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Evaluation of Antimicrobial Efficacy of Nanofluid Containing Carbon Nanotubes Functionalized with Antibiotic on Urinary Tract Infection

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Abstract : Background: Urinary tract infection is one of the most common nosocomial infections, especially among women. E. coli is one of the main causes of urinary tract infections and one of the most common antibiotics to fight this bacterium is ampicillin. As conventional antibiotics led to bacterial antibiotic resistance, modification of the pure drugs can address this issue. The aim of this study was to prepare nanofluids containing carbon nanotubes conjugated with ampicillin to improve drug performance and reduce antibiotic resistance. Methods: Multi-walled carbon nanotubes (MWCNTs) were activated with thionyl chloride by reflux system and nanofluids containing antibiotics were prepared by ultrasonic method. The properties of the prepared nano-drug were investigated by general element analysis, infrared spectroscopy, Raman spectroscopy, scanning electron microscopy and transmission electron microscopy. After the treatment of the desired strain with nanofluid, microbial studies were performed to evaluate the antibacterial effects and molecular studies were carried out to measure the expression of the resistance gene AcrAB. Result: We have shown that the antimicrobial effect of ampicillin-functionalized MWCNTs at low concentrations performed better than that of the conventional drug in both resistant and ATCC strains. Also, a decrease in antibiotic resistance of bacteria treated with ampicillin-functionalized MWCNTs compared to the pure drug was observed. Also, ampicillin-functionalized MWCNTs downregulated the expression of AcrAB in treated bacteria. Conclusion: Because carbon nanotubes are capable of destroying the bacterial wall, which provides antibiotic resistance features in bacteria, their usage in the form of nanofluids can make lower dosages (about three times less) than that of the pure drug more effective. Additionally, the expression of the bacterial resistance gene AcrAB decreased, thereby reducing antibiotic resistance and improving drug performance against bacteria.

Keywords : urinary tract infection, antibiotic resistance, carbon nanotube, nanofluid
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