Evaluating the Antimicrobial Efficacy of Ginger (Zingiber officinale) Against Common Bacterial and Viral Pathogens

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Introduction

Herbal remedies, such as ginger, present a compelling opportunity to address pressing global health challenges like Chikungunya, a highly contagious viral infection for which there is currently no available vaccine or antiviral therapy. The demonstrated efficacy of ginger could pave the way for its critical role in vaccine development against Chikungunya, offering a natural alternative with fewer adverse effects than conventional synthetic drugs. Additionally, ginger exhibits notable antibacterial properties, effectively combating certain pathogenic bacteria. This dual action not only promises to mitigate the disease but also underscores the potential of plant-based therapeutics in reducing the risk of harmful side effects typically associated with synthetic pharmaceuticals, thereby enhancing overall health outcomes.

Methods

A comprehensive literature search was conducted through the University of Washington Library database. All research articles had to be published in peer-reviewed journals with an impact factor of at least 1.6.

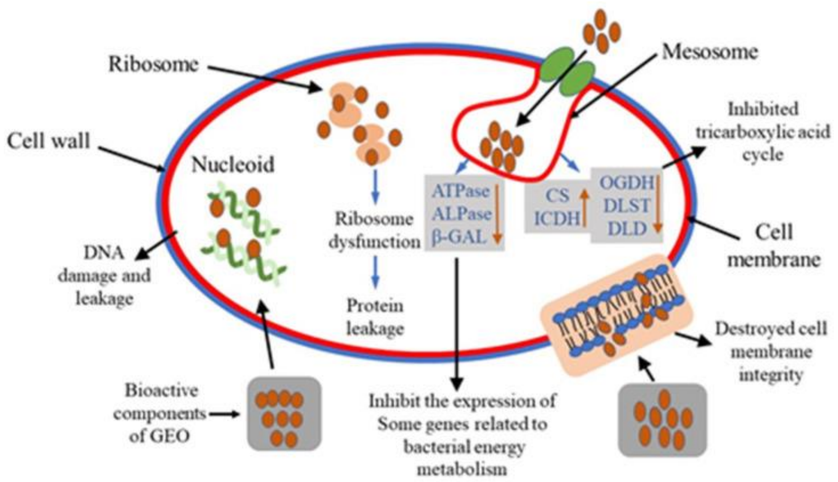

Figure 1. Proposed antibacterial mechanism of ginger essential oils (GEOs). GEOs disrupt bacterial cell membranes, increasing permeability and impairing essential functions such as protein synthesis, nucleic acid stability, and enzyme activity, ultimately leading to cell death.

Results

- Pre-treatment with plant extract: Vero cells infected with CHIKV demonstrated a cell viability enhancement of 51.05% at the maximum non-toxic dose (MNTD) and 35.1% at half the MNTD.
- Co-treatment with plant extract**:** Treatment at MNTD resulted in a 52.9% increase in cell viability, while half the MNTD led to a 49.02% improvement.
- Generation Time Reduction**:** Generation time for both *E. coli* and *S. aureus* decreased significantly ($p < 0.05$) as GEO concentration increased and was influenced by culture duration 2 to 24 hours.
- Specific Growth Rate Decline**:** The specific growth rate significantly decreased ($p < 0.05$) with extended culture time post-GEO treatment.
- Nucleic acid absorbance increased from 0.0303 to 0.7009 at the minimum inhibition concentration (MIC) level and from 0.0303 to 0.822 at the minimum bactericide concentration (MBC) level after 16 hours, after which it remained essentially constant.

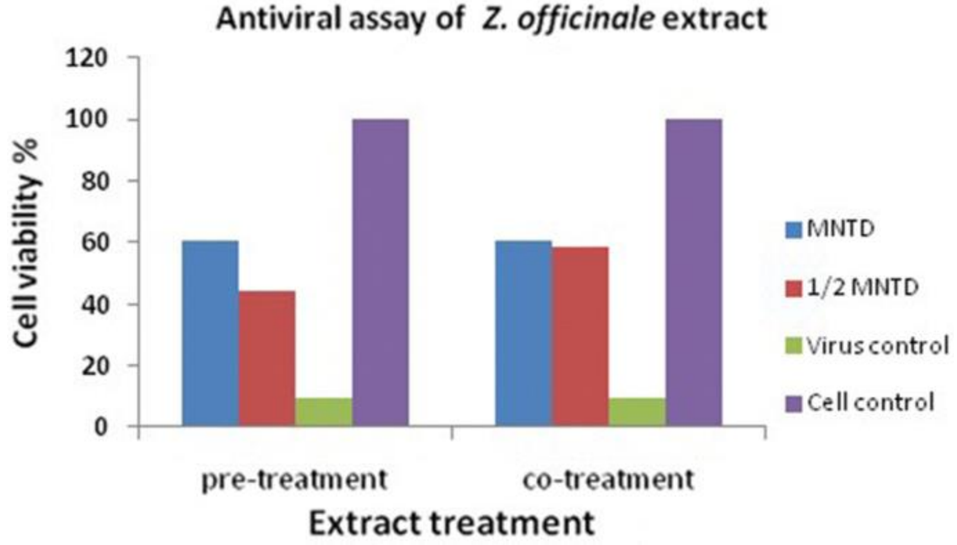

Figure 2. Effect of plant extract on Vero cell viability following CHIKV infection in pre-treatment, cell viability.

Conclusion

- Ginger has demonstrated potent antiviral properties, significantly reducing viral infectivity across various treatment scenarios, including pre-treatment, co-infection treatment, and post-infection treatment approaches.
- Medicinal plants offer a potential source for developing diverse antiviral agents, which could significantly contribute to alternative virus treatments.

Future Directions

- Future investigations should encompass in vivo studies to assess the cytotoxicity, pharmacological interactions, potential side effects, and the efficacy of various extraction methods for ginger.
- Conduct further investigations to explore additional antibacterial mechanisms associated with the diverse bioactive compounds present in ginger essential oils (GEOs).
- In the future, medicinal plants could be used to offer a potential source for developing a diverse array of antiviral agents.

Acknowledgements

Thank you to the University of Washington Tacoma for granting the resources, background and opportunities to be able to create this project.

Special thank you to Dr. Bleecker for providing the endless support and guidance require to successfully produce this review.

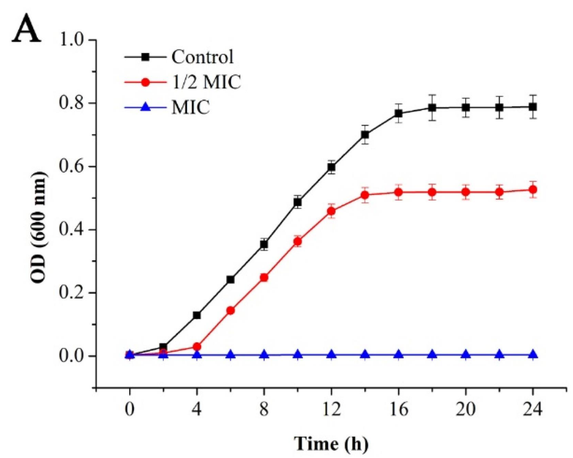

Figure 3. Impact of GEO the proliferation of *E.coli* (**A**) and *S. aureus* (**B**).

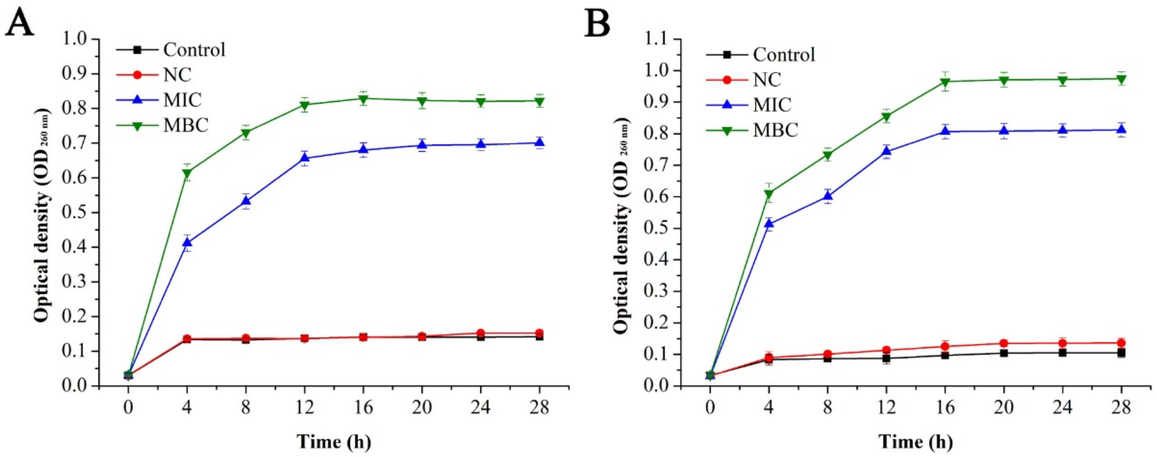

Figure 4. Effect of GEO on cell membrane integrity of *E. coli* (**A**) and *S. aureus* (**B**).

References

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