in Mayurbhanj districts of northern Odisha, India (Fig.1). In Similipal Biosphere Reserve there are 4 villages inside the core area, 65 villages in the buffer zone and 1200 villages in the periphery with a population of 4.5 lakhs. Among the total population, tribal occupy 52% of it and 53 communities both aboriginal and migrated are found in the district glorifying the rich heritage of tribal culture. The area is inhabited by a number of aboriginal tribes like Santal, Kol, Bhomij, Bhuyan, Bathudi, Kharia, Gondo, Mankdias, Pauri-Bhuyan, Mahalis, Sounti and Souras. Some of these tribes, namely Kharias, Mankdias and Souras are still in primitive state of living. Agriculture is not well developed and therefore most of them depend solely on forests for catering their daily and perpetual need from food to medicine.

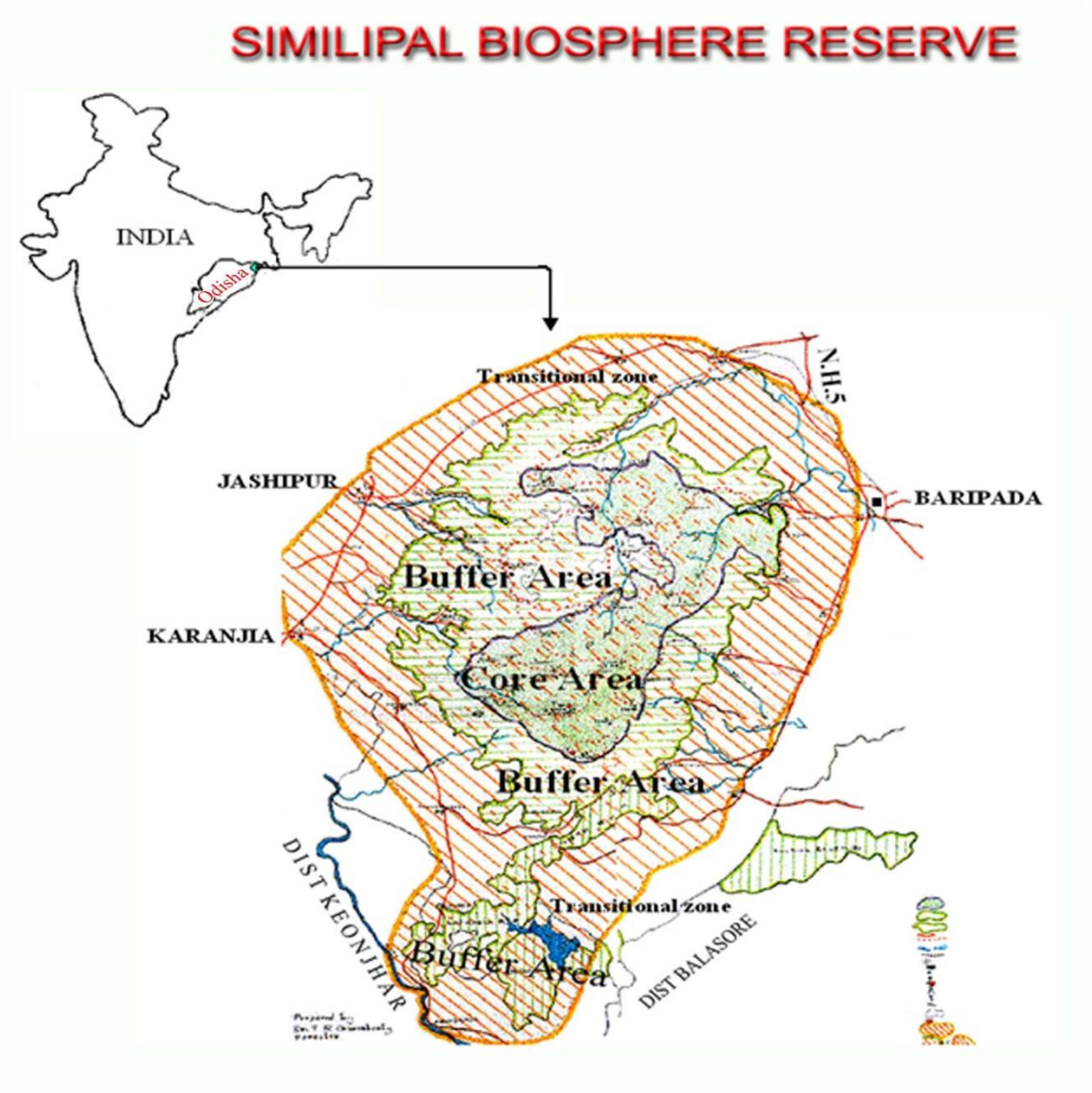

Fig. 1 . Map of the study site.

Since time immemorial the intimate association and dependence of the tribal communities on the local natural resources have empowered them with invaluable knowledge on bio-resource utilization and consequently they have developed extensive knowledge on various plants.

Data Collection

In Mayurbhanj district, phytotherapy are integral to the local culture. Information about plants and their uses is passed from generation to generation through oral folklore. Elderly people are the primarily natural retainers of traditional knowledge. In order to assess the consumption of indigenous medicinal plants, survey was carried out from 2012 to 2014 in Similipal forest. Data on the use of medicinal plants were obtained through structured questionnaires, complemented by unstructured interviews and informal conversations (Huntington 2000). The interviews were individually carried out with members of the local population. We interviewed "native specialists'', who were considered by their communities as having exceptional knowledge of the use of plants. Fifty three persons were interviewed. Knowledgeable persons or medicine men, Vaidya

(indigenous herbalist with hereditary practice), experienced aged rural folk, local herbal drug sellers were consulted to record local plant names, parts of plants used, methods of drug preparation and recommended doses. Personal interviews and group discussions with local inhabitants revealed some valuable and specific information about the plants that were authenticated by crosschecking. In addition to crosschecking and recording folk names of plants through collecting voucher specimens, it is important to crosscheck information with different people and compare the results from different methods (Cunningham 2001). The voucher specimen of plant species were identified by using standard floras and available literature (Haines 1925; Saxena and Brahmam 1996). The list of medicinal plants were depicted along with their botanical names followed by family, their local names in Odia , if any, and the parts used for medicinal purpose.

Results and Discussion

Plants are vital for existence of life on earth and have traditionally served as man's most important weapon against pathogens. Medicines derived from plants have played a pivotal role in the health care of many cultures, both ancient and modern (Balunas and Kinghorn 2005; Gurib-Fakim 2006; Newman and Cragg 2007). Having co-evolved with animal life, many natural products derived from the plants have pharmacological or biological activity that can be exploited in pharmaceutical drug discovery and drug design. During the present study 47 medicinal plant species belonging to 45 genera and 33 families has been reported to treat dysentery and diarrhea by the tribal community of Similpal forest of Mayurbhanj district, Odisha, India. In the enumeration all plant species are arranged with their family name followed by local name, parts used and mode of treatment (Table 1; Fig. 2). Euphorbiaceae is the dominant family with 4 species followed by Zingiberaceae (3 species), Mimosaceae, Rutaceae, Combretaceae, Menispermaceae, Verbenaceae, Fabaceae, Moraceae and Lygodiaceae with (2 species) and others with one species each. The most cited plant species are Acorus calamus L., Aegle marmelos (L.) Correa., Centella asiatica (L.) Urb., Curculigo orchioides Gaertn. Emblica officinalis Gaertn, Oroxylum indicum (L.) Vent., Syzygium cumini (L.) Skeels and Terminalia bellerica (Gaertn.) Roxb. Most of the plants used in the treatment are herbs (20 species) followed by trees (14 species), shrubs (9 species) and rarely climbers (4 species) [Fig.3]. Among the different plant parts used for the preparation of medicine, leaves (31.45%) are found to be the most frequently used plant parts followed by fruit and roots (16. 05%), stem bark (12.49%), whole plant (7.14%), seed (7.13%),flower (4.35%), gum (3.56) and rhizome (1.78%) (Table 1, Fig.4). The methods of preparation fall into 6 categories, viz., extract (36.79%), decoction (23.18%), cooked (14.28%), infusion (12.75%), raw (10.7%) and powder (3.56%) (Table 1, Fig.5).

The reported plant species have been fairly well accepted by a majority of tribal population in the study area for generations. Previous reports have also linked some of the plants encountered in the course of this survey with remedy of diarrhoea, and dysentery (Raju and Reddy 2005; Gupta et al. 2009; Laloo and Hemalatha 2011; Shanmugam et al. 2011; Gairola et al. 2013), however, in some cases, parts and methods of uses are different. For example, whole plant of Centella asiatica (L.) Urb. is used for dysentery and diarrhea by the tribes of Kameng district of Arunachal Pradesh (Kar and Borthakur 2008); roots of Ficus benghalensis L. are used for antidiarrhoeal activity by the people of West Bengal (Mukherjee et al. 2011); stem bark and leaves of Oroxylum indicum (L.) Vent. are used to cure dysentery and diarrhea by the tribes of Kameng district of Arunachal Pradesh (Kar and Borthakur,2008); bark powdered of Punica grantatum L. is given to cure diarrhea and dysenteryby the people of Kanyakumari forest division constitutes the southern tip of Western Ghats (Johnsy et al. 2013); bark of Syzygium cumini (L.) Skeels. is used for dysentery and diarrhoea by tribals of Jhabua District of Madhya Pradesh (Wagh et al. 2011); fruit powder of Terminalia bellirica (Gaertn.) Roxb. is used by the people of Kumaon Himalaya, Uttarakhand (Jeewan and Satish 2013); Leaf extract of Sida cordifolia L. is used by the tribals of Bankura Districts, West Bengal (Sinhababu and Banerjee 2013). Similarly, roots of Adhatoda zeylanica Medik. are used to treat dysentery by the Jaunsari tribe of Garhwal Himalaya, Uttranchal (Bhatt and Negi 2006); powder bark of Bombax ceiba L. is used by the people of Madhya Pradesh to cure diarrhea (Dahare and Jain 2010); Euphorbia hirta L. leaf juice is used to treat dysentery by the people of Sonebhadra district, Uttar Pradesh (Singh et al. 2010) and root juice of Mimosa pudica L. mixed with the fruit juice of Dillenia indica L. is used by the tribes of Cachar district, Assam to cure dysentery (Das et al. 2008). Further studies on active principles and drug action of the reported plant species may be taken up to evolve safer medicine for the treatment of diarrhoea and dysentery.

Conclusion

The use of herbal medicine continues to increase and there is growing evidence that herbal medicines are used widely by all groups of society including children, pregnant and breast feeding mothers, women, especially during the menopause, and the elderly. The rural area of this district which was our study area is an important source of traditional medicines. More information may be explored from the peoples residing in the remote villages in this district. A search for new antidysenteric and antidiarrhoeal drugs is essential which could provide effective protection against microorganisms. The present information may serve as a base line data for phytochemists and pharmacologists to initiate further research for discovery of new compounds and biological activities of these potential plants. The present study recommended that local knowledge can be converted into medicinal or other commercial products. Local people and the keepers of this knowledge should be recognized

and appropriately compensated. Secondly, over-exploitation of medicinal plants is bound to put their survival at risk and measures need to be implemented to conserve them. The situation is made more urgent since in many regions both traditional knowledge and plant diversity are disappearing rapidly.

Fig. 2. a. *Acacia nilotica* (L.) Delile. b. *Adhatoda zeylanica* Medic. c. *Aegle marmelos* (L.) Corr.d. *Asparagus racemosus* Willd. e . *Bombax ceiba* L. f. *Centella asiatica* (L.) Urb. g . *Cissampelos pareira*, L. h. *Curculigo orchioides* Gaertn. i. *Curcuma longa* L. j. *Cymbopogon flexuosus* (Nees ex Steud.) Wats. k. *Eclipta prostrata* (L.) L. l . *Lantana camara* L. m. *Mimosa pudica* L. n. *Morinda pubescens* Sm. o . *Oxalis corniculata* L. p. *Saraca indica* auct.non L. q. *Spondias pinnata* (L.f.) Kurz . r. *Streblus asper* Lour. s . *Terminalia bellerica* (Gaertn.)Roxb. t . *Tinospora cordifolia* (Willd.) Hook.f. & Thoms.

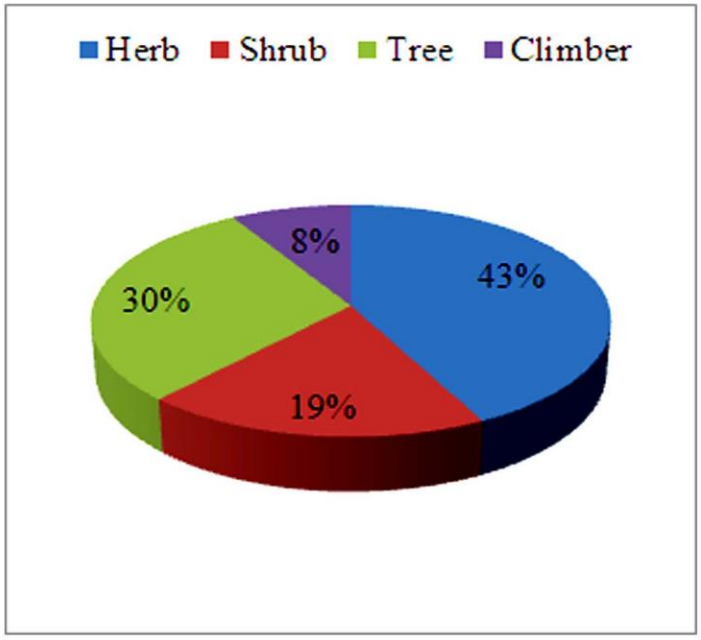

Fig. 3. Growth form analysis.

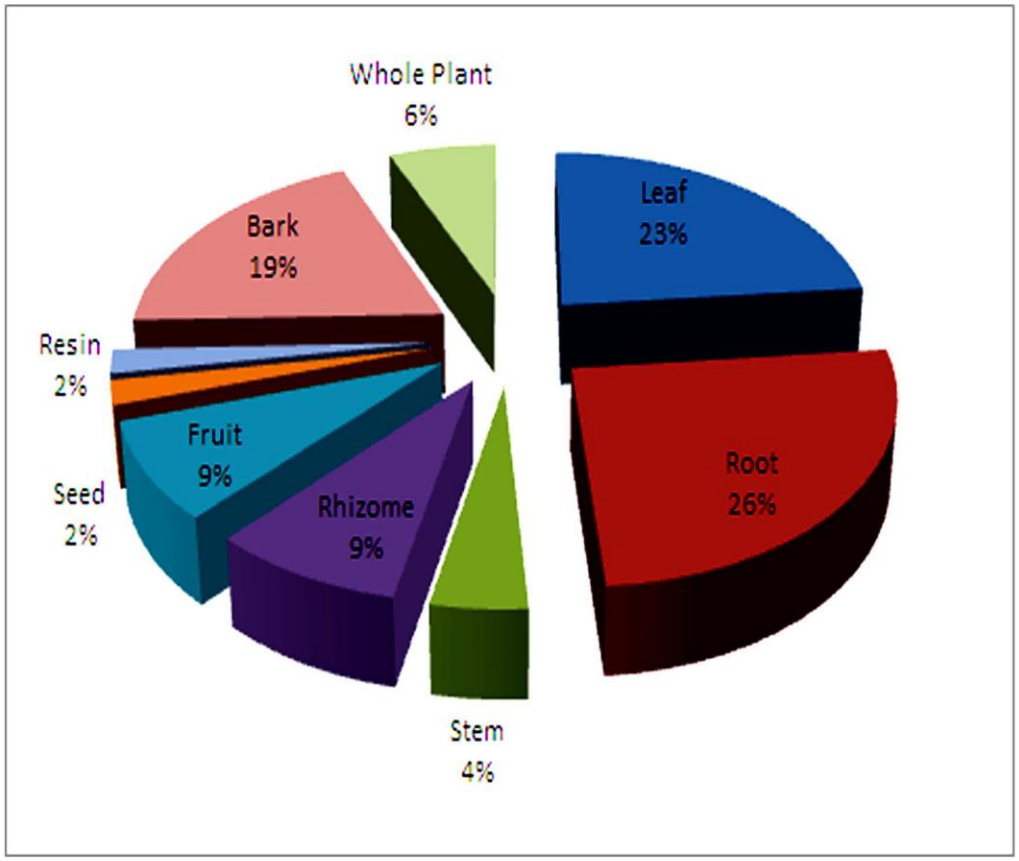

Fig. 4. Percent distribution of plant parts used to cure diarrhoea and dysentery.

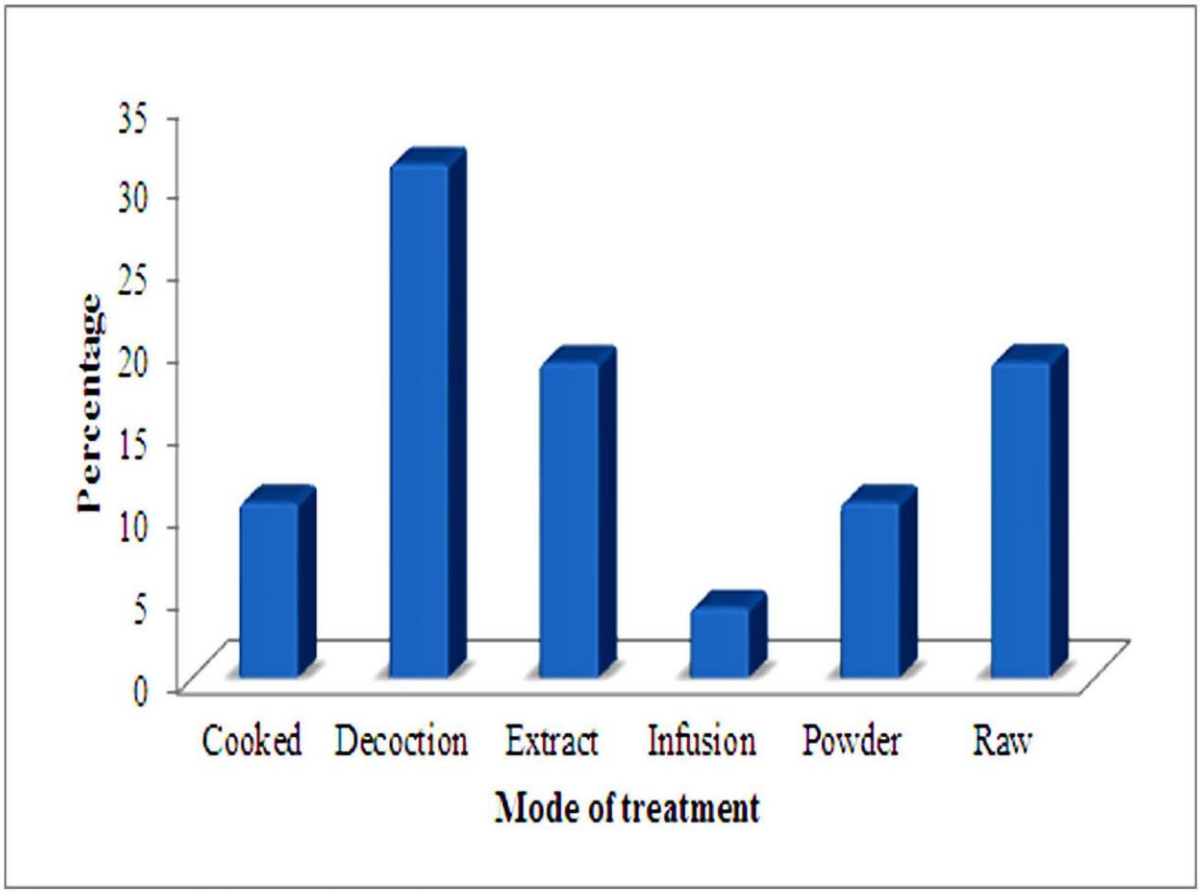

Fig. 5. Percent distribution of mode of treatment.

Table: 1 Ethnobotanical inventory of medicinal plants used for diarrhoea and dysentery in Similpal forest of Mayurbhanj district, Odisha, India

S. No.	Botanical name & Family	Local name	Parts used	Mode of use
1	Acacia nilotica (L.) Delile. Mimosaceae	Babbul	Seed	One teaspoonful of seed powder is given in empty stomach in the morning thrice daily for two days to cure dysentery.
2	Acorus calamus L. Araceae	Bacha	Rhizome	Infusion of rhizome is given to children for diarrhea and dysentery. Rhizome cut in to small pieces, roasted made into paste with honey and given orally for diarrhoea.
3	Adhatoda zeylanica Medic. Acanthaceae	Basang	Leaf	Infusion of leaf juice is given orally for diarrhea and dysentery.
4	Aegle marmelos (L.) Corr. Rutaceae	Bael	Fruit	Ripen fruit pulp is given to drink in the morning or powder of half ripen fruits is given twice daily for 2-3 days to cure dysentery.
5	Anogeissus latifolia (Roxb.) Wall. ex Bedd.Combretaceae	Dhaura	Bark	Bark powder is administered twice or thrice daily for diarrhoea.
6	Asparagus racemosus Willd. Liliaceae	Satabari	Root	Root is used as demulcent and also to treat diarrhoea and dysentery.
7	Bacopa monnieri (L.) Penn. Scrophulariaceae	Brahmi	Leaf	Decoction prepared from powder of fresh leaves (25g) and garlic (20g) is taken twice daily (15ml) for 3 days for dysentery.
8	Bombax ceiba L. Bombacaceae	Simuli	Resin	15-20g resin mixed with water is taken once daily to control diarrhoea and dysentery.
9	Centella asiatica (L.) Urb. Apiaceae	Thalkudi	Leaf	One teaspoonful of leaf paste is given once a day to cure dysentery.
10	Cissampelos pareira, L. Menispermaceae	Akanbindhi	Root	Infusion of root is given for diarrhoea and dysentery.
11	Clausena excavata Burm. f. Rutaceae	Agnijhal	Root	Roots are mixed with the barks of Holarrehna pubescens, Anogeisus latifolia and Pterocarpus marsupium and prepared a pill. One pill is taken orally in empty stomach for three days against dysentery.
12	Clerodendrun viscosum Vent .Verbenaceae	Kharkhari	Leaf	Leaves of Clerodendron viscosum and Justicia adhatoda are taken in equal quantities and crushed to obtain juice. One teaspoonful of juice once daily for children and three teaspoonfuls once daily for adults are taken against dysentery.
13	Coleus amboinicus Lour. Lamiaceae	Rukunihatapochha	Leaf	Handful of leaves made into juice is taken orally every day for dysentery.

14	Croton roxburghii Balak. Euphorbiaceae	Putudi	Bark	Stem bark paste with a pinch of salt is taken thrice a day to cure blood dysentery.
15	Curculigo orchioides Gaertn. Hypoxidaceae	Talmuli	Tuber	Decoction made from the tuberous roots is used for diarrhoea.
16	Curcuma angustifolia Roxb. Zingiberaceae	Palua	Root	Roots and sugar are mixed with large quantities of water and given twice daily for three to four days to cure dysentery.
17	Curcuma longa L. Zingiberaceae	Haladi	Rhizome	Rhizome is used in chronic dysentery.
18	Cymbopogon flexuosus (Nees ex Steud.) Wats. Poaceae	Dhanantari	Root	Root decoction is taken thrice daily to cure diarrhoea.
19	Dalbergia sissoo Roxb. Fabaceae	Sisso	Leaf	Leaves are crushed with curd and given orally for dysentery.
20	Eclipta prostrate (L.) L. Asteraceae	Bhrungaraj	Whole plant	Whole plant extract mixed with curd is divided into two halves and is taken twice daily for 4-5 days to cure diarrhoea.
21	Emblica officinalis Gaertn Euphorbiaceae	Aonla	Fruit	Powdered dry fruit is used in the treatment of diarrhea and dysentery.
22	Euphorbia hirta L. Euphorbiaceae	Chitakuti	Root	Root extract is given to drink to cure blood dysentery.
23	Ficus benghalensis L. Moraceae	Baro	Stem	Decoction prepared from stem (50g) with water (100ml) is taken 10ml twice a day for dysentery.
24	Helicteres isora L. Sterculiaceae	Modimodica	Fruit	Fruit powder is mixed with water and given to drink for diarrhea and blood dysentery.
25	Holarrhena pubescens (Buch.-Ham.)Wall. ex G. Don Apocynaceae	Kuluchi	Bark	5-10 g of dried bark powder with boiled and cold water is used twice a day for 5-7 days in amoebic dysentery.
26	Indigofera cassioides Rottl. Ex DC. Fabaceae	Gileri	Flower, root	Flowers and roots are mixed and ground into paste with water and given to cure dysentery. Roots with bark juice of Careya arborea are given as a remedy for blood dysentery.
27	Kaempferia rotunda L. Zingiberaceae	Bhuichampa	Rhizome	The rhizome of the plant with root of Swertia angustifolia and honey made paste given orally twice a day till cure of dysentery.
28	Kalanchoe pinnata (Lam.) Pers. Crassulaceae	Hemsagar	Leaf	25 ml. of fresh leaves juice is given orally three times a day for three days to cure dysentery.
29	Lantana camara L. Verbenaceae	Nagaairi	Leaf	Leaf juice is used to treat dysentery.
30	Lygodium flexuosum (L.) Sw. Lygodiaceae	Kalamahajal	Root	Powdered root 2g mixed with 1g Piper nigrum and 100ml of water are orally administered twice a day for three days to check blood dysentery.
31	Lygodium microphyllum (Cav.) R.Br. Lygodiaceaea	Mahajal	Frond	Fronds are used for the treatment of dysentery.
32	Mimosa pudica L. Mimosaceae	Lajkuli	Leaf	Leaf extract is taken with black pepper powder and honey twice daily to cure diarrhoea.
33	Morinda pubescens Sm. Rubiaceae	Achu	Root	Decoction of root (30-40ml) is given for dysentery.
34	Oroxylum indicum (L.) Vent. Bignoniaceae	Phanphena	Root	Root bark (5-6 teaspoons) decoction administered daily twice for three days to cur dysentery.
35	Oxalis corniculata L. Oxalidaceae	Amliti	Leaf	Leaves rolled with banana leaf is boiled and then allowed to cool down. Leaves removed from the roll of banana leaf are crushed to make paste. Boiled leaves chewed or prepared paste taken 10mg (approx.) once daily on empty stomach to cure dysentery.
36	Phyllanthus niruri L. Euphorbiaceae	Bhuinamla	Tender leaf	Decoction of the tender leaves is useful for dysentery.
37	Pterocarpus marsupium Roxb. Dipterocarpaceae	Piasal	Bark	Paste is made with bark of above plant pounded with Mangifera indica (bark), Shorea robusta (bark) and Spondias pinnata (bark) of 2 inch size each and administered once in a day against blood dysentery.
38	Punica grantatum L. Puniaceae	Dalimba	Fruit	Peel from fruit is used for treating dysentery and diarrhea.
39	Saraca indica auct.non L. Caesalpiniaceae	Ashok	Bark, Flower	Stem bark decoction is used for blood dysentery. Flowers also are eaten as raw for dysentery.
40	Sida cordifolia L. Malvaceae	Bishiripi	Root bark	Root bark is powdered, mixed with milk and sugar and given for chronic dysentery.
41	Soymida febrifuge (Roxb.) A. Juss. Meliaceae	Ruhini	Bark	Bark juice is very effective in curing dysentery.
42	Spondias pinnata (L.f.) Kurz. Annacardiaceae	Ambada	Bark	Decoction of bark is used in treating diarrhea.
43	Streblus asper Lour. Moraceae	Sahada	Root	Extract made from root powder is given for dysentery. Decoction of stem bark is used for blood dysentery.
44	Syzygium cumini (L.) SkeelsMyrtaceae	Jamu	Root	Root extract is taken twice daily in empty stomach to cure diarrhoea and dysentery.
45	Terminalia bellerica (Gaertn.)Roxb. Combretaceae	Bahada	Bark	The paste of bark is kept in water overnight and administered next day in dysentery.
46	Tinospora cordifolia (Willd.) Hook.f. &Thoms. Menispermaceae	Guluchilata	Whole plant	Decoction of whole plant is given orally thrice daily for two days to cure diarrhea.
47	Tragia involucrate L. Euphorbiaceae	Bichhuati	Whole plant	Decoction of whole plant is given twice daily for 7 days to improve digestion and to cure constipation alternated with diarrhea.

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