Development of PVA Hydrogels with Green Synthesis Metallic Nanoparticles for Water Disinfection

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INTRODUCTION

Contaminated drinking water is the leading cause of the proliferation of diseases such as diarrhea, typhoid fever, hepatitis A and E, poliomyelitis, and cholera. The main objective of this project is the development of a safe polymeric matrix with superabsorption characteristics, loaded with green-synthesis silver nanoparticles (NPs), with biocidal activity for the treatment of contaminated water.

METHODOLOGY

The synthesis of Ag-NPs was carried out through the reduction of silver nitrate using fungal exudates of *Macrophomina phaseolina*, *Trichoderma harzianum* and *Penicillium bilaiae*.

PVA hydrogels was formed by physical crosslinking (freeze-thaw cycles).

Characterization techniques was applied to both materials.

RESULTS OF Ag-NPs

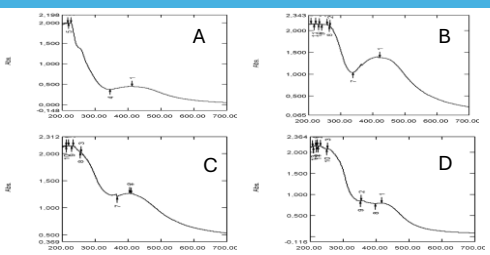

Fig. 1. UV-Vis spectra showing the surface plasmon resonance of Ag-NPs synthesized using different exudates: (A) Macrophomina, (B) Macrophomina+starch, (C) Trichoderma+starch, and (D) Penicillium+starch.

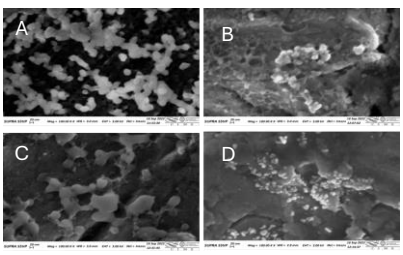

Fig. 2. SEM micrographs of Ag-NPs. (A) Macrophomina, (B) Macrophomina+starch, (C) Trichoderma+starch, and (D) Penicillium+starch. scale bar = 20 nm.

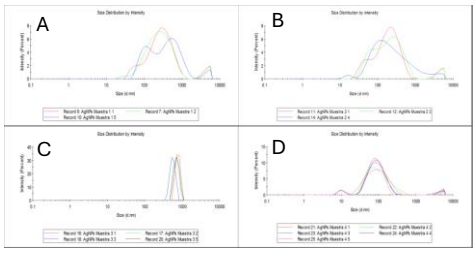

Fig. 3. Size distribution of silver nanoparticles (Ag-NPs) obtained from dynamic light scattering (DLS): (A) Macrophomina sp., (B) Macrophomina sp. + starch, (C) Trichoderma sp. + starch, and (D) Penicillium sp. + starch.

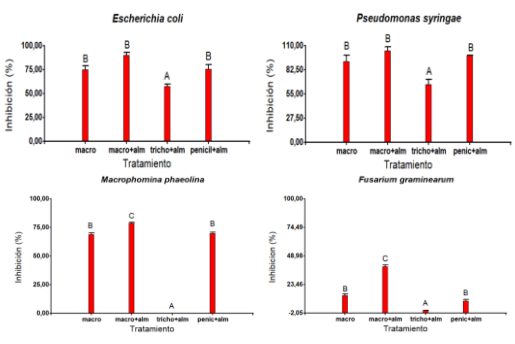

Fig. 4. Biocidal activity test of Ag-NPs.Ag-NPs were tested on *Escherichia coli*, *Pseudomonas syringae*, *M. phaseolina*, *and Fusarium graminearum*. For bacteria, the Ag-NPs concentration used was 1 µg/µl, while for fungi, it was 0.1 µg/µl.

RESULTS OF PVA HYDROGELS

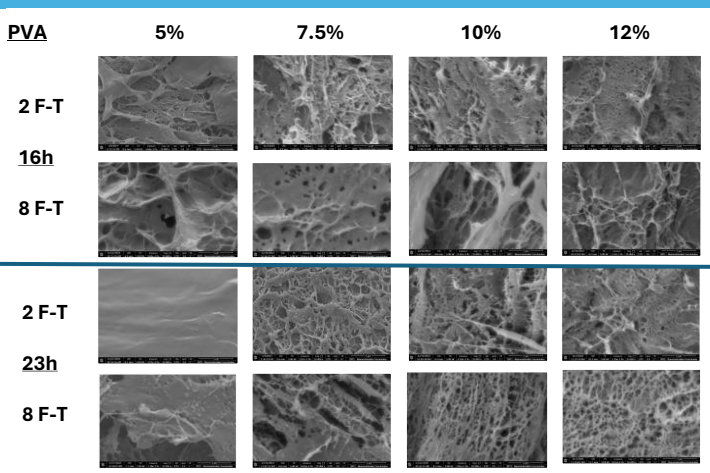

Figure 5. Representative SEM micrographs of PVA hydrogels samples. From left to right: 5%, 7.5%, 10%, and 12%. From top to bottom: 16 hours with 2, and 8 F-T cycles; 23 hours with 2, and 8 F-T cycles.

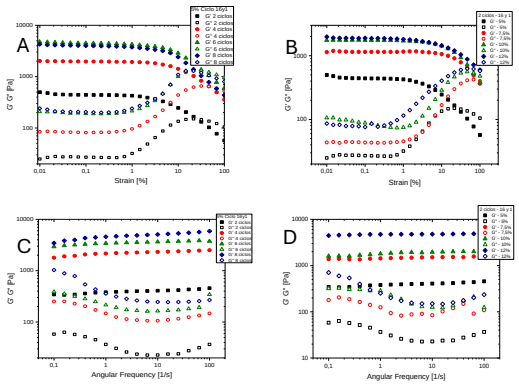

Fig. 6. Rheology analysis of PVA hydrogel samples. A and B: Strain sweep tests. C and D: Frequency sweep. In A and C, freeze-thaw (F-T) cycles are compared, while in B and D, PVA concentrations are compared.

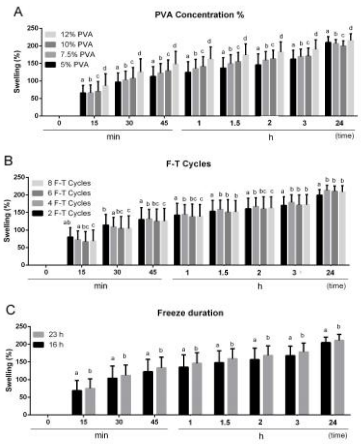

Figure 7. Swelling of hydrogels (%) as a function of time. A) Comparison of freezing-thawing cycles (2, 4, 6, and 8). B) Comparison of PVA concentrations (5, 7.5, 10, and 12%). C) Comparison of freezing duration (16 and 23 h).

CONCLUSIONS

Successful optimization of the synthesis of Ag-NPs and the PVA hydrogels. The results obtained allow for the optimization of material production, considering their properties, functionality, and the inputs used.

The next stage will focus on the production and characterization of PVA hydrogels loaded with different concentrations of Ag-NPs, aiming to evaluate their potential for water disinfection.

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