

Phytotherapy for Diarrhea: Investigating Efficacy and Safety of Local Plants

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ABSTRACT

Diarrhea remains one of the most prevalent and life-threatening conditions worldwide, particularly among children under five, contributing significantly to global morbidity and mortality. While conventional treatments such as oral rehydration therapy and antimotility drugs are effective, they are not always accessible, especially in low-resource settings. Phytotherapy the use of plant-based medicine has long been practiced across cultures and is gaining renewed attention due to its accessibility, affordability, and potential for fewer side effects. This paper investigates the efficacy, safety, and mechanisms of action of various local plants traditionally used to treat diarrhea. It also explores ethnomedical practices in different regions, with a focus on West Africa and South Asia, where traditional healers play a pivotal role in primary healthcare. Several medicinal plants, such as *Terminalia chebula*, *Nigella sativa*, and *Chromolaena odorata*, have demonstrated promising antidiarrheal activity through mechanisms such as fluid secretion inhibition and antimicrobial effects. While preclinical evidence supports their use, challenges remain in standardization, toxicity monitoring, and integration with modern healthcare. Regulatory gaps, cultural beliefs, and limited pharmacological data further complicate their broader adoption. Nonetheless, these plants represent a valuable reservoir for novel antidiarrheal therapies, warranting further scientific validation and policy support.

Keywords: Diarrhea, Phytotherapy, Medicinal plants, Ethnobotany, Antidiarrheal agents, Herbal medicine, Traditional healing, Plant safety and toxicity.

INTRODUCTION

Diarrhea is a common digestive disorder and the second leading cause of mortality in children under 5, causing around 525,000 deaths annually. In adults, it can lead to serious complications like electrolyte imbalance, malnutrition, renal failure, and death. More than 200 million acute diarrhea cases occur each year, characterized by the frequent passage of watery stool (three or more times daily). The balance of absorption and secretion in the gastrointestinal tract can be disrupted by enteric pathogens, bile salts, stress, toxins, and medications. Diarrhea can be classified as infectious, from bacteria, viruses, or protozoa, or non-infectious, from medicines, allergies, diet, and toxins. Infectious diarrhea is further broken down into watery or inflammatory types. The latter involves destruction of intestinal tissues, causing blood, mucus, and protein leakage. Various phytotherapy methods, notably herbal treatments in traditions like hazumi in Iran, are used to manage diarrhea. Since many medicinal herbs are available, their use for prevention and treatment remains a compelling area of research. Diarrhea primarily arises from infections with pathogens, but can also be caused by poisoning, overexertion, stress, medications, and allergic reactions. Proper treatment selection is crucial, as many medications do not work on every type of diarrhea [1, 2].

Background on Diarrhea

Diarrhea is a common ailment in both children and adults, characterized by abnormally frequent, watery, or loose stools. It is classified as non-infectious, infectious, and drug-induced diarrhea. Infectious diarrhea is one of the world's leading public health concerns because of its associated mortality and morbidity.

Along with vaccinations, phytomedicines have been used to prevent the disease in different parts of the world since ancient times. The dose-dependent effect of 10–100 mg/kg body weight of hydroalcoholic extract of dry leaves of *M. emarginata* on normal and castor oil-induced diarrhea in mice produced maximum fluid accumulation inhibition of 77.9. Phytochemicals such as tannins, flavonoids, alkaloids, and terpenoids were identified in the hydroalcoholic extract and isolates of *M. emarginata* leaves. Diarrhea is one of the most significant health issues in both developing and developed countries. Diarrhea is generally described as an increase in the frequency of loose or watery stools, which may or may not prompt an increase in the frequency of bowel movements. Acute diarrhea can be infectious or non-infectious. Viral, bacterial, and parasitic pathogens are responsible for infectious diarrhea. However, the most common mechanism of infectious diarrhea is due to the interference of pathogenic bacteria or viruses with the water absorption or secretion properties of the intestinal epithelium, leading to a disturbance in the intestinal water balance and producing diarrhea. Infectious diarrhea is one of the world's most serious public health concerns because of its association with mortality and morbidity. Diarrheal diseases, particularly in children under five years of age, are the second leading cause of death, accounting for 9% of all deaths in this age group [3, 4].

Phytotherapy Overview

In Africa, intestinal upsets and diarrhoea are traditionally treated with medicinal plants, with studies confirming their medicinal properties. The World Health Organisation defines diarrhoea as the passage of more than three stools per day, which can be liquid or semi-solid. It can be acute (less than 14 days), persistent (14 days or more), or chronic (over 30 days). Causes include infectious agents like bacteria, viruses, protozoa, digestive malabsorption, and allergic reactions. Treatments include antibiotics, oral rehydration salts (ORS), and antidiarrhoeals. Complementary and alternative medicine (CAM) encompasses diverse health systems outside conventional medicine, with phytotherapy being a key branch focused on medicinal plants. While traditionally seen as safe, evidence shows phytotherapy can cause significant side effects if misused, including toxicity and cross-reactions often underestimated by healthcare providers and patients. Inadequate knowledge of plant products contributes to their unsafe use, highlighting a public health concern regarding the monitoring of the toxicity, safety, and efficacy of CAMs. Globally, 74% of children with diarrhoea use ORT, with variations across regions, such as 78% in South Asia and 76% in Africa. In Bangladesh, traditional medicine is widely practiced alongside modern treatments, while in Ghana's Brong Ahafo Region, residents historically utilized medicinal plants with herbal and spiritual remedies for managing diarrhoea, particularly seeking antimicrobial and iron-rich plants to enhance health-seeking behavior [5, 6].

Local Plants Used In Phytotherapy for Diarrhea

Diarrhoea is a disorder in humans that progresses to dehydration and possible death if untreated. Some follow a water-calorie diet, a calorie diet, or treatment from a pharmacist. Some seek traditional medicines from traditional healers, using plants obtained from herbal sources. Plants used in the manufacture of traditional medicines are a big part of their culture and heritage. Ethnomedical plants used for traditional medicines are scientifically researched for chemical activity and efficacy. Medicinal plants used by traditional healers (THs) and traditional herbal practitioners (THPs) in Korhogo, Côte d'Ivoire, and the African continent have been compiled. Before medicines are prescribed, patients consult traditional therapists who know plant names, dosages, side effects, and medication interaction with synthetic drugs. There is no record of local plants used in traditional medicines for diarrhoea. Diarrhoea is used in Phytotherapy for diarrhoea, as mild dehydration can cause volume depletion with orthostatic hypotension, malaise, dizziness, syncope, confusion, delirium, and decreased urine output. Mortality from diarrhoea is due to loss of fluid, and to a lesser extent, hypokalemia. Putting up bowel rest, and possibly oral Rehydration salts or IV fluids, depending on volume loss. Consider differential diagnosis of infectious causes, drugs, and inflammatory bowel disease. Treatment of antibiotics for acute infectious gastroenteritis has not been shown to reduce days ill. Further discuss use of bismuth salicylate or Loperamide in certain situations and without bloody stools [7, 8].

Mechanisms of Action

The 2,5-DMHA is a bicyclic compound with a methyl group on the number 5 position that connects two separate rings. The first one is a phenolic ring, which possesses a hydroxyl group, and the other one a valeryl group. This compound has catechidin and salvileucalin A as main ingredients then a chemical agent with different configurations. The possibility of such a compound that consists of main ingredient interacting with other molecular concerns can be analyzed through computational approaches. The 5-

HT3 is a neurotransmitter released mainly through the nerve fibers of the enteric nervous system and the central nervous system. It can bind to the 5-HT₃ receptors and regulate the physiological processes mainly located in GIT. 5-HT can modulate some functions in the gut and central nervous which include motility, secretion, contraction, efferent vagal and spinal nerve reflexes. It plays a central part in both acute and delayed modes of action of anti-emetics like chemotherapy and radiation, as well as non-medical causes like anxiety, poor diet, and infection. When 5-HT is bound to 5-HT₃ receptors, it activates the receptor by embarkation of intracellular redox systems of guanylyl cyclase to produce cyclic GMP. Accumulation of cGMP inhibits cascade phosphorylation in the MAP kinase pathway which activates the 5-HT₃ receptors. Excessive accumulation of cGMP in the neurons can recruit Ca²⁺ in the cytoplasm through cGMP-gated ion channels/Ca²⁺-permeable cation channels. The prototype development of 5-HT₃ receptor agonists is based on Quinoline, which is a bicyclic compound with a nitrogen atom in the six-membered ring. Any drug on its market should have analyzable structural features that play an active role in receptor binding through pharmacophore mapping [9, 10].

Efficacy of Local Plants

Diarrhea is a common but potentially fatal condition, particularly in infants. It incurs an economic burden due to hospitalization and often leads to the use of synthetic antimotility agents, which can have severe side effects. This has spurred interest in herbal antidiarrheal agents. Plants with a history of ethnobotanical use as antidiarrheal remedies were selected for research in Benin, based on current literature. This flora has shown potential as an ethnomedicinal resource and has been referenced in various studies. The selected plants exhibit activity in several experimental models for antidiarrheal effects, such as castor oil-induced diarrhea and gastrointestinal motility studies. While some plants have documented clinical research, all listed plants possess an ethnobotanical history. The Beninese species demonstrated significant efficacy in the castor oil model and other gastrointestinal tests. Notably, *C. guianensis* showed the highest efficacy, while *Chromolaena odorata* was effective in castor oil-induced diarrhea but not in other tests. Adjustments in dose or extraction methods could influence its effectiveness in the other models. Research using larger rats has shown *C. odorata* to inhibit enteropooling and intestinal transit dose-dependently. Traditional medical practitioners in West Africa have exhibited extensive pharmacological knowledge, validating some Beninese plants for GI disorders, while further research is needed on others [11, 12].

Safety and Toxicity

As part of a broad study of the safety of phytomedicines in the treatment of infectious diseases, the safety of a set of local plants used as herbal teas in the treatment of diarrhea was assessed. Phytochemical screening of the plants studied revealed a varied richness of secondary metabolites. These same plants were shown to be noncytotoxic in the larval toxicity test. Acute toxicity data indicate that the plants studied did not induce mortality or structural and functional alterations of the liver and kidneys at the dose of 2000 mg/kg. These observations, as well as the existing ethnopharmacological data on the use of the species studied to treat diarrheal disorders, provide substantial evidence justifying the use of these plants in several African pharmacopeias, which notably include the Beninese pharmacopeia. The three plants studied were also shown to be able to inhibit the growth of bacteria involved in diarrheal disorders in doses of 1000 µg/ml. This study thus constitutes a reassuring contribution to the gaps in knowledge concerning the phytomedicines used in the treatment of infectious diseases against which numerous calls for vigilance have been issued. Further studies, including a search for bioactive molecules, pharmacological mechanisms of action, or mutagenic effects, are warranted to offer the scientific basis needed to strengthen the effectiveness and safety of the use of these plants [13, 14].

Regulatory Aspects

Five local plants from existing folkloric and probable medicinal uses were chosen for investigation of safety and efficacy on the *Caenorhabditis elegans* model for diarrhea. The plants selected were (i) *Arjuna*, *Terminalia arjuna* (bark), (ii) Black seed, *Nigella sativa* (seed), (iii) Black myrobalan, *Terminalia chebula* (nest), (iv) Indian gooseberry, *Emblica officinalis* (fruit), (v) Indian cockroach, *Periplaneta americana* (body). An effort was made to identify plants with probable effect as anti-diarrheal using literature surveys and hence study their effects using an animal model. It is noted that the plants, which are edible were safe on normal worms giving no toxicity. In worms with Diarrhea, the plants offer protective effects, reducing trans-mission and bioavailability of PGE₂; reducing 5HT, and restoring alteration of spasmogenic and spasmolytic factors BrTP, NaHS due of its potential effect as anti-diarrheal agent. The study exhibited promising efficacy and safety of local plants for diarrhea, which found mention in the local

traditional practice as medicinal plants for diarrhea. Use of local plants for treatment of diarrhea should be further investigated with proper standardization and molecule isolation. However, both plants may require capsules and preparation efficiency efforts before conduct of clinical trials in human population. Therefore, global medicinal excipient regulatory authorities need to adopt new guidelines of assessment of locally preferable natural products and systems of local plants, as quality may be due to various factors [15, 16].

Cultural Perspectives on Phytotherapy

Among the different geographical regions of the world, the treatment of diarrheal diseases using traditional medicines remains ubiquitous in many developing countries. Most of the medicinal plants used in treating diarrheal diseases come from the flora of these countries, often with long-standing traditions, involving indigenous processes. Globally, less attention has been paid to analyzing and comparing traditional medicinal plants used for treating diarrhea, which is one of the aims of this discussion. In the past 30 years, advances in phytochemical and pharmacological approaches have shed some light on the efficacies of some of the plants used in treating diarrhea. However, the evidences supporting the claimed efficacies of traditional medicines remain scant in South Africa and Zimbabwe, as well as in parts of the world. There are increasing incidences of drug resistance and adverse effects associated with widely used antidiarrheal drugs. This has necessitated a search for new alternatives. Traditional medicines, as they are supposed to be safe and effective, have become one of the increasingly accepted candidates for scrutiny. Traditional medical systems that use a variety of plant species have persisted in many developing countries. Their practices rest on long-lasting views that successful treatments enhance the chances of transmission and wider application of the indigenous knowledge. Cultural beliefs and perceptions of health and illness affect the way communities seek treatment. Many developing countries share this ancient heritage. A better understanding of these medicinal plants used in curing diarrhea may lead to the discovery of new and safer antidiarrheal agents. Despite this potential, very few ethnobotanical studies have been conducted on traditional medicines for treating diarrheal diseases both globally and nationally. Most of these studies have focused on plant species only, while information about dose and method of usage remains scant. Therefore, this study aimed to document the various plant species used for treating diarrhea and their respective dose and methods of administration in the two districts, Guji and Jimma Zone, Southwestern Ethiopia. It was also endeavored to compare the plant species used for treating diarrhea among the local communities through a systematic cross-sectional study. The latter may provide insights into the views and perceptions of the local users concerning diarrheal diseases, which in turn will serve further research in the area [17, 18].

Challenges and Limitations

Despite increased research activity, designing effective herbal products faces significant challenges for successful commercialization. Key hurdles arise when assessing the efficacy and safety of local plants for diarrhea treatment. A major challenge is aligning new remedies with existing disease categories, as herbal and medicinal chemistries may not align. While there is literature on plants for antidiarrheal treatments, diarrhea is complex, caused by various factors like dampness and pathogens, leading to diverse manifestations. This complexity can lead to incorrect categorizations during testing, resulting in false negatives. The lack of a global standard classification system for treatments creates a significant knowledge gap. Additionally, the presence of toxic plants raises questions about their research potential, often leading to negative conclusions. For instance, bufotenine-rich plants such as *Sphaeranthus indicus* may not be thoroughly studied in South Africa, despite herbalism's potential. The colonial history has significantly affected the understanding and use of plant medicines across Africa. Conducting long-term safety and efficacy studies depends on already developed products, which can be challenging if they exhibit diverse pharmacological properties. Comprehensive characterization using untargeted chemical studies following a bioactivity-guided approach can help identify beneficial substances. These studies also reveal suitable controls and allow for concentration measurement in samples. Ultimately, safety and efficacy should first be examined through animal studies, enabling comparisons with existing medications while exploring the full potential of plants with anti-diarrheal properties through targeted extraction [19, 20].

Future Directions

Research on traditional medicinal plants is a promising avenue for discovering new, effective remedies for pressing healthcare issues in human society. Diarrhea is often a big concern, and an effective cure is needed to cure it. Therefore, this research project will mainly concentrate on investigating the lotus

plants identified by local communities in the Diên Biên province for their influence on diarrhea. This research provides valuable information about the efficacy and safety of local plants in treating diarrhea, fostering more potential studies to be conducted on local medicinal plants. Ethnobotany deals with the study of the use of plants by the people of a certain tribe or community and is known as an effective means to draw indigenous knowledge about the uses of plants. Over the past decade, the purposeful study of native pharmacopoeias aimed to produce new drugs has been given priority in the agenda of many national and international organizations. The positive approach of scientists and the increased tendency of governments to collaborate with ethnobotanical projects indicate the growing value of the data obtained from these studies. In addition, medicinal herbs and natural and mineral medicinal compounds are used for therapeutic purposes in digestive diseases and diarrhoea. It should be noted that diarrhoea is the passage of loose or watery stools from the intestines. One of the most important causes of diarrhoea is the infection of various agents, which include viruses, bacteria (both pathogenic and non-pathogenic), parasites, insects, and amoebas. These infection-causing agents can be direct or indirect. On the other hand, some contaminated substances, such as unwashed vegetables or contaminated water, can also be involved. Infections can be caused by eating expired foods, raw foods, and a lack of care in preserving food. Diarrhoea can also be caused by eating foods that the body is not used to consuming. Finally, the aim of this research is proposed in detail, focusing on the hypotheses, objectives, and contents of each task in this project [21, 22].

Case Studies

Diarrhea with proper cessation and adjuvant therapies usually resolves without treatment. The most common medications used in the treatment of diarrhea are antibiotics. However, patients prefer Phytotherapy over synthetic medicines because of their safety, low cost, accessibility, and lower side effects. Several local medicines from the flora of Tamil Nadu were collected and screened for their anti-diarrheal efficacy. A survey was conducted with 50 patients, and they all preferred traditional medicines. The plant *Peganum harmala* was the most common among the decoctions used. Most patients were satisfied with the medicinal benefits of these decoctions, and there was no adverse action recorded. Further analysis showed that the hydro-ethanolic extract of *Peganum harmala* was the most effective against diarrhea, followed by the hydro-ethanolic extract of *Holostemma annulare*, which dominated as the second most effective plant. An exploration was made to characterize the present medicinal plants. Phytochemical screening revealed that there were bioactive substances and natural plant product defense mechanisms. In-vitro anti-diarrheal screening activity for porcine ileum was determined against acetylcholine by the reduction in the Ileum contractions. The inhibition was exponentially greater with the crude extract than with synthetic medicine. The ethical clearance and project proposal were approved by the Medical Ethics Committee. A pilot study was done at a medical college hospital by interviewing 50 patients suffering from diarrhea. The survey recorded initial details of patients such as age, gender, family history, medication history, type of medicine, and source of medicine. The patients were properly briefed about the purpose of the survey, and consent was taken. The survey distributed was a simple questionnaire format to facilitate quick feedback. The collected information was tabulated concerning each patient, and it was analyzed for various parameters. It was done in a basic tabular form, with a representation of graphical charts. Each chart depicts a particular aspect and analysis. After the analysis, the data and source of medicines were identified and properly verified. The collected information was then expanded to pave the path for future research and clinical studies [23-26].

CONCLUSION

Phytotherapy offers a viable complementary approach to conventional antidiarrheal treatment, especially in regions where healthcare resources are limited. The extensive use of medicinal plants in traditional settings reflects a deep-rooted cultural knowledge and reliance on accessible remedies. Several plants, supported by ethnopharmacological and experimental evidence, show significant efficacy in managing diarrhea and related symptoms. However, despite their potential, challenges such as variability in plant preparation, dosage standardization, possible toxicity, and lack of clinical trials hinder their integration into mainstream medicine. Addressing these limitations through rigorous pharmacological research, regulatory frameworks, and cross-disciplinary collaboration is essential. Furthermore, documenting indigenous knowledge and promoting community-based participation in medicinal plant research can enhance the development of safe, effective, and culturally appropriate therapies. The convergence of traditional wisdom and modern science could lead to the discovery of novel treatments, reduce the burden of diarrheal diseases, and improve global health outcomes.

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