Synthesis and Antibacterial Activity of Silver Graphene Oxide Nanocomposites

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INTRODUCTION

- Escherichia coli (E. coli) is a significant contributor to chronic wound infections, such as post-surgical wounds and diabetic ulcers, which complicate recovery and place excessive strain on healthcare resources.
- The rise of antibiotic resistance has intensified the search for alternative treatments.
- Silver-graphene oxide (AgGO) nanocomposites emerge as a promising solution, offering antimicrobial benefits while limiting systemic side effects.
- This study focuses on the antibacterial potential of AgGO nanocomposites to eradicate E. coli infections, presenting an innovative approach to wound healing.
- The goal of this study of to determine the Minimum Inhibitory Concentration (MIC) and the Minimum Bactericidal Concentration (MBC) of AgGO against E. coli.

METHODS

- We synthesized Ag nanoparticle-doped GO via solution synthesis using GO, sliver nitrate ($AgNO_3$), and sodium borohydride ($NaBH_4$) as precursor at room temperature.
- The synthesized AgGO nanocomposites were washed and dried at 90°C.
- Transmission electron microscopy (TEM) combined energy dispersive x-ray spectroscopy (EDS) was used to characterize the size and chemical composition of nanocomposites.
- E. coli suspension at 10^3 CFU/mL in LB broth was treated with:
  - Increased concentrations of AgGO ranging from 0.02 to 3 mg/mL
  - LB broth (0 mg/mL) (Negative control)
  - 1 µL Kanamycin (KAN) at 100 ng/µL (Positive control)
  - LB broth alone was used as a blank control (LB)
- To determine the Minimum Inhibitory Concentration (MIC) of AgGO, treated E. coli was incubated at 37°C and optical density (600 nm) was monitored every hour for up to 16 hours using a UV-visible spectrophotometer.
- To determine the Minimum Bactericidal Concentration (MBC) of AgGO, we subcultured E. coli from MIC wells onto agar plates for another 21 hours and determined the MBC as the lowest AgGO concentration with no colony growth, indicating 99.9% bacterial death.

RESULTS

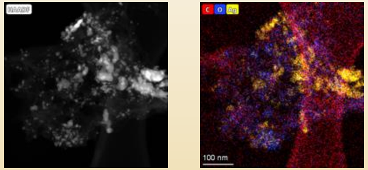

Figure 1: TEM images and chemical mapping of synthesized AgGO nanocomposites showing successful nucleation of AgNPs on GO nanosheets.

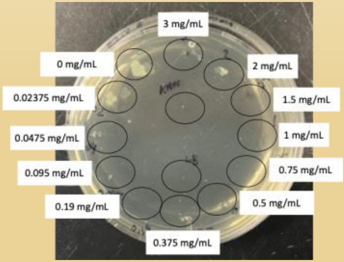

Figure 2: The MIC and MBC of AgGO against E. coli during a 3 hours incubation were 0.02375 and 0.0475 mg/mL, respectively.

RESULTS

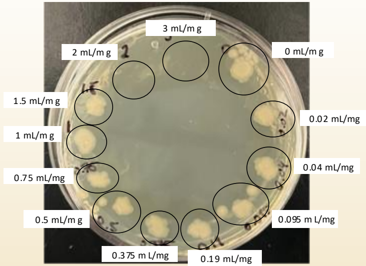

Figure 3: The MIC and MBC of AgGO against E. coli during a 16 hours incubation were 0.75 and 2 mg/mL, respectively.

CONCLUSION

- AgGO nanocomposites were successfully synthesized and demonstrated antibacterial activity against E. coli.
- AgGO shows strong antimicrobial at shorter culture times.
- Its topical application provides an alternative to oral antibiotics, reducing systemic effects and addressing antibiotic resistance concerns for treating wound infections.
- Further research is needed to assess AgGO's antimicrobial efficacy against a broader range of wound-associated pathogens.
- Exploring its full potential could enhance the development of advanced antimicrobial therapies in healthcare settings.

ACKNOWLEDGEMENT

This work was supported by the Surgical Infection Society and WMed Pilot grant program.