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The Role of Phytotherapy in Supporting Gut Health for Diarrhea Management

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ABSTRACT

Diarrhea remains a major global health challenge, particularly among children and immunocompromised individuals, often resulting in dehydration, malnutrition, and increased morbidity. Conventional treatments include antibiotics, oral rehydration therapy, and probiotics, but these approaches face challenges such as antimicrobial resistance, limited access, and microbiome disruption. Phytotherapy, the use of plant-based remedies, has emerged as a promising, holistic alternative or complement to standard interventions for diarrhea management. This paper examines the role of phytotherapy in restoring gut health through bioactive plant compounds that promote microbiota balance, reduce intestinal inflammation, and support immune function. It reviews the mechanisms of action of phytotherapeutic agents, including antimicrobial, anti-secretory, and anti-inflammatory effects, and highlights evidence-based applications of commonly used medicinal herbs. The integration of phytotherapy into fermented functional foods and probiotic formulations further enhances its therapeutic potential. Safety, standardization, and patient education are also discussed as critical factors for the responsible adoption of phytotherapy in clinical and community settings. The review advocates for a One Health approach, acknowledging the interconnectedness of human, animal, and environmental health in advancing sustainable phytotherapeutic practices.

Keywords: Phytotherapy, Gut Health, Diarrhea Management, Medicinal Plants, Gut Microbiota, Herbal Medicine, Fermented Beverages.

INTRODUCTION

Conventional therapy for diarrhoea typically involves antibiotics, rehydration, and possibly probiotics. However, issues with antibiotic overuse and the availability and quality of probiotics have emerged. Consequently, bioactive molecules from natural resources, such as herbs, fruits, and medicinal plants, are gaining attention as alternative therapeutic agents. These compounds exhibit antimicrobial properties and are derived from edible materials, thereby avoiding synthetic chemicals. Moreover, identifying nutrient-replenishing edible materials is crucial. Natural substances with health benefits can be integrated with probiotic cultures in fermented drinks or supplements, aiding in restoring beneficial gut microbiota lost during diarrhoea. Alongside probiotic therapy, rehydration with fermented beverages can deliver essential bioactive compounds, electrolytes, sugars, and vitamins to counteract nutrient loss during diarrhoea. The goal of these beverages is to provide a holistic, chemical-free solution for managing diarrhoea, addressing gut imbalances, intestinal disorders, and gastrointestinal diseases. This strategy prioritizes localized, targeted action against pathogenic microbes and promotes consumer awareness of natural, herbal products as preventive and remedial measures for gut infections. The emerging focus is on creating safe, economical, and effective natural therapies for diarrhoea and related gastrointestinal issues [1, 2].

Understanding Gut Health

Gut health is crucial for the gastrointestinal (GI) tract, including the stomach and intestines, playing a vital role in digestion, nutrient absorption, and waste elimination. A healthy gut features a balanced microbiota, which includes various microorganisms alongside a well-functioning immune system and gut lining. Disruptions in this balance, such as an imbalanced microbiota or weakened immune system, can

lead to gastrointestinal and other health issues. Supporting gut health requires promoting a balanced microbiota, immune strength, and gut function through dietary, lifestyle, and physiological strategies. Interventions may focus on enhancing beneficial bacteria growth, inhibiting harmful bacteria, and improving overall gut health. Phytotherapy involves using plant-derived products to enhance gut microbiota function, immunity, and physiology, encompassing herbal medicines and dietary supplements. Foods rich in bioactive phytochemicals, such as fruits and vegetables, can positively impact gut health. Hawthorn berry traditionally relieves digestive problems, providing soluble fiber and flavonoids beneficial for gut function. Cocoa powder, rich in methyl xanthines, supports beneficial bifidobacteria growth while suppressing harmful bacteria like E. coli. Nutrient-rich foods enhance digestion, absorption, and gut microbiota dynamics, bolstering immunity and overall gut function. Ethnobotanical extracts from diverse sources improve gut health by supporting microbiota balance, enhancing permeability, reducing inflammation, and positively influencing gut physiology and function [3, 4].

Diarrhea: Causes and Implications

Diarrhea involves frequent bowel movements and unusual stool consistency, categorized as acute or chronic by clinicians. It is often marked by changes in stool consistency, mucus presence, and abdominal pain, typically associated with rapid transit of liquid stool through the gastrointestinal tract, resulting in loss of fluids and electrolytes. This condition can stem from both infectious and non-infectious causes, highlighting the importance of gut health, which is often overlooked despite millions suffering from bowel disorders. Diarrhea is a significant health issue globally, constituting around 17% of recurrent medical visits. It can be pathophysiologically classified into secretory, osmotic, and inflammatory types, with mucosal disease causing diarrhea from poorly absorbed solutes. Osmotic diarrhea features large stool volumes with normal osmotic gaps, while secretory disease arises from disruptions in the colonic mucosa, affecting absorption and leading to increased fluid secretion. An osmotic challenge may inhibit intestinal twisting and diarrhea [5, 6].

Mechanisms of Action of Phototherapeutic Agents

Phytotherapy involves using plants and their active compounds to treat diseases, often through complex mixtures of metabolites with various actions. Unlike pharmaceuticals, phytotherapy utilizes co-existing metabolites, where their collective effects exceed those of individual components. These components may have different effects in isolation, potentially diminishing overall action. Phytotherapy supports health in agriculture and forestry against pathogens, employing essential oils and natural extracts as botanical fungicides, insecticides, and bactericides. It operates through general modes affecting infectious agents and specific modes enhancing the host immune system. Various plants exhibit anti-diarrhoeal properties, with pomegranate, Mangifera indica, Syzygium cumini, and Aegle marmelos among the most effective. By protecting enterocytes and inhibiting secretory processes, phytotherapy can counteract the effects of enterotoxic pathogens. It helps restore gut health by enhancing microbiota diversity and potential, alongside utilizing beneficial microbes like Lactobacillus plantarum. Effective diarrhoea treatment must be multifaceted due to its complexity. Addressing the various contributing factors is crucial, and pre- and probiotics with comprehensive actions show potential for affordable treatment solutions [7, 8].

Common Phototherapeutic Herbs for Gut Health

The therapeutic use of plants has existed since ancient times, with various parts of medicinal herbs employed to treat ailments. Ethnomedicinal plants are crucial for discovering new drugs and are extensively researched for their safety and efficacy in traditional medicine for disease prevention and treatment. Different plants are utilized in various countries for human digestive disorders. Despite the common occurrence of such diseases, underlying chronic inflammation lacks a clear etiology, and current medical treatments remain inadequate. Recent research highlights the positive effects of certain herbs on gastrointestinal health, particularly for gastroduodenal ulcers (GDU), which include gastric and duodenal ulcers. Searching terms like ‘stomach digestion’ AND ‘herbal medicine’ and ‘digestive herb’ revealed numerous articles on herbs affecting the stomach. Excluding nonherbal treatments, 20 samples served as positive controls along with 35 herbs used for GDU. Three herbs demonstrated preliminary scientific support for their efficacy against GDU. Research identified herbs for constipation (CST) through phrases such as ‘herb’ AND ‘constipation’ or ‘laxative herb,’ yielding numerous papers on laxative mechanisms. After excluding irrelevant plant species and nonherbal treatments, 41 samples were selected as positive controls, many containing bioactive compounds linked to their CST efficacy. Several researchers reported herbs for heartburn, employing phrases such as ‘heartburn’ AND ‘herb medicine’ or ‘herb’ AND ‘GERD.’ Inclusion criteria focused on commonly used herbs documented publicly, with misidentified species excluded. Ultimately, 31 samples formed the positive control group [9, 10].

Clinical Evidence Supporting Phytotherapy

Globally, diarrhoea or excessive watery stools and associated loss of body fluids are among the most serious health concerns, with a high death rate in young children (<5 years). Effective and safe combined medications to stop the attack or control the severity of watery stools are urgently required. Phytotherapy to cure several gastrointestinal ailments and gut infections has now become a topic of research and promotion by the science community and the public, respectively. Plant-derived extracts and edible materials are emerging as nutraceuticals with bioactive molecules (BACs) for treating several diseases/health disorders. Earlier plant-based medications were in a solid, powdered form, which caused inconvenience in consumption. The now-in-vogue possibility of combining therapeutic plant extracts with the activities of probiotic microbes in the fermented beverage form ensures the universal acceptability of medication. This paper summarises the phytonutrients, their activities, and prospects of fruit-based probiotic fermented beverages in regaining lost hydration, nutrition, and gut health during the fight against diarrhoea. Diarrhoea is defined as the passage of more than 3 loose or liquid stools per day, with a change in the consistency of stool. In some patients, the increase in daily frequency or volume is less marked, but their stool is watery. An episode of diarrhoea is defined as the occurrence of loose or watery stools for more than 24 hours. Fecal incontinence or the involuntary passage of stools is not claimed as diarrhoea unless there is also a change in the stool consistency or frequency. Diarrhoea is a common condition with a varied pathogenesis. It can be all affecting and result in heavy losses of body water and salts in a short time, leading to severe metabolic complications or even death. It can also be self-limited and harmless, not requiring any intervention, contrary to the pathological categories where mortality can be observed in a short time [11, 12].

Phytotherapy Vs. Conventional Treatments

Diarrhea causes significant issues, particularly in young children and the elderly, and can be classified into acute and chronic forms. Acute diarrhea further divides into noninflammatory (watery) and inflammatory (bloody). With rising drug resistance, herbal medications are becoming an alternative treatments for synthetic drugs. Phytotherapy restores normal gastrointestinal function and helps prevent diarrhea by maintaining gut microbiota. It increasingly treats diarrhea linked to enteric infections due to its diverse actions against various pathogens. Herbal medicines are available in multiple forms, including tinctures and powders, for both adults and children. The global focus on safe, effective herbal treatments for diarrhea is growing. Plants like Pomegranate possess strong antimicrobial properties, and herbal manufacturers are pursuing WHO compliance and certifications for quality and trademark protection. Phytotherapeutics can also exhibit bactericidal effects, aiding in gastrointestinal infections. The acceptance and use of herbal medicines often rely on traditional knowledge, as traditional healers have extensive knowledge of herbs and their medicinal use. Studies indicate a strong awareness among communities regarding medicinal plants for disease treatment [13, 14].

Safety And Side Effects of Phytotherapy

The safety and side effects of phytotherapy for gastrointestinal health must be carefully considered alongside its advantages. Plant materials have served as medicine since ancient times, with extensive use recorded in the Middle Ages for various ailments. These materials now hold a significant share in the pharmaceutical industry, driven by their biogenic properties. There is an increasing demand for biogenic substances, necessitating adherence to "eco-friendly" processes and “rules of tolerance.” Drug manufacturing often shifts from non-renewable to renewable resources to comply with sustainable development principles, contrasting with synthetic metabolites, which can include harmful chemical additives that seep into food supplies through improper technology. Such additives may disrupt ecosystems, transforming into harmful compounds that impair biological functions. Phytotherapy presents potential benefits for restoring homeostasis, yet various concerns regarding herbal medications must be addressed before market release. Standardization, production regulations, and analytical development concerning herbal preparations are critical. While acknowledging the potential of these compounds, their drawbacks must also be communicated to consumers. Essential studies on toxicity, bioavailability, pharmacokinetics, clinical efficacy, and safety should be conducted, along with data on immunomodulatory effects, reactions with existing substrates, side effects, precautions, and contraindications. Clear information on the chemical composition and active agents of herbal preparations, as well as the tested batches, is necessary. The benefits of phytotherapy for gastrointestinal health come with associated risks. Consumers must be informed of potential health hazards from therapeutic phytochemicals, including toxicity and drug interactions that could result in adverse effects.

Furthermore, the toxicity and adverse effects of herbal medications may be influenced by demographic factors like age, sex, race, allergen sensitivity, and existing health conditions [15, 16].

Integrating Phytotherapy into Diarrhea Management Plans

To catalyse the One Health approach to fight the infectious disease threat, promoting research on sustainable phytotherapy could potentially support pragmatic and understanding-based communication with consumers concerning the sustainability of herbal medicines from collection to clinical application, treatment of infectious enteritis in domesticated mammals. The impact of phytotherapy on biodiversity and the environment must be further elaborated. Moreover, how herbal medicines and phytomedicines interact with the microbiota of their hosts still remains to be addressed. OMIC technologies and bioinformatics tools are expected to provide powerful means to investigate aforementioned multimodal interactions with systemic and global approaches. In addition, the integration of OMIC technologies also aids in discovering novel phytotherapeutic agents in herbal medicines. In contrast to conventional approaches to trace and identify compounds, they enable a holistic approach to ascertain the pharmacological effects and side effects of herbal medicines and phytomedicine based on parallels between bioinformation and chemoinformatics. Screening time has been reduced from months to weeks. Herbal medicines and phytomedicines may also be used as an alternative in keeping a mammalian gut microbiota balanced in the One Health perspective. Animals and humans are mutually dependent and if one of them goes sick, the other one suffers as well. Novel pyrolidone and morpholine-derived fluorinated naphtho[2,3] thiazole derivatives were designed, and optimal synthetic routes to such compounds were developed to assess their antiproliferative potency and selectivity. Suitably functionalised luteolin derivatives were synthesised to assess their anticancer potential based on their ability to inhibit bioactive sphingolipid production and activate apoptosis in human cancer cell lines. In parallel, the emergence of new broad-spectrum humans is contradicting their uniqueness. In addition, the use of conventional pesticides appears more efficient than BT control in several cases of New World CLCuD transmission. Thus, phytroll and side relative enrichment reveal alteration in community composition [17, 18].

Patient Education and Awareness

Dietary habits significantly impact gastrointestinal health and the gut microbiota, increasingly recognized as modifiable risk factors for digestive disorders. There is a rising trend toward altering dietary habits to enhance gut health, aiming to maintain well-being and prevent digestive issues. For patients with gut disorders, dietary habits form the cornerstone of their care. Effective nutritional care requires heightened awareness and practice adjustments from both healthcare professionals and patients. Tailoring dietary habits to individual symptoms and clinical conditions follows a three-step strategy: implementing basic measures, improving habits to manage symptoms, and optimizing intake to enhance nutritional status. Patient education is essential to clear misconceptions about diet and gut health while motivating lasting behavioral changes. Understanding the mechanisms behind dietary alterations fosters engagement, trust, self-efficacy, and adherence among patients. Tools like videos, infographics, apps, and social media can effectively educate and engage patients and the public on gut health. There is a pressing need for self-help interventions responding to the rising demand for gut health information, ensuring the credibility of such tools while promoting digital solutions' social acceptance. Integrating gut health into health education programs can elevate understanding of diet and gut diseases in the general population, fostering impactful changes in dietary habits. Empowering parents through educational programs is vital to ensure children receive healthy diets and environments. A structured yet personalized approach to dietary management enhances effectiveness and sustainability while balancing strict adherence with patient preferences. Collaborations among stakeholders are necessary to nurture supportive ecosystems conducive to better dietary habits [19, 20].

Cultural Perspectives on Phytotherapy

A great number of plants and plant combinations growing in Africa, Asia, Europe, Oceania and America were evaluated for a potentially curative effect on diarrhoea. Ethnophemiatric research was conducted, and through interviews with traditional medicine practitioners and users, medicinal plants were listed that were in current use for the treatment of diarrhoea. Experimental animal studies were then performed with these plant preparations to confirm or to invalidate traditional beliefs. Extracts and fractions were subjected to tests for acute toxicity. After ethical questions had been settled and permits obtained, gerbils were used for the tests. Historic reports on curative remedies for cholera and other diarrhoeas as well as screening of commercial herbal medicines were also evaluated for potential curative effects on human diarrhoeas. Finally, research was done at the microscopic and macroscopic description of standardised herbal preparations for their use in traditional medicine.Many of the species tested had a potent dose-

dependent effect on the faeces output of the treated gerbils. Most plants that had ocular astringency also had activity against the increased faeces output. Phytochemical screenings suggested several compounds or classes of compounds that could be potentially responsible for the antidiarrhoeal efficacy of some of these plants. The most common compounds to be detected included alkaloids, tannins, flavonoids and phenols, saponins, terpenoids and stilbenoids. Though results were not always positive, some indication of possible toxicity of these medicinal plants was found. Tagged studies on ethno-phytopharmacology, assessing the antidiarrhoeal properties of herbal remedies mentioned in the South African traditional medical literature [21, 22].

Future Directions in Phytotherapy Research

Health authorities worldwide aim to reduce diarrheal disease and dehydration-related mortality. African countries contribute approximately 68% of annual diarrheal disease deaths, making it a leading cause of morbidity among infants. Currently, 1.08 billion people lack access to clean drinking water, raising concerns about the effectiveness of chemical treatments for diarrhoea. Thus, there is a growing interest in safe alternatives. Historically, medicinal plants have been vital for treating ailments. In developing countries, herbal medicine is favored for its safety, availability, and affordability. This study aims to identify antidiarrheal medicinal plants and evaluate their effectiveness in prevention and treatment, alongside their consumption methods. Interviews with 29 traditional therapists in Shahrekord, Iran, led to the identification of 10 plant species. Noteworthy findings include Plantago major, Primula vulgaris, Plantago ovata, Silybum marianum, and Pyrus elaeagnifolia. Silybum marianum, M. spicata, W. somnifera, and P. elaeagnifolia were newly recognized for their preventive effects on diarrhoea. Previously, 65% of the documented plants showed antidiarrheal efficacy. Traditional herbal medicines significantly contribute to primary healthcare in developing regions. Medicinal plants with high therapeutic activity and safety may pave the way for new cost-effective treatments for maternal and neonatal infectious diarrhoea [23, 24].

Case Studies: Successful Use Of Phytotherapy

The role of herbal medicine in the management of diarrhoea is widely recognized in various countries. Anti-diarrhoea herbs are growing in popularity due to their advantages of fewer side effects than synthetic drugs. This study investigated the anti-diarrheal uses reported in the Ethiopian herbal medicine. Moreover, the present review discusses the commercially available herbal anti-diarrheal medicine throughout the globe. The reviewed indigenous herbal anti-diarrheal remedies used in Africa, America, Asia, Australia, and Europe were also summarized. It is believed this medicine could help in preventing and managing diarrhoea in addition to its usage in traditional medicine. Clinical studies are needed on the efficacy of herbal medicine in the management of diarrhoea to investigate its beneficial effects. For the past decades, herbal medicine has been widely used in developing and developed countries to treat various ailments. The possible reason behind the wide usage of herbal medicine include their easy accessibility, affordability, and being effective with fewer side effects than modern synthetic drugs. Herbal anti-diarrheal agents are amongst herbal medicines with their potential anti-diarrheal activity recognized worldwide. Diarrhoea is mainly the increased stool frequency and a change in stool consistency. Even though some occurrences are normal, the devastating impact of this condition is observed when it happens frequently. Diarrhoea is one of the major causes of morbidity and mortality globally, especially in children under five years, and is the second leading cause of death after pneumonia in this age group. It is estimated that there are 1.7 billion cases of diarrheal diseases yearly, resulting in 525,000 deaths in children under five. Particularly, 80% of all deaths due to diarrhoea among children occur in developing countries. In other words, it is estimated that the risk of mortality due to diarrhea in children is over 10 and 100 times greater for Sub-Saharan African and South-east Asian countries, given the model, respectively. Diarrhoea is caused by the disruption of water and electrolyte homeostasis in intestinal fluid, leading to increased fluid volume in the intestinal lumen and stool expulsion. Hence, there are increased amounts of electrolytes and secretory fluids delivered to the intestine. Diarrhoea is chiefly caused by intestinal infection due to bacterial, viral, and parasitic pathogens, increasing intestinal electrolyte secretion [25, 26].

Regulatory Considerations for Phytotherapeutic Products

Phytotherapeutic products, defined by Regulation (EU) 2015/2283, are food-based, typically plant-derived, with weaning, thirst-quenching, or nutritional purposes, featuring under 1% pre-approved health claims. They do not undergo a pre-marketing safety assessment as novel foods. However, aspects like Regulation (EU) 1169/2011 on food labeling, specifically Articles 9 and 29 regarding nutrition labeling, are crucial. Mandatory nutritional declarations and substantiated health claims are necessary to prevent

misleading perceptions. In the EU, phytotherapy products fall under Regulation 2004/24/EC, requiring efficacy substantiation and possibly a safety assessment for minor digestive tract relief. Although interactions between food and medicinal authorities are generally avoided, regulating food with medicinal properties is still evolving, highlighting the need for a harmonized EU approval pathway and tailored requirements for credible health claims and consumer protection. Analyzing current regulations is essential to address regulatory gaps and identify relevant issues. In the US, most herbal products fall under "food" labeling, exempt from pre-marketing safety assessments as "novel foods." However, considerations around adverse effects remain. FDA-approved medications go through the New Drug Application, while dietary supplements are regulated separately under the Dietary Supplement Health and Education Act of 1994. Official compendia's provisions do not apply to dietary supplements, and adverse event reports are examined on a case-by-case basis. Discussions focus on safety and regulatory challenges for dietary supplements from plant materials, including standardization, contamination, and bioactive constituent levels [27, 28].

Challenges in Phytotherapy Research

Despite growing interest in phytomedicine, significant hurdles hinder research on medicinal plants, particularly funding, awareness, and infrastructure shortcomings. The limited number of research institutions focusing on herbal medicines leads to minimal scientific data on the efficacy of traditional treatments for diarrhoea. While some studies have evaluated specific traditional remedies, most have occurred outside their countries of origin. Most research has only assessed individual plant extracts, overlooking the diverse plant species, formulations, and applications employed in communities. Future research must consider both the efficacy and the safety of the traditional medicines used by LLBIRD communities in managing diarrhoea. Although herbal medicines are often viewed as safe, many overlook potential toxicity arising from overdoses or toxic species. Safety assessments should include the identification, purity, and chemical composition, along with dosage and formulation. Toxicity studies are crucial for understanding potential harmful effects, with clinical trials offering new drug development opportunities. Despite reliance on ethnomedicinal plants for diarrhoea treatment, few toxicological studies exist. Evidence suggests many medicinal plants can be toxic, implying similar risks for traditional medicines. Scientists and clinicians must educate the public on safe herbal medicine usage. Many plants used for diarrhoea treatment lack comprehensive toxicity research, warranting future focus on the safety of widely used antidiarrhoeal herbal formulations [29-33].

CONCLUSION

Phytotherapy represents a promising, sustainable, and multifaceted approach to managing diarrhea and promoting gut health. With rising concerns about antibiotic resistance and the limitations of conventional therapies, plant-based treatments offer a natural and effective alternative. Bioactive compounds derived from medicinal plants not only combat pathogens but also restore microbiota balance, enhance nutrient absorption, and strengthen immune responses. Clinical evidence supports the efficacy of several herbal agents, particularly when integrated with probiotics in fermented formulations. However, the successful implementation of phytotherapy requires attention to safety, standardization, regulatory oversight, and public education. By incorporating phytotherapy into dietary and clinical protocols and embracing a One Health perspective, healthcare systems can enhance resilience against gastrointestinal disorders and contribute to global health sustainability.

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