

Enhancing the Antimicrobial Properties of Garlic Against Human Pathogens Through the Inoculation of Trichoderma Asperellum and Molecular Docking Analysis

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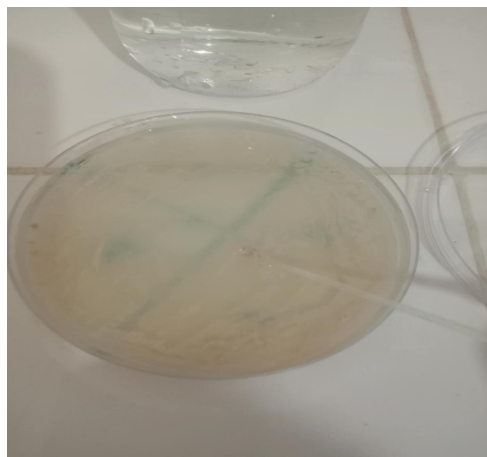
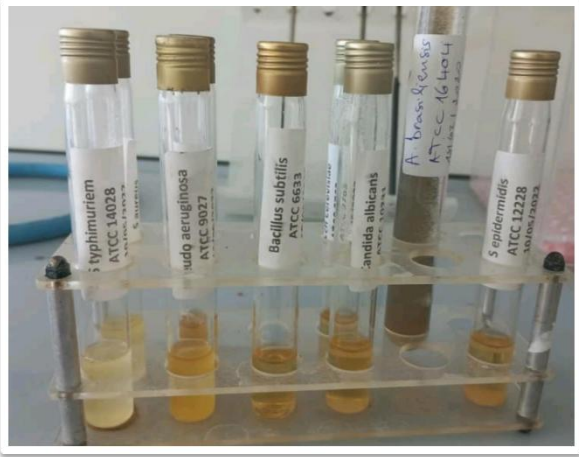
INTRODUCTION & AIM

Garlic (*Allium sativum*) is a widely used spice and one of the oldest cultivated bulbs. It contains numerous phytochemicals responsible for its biological activities. The inoculation of garlic with endemic microorganisms such as *Trichoderma* can enhance plant growth and secondary metabolite production. This study aimed to evaluate the influence of *Trichoderma* inoculation on the antimicrobial properties of garlic against human pathogens and explore potential mechanisms using molecular docking.

METHOD

Garlic was cultivated in greenhouse conditions and inoculated with three *Trichoderma asperellum* strains: T1 (TMSKOLDZ20), T2 (TMS11DZ15), and T3 (TMS5DZ15). After harvesting and extraction, extracts at 100%, 75%, 50%, and 25% concentrations were tested for antimicrobial activity against human pathogens as describe in figure 1

In silico molecular docking was performed to assess binding interactions between garlic compounds and the outer membrane protein of *Salmonella typhi*. A General Linear Model (GLM) confirmed the significant effect of endemic microorganisms on the antimicrobial activity of garlic extracts.



RESULTS & DISCUSSION

T3 and T2 showed the strongest antimicrobial activity, especially against *S. aureus* (32 mm),

Table1:Inhibitory effect of garlic extract inoculated with *trichoderma* isolateson on microbial pathogens according to treatments.

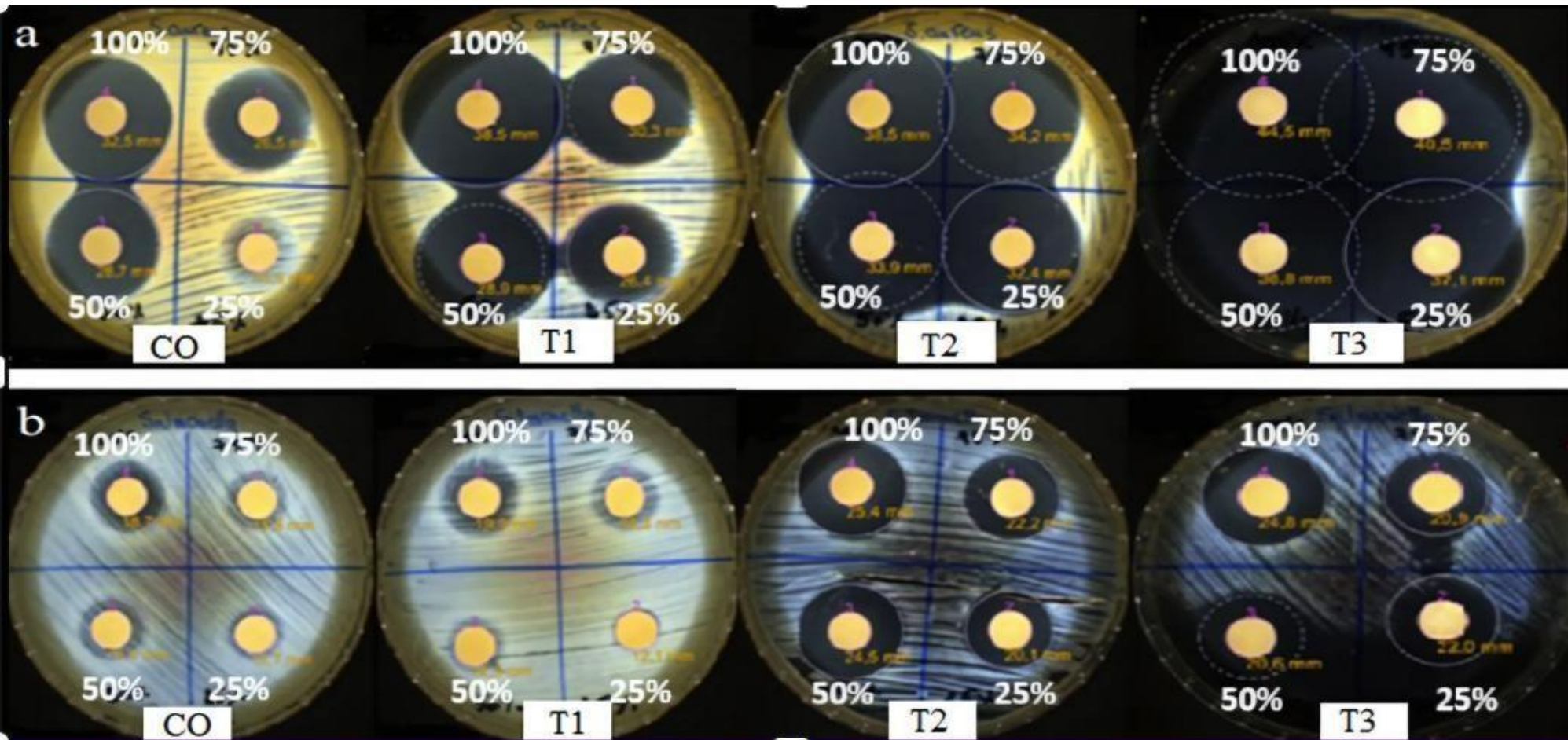
Treatments	Inhibition zone (mm)
CO	24,0145c (+++)
T1	27,1836b (+++)
T2	29,8511a (+++)
T3	29,2571a(+++)

Table2:inhibitory effect of garlic extract inocula ted with *trichoderma* isolates on microbial pathogens according to concentration.

Concentrations %	Inhibition zone (mm)
100	32,6321a(+++)
75	28,5273b(+++)
50	26,7442c(+++)
10	22,4026d (+++)

Table3:Inhibitory effect of garlic extract inoculated with *trichoderma* isolates on microbial pathogens according to strains.

Strains	Inhibition zone (mm)
Staphylococcus aureus	32,6917a(+++)
Saccharomyces cerevisiae	31,2064ab(+++)
Candida albicans	28,8292bc(+++)
Bacillus subtilis	28,4275cd(+++)
Escherichia coli	26,9521cd(+++)
Staphylococcus epidermidis	25,9 d (+++)
Salmonella typhimyrum	19,0292e(++)



a: *Staphylococcus aureus*, b: *Salmonella typhimyrum*
Figure 31: Inhibitory zone of aqueous extracts of garlic inoculated with *T.asprellum* against the most and least sensitive strain

Among the tested garlic phytochemicals, γ-glutamyl-S-allylcysteine exhibited the strongest binding affinity against *Salmonella typhi*, suggesting that *Trichoderma asperellum* inoculation may enhance its production.

CONCLUSION

The T3 and T2 isolates demonstrated superior efficacy in enhancing the antimicrobial properties of garlic, particularly by promoting the synthesis of γ-glutamyl-S-allylcysteine when compared to the other isolate and the control under investigation. These findings suggest that T3 and T2 have the potential to serve as promising sources for the development of natural antimicrobial formulations. alternatives to conventional antibiotics.

FUTURE WORK / REFERENCES

- Assefa, A. G., Mesgina, S. H., and Abrha, Y. W. (2015). Effect of inorganic and organic fertilizers on the growth and yield of garlic crop (*Allium sativum* L.) in Northern Ethiopia. *Journal of Agricultural Science*, 7(4), 80–86.
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