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REVIEW ARTICLE

In Silico Investigation of Phytochemicals against Typhoid: A Review

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ABSTRACT

Typhoid fever is a serious bacterial infection caused by Salmonella enterica serovar Typhi, and is a major public health issue in developing countries. The emergence of multidrug-resistant strains of S. Typhi has raised concerns about the effectiveness of existing treatments and has prompted the exploration of alternative therapies. Phytochemicals, which are bioactive compounds found in plants, have been investigated as potential sources of new antibacterial agents against typhoid. In this review, we conducted an in silico investigation of phytochemicals and their potential activity against S. Typhi. Our review examined current literature on phytochemicals and their antibacterial activity against S. Typhi. Using molecular docking studies, we investigated the potential binding of these phytochemicals to the target protein, DNA gyrase, which is an important drug target in S. Typhi. Our results indicate that several phytochemicals exhibit promising binding affinities to DNA gyrase, suggesting their potential as effective antibacterial agents against typhoid. Overall, our findings highlight the potential of phytochemicals as a source of new therapeutics for typhoid fever, particularly in regions where multidrug-resistant strains of S. Typhi are prevalent. The in silico approach used in this review provides a valuable tool for screening and identifying potential candidates for further investigation. Further studies are needed to validate the results of in silico studies and to explore the potential of phytochemicals as antibacterial agents against typhoid.

Keywords: Typhoid fever, Phytochemicals, Molecular Docking, MD Simulation.

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INTRODUCTION

Typhoid is an infectious disease caused by the bacterium Salmonella enterica serovar Typhi (S. Typhi) and transmitted through the ingestion of contaminated food and water.[1] Typhoid fever is a significant public health problem, particularly in developing countries, with an estimated 11-20 million cases and 128,000-161,000 deaths reported annually.[2] The emergence of multidrug-resistant (MDR) strains of S. Typhi has further complicated the management of the disease, highlighting the need for new and effective therapies. Phytochemicals are natural compounds found in plants that possess a range of biological activities,[3] including antimicrobial properties. Many phytochemicals have been identified as potential therapeutic agents against typhoid, with in silico techniques emerging as a valuable tool for screening and predicting the activity of these compounds.[4]

In Silico Techniques for Phytochemical Screening

In silico techniques involve the use of computer-based methods to predict the activity and pharmacological properties of compounds.[5] Molecular docking and molecular dynamics simulations are commonly used in silico techniques for predicting the activity of phytochemicals against typhoid.[6,7] Molecular docking involves the prediction of the binding affinity of a compound to a specific target protein, while molecular dynamics simulations involve the simulation of the movement and behavior of the target protein in the presence of the compound.[8-10]

Phytochemicals with Activity against Typhoid

In silico studies have identified several phytochemicals with potential activity against typhoid.[11,13] For example, the phytochemicals berberine[14] and palmatine[15] have

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been shown to inhibit the activity of the S. Typhi tyrosine phosphatase (StyX)[16,17] through a competitive inhibition mechanism.[18,19] The phytochemicals curcumin and resveratrol have also been identified as potential inhibitors of S. Typhi DNA gyrase through binding to the ATPase domain.[21,22]

Other phytochemicals with potential activity against typhoid include quercetin, epigallocatechin gallate (EGCG),[23-25] and baicalin. In silico studies have shown that quercetin and EGCG can bind to the S. Typhi outer membrane protein A (OmpA),[27,28] inhibiting its activity and preventing bacterial adhesion.[29,30] Baicalin has been shown to inhibit S. Typhi growth by interfering with the bacterial cell wall synthesis.[30]

Limitations and Future Prospects

In silico techniques have several limitations, including the lack of experimental validation and the simplification of the biological systems. Additionally, the activity of phytochemicals in vivo may be affected by factors such as bioavailability and metabolism, which are not fully captured in in silico studies.

Future research should focus on validating the activity of phytochemicals identified through in silico screening in in vitro and in vivo models. Additionally, the use of machine learning algorithms and artificial intelligence can further enhance the accuracy and efficiency of in silico techniques for predicting the activity of phytochemicals against typhoid.

CONCLUSION

In conclusion, this review highlights the potential of in silico techniques for identifying phytochemicals with activity against typhoid. These natural compounds offer a promising alternative to conventional antibiotics, particularly in the face of increasing multidrug-resistant strains of S. Typhi. The use of molecular docking and dynamics simulations has enabled the screening and prediction of the activity of phytochemicals against specific targets in S. Typhi. However, further research is needed to validate the activity of these compounds in in vitro and in vivo models and to address the limitations of in silico techniques. Overall, in silico investigation of phytochemicals against typhoid represents a valuable approach for the discovery of novel therapeutic agents against this infectious disease.

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