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Synthesis and Use of Gold Nanoparticle Therapeutics in Antibiotic-Resistant Bacteria

In recent years, nanoparticles have become increasingly promising in the biomedical industry due to their potential as novel tools in drug delivery. This research focused on the synthesis and applications of gold nanoparticle systems that would potentially maximize bacterial uptake and the growth inhibition of various bacteria. These experiments explored the abilities of gold nanoparticles not only to act as binding sites for antibiotics and uptake promoters (i.e. glucose or biotin) but also to carry antibiotic drugs into S. aureus and E. coli. I synthesized gold nanoparticles of two sizes by attaching them to various ciprofloxacin-based antibiotics as well as to glucose or biotin. First, the ligand attachments to the gold nanoparticles were confirmed by gel electrophoresis and UV-visible spectroscopy. The concentrations of gold and antibiotic in each nanoparticle system were determined using the Beer-Lambert Law. Then the inhibitory effects of the nanoparticle systems were tested and evaluated on E. coli and methicillin-resistant and methicillin-susceptible S. aureus. The results showed that nanoparticles can be successfully modified to increase their uptake in bacterial cells, consequently inhibiting bacterial growth. The nanoparticle systems studied were able to significantly inhibit both strains of S. aureus while they had limited effects on E. coli. Given the results on bacterial inhibition, these gold nanoparticles show potential as vehicles for drug delivery, which may be applicable to other therapeutics as well.