

# The Role of Antimicrobial Medicinal Plants in Combating Diarrheal Diseases

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## ABSTRACT

Diarrheal diseases, a leading cause of mortality, particularly among children under five in developing countries, pose significant global health challenges. Antibiotic resistance has further complicated treatment strategies, driving interest in alternative therapies. Antimicrobial medicinal plants, rich in phytochemicals like essential oils, alkaloids, and flavonoids, offer a promising solution. These plants exhibit mechanisms such as disrupting microbial cell membranes and inhibiting pathogen growth. This review examines the causes and impact of diarrhea, highlights the antimicrobial properties of key medicinal plants, and explores their traditional and modern applications. Case studies from various regions underline the efficacy of these plants in diarrhea management. The integration of ethnopharmacological knowledge with modern scientific methods can pave the way for developing safer, plant-based antimicrobial drugs.

**Keywords:** Antimicrobial medicinal plants, Diarrheal diseases, Antibiotic resistance, Ethnopharmacology, Phytochemicals.

## INTRODUCTION

Diarrhea is the world's most common waterborne gastrointestinal disease and can result from a variety of causes, of which infectious agents such as bacteria, viruses, or parasites are the most common. About 820,000 children under the age of 5 die annually from diarrhea, making it the second leading cause of death among children. Diarrhea particularly affects communities in developing countries where they do not have obtainable sources of clean drinking water, leading to severe mortalities and morbidity among all ages. The use of antibiotics to treat these infections has greatly risen in the past several decades, but antibiotic resistance has accompanied this increased use, which has now become a major public health concern. Antibiotics are also unable to kill viruses or act as a cure for viral infections. In some countries, many have turned to traditional medicinal plants to hunt for a more holistic treatment for diarrheal diseases and overcome the associated problems. The use of plant substances with substances that can kill or inhibit the growth of microorganisms is known as ethnopharmacology [1, 2]. The objectives of the current review are to assess the role of some antimicrobial medicinal plants in controlling diarrhea, including their doses, and development of diarrhea based on the reported research, and to evaluate the knowledge and attitude of people regarding the use of medicinal plants in treating diarrhea. The use of plants as a cure for diseases has deep roots in human civilization, echoed by historical evidence of the use of plants as medicine in the form of drawings on the rocks of caves in Brazil dating back approximately 10,000 years. Moreover, 300,000 herbaria have revealed the use of about 10,000 medicinal plants globally [3, 4].

### **Diarrheal Diseases: Causes and Impact**

Infectious diarrhea remains an important public health problem all over the world. More than 50% of cases of diarrhea were reported to have been caused by bacteria. A wide range of viruses were reportedly responsible for approximately 20–30% of diarrhea cases, with infections by adenoviruses, astroviruses, reoviruses, and the dreaded rotavirus. Diarrheal diseases are easily transmitted from person to person, but also through contaminated food, water, or contact with animals and humans. The *Shigella*, *Vibrio*, *Yersinia*, and *Campylobacter* bacteria among many different isolates are leading causes of food- and water-borne diarrhea and are classified as major threats to the public health of the developed world [5, 6]. Acute diarrhea generally does not pose a serious health risk to an otherwise healthy adult, but it can create a heavy economic burden on an already overburdened healthcare system. In developing countries with inadequate sanitation infrastructure, diarrheal diseases are a major cause of morbidity and mortality among infants and young children. About 88% of diarrheal deaths occur among children under five years of age, mostly in South Asia and sub-Saharan Africa. Although some causes of diarrhea are self-limited, the risk for complications is greater among some populations such as malnourished children, elderly persons, pregnant women, and immunocompromised individuals. The repeated nature of natural infections can also lead to malnutrition due to mineral, protein, and/or caloric losses from hypersecretory diarrhea or vomiting, poor nutrient absorption due to damage to the small intestine and pancreas, and lack of appetite due to infection or feeling unwell. The prevalence and overall impact of diarrhea globally showed substantial regional variation despite having decreased for years. It can be inferred that one in ten people in developed nations experience infectious gastroenteritis each year. This clarifies that these threats, being common all over the world for many decades, should be considered more seriously [7, 8].

### **Antimicrobial Properties of Medicinal Plants**

Typically, the antimicrobial activities of phytochemical compounds present in different natural medicinal plants are due to secondary metabolites that help defend plants from various natural enemies, such as pests, diseases, and herbivores. Essential oils, alkaloids, and flavonoids are some of the common groups of phytochemicals with broad-spectrum pharmacological properties. Other reported active antimicrobial compounds found in essential oils and the leaves, roots, seeds, and shoots of various medicinal plants may prevent the spread or even kill the pathogens causing diarrhea and other gastrointestinal infections [9, 10]. The antimicrobial action of commonly found phytochemicals includes the disruption and destruction of microbial cell membranes, cell walls, and endospores, either by causing electrolyte leakage and dissipation of the pH gradient across the plasma membrane of prokaryotes, or by damaging the cells directly, leading to cell disintegration. Some other antimicrobial compounds and essential oil ingredients of medicinal plants are potent inhibitors of microbial growth both in vivo and in vitro. Garlic, peppermint, cloves, honey, cinnamon, Aloe vera, oregano, neem leaves, basil, onion, black seeds, and turmeric are some of the famous antimicrobial medicinal plants and herbs with healing and medicinal properties. The reported antimicrobial activities of essential oils, their constituents, and other secondary metabolites present in the extracts of these medicinal plants and herbs were comparable and even more potent than the standard synthetic antimicrobial drugs. Therefore, native knowledge of medicinal plants and herbs can help integrate it with modern scientific technology and develop effective and safe antimicrobial drugs obtained from different chemical constituents of medicinal plants [11, 12].

### **Traditional And Modern Uses of Medicinal Plants in Diarrhea Treatment**

Diarrhea is a very commonly occurring disease caused by bacterial, viral, and metazoan infectious agents. In many cultures, traditional herbal medicine is used to prevent, alleviate, or heal diseases and is learned from parents, relatives, friends, and community members. Diarrhea remedy is one of them in which medicinal plants are tailored as a traditional pharmacopoeia in folklore curative practices. Medicinal plants have been used for a long time to treat diseases. Various traditional and home remedies for diarrhea are in place in several cultures. In the absence of a standard healthcare system, traditional healers and herbalists can provide valuable insights to help contextualize basic and biomedical research findings for clinical relevance. Biomedical and traditional medicinal practices can complement each other in treating patients and also translate into more meaningful management of diseases in the community. Medicinal plants have played an increasingly important role in modern medicine, not only in the management of prevalent diseases but also for their nutritional benefits. Medicinal plants used in the past are rationalized by scientific data from many studies proving their effectiveness in modern treatments. Diarrhea in children is one of the world's most serious microbial infections because of high mortality and morbidity. Every country has its traditional medicines and healers who treat disorders in the community;

many of them are knowledgeable about the treatment and cure for diarrhea using medicinal plants. Most respondents use plant remedies, and many of these herbs have life-saving powers against many gastrointestinal tract disorders, including diarrhea. However, herbal medicine presents enormous challenges when scientific evidence is required. Anecdotes clearly demonstrate not only the consistency but also the effectiveness of traditional herbal medicine to cure various illnesses, including diarrhea. Antibiotic resistance has forced people to use medicinal plants as prophylactic agents [13, 2].

#### **Case Studies: Efficacy Of Specific Medicinal Plants in Diarrhea Management**

The last few years have seen attempts to verify the general effectiveness of traditional medicinal plants in particular, but sheer volumes of material have precluded a definitive statement of efficacy. Instead, anecdotal and small epidemiological studies have been attempted. A compilation of antidiarrheal plants has been collected based on years of fieldwork in the Barangay health stations in the Agusan Provinces, where use is often apparently self-perpetuating and managed following the systems. A long list of medicinal plants has also been accumulated through extensive fieldwork. There is a list of medicinal plants that are often used as empiric choices in Africa. In these semi-ethnographic works, the excitement of untested claims is matched with the despair of trying to develop a scientifically based antidiarrheal from amongst the remedies in his kit [14, 15]. An attempt to combine descriptive population studies and ethnopharmacological evaluations presents findings in Western Kenya amongst several herbalists and medical practitioners. The most frequently mentioned plants in each group were used to conduct in vitro tests for anti-Salmonella and anti-shigella activity; only three plants showed significant in vitro activity and human testing was underway to check for similar efficacy. These kinds of approaches, particularly when taken together, provide a degree of justification for public sector funds to be spent on testing medicinal plants. However, even the most rationalized use of folk remedies for identification and possible isolation of novel, useful, and improved materials should not be sought in peppers, Nigerian homeland remedies, ginger beer, or per se. To me, a largely empirical therapeutics specialist comments, that data rank a bit lower on the source of useful information than the word of the high holy mother [16, 17].

#### **CONCLUSION**

Antimicrobial medicinal plants hold significant potential in addressing the global burden of diarrheal diseases. Their natural phytochemical compounds provide effective, sustainable alternatives to synthetic antibiotics, particularly in regions with limited access to conventional healthcare. Leveraging traditional knowledge and integrating it with modern scientific approaches can lead to innovative, plant-based solutions to combat gastrointestinal infections. However, further clinical trials and systematic studies are necessary to validate their efficacy, safety, and optimal dosages. Emphasizing the use of medicinal plants not only mitigates antibiotic resistance but also contributes to global health equity by providing accessible treatment options for vulnerable populations.

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**CITE AS: Apio Christine (2024). The Role of Antimicrobial Medicinal Plants in Combating Diarrheal Diseases. EURASIAN EXPERIMENT JOURNAL OF PUBLIC HEALTH. 7(2):163-166.**