Biological Fabrication of Copper Sulfide Nanoparticles for Antimicrobial Applications

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Introduction

- The growing number of drug-resistant bacteria is one of the major concerns in medical healthcare.
- Bacteria has developed multiple protection mechanisms of resistance to antibiotics (i.e. enzyme inactivation, decreased cell permeability, altered antibiotic target site).[1]
- Copper sulfide (CuS) nanoparticles (NPs) have shown excellent antibacterial activity by creating Reactive Oxygen Species (ROS) and disturbing bacteria's membrane.[2]
- Bacterial biomolecules reduce and stabilize nanoparticle synthesis; helping with nanoparticle growth and dispersion.
- Biologically synthesized nanoparticles are fabricated by green synthesis and do not produce toxic byproducts; making it more attractive for biomedical applications.[3]

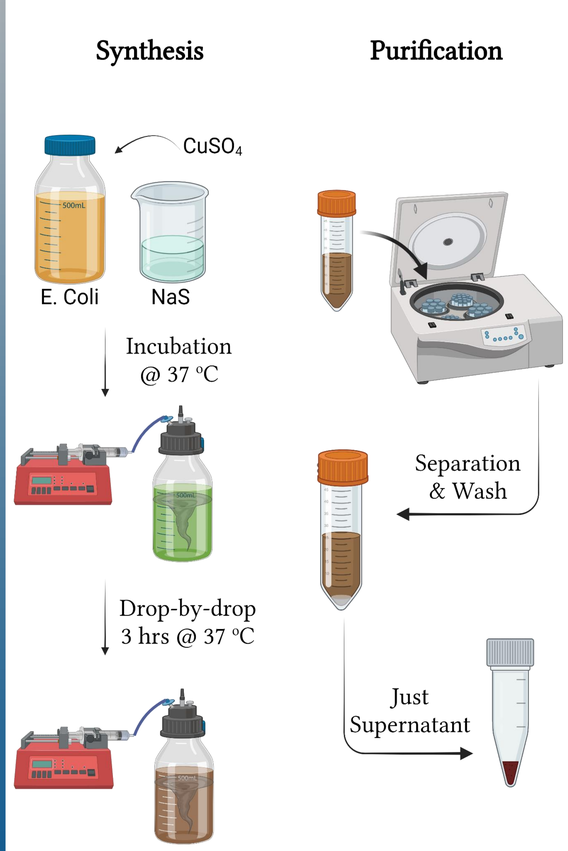
Objectives

i. **Develop** a novel biogenic synthesis protocol using Gram-negative and positive bacteria.

ii. **Determine** the effect of biogenic synthesis on the surface composition of the CuS NP.

iii. **Evaluate** CuS NP's potential antimicrobial capacity.

Synthesis & Purification



Results

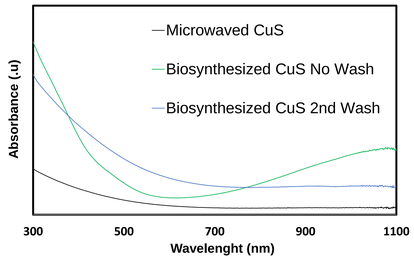


Fig. 3 UV-Vis for Chemical Vs. Biologically synthesized CuS

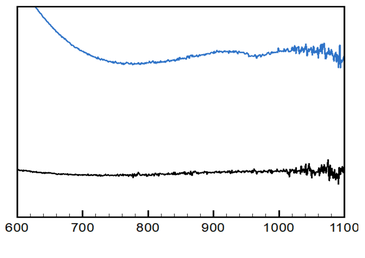


Fig. 4 UV-Vis detailed region from 600 to 1100 nm

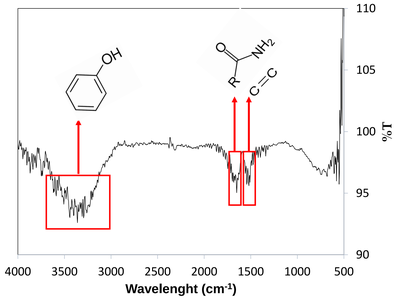


Fig. 5 FTIR of biosynthesized CuS NP

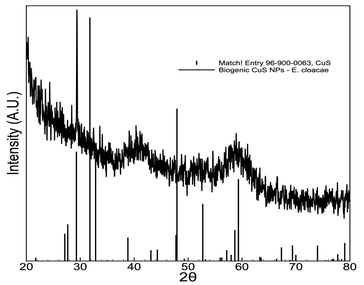


Fig. 6 XRD for biosynthesized CuS NP

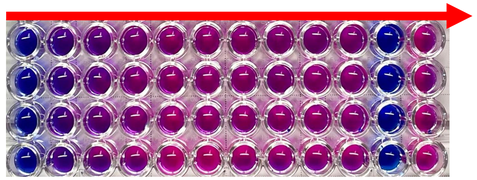


Fig. 6 Minimum Inhibitory Concentration (MIC)
The initial well started with a NP concentration of 2000 ppm (left) and a consecutive dilution (1:2) was made.

Conclusions

- Biogenic synthesis offers green alternatives to chemical synthesis.
- UV-Vis showed a smooth peak at ~920 nm suggesting formation of CuS.
- CuS nanoparticles shows a minimum inhibitory concentration at 2000 mg/L.
- The Fourier-Transform Infrared Spectroscopy suggests the presence of biologic material on the nanoparticle's surface.

Future Work

- Evaluate biologically and chemically synthesized CuS NP toxicity on multicellular organisms.
- Measure bacterial growth curves to verify the effects of the CuS salts when added to the bacteria culture medium.
- Characterize the possible Protein Corona in NP's surface through 2D Electrophoresis and Mass Spectroscopy

Acknowledgments

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