Nano Today, Huge Tomorrow: Improving Antibiotic Drug Delivery for S. epidermidis Strains with a Novel CNT Dispersion

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Although conventional antibiotics have become a staple of modern medicine, resistance is becoming a daunting threat. Essentially, misuse and overuse has allowed bacterial strains to evolve and adapt, making them invulnerable. The projected consequences are unimaginable with the WHO issuing a 10 million mortality prediction by 2050. Previous research showed that the combination of antibiotics and Ag nanoparticles is viable, promoting cell wall penetration and bacterial death. In this project specifically, carbon nanotubes (CNTs), known for their absorption and fluorescence properties, are being used as carriers of antibacterial treatments. With CNTs being relatively underexplored in the scope of antibacterial study, this project looks at finding a noncovalent method of CNT dispersion in antibiotics without the use of toxic binding agents such as polyethylene glycol (PEG). CNTs were successfully dispersed in two different carbon-ring structure antibiotics, doxycycline and methicillin, with elongated tip sonication and centrifuge filtration. All combinations were characterized with absorption spectroscopy and newly-derived solution coefficients. The antibiotic-nanotube dispersion was then introduced to S. epidermidis, a clinically resistant strain, through disk diffusion. All collected data was statistically analyzed with ANOVA and Dunnett's method to demonstrate the viability of the dispersion method. The findings of this study confirmed an increased antibacterial efficacy with a CNT-antibiotic dispersion, improving doxycycline by 8% and methicillin by 73%. Microscopy of treated cells demonstrated that carbon nanotubes were not just excellent combination materials and drug carriers, but also facilitators of existing modes of action, making them a multifaceted solution.

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