

Microbial Resistance and Medicinal Plants: A New Frontier in Diarrhea Treatment

Fumbiro Akiriza O.

School of Applied Health Sciences Kampala International University Uganda

ABSTRACT

The rise in antibiotic-resistant microbial strains has created a significant challenge in treating diarrhea, a leading cause of morbidity and mortality globally, particularly among children. Antibiotic overuse, misdiagnosis, and inadequate healthcare access in resource-limited settings exacerbate this issue. Medicinal plants offer a promising alternative, providing bioactive compounds with broad-spectrum antimicrobial properties and diverse mechanisms of action. This review examines the role of medicinal plants in combating microbial resistance, emphasizing their pharmacodynamics, synergistic potential, and application in traditional medicine systems. Additionally, it highlights key anti-diarrheal plants, their mechanisms of action, and the need for collaboration between ethnobotanists and modern scientists to validate and integrate plant-based remedies into healthcare systems. The findings underscore the urgency of advancing research in medicinal plants and developing innovative therapeutic strategies to address the global diarrhea crisis while reducing dependency on antibiotics.

Keywords: Microbial resistance, Medicinal plants, Diarrhea treatment, Antimicrobial resistance (AMR), Traditional medicine, Ethnobotany.

INTRODUCTION

Discretionary use of antibiotics for diseases such as diarrhea has resulted in an upsurge in the growth of resistant strains. The escalation in the antibiotic resistance dilemma is of serious concern to public health. Resistant bacterial species exhibit hidden virulence that poses a significant obstacle in the form of a deficiency in treatment methodology through antibiotics. A quick assessment of the percentage prevalence of antibiotic resistance among patients suggests a lack of proper treatment for diarrhea through the used antibiotics, and the more frequently these antibiotics are employed, the greater the prevalence of pathogens associated with such resistant diarrhea. This signifies simple facts related to the emergence of resistant strains in the treatment of any antibiotic-based disease. The growing incidence of the close association between the overuse of antibiotics and the rapid pace at which microbes develop antibiotic resistance indicates bacteria's adaptability in producing resistance. Significant contributors to the scenario include excessive prescriptions of antibiotic treatments due to patient pressure, and the most troubling expression of resistant strains in poor communities due to inappropriate and incorrect medications associated with particular bacteria for conditions that were misdiagnosed by medical practitioners. Developing resistance highlights the need for many advances in our treatments against pathogenic bacteria as possibilities for new strategies to increase the efficacy of existing therapies. With that noted, diarrheal diseases kill about 500,000 children annually, globally, accounting for three-quarters of all child mortality. The percentage of antibiotic-resistant strains associated with the development of diarrhea due to contamination, malnutrition, poor access to healthcare, and the use of available treatments has opened a frontier for the exploration of new strategies for diarrhea treatments [1, 2].

Role of Medicinal Plants in Combating Microbial Resistance

Resistant microbial strains and the rising prevalence of multidrug-resistant bacteria have prompted a new vision of the complementary, synergistic, or alternative use of medicinal plants for treating infections, particularly those that counteract episodes of diarrhea. Ethnobotanical resources have a long history of being considered invaluable for the treatment of common infections in the absence of modern diagnostic resources and pharmaceutical inputs, with a comfortable threshold set at four stools a day. The primary reason for using these resources is that they contain various plant secondary metabolites with broad-spectrum antimicrobial functions. Recent studies have shown the role of antimicrobial strategies in killing pathogens by more than a single target mechanism. Because of the high likelihood that pathogens will develop resistance to a single compound, these alternative drugs are said to act by multiple antimicrobial mechanisms [3, 4]. The use of such traditional treatments has substantial advantages because they can augment existing modern treatments and avert the need for antibiotics. The plant-based strategy not only kills the microbes but also has mechanisms that effectively inhibit toxin dissemination. This adjunct therapy strategy has clear competitive benefits that suggest the use of medicinal plants in combination therapies that could be instrumental in preventing diarrhea. There is a need to identify useful indigenous knowledge regarding diarrhea treatments. The great challenge lies in bringing together the knowledge of ethnobotanists and the pharmaceutical industry to produce strong evidence that modifying a plant compound or its formulation can lead to effective treatments. Additionally, it may be difficult to understand some of the overlapping views and the value of historical and ethnobotanical clues [5, 6].

Key Medicinal Plants with Anti-Diarrheal Properties

Medicinal plants are seen as the richest sources of bioactive compounds for combating infective diarrhea. It can be seen that northern areas of Pakistan are the world's most productive resources for the production of medicinal plants with promising anti-diarrheal properties. The plants described in this review have wide distribution and have been used for a long time by rural people to treat diarrhea. These plants are also found as new materials for the treatment of diarrhea worldwide [7, 8]. Natural remedies with fewer side effects are the choice now the world over, including Pakistan. Several medicinal plants having profound antimicrobial and anti-diarrheal properties are deemed especially useful. The anti-diarrheal plants of the family Phytaceae, which were validated for constituting loperamide or codeine, are noteworthy. The therapeutic importance of several medicinal plants present in various regions of Pakistan with empirical validation is important. Pakistan is home to a variety of indigenous, ethnomedicinal plants that have ethnobotanical importance and can be evidenced as a useful source in drug designing. These medicinal plants need authentic collection and validation from remote areas based on indigenous knowledge for prospective use in human health [9, 10]. Many thousands of plants have been tested and have yet to undergo detailed scientific investigations. Finding anti-diarrheal compounds from medicinal plants is possible once the correct species are identified. Sometimes the same genus or plant family from different geographical areas, even close regions, may show altered efficacy or potency. Some conditions are endemic, and therapeutic remedies should be taken in light of the species, adjuvant management, and the presentation. Modern science has been able to validate traditional uses, and new synergies of herbal remedies and allopathic medications are being integrated for better treatment outcomes. The pharmacology of these medicinal plants can enhance the conventional course of treatment. To treat diarrhea, the correct quantity of species, medium of preparation, the part used, and doses are very important for the targeted medicinal effects. Several people mix medications at will and select a handful from a variety of different plants, so it is difficult to say how effective they are. It is important to follow and validate the methods described by living ethnomedical practitioners. Information was obtained through an interview with the participants of the Trans-ethnic Diarrheal Detection Programme [11, 12].

Mechanisms of Action and Synergies in Medicinal Plants

Previous studies have demonstrated the potential of natural products in oral rehydration therapy and hinted at possible new avenues for the development of more effective antidiarrheal agents. Here we have reviewed additional studies describing the pharmacodynamics of herbal preparations and isolated phytochemicals that act on microbial targets in the treatment of diarrhea. Although delayed antimicrobial resistance has not been reported for herbal remedies, given the recent increase in multiresistant strains, these traditional treatments require evaluation for biofilm dispersal properties, since biofilms have been shown to protect against all antibiotics and to cause an increase in minimum biofilm eradication concentrations. Microbial biofilms have a central role in disease pathogenesis and the development of resistance against many classes of antibiotics, and biofilm infancy is the most promising stage for novel antibiotic development [13, 14]. Synergy is a phenomenon by which combinations of two or more herbal extracts show better results (reduction in major symptoms such as vomiting and diarrhea) than the total

concentration obtained by adding each independent herbal extract. Recent clinical studies have described the major signs and symptoms that are reduced by the administration of mixtures of a minimum of two different herbal medicinal plants compared to when the action of a single extract of herbal plants is administered. The pharmacodynamic activity of these herbal combinations may involve affinity to different microbiological targets or influence on diverse mechanisms in signaling pathways or virulence activity of one or more species of enteropathogenic bacteria or fungi. Generally, botanically derived phytochemicals act on microorganisms by blocking adhesion to receptors in the gut, causing pathogens to secrete toxins, and impeding toxins from being propagated through the gut. It has been proposed that understanding the interaction of plant materials with conventional medication is important because it takes into consideration all the facts for the development of an effective drug product with fewer side effects. Nature favors a progressive approach where new species mutually decide to develop mechanisms of resistance, at which time they will only become reliably affected by an increase in the concentration of antimicrobial agents or by the action of a recent antimicrobial. In conclusion, the data showed a complex interaction of natural compounds antagonizing conventional modern antimicrobials, and it is necessary to develop new paradigms that target directed strategies where the overuse of antimicrobials is minimized, allowing the microorganisms to display a single defense strategy [15, 16].

Future Directions and Implications for Healthcare

While the scientific evidence supporting the use of both plants and indigenous remedies against diarrheal disease is compelling, it should be noted that vigorous research protocols that meet the criteria of clinical research, and the investigations of the safety of plants in any clinical trial, are without international guidelines and should be studied in themselves. Similarly, quality control and standardization, and the regulation to which knowledge belongs or is public information in the native land of the remedy, are yet to be addressed. It is recognized that public interest in alternative medicine has gone mainstream and must be addressed by healthcare professionals when they counsel clients about microbial resistance and alternatives. This would also require consumer-oriented information to be given to healthcare practitioners and to alleviate those who have already participated in focused research efforts who indicate that it is the practitioners themselves who are the main barriers to changing healthcare practice [17, 18]. It is also realistic to acknowledge the potential of research using medicinal plants against infectious disease and microbial resistance as funding councils have demonstrated their interest in the field, with published calls for collaborative research between traditional medicine practitioners and modern scientists. Many national agricultural research systems can see a role for plant-based medicines that correlates to their use and public demand in treating diarrheal disease in most developing countries. Most of the work would be transferable, fully acknowledging that indigenous knowledge is a key barrier in becoming involved in this area and is not going to change significantly over time. Perhaps one area of barrier reduction is the uptake of a limited number of treatments in the international arena that would address pressing, current needs in poverty reduction. The implications of a developed country's national agricultural research systems success in working with developing country national agricultural research systems, traditional medicine practitioners, and the pharmaceutical industry would significantly impact global health strategies. Medical professionals must be made aware of therapies using medicinal plants and their effectiveness must also be clearly demonstrated to consumers [19, 20].

CONCLUSION

The increasing prevalence of antibiotic-resistant pathogens has necessitated the exploration of alternative therapeutic approaches, with medicinal plants emerging as a viable solution in diarrhea management. Their bioactive compounds demonstrate diverse mechanisms, ranging from antimicrobial action to toxin inhibition, offering a multifaceted approach to combating microbial resistance. Furthermore, the synergistic use of plant-based remedies with conventional treatments has shown enhanced efficacy, underscoring their potential as adjunct therapies. While substantial progress has been made in validating the traditional use of medicinal plants, further research is required to standardize formulations, ensure safety, and establish international guidelines for clinical applications. Collaborative efforts between traditional healers, modern scientists, and the pharmaceutical industry will be crucial in transforming ethnobotanical knowledge into globally accessible treatments. By integrating these strategies into healthcare systems, we can address the urgent need for effective and sustainable solutions to the global burden of diarrheal diseases while minimizing antibiotic dependency.

REFERENCES

1. Turyare MD. *Determinants of Diarrhea Occurrence in Children Under Five Years in Bondhere District, Somalia* (Doctoral dissertation, JKUAT-COHES).

2. Hassan M, Saif K, Ijaz MS, Sarfraz Z, Sarfraz A, Robles-Velasco K, Cherrez-Ojeda I. Mean Temperature and Drought Projections in Central Africa: A Population-Based Study of Food Insecurity, Childhood Malnutrition and Mortality, and Infectious Disease. *International journal of environmental research and public health*. 2023 Feb 2;20(3):2697.
3. Abdallah EM, Alhatlani BY, de Paula Menezes R, Martins CH. Back to Nature: Medicinal plants as promising sources for antibacterial drugs in the post-antibiotic era. *Plants*. 2023 Aug 28;12(17):3077. [mdpi.com](https://doi.org/10.3390/pl12173077)
4. Uddin TM, Chakraborty AJ, Khusro A, Zidan BR, Mitra S, Emran TB, Dhama K, Ripon MK, Gajdacs M, Sahibzada MU, Hossain MJ. Antibiotic resistance in microbes: History, mechanisms, therapeutic strategies and future prospects. *Journal of infection and public health*. 2021 Dec 1;14(12):1750-66. [sciencedirect.com](https://doi.org/10.1016/j.jiph.2021.12.011)
5. Roy DN, Ahmad I. Combating biofilm of ESKAPE pathogens from ancient plant-based therapy to modern nanotechnological combinations. In *A complete guidebook on biofilm study* 2022 Jan 1 (pp. 59-94). Academic Press.
6. Goyal N, Chandra A, Vashistha M, Singh AP, Goel VK, Singh N. Natural Product-Based Treatment for Food Poisoning. In *Natural Products for Antibacterial Drug Development: Recent Advancement of Computational Approach* 2024 Dec 13 (pp. 199-233). Singapore: Springer Nature Singapore. [\[HTML\]](#)
7. Yala JF, Mabika Mabika R, Ikabanga DU, Mounioko F, Mokouapamba PR, Lepengue AN, Souza A. Ethnopharmacological Survey, Phytochemical Screening and Antimicrobial Activities of Medicinal Plants Used in the Treatment of Diarrhea in Southeastern Gabon. *Plants*. 2023 Oct 20;12(20):3629. [mdpi.com](https://doi.org/10.3390/pl12203629)
8. Adeleye OA, Bamiro OA, Bakre LG, Odeleye FO, Adebawale MN, Okunye OL, Sodeinde MA, Adebona AC, Mena F. Medicinal plants with potential inhibitory bioactive compounds against coronaviruses. *Advanced Pharmaceutical Bulletin*. 2021 Jan 30;12(1):7. [nih.gov](https://doi.org/10.1016/j.apb.2021.01.007)
9. Vidya HA, Murthy N, Thara DK. Leveraging deep learning for identification of medicinal plant species. In *2024 International Conference on Data Science and Network Security (ICDSNS) 2024* Jul 26 (pp. 1-9). IEEE. [\[HTML\]](#)
10. Bhagawan WS, Ekasari W, Agil M. Ethnopharmacology of medicinal plants used by the Tenggere community in Bromo Tenggere Semeru National Park, Indonesia. *Biodiversitas Journal of Biological Diversity*. 2023 Nov 13;24(10).
11. Alseekh S, Kostova D, Bulut M, Fernie AR. Genome-wide association studies: assessing trait characteristics in model and crop plants. *Cellular and Molecular Life Sciences*. 2021 Aug;78:5743-54. [springer.com](https://doi.org/10.1007/s00035-021-01911-1)
12. Shi L, Zhao W, Yang Z, Subbiah V, Suleria HA. Extraction and characterization of phenolic compounds and their potential antioxidant activities. *Environmental Science and Pollution Research*. 2022 Nov;29(54):81112-29. [springer.com](https://doi.org/10.1007/s11356-022-21112-2)
13. Sharma S, Mohler J, Mahajan SD, Schwartz SA, Bruggemann L, Aalink R. Microbial biofilm: a review on formation, infection, antibiotic resistance, control measures, and innovative treatment. *Microorganisms*. 2023 Jun 19;11(6):1614. [mdpi.com](https://doi.org/10.3390/mi11061614)
14. Mirghani R, Saba T, Khaliq H, Mitchell J, Do L, Chambi L, Diaz K, Kennedy T, Alkassab K, Huynh T, Elmi M. Biofilms: Formation, drug resistance and alternatives to conventional approaches. *AIMS microbiology*. 2022;8(3):239. [nih.gov](https://doi.org/10.3934/microbiol.2022239)
15. El Khetabi A, Lahlali R, Ezrari S, Radouane N, Lyousfi N, Banani H, Askarne L, Tahiri A, El Ghadraoui L, Belmalha S, Barka EA. Role of plant extracts and essential oils in fighting against postharvest fruit pathogens and extending fruit shelf life: A review. *Trends in Food Science & Technology*. 2022 Feb 1;120:402-17. [\[HTML\]](#)
16. Vaou N, Stavropoulou E, Voidarou C, Tsigalou C, Bezirtoglou E. Towards advances in medicinal plant antimicrobial activity: A review study on challenges and future perspectives. *Microorganisms*. 2021 Sep 27;9(10):2041. [mdpi.com](https://doi.org/10.3390/mi9102041)
17. Amoussa AM, Lagnika L, Jullian V, Chassagne F. Anti-Salmonella activity of plant species in the Benin republic: *Artemisia afra* and *Detarium senegalense* with promising in vitro and in vivo activities. *Biomedicine & Pharmacotherapy*. 2023 Feb 1;158:114119. [sciencedirect.com](https://doi.org/10.1016/j.biopha.2023.114119)
18. Kacholi DS, Mvungi HA. Ethnomedicinal survey of antidiarrheal plants of the Nyamwezi people of Nsenda ward in Urambo District, central western Tanzania. *Ethnobotany Research and Applications*. 2022 Oct 12;24:1-4. [ethnobotanyjournal.org](https://doi.org/10.1016/j.ethnobot.2022.101611)

19. Sultana A, Hossain MJ, Kuddus MR, Rashid MA, Zahan MS, Mitra S, Roy A, Alam S, Sarker MM, Naina Mohamed I. Ethnobotanical Uses, Phytochemistry, toxicology, and pharmacological properties of *Euphorbia neriifolia* Linn. against infectious diseases: A comprehensive review. *Molecules*. 2022 Jul 8;27(14):4374. [mdpi.com](https://doi.org/10.3390/molecules27144374)
20. Husen A. Traditional herbal therapy for the human immune system. 2021. [\[HTML\]](#)

CITE AS: Fumbiro Akiriza O. (2025). Microbial Resistance and Medicinal Plants: A New Frontier in Diarrhea Treatment. EURASIAN EXPERIMENT JOURNAL OF PUBLIC HEALTH, 7(1):71-75