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Phyto-nano-hybrids of Ag-CuO particles for antibacterial activity against drug-resistant pathogens

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Abstract

Background: The present study reports the antibacterial potential of phyto-nano-hybrid particles Ag-CuO (silver-copper oxide) against drug-resistant pathogens isolated from a Russian hospital in Krasnoyarsk, Siberia. The synthesis of nano-hybrid was achieved by phytogenic source by using leaves of *Murraya koenigii*. The nano-hybrid particles were well characterized using hyphenated techniques and results of the antibacterial assay was tabulated.

Results: The UV-visible spectra displayed absorption at 420 nm with the shoulder peak at 355 nm indicating the hybridization. The FTIR analysis revealed the presence of phenol, amine, methyl, carbohydrate and aromatic as major functional groups. The XRD analysis revealed the presence of Bragg's intensities at 2 theta angle depicting the crystalline nature of Ag-CuO nano-hybrid. The TEM analysis displayed the polydispered properties of Ag-CuO nano-hybrid with the size in the range of 60–80 nm exhibiting different shapes ranging from spherical, rod and oval. The antibacterial activity of Ag-CuO nano-hybrid was tested against multidrug-resistant pathogens that resulted in highest activity against *P. aeruginosa* strain with an inhibition zone of 14 mm in diameter. The MIC concentrations ranged from 0.3125 to 2.5 μg/ml and broth dilution assay displayed dose-dependent properties of Ag-CuO nano-hybrid particles.

Conclusion: The obtained results are interesting to report the preliminary insight to develop biocompatible hybrid particles to combat drug-resistant pathogens. The developed nano-hybrid particles displayed activity against all the test pathogens investigated against both Gram-positive and Gram-negative bacteria. Thus, the study forms preliminary investigation to report nano-hybrid particles as broad spectrum antibacterial agents.

Keywords: Phytogenic, Nano-hybrid, Silver nanoparticles, Copper oxide nanoparticles, Multi-drug resistance, Antibacterial properties

Background

The implementation of nanoscience has led to considerable advancements in the development of novel structures for specific activities [1]. In recent years, construction of hybrid structures is of great interest since they efficiently perform desired activity [2]. The process of hybridization can be of different types based on the role and type of participating materials [3]. The utilization of evolved nano-hybrid complex can substantially improve the existing system or application. Metallic nanoparticles have proven greater efficiency to act as potent antibacterial agents in the recent years [4]. The efficacy of metallic nanoparticles to inhibit or suppress the growth of pathogenic bacteria can be attributed to their unique physicochemical properties [5, 6]. In the current scenario, there is an urgent need to develop novel or alternative antibacterial agents to combat drug resistance which has posed deleterious effects to increase mortality and morbidity

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