Synthesis and Characterization of Nanoparticle from the Waste Forinhibition of Microbial Growth

Mohammad Ikbal

Department of Chemistry Faculty of Science Dayalbagh Educational Institute Dayalbagh Agra, India

Author list (excluding presenting author)

Vaishnav Bartaria, Ranjit Kumar

Abstract

In this study, we delve into the intricate world of aerosol-associated microbial contaminants, embarking on a journey that encompasses the detection of microbial components in aerosol samples, the detailed characterization of bacteria and fungi within respirable suspended particulate matter, and the synthesis of graphene oxide (GO)-based nanoparticles for microbial inhibition. We employ a novel modified Hummers method to convert agricultural waste biomass, specifically coconut shell and pencil waste, into reduced graphene oxide (rGO) under mild operating conditions. The pilot study has been carried out at a suburban site in Agra over Indo-Gangetic basin. The Sub-urban area exhibited dynamic particulate matter fluctuations, reaching PM_{10} and $PM_{2.5}$ levels of 330.4 µg m^{-3} and 249.2 µg m . The concentration of respirable suspended particulate matter and fine particulate matter was much higher than WHO, USEPA and NAAQs of India. Microbial analysis revealed varying concentrations, suggesting seasonal influences. The concentration of microbial components in ambient air was in the reported range. Microscopic analysis identified respiratory threats and protozoans in particulate matter. The biomasses yield of rGO with unique characteristics was obtained from the wastes (coconut shell and pencil) through an eco-friendly and costeffective route to produce graphene-based materials. The synthesized rGO was characterized and investigated by advanced techniques such as Field Emission Scanning Electron Microscopy (FE-SEM), EDX, X-ray Diffraction (XRD) and UV-visible spectrophotometer to scrutinize the structural intricacies of the synthesized nanoparticles. The antimicrobial efficacy of these nanoparticles is rigorously assessed through Kirby Bauer tests on clinically relevant strains, providing qualitative insights into their inhibitory potential. FE-SEM displayed diverse microbial elements. GO inhibited Coccus by 93.7% and Aspergillus by 100%, while rGO inhibited E. coli by 88% and Brucella by 100%. The antimicrobial efficacy of GO-based nanoparticles is paving the way for innovative strategies in aerosol microbial inhibition across diverse applications.

Early Career Scientist

YES, I am an early career scientist.

IGAC Activities

ACAM: Atmospheric Chemistry and the Asian Monsoon, CCMi: Chemistry Climate Model Initiative, Allin-Wayra: Small Sensors for Atmospheric Science

IGAC Regional Working Groups

ANGA: African Group on Atmospheric Sciences