

# Ethnomedicinal plants used for diarrhea by tribals of Meghalaya, Northeast India

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## ABSTRACT

Environmental status and diarrhea is regarded as a complex and multidimensional topic. Diarrhea is one of the main water-borne diseases considered to be endemic in many regions of the world and brings the major health threats to the world populations, both in tropical and subtropical poor countries. The state Meghalaya situated in the North-Eastern India is an upland landmass bound by seven districts surrounded within by different tribes. The population is predominantly rural, with 81.41% of the population belongs merely to the scheduled tribes. The state offers a wide range of disease environments, dominated by communicable diseases (35.68%), and diarrhea is one of the water-borne diseases that alter the society of the state. Various factors like poor environmental sanitation, unavailability of safe drinking water, seasonal rainfall, infected foods, infection through fomites, flies, cockroaches, etc. are the main culprit that led to the cause of diarrhea in the state. The local people are very much closely associated with nature, and with their ethnobiological knowledge about the plants available around them, they can easily avert and cure themselves from several disease complications. In this review, the information regarding the traditional method of utilization of 58 plant species that are used to treat and cure diarrhea and dysentery are enlisted briefly.

**Key words:** Diarrhea, dysentery, Meghalaya, medicinal plants, sacred groves

## INTRODUCTION

Meghalaya [Figure 1] which is regarded as one of the seven sisters among the seven states of the Northeastern India is surrounded by three distinct primitive aboriginal tribes - the Khasis, the Jaintias, and the Garos, each occupying the respective hills district in the state. The Khasis and the Jaintias are believed to belong from the "Mon Khmer" subfamily which originated basically from the Indo-Chinese linguistic family. On the other hand, the Garos along with the kacharis are believed to belong to a distinct tribe which subsequently got separated and these people are still primitive among the tribes in Meghalaya.<sup>[1]</sup> Most of these tribes have a close association

with nature and lived among most of the dense vegetation which is categorized into tropical, temperate, alpine, and the grassland areas. These regions are richly well surrounded by various plant resources which are either utilized by these tribes as edible food, shelter, and fodder or used as medicinal purpose to treat various ailments. The tropical monsoonal climate of the state Meghalaya is believed to be responsible for adaptation and the growth of various plants ranging from herbs, shrubs to trees. These areas are geo-morphologically young and active. Most of the region is botanically under-explored or even unexplored. However, most of the explored plants are of medicinal values, which are well utilized by the local tribal for curing and treatment of various disease ailments. The use of medicinal plants in the world, and especially in India, contributes significantly to primary health-care and was mostly utilized on the basis of their ethno-botanical purpose. Primarily, it is interesting to investigate whether their traditional uses are either supported by actual pharmacological effects or merely based on folklore.<sup>[2,3]</sup> Seventy percent of the total area of the state is covered mostly by forest and 90% of this area is under the property of tribal communities.<sup>[4]</sup> Most of these forest falls under the religious sacred groves of which 79 groves were reported totally in the state and of which more than 1886 plant species of various families belonging to orchids, medicinal and ornamental plants, timber, and resin-yielding plants were preserved safe inside these sacred areas.<sup>[5]</sup>

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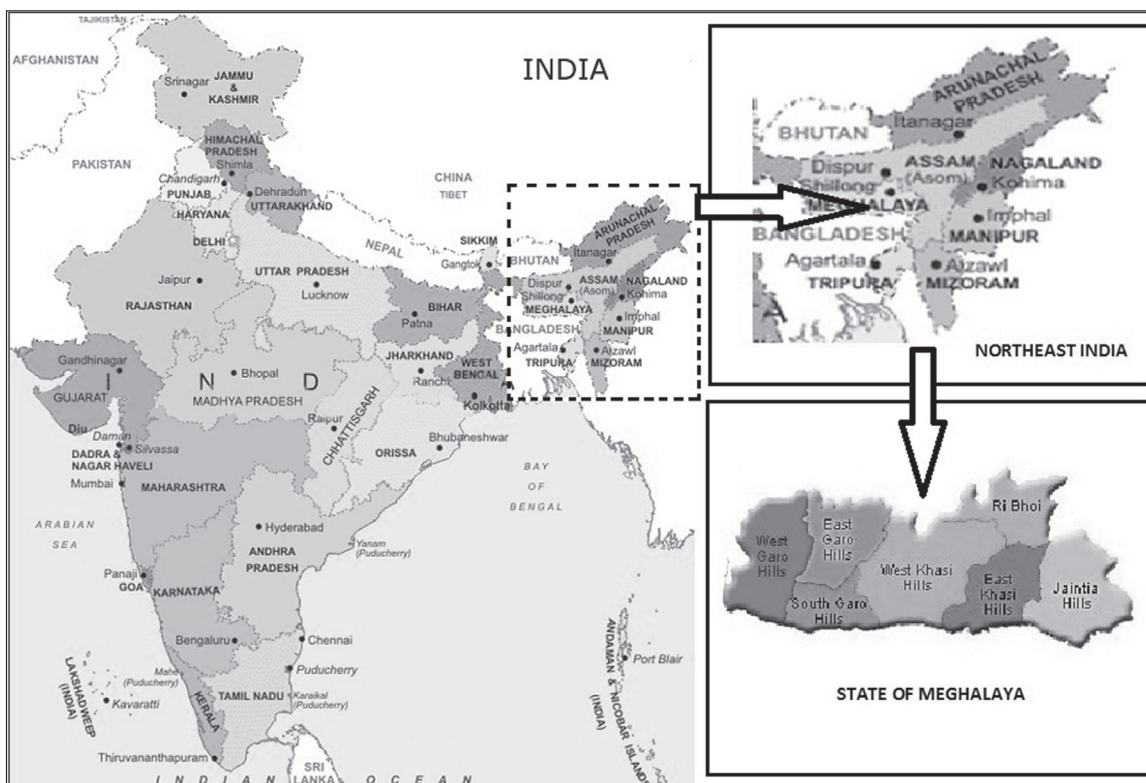


Figure 1: Map of India representing the state of Meghalaya with seven districts

## CLIMATIC CONDITIONS OF THE STATE

The state has an approximate area of 22 549 -km<sup>2</sup> and is globally situated between 25°47'-26°10' N latitude and 89°45'-92°47' E longitude.<sup>[1]</sup> The climate of the state is very much influenced by its topography and is controlled by seasonal winds like the south-west monsoon and the north-east winter winds. The temperature in the summer time reached as high as 25°C and in the winter season with the appearance of the higher altitudes, the temperature drops down up to as low as 2°C or sometimes even below freezing point at night and in the morning. The state has its record which is regarded presently as the world's rainiest and wettest place, with Mawsynram as the main affected area lying in the southern slopes of Khasi hills district of the state and occupying the maximum annual average rainfall of 1169 -cm in the world.<sup>[5]</sup> In 1974, Cherrapunji holds a worldwide record with the reported rainfall of 2500 -cm, but recently; it was surpassed by Mawsynram which is located nearby but a few miles away from it.<sup>[6,7]</sup>

## DIARRHEAL DISEASE ENVIRONMENT OF THE STATE

Water quality, purity, and its accessibility affect substantial numbers of the world population,<sup>[8]</sup> and bacterial water contamination, particularly water -borne diseases, is likely to disturb the whole fabric of society. Diarrhea and dysentery are regarded as the two major wide-spread water -borne diseases. Both are said to be endemic in many regions of Asia and are the leading causes of high degree of morbidity and mortality.

Diarrhea is considered to be one of the major health threats to the world populations both in tropical and subtropical poor countries, and is responsible for about 5 million deaths annually, of which 2.5 million falls under the children of less than 5 years.<sup>[9]</sup> World Health Organization (WHO) defines diarrhea as the “passage of loose or watery stools at least three times in a 24 hour period”, but emphasizes the importance of change in stool consistency rather than frequency, and the usefulness of parental insight in deciding whether children have diarrhea or not.<sup>[10]</sup> Blood in stool could indicate an acute diarrheal illness or dysentery, irrespective of frequency.<sup>[10, 11]</sup> The major causative agents of diarrhea in human beings include various enteropathogens like *Shigella flexneri*, *Escherichia coli*, *Staphylococcus aureus*, *Salmonella typhi*, and *Candida albicans*.<sup>[12, 13]</sup> On the other hand, *Shigella* spp. are also the most important causes of acute bloody diarrhea (dysentery) and account for about 15% of all deaths attributable to diarrhea in children younger than 5 years.<sup>[14]</sup> The major thread that can control the causes of various water -borne diseases is the use of advance multiple drug regime such as antibiotics among various enteropathogens. On the other hand, correct case management of acute diarrhea is also now well defined: Oral Rehydration Therapy and continued feeding are sufficient in the majority of episodes and antimicrobial treatment is only warranted in cases of dysentery, parasitic diseases, and severe cholera.<sup>[15]</sup>

Meghalaya with an estimated population of 2, 357, 510 (density of population is 104 person/ km<sup>2</sup>) is one among the smallest States in India.<sup>[16]</sup> The state is divided into seven districts viz. Jaintia Hills, East Khasi Hills, West Khasi Hills, East Garo

Hills, West Garo Hills, South Garo Hills, and Ri -Bhoi district. The population is predominantly rural, with 81.41% of the population belonging merely to the scheduled tribes.<sup>[17]</sup> Though there has been several turn down in death rate, improvement in life expectancy, and increase in health infrastructure, the State's population is still uncovered and lack primary and central health-care services. According to information showed by the Executive Summary Report (1994) of the Directorate of Health Services, Government of Meghalaya, 35.68% covers both the diseases related to natural environment (mainly water -borne) as well as of communicable nature and is more as compared with the overall India rate of 20.80%.<sup>[17]</sup> Diseases of respiratory tract infections (including pneumonia) and other intestinal infectious diseases (like diarrhea, dysentery, gastroenteritis, etc.) are the two main groups prevailing all over Meghalaya. Among the seven districts of the state, diarrheal diseases ranked first in East Khasi Hill district and second in Ri Bhoi district along with acute respiratory infections. The National Family Health Survey report (1993) showed that one of every twelve children dies before reaching the age of five in the state and in relevant to this, diarrhea is likely to be considered worldwide as the important killer of children under age 5 years. The national average percentage of people suffering from diarrhea with blood (dysentery) is 2.6%. The prevalence in north -eastern states varies from 2.2% in Assam to 6.1% in Meghalaya, and when compared with national average, it is very much high. Meghalaya's prevalence rate of 6.1% is reported to be the highest in the country.<sup>[18]</sup> Unhealthy and unhygienic environment is the main culprit for the widespread and overflow of diarrhea and dysentery in the community. Even though the state reported the highest rainfall in the world, most of the villages situated in the higher slopes suffer mainly from shortage of drinking water throughout the year. The crisis of water in the state led the people living in households to use unhygienic surface water for drinking which are more prone to diarrheal infections than any other sources of drinking water. The incidence that leads to the overspread of these water borne diseases is directly related to the hot seasonal climate, poor environmental sanitation, and the quality of water available. Infected foods, fomites, flies, and cockroaches often spread infections that carry a variety of diarrheagenic enteropathogens. A temperature of 25 °C or more is the most suitable environment for faster breeding of these insects.<sup>[19]</sup> Moreover, in addition to all these factors, the variations in altitudes and seasonal rainfall are also the main factors in which diarrhea strikes in several districts of the state.<sup>[17]</sup> According to Mukherjee the highest proportion of this disease was observed in the Nongstoin block of the West Khasi Hills districts with an average of 39.18%, much higher than that of the state average of 20.57%. The main reason behind such discrepancy is the poor utilization of drinking water.

## ETHNOBOTANICAL PLANTS UTILIZED BY THE TRIBALS TO COMBAT DIARRHEAL DISEASE

In order to combat the problems of diarrhea globally, the WHO in its Diarrheal Disease Control program has given a

special emphasis on the use of traditional folklore medicines in the control and management of diarrhea.<sup>[20]</sup> Medicinal plants are promising and most suitable source of anti -diarrheal drugs.<sup>[21, 22]</sup> *Jaintia*, along with the *Khasi* and *Garo* tribes of Meghalaya, use the ethnobotanical traditional knowledge of treatment based on herbal drugs to combat various diseases and treat different ailments. Some of the most commonly used medicinal herbs for the treatment of diarrhea and dysentery are enumerated alphabetically in the Table 1.

## DISCUSSION

Diarrhea is regarded worldwide as one of the killer diseases and unfortunately, it happens to be among the symptoms of many other diseases.<sup>[23]</sup> The main cause of death from diarrhea is dehydration which results from the loss of electrolytes in diarrheal stools. The inappropriate utilization of sanitation and water for drinking is the main turnover that leads to the outbreak of the disease in the state Meghalaya. Hence, to restore personal comfort and convenience, many patients require antidiarrheal therapy and they were prescribed with several antidiarrheal drugs. In traditional medicine system, many plants or herbs are claimed to have antidiarrheal efficacy without any scientific basis.

The state Meghalaya is rich in plant biodiversity and majority of the population relies mainly on agriculture. The strange climatic and geographical positions as well as the physical features of various districts explain to a large extent the extreme isolation of tribes in different districts. Different tribes have their own way of living and adaptation. Their gradual contact with nature has led to the development of an inquisitive knowledge which ultimately is reflected in their traditional culture, local belief, religion, folklore, taboos, and dialects which are found to be ethno -botanically interesting. About 90% of the rural population in hilly terrain depends on traditional healthcare system.<sup>[24]</sup> Most of the tribes are farmers and quite a good number of medicine men, and different varieties of medicinal plants prepared in different formulation are sold that can be available during the market day ("*Ka Iewdub* in Khasi" and "*Ka Iawmusiang* in Jaintia") which is held ones in a week in different areas of the state. The medicinal plants sold are mostly edible in nature. In most of the rural areas of the state, people belief that traditional medicines have a good impact in the treatment of various disease ailments and they rely mainly on the medicine men. The medicinal plants on which these medicines men prescribe for the cure of certain disease have an outstanding activity and are given in different formulations but mostly in extracted liquid form. Preparation might be either in extract of single herb or mixtures of one herb with others and may be dose -dependent, as shown with certain examples in Table 1. The mixtures of one or more herbs seem to have a synergistic effect that is more likely to produce a possible cure of the diseases. Most of the well -known plants like *Agele marmelos*, *Asparagus racemosus*, *Azadirachta indica*, *Cannabis sativa*, *Centella asiatica*, *Holarrhena antidysenterica*, *Terminalia chebula*, etc.

**Table 1: List of medicinal plants use by the tribal people of the state for curing diarrhea and dysentery**

Species (Common and Local Name)	Family	Part used	Method of utilization	Reference no.
<i>Aegele marmelos</i> Linn. Corr (CN- Wood apple or Bel <sup>[34]</sup> , K & J- Soh bel)	Rutaceae	Fruit	Fruit pulp is together boiled and filtered with fruits of <i>Punica granatum</i> L. (K- Soh anar) and leaves of <i>Psidium guajava</i> L. (Soh-priam). The filtrate after mixing along with sugar and water is taken to get cure from chronic dysentery and diarrhea. Dose: 5 teaspoon for adults and 2 teaspoon for children, three times daily.	[29]
<i>Ageratina adenophora</i> (Spr.) King & Robinson. (CN- Catweed <sup>[34]</sup> , J- Langsoo)	Asteraceae	Shoot	Tender shoots are ground and the juice obtained by squeezing is used for the treatment of dysentery and diarrhea. Dose: 1 teaspoon thrice daily till cured.	[29]
<i>Asparagus filicinus</i> Buch. Ham. Ex D. Don. (CN- Asparagus <sup>[34]</sup> , K- Bat niang soh pet)	Liliaceae	Root	Root juice is mixed along with equal amount of honey and is taken to cured diarrhea. Dose: Half a cup of mixture is taken thrice daily.	[29]
<i>Asparagus racemosus</i> Wild. (CN- Asparagus <sup>[34]</sup> , K- Bat niang soh pet, J- Phlang chokria)	Liliaceae	Root	Mixture of ground <i>Asparagus racemosus</i> and <i>Byttneria pilosa</i> together with the boiled bark of <i>Myrica esculenta</i> and is given all together to cure dysentery.	[29]
<i>Azadirachta indica</i> A. Juss. (CN- Neem <sup>[34]</sup> , K- Dieng neem)	Meliaceae	Leaf	Boiled leaf extracts are used for the treatment of diarrhea and dysentery.	[33]
<i>Bauhinia variegata</i> Linn. (CN- Mountain Ebony or orchid tree <sup>[34]</sup> , K- Dieng tharlong, J- Jalong)	Ceasalpiniaceae	Flower	Flowers are boiled and eaten for 6-7 days to treat piles and dysentery.	[33]
<i>Begonia roxburghii</i> A. DC. (CN- East Himalayan Begonia <sup>[34]</sup> , K- Jajew Jylwang)	Begoniaceae	Root	Root is taken to cure bile dysentery	[30]
<i>Begonia rubrovenia</i> Hook. (K- Jajew Shilliang)	Begoniaceae	NM	Taste sour and used for dysentery and diarrhea.	[33]
<i>Berberis wallichiana</i> DC. (K- Dieng niangmat)	Berberidaceae	Young twigs	Decoction of young twigs mixed with leaf juice of <i>Oxalis richardiana</i> is given for dysentery.	[33]
<i>Boehmeria macrophylla</i> Horn. (CN-False nettle <sup>[34]</sup> , K- Dieng soh khasim)	Urticaceae	Stem & Leaf	A paste of the stem and leaf is taken twice daily to get cured from dysentery. Dose: 2 teaspoon twice daily.	[29]
<i>Bombax ceiba</i> Linn. (CN- Silk cotton tree <sup>[34]</sup> , G- Bolchu)	Bombaceae	NM	Aqueous extracts mixed along with curd is used to check blood dysentery.	[33]
<i>Cannabis sativa</i> Linn. (CN- Marijuana <sup>[34]</sup> , K & J- Bhang, Kynja)	Cannabinaceae	Leaf	Leaves are ground with water and filter. The filtrate is given to cure dysentery. Dose: 2 teaspoon twice daily.	[29]
<i>Careya arborea</i> Roxb. (CN- Wild Guava <sup>[34]</sup> , J- Styngkrain)	Barringtoniaceae	Bark	Decoction of the crushed bark is taken to cure dysentery. Dose: 2 teaspoon twice daily.	[29, 33]
<i>Centella asiatica</i> Linn. Urb. (CN- India Pennywort <sup>[34]</sup> , K- Batmoina; J- Khlein)	Apiaceae	Whole plant	Whole plant is ground and the juice is squeezed out of it and is used to get relieve from both diarrhea and dysentery.	[29, 33]
<i>Cinnamomum pauciflorum</i> Nees. (K & J- Dieng Lorthia)	Lauraceae	Bark	Dose: 2 teaspoon thrice daily. Treatment of diarrhea.	[24]
<i>Cinnamomum tamala</i> Fr.Nees (CN- Indian Bay Leaf, K- Dieng-sia-sia, J- Latyrpad)	Lauraceae	Leaf	Leaf extract which is aromatic in odor is used to treat diarrhea.	[24]
<i>Citrus medica</i> Linn. (CN- Citron <sup>[34]</sup> , K- Sohkwit)	Rutaceae	Root	Preserved rind is used for diarrhea and dysentery.	[24, 33]
<i>Cordia fragrantissima</i> Kurz. (G- Bahari)	Boraginaceae	Bark	Used for the treatment of diarrhea and dysentery.	[24]
<i>Coix lacryma-jobi</i> Linn. (CN- Job's Tears <sup>[34]</sup> , K- Sohriew)	Poaceae	Leaf	Leaf juice is taken in diarrhea and dysentery.	[30]
<i>Deeringia amaranthoides</i> (Lam.) Merr. (G- Sanum)	Amaranthaceae	Leaf	Fresh leaf paste is applied on forehead for fever, headache, nose bleeding and dysentery.	[33]

**Table 1: (Contd..)**

Species (Common and Local Name)	Family	Part used	Method of utilization	References no.
<i>Desmodium gangeticum</i> (Linn.) DC. (CN- Sal Leaved Desmodium) <sup>[34]</sup>	Papilionaceae	Root	The roots crushed and mixed with Ginger ( <i>Zingiber officinale</i> ) useful to treat dysentery.	[1, 33]
<i>Diospyros pilosula</i> (DC.) Heim.	Ebenaceae	All parts	Incorporate for the treatment of diarrhea.	[24]
<i>Dysoxylum procerum</i> Heim.	Meliaceae	Leaf Root	The decoction of the crushed leaves is drunk to cure dysentery.	[33]
(J- Sla-Khro) <i>Elephantopus scaber</i> Linn. (CN-Elephant foot) <sup>[34]</sup> ,	Asteraceae	& leaf Bark	The decoction of the root and leaf is used against diarrhea and for urinary problems. Bark used for treatment of diarrhea. Leaf juice is used to stop bleeding and treat dysentery.	[31]
K- Kynbat-skur sniang) <i>Eriosema chinense</i> Baker (K- Sohpen, J- Sa-pyrdong) <i>Eupatorium odoratum</i> Linn. (K & J- Krah-lynroh)	Fabaceae Asteraceae	Leaf		[33] [31]
<i>Ficus benghalensis</i> Linn. (CN- Banyan tree) <sup>[34]</sup> , K- Diengjri)	Moraceae	Leaf	Powdered leaves mixed with curd and used for treatment of diarrhea.	[5]
<i>Garcinia cowa</i> Roxb. ex DC. (K- Soh-syrum, G- Rengran)	Clusiaceae	Fruit	The fruit is finely powdered after sun dried and used for dysentery.	[1, 24]
<i>Gaultheria fragrantissima</i> Wall. (K- Soh-lyngthrait)	Ericaceae	Leaf	Powdered leaf mixed with water is taken orally to treat diarrhea.	[5]
<i>Glochidion khasianum</i> (K- Jalwai)	Euphorbiaceae	Leaf	Leaf eaten for treatment of dysentery.	[33]
<i>Holarrhena antidysenterica</i> (Linn.) Wall. (CN- Connessi bark) <sup>[34]</sup> , G- Bol-matra)	Apocynaceae	Bark & seed	Dried bark and seed soaked in water and is used to treat amoebic dysentery.	[33]
<i>Houttuynia cordata</i> Thunb. (CN- Chameleon plant) <sup>[34]</sup> , J- Jamyrdoh)	Saururaceae	Root & leaf	Roots and leaves are eaten raw to treat amoebic dysentery.	[29]
<i>Hydrocotyle javanica</i> Thunb. (CN- Java Pennywort) <sup>[34]</sup> , J- Tyngkhieh)	Apiaceae	Whole plant	The whole plant is ground with water and the leaves of <i>Rubus hexogonus</i> Roxb., and <i>Cymbopogon</i> species. This decoction given to cure watery diarrhea. Dose: Half cup is taken for two days on empty stomach.	[29]
<i>Lpomea uniflora</i> Roem. & Schult.	Convulvulaceae	NM	1 tablespoon twice a day of the aqueous extract is consumed daily to treat dysentery.	[32]
<i>Mikania micrantha</i> Kunth. (CN- Climbing hempweed) <sup>[34]</sup> , K- Bat refugee)	Asteraceae	Leaf	Leaves are chewed and used to get relieved from diarrhea.	[29]
<i>Molineria recurvata</i> Herb. (G- Rekosi)	Hypoxidaceae	Leaf & tuber	Fresh leaves and tuber ground to paste and mixed with heifer urine were taken orally to treat diarrhea and dysentery.	[32]
<i>Musa paradisiaca</i> Linn. (CN- Banana) <sup>[34]</sup> , K- Ka Kait)	Musaceae	Fruit	Plant juice or crushed raw fruit mixed with curd is taken orally 2-3 times daily to treat diarrhea and dysentery.	[5]
<i>Musa sapientum</i> Linn. (CN- Banana) <sup>[34]</sup> , K- Ka Kait)	Musaceae	Fruit	Medicines for dysentery.	[33]
<i>Myrica esculenta</i> Buch-Ham ex D. Don (K- Sohphie, J- Sa-phei )	Myricaceae	Bark	Fruit juice in raw condition is preserved in airtight container for use in dysentery. Dose- 2 teaspoon thrice daily after food.	[24, 29]
<i>Myrica indica</i> (K- Sohphie)	Myricaceae	Fruit	Fruit juice in raw condition is preserved in airtight container for use in diarrhea and dysentery.	[33]
<i>Oroxylum indicum</i> Benth. ex Kurz. (CN- Broken bones tree) <sup>[34]</sup> , K- Diengtit-kong-ling)	Bignoniaceae	Root bark	Root bark juice is taken orally two to three times daily to control diarrhea and dysentery.	[5]
<i>Osbeckia crinata</i> Benth. Ex Naudin (CN- Leschenault's osbekia) <sup>[34]</sup> , K- Soh-lyngkthut)	Melastomaceae	Leaf	Leaf paste is used to treat diarrhea and dysentery.	[33]
<i>Oxalis corniculata</i> Linn. (CN- Creeping Wood Sorrel) <sup>[34]</sup> , K- Soh-dkhiew, Jabuit)	Oxalidaceae	Leaf	Whole plant is ground into paste together with <i>Drymaria cordata</i> , <i>Centella asiatica</i> and <i>Mentha spicata</i> ; juice extracted from the paste is used as a medicine in diarrhea and dysentery. Dose: Half a cup, only once is enough for cure.	[29, 31, 33]

**Table 1: (Contd..)**

Species (Common and Local Name)	Family	Part used	Method of utilization	References no.
<i>Paedaria foetida</i> Linn. (CN- Skunk vine <sup>[34]</sup> , G- Gandharadal)	Rubiaceae	Leaf	Either juice of the leaf or the leaf itself fried with rice powder and given to cure dysentery.	[33]
<i>Paedaria scandens</i> (Lour.) Merr. (CN- Skunk vine <sup>[34]</sup> , K- Kynbat- iw -tung, J- Nangra puhung)	Rubiaceae	Leaf	Leaves are ground and the juice extracted is taken in diarrhea and dysentery. Dose: 2 teaspoon thrice daily.	[29]
<i>Passiflora edulis</i> Sims. (CN- Passion fruit <sup>[34]</sup> , J- Soh brap)	(Passifloraceae)	Leaf	Leaf juice is given in dysentery. Dose: Half cup twice daily, till cured.	[29]
<i>Phyllanthus parvifolius</i> Ham.	Euphorbiaceae	Whole plant	Treatment of diarrhea.	[24]
<i>Plumbago zeylanica</i> Linn. (CN- Chitrak <sup>[34]</sup> , K- Diengshitu)	Plumbaginaceae	Root bark	Root bark decoction is taken orally 2-3 times daily to treat diarrhea.	[31]
<i>Polygonum perfoliatum</i> Linn. (J- Shrat)	Polygonaceae	Leaf & root	Crushed leaves and roots mixed with water and taken to cure diarrhea and dysentery.	[33]
<i>Psidium guajava</i> Linn. (CN- Guava <sup>[34]</sup> , K- Sohpriam, J- Sa-pyriam)	Myrtaceae	Leaf	Leaves crushed and the extracts are drunk in case of chronic dysentery. Sometimes the leaves are ground with the peels of raw mango and bark of <i>Rubus ellipticus</i> or with the leaves of <i>Passiflora edulis</i> and rhizome of <i>Curcuma longa</i> and the juice obtained from these mixtures are given to cure blood dysentery. Dose: 2 teaspoon twice daily after food till cured	[29, 33]
<i>Rhododendron arboretum</i> Sm. (CN- Tree Rhododendron <sup>[34]</sup> , J- Tiew saw, Latuthuiñ)	Ericaceae	Bark & flower	Dried flower either eaten raw or fried with ghee is used to treat dysentery. Dose: 5 grams thrice daily till cured.	[24, 29]
<i>Rhus semialata</i> Murr. (K- Dieng Sohma, J- Sohmluh, dien sama; G- Khitma)	Anacardiaceae	Fruit	Ripe fruits are either boiled or eaten raw to relieve diarrhea and dysentery. Sometimes the fruits are boiled in water till the colour changes. The filtrate is boiled again for about one hour till it becomes highly concentrated. Approximately, 1 kg of fruit and water will give 1 cup of concentrate juice. This concentrated juice is given in diarrhea and dysentery. Dose: Half a teaspoon twice daily.	[29, 33]
<i>Rhus succedanea</i> (non L.) Gamble (K- Dieng-Khlaw)	Anacardiaceae	Fruit	Used for the treatment of diarrhea.	[24]
<i>Rubus ellipticus</i> Sm. (CN- Yellow Himalayan Raspberry <sup>[34]</sup> , K- Soh-shiah, J- Sa-siah)	Rosaceae	Fruit, root & stem	The fruits and crushed roots are given to cure dysentery. Even the juice of the tender stem is mixed with any sour juice like lemon juice and is taken in dysentery. Dose: Half a cup twice daily.	[1, 29]
<i>Spondias pinnata</i> (Linn f.) Kurz. (CN- Wild Mango <sup>[34]</sup> , K- Dieng- sohpien)	Anacardiaceae	Bark	Used for the treatment of diarrhea and dysentery.	[24]
<i>Symplocos racemosa</i> Roxb. (K- Bolimitap)	Symplocaceae	Bark	Diarrheal treatment.	[24]
<i>Terminalia chebula</i> Retz. (CN- Chebulic Myrobalan <sup>[34]</sup> , G- Artak, Saluka)	Combretaceae	Fruit	Decoction of dry fruits is taken to cure diarrhea.	[32, 33]
<i>Tinospora cordifolia</i> (Willd.) Hook. f. & Thoms. (CN- Gulbel <sup>[34]</sup> , K- Ksaiblet)	Menispermaceae	Leaf, bark & root bark	Decoction of leaves, bark and root bark in equal amounts is taken orally thrice daily in the treatment of diarrhea and dysentery.	[5]

\*CN- Common name; J- Jaintia; K- Khasi; G- Garo; NM- Not mentioned

are found to be distributed in different areas of the state and used by the local tribes to treat the complications of diarrheal disorders. Despite the easy availability of medicinal plants in the local market, there are also various numerous medicinal plants that are still scientifically unexplored and unfamiliar. In fact, medicinal plants are also available in many religious forests or sacred groves in different areas of the state. The

sacred groves are regarded as the virgin forest where there are various rules and restrictions held by the head of the tribes who are considered to be residences of the local deities. These groves are regarded as the treasure house of plant diversity and harbor a large number of valuable species either plant or wild life. Different groves have different restrictions which prevents the intruders from misuse of the land inside the forest area.

Cutting of trees, plugging of twigs, flowers, and fruits, and spitting or urination is strictly prohibited. Various cultural and religious rites and rituals are also performed in these groves and except for medicinal purposes, none of the plant species is harmed in any way.<sup>[25, 26]</sup> A number of the medicinal plant species of antidiarrheal value were found to be distributed inside the two sacred grove forests (Swer and Mairang sacred groves) situated in Meghalaya.<sup>[24]</sup> Most of these plant species are woody in nature and they are found mostly in the disturbed sacred groves forest of Swer. Species like *Cinnamomum tamala*, *Diospyros pilosula*, *Phyllanthus parvifolius*, *Rhododendron arboretum*, *Spondias pinnata*, and *Symplocos racemosa* are found to be present in the Swer sacred groves and very less species are distributed in the undisturbed Mairang sacred groves. Species like *Cinnamomum pauciflorum*, *Garcinia cova*, *Myrica esculenta*, and *Cordia fragrantissima* are found to be well distributed both in the forest of Swer and Mairang sacred groves. In addition to these two sacred groves, there are a lot more that has been reported in the state of which 15 of 79 sacred groves were found only in the Jaintia hills district alone. Plant belonging to some strange families like Magnoliaceae, Himantandraceae, Digneriaceae, Eupomatiaceae, Winteraceae, Trochodendraceae, Lardizabalaceae, Poaceae, Fabaceae, and Orchidaceae are found to be distributed inside these sacred forests.<sup>[27, 28]</sup>

## CONCLUSION

Traditional health-care system is an age-old practice performed since ancient time by the people in the state of Meghalaya. It is seen that different plant species were ethnobiologically used by the local people to overcome the complications of diarrhea and dysentery which are the dreadful diseases of the state. The pharmacological screening of the antidiarrheal activity and the isolation of a pure lead compounds from each of the individual plants will give the excellent information in regard with the true remedial activity to cure diarrheal complications.

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