



CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s) Titash Biswas	Project Number S1604
Project Title Pyrimidine Derivatives Conjugated to Gold Nanoparticles to Combat Antibiotic Resistance	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Increased antibiotic resistance in bacteria has rendered many antibiotics useless; thus, the objective of this project was to develop a novel antimicrobial compound of pyrimidine derivatives conjugated to gold nanoparticles (AuNPs) to combat antibiotic resistance through varying mechanisms. Conjugated AuNPs were proposed to be self-therapeutic and to provide localized delivery of antibiotics. Combinations of the pyrimidine derivatives and common antibiotics may pose synergistic properties and demonstrate increased efficacies of the antibacterial agents.</p> <p>Methods/Materials Four pyrimidine derivatives with different functional groups attached to the rings and two antibiotics, ampicillin and gentamicin, were chosen for comparisons of antimicrobial properties against gram-negative Escherichia coli and gram-positive Bacillus subtilis. Each compound's antimicrobial properties were determined by broth microdilution assays, which produced minimum inhibitory concentrations (MICs). Two pyrimidine derivatives with confirmed MICs were conjugated to 20nm gold nanoparticles using covalent conjugation chemistry and the conjugations were confirmed by spectrophotometry. In addition, the antibacterial properties of combinations of pyrimidine derivatives and antibiotics were analyzed using the fractional inhibitory concentration index.</p> <p>Results Out of the four pyrimidine derivatives tested, the two with electron withdrawing groups, cytosine and 5-(4-chlorophenyl)pyrimidin-4-amine demonstrated strong antibacterial activity against E. coli and B. subtilis. After conjugation with the AuNPs, the two pyrimidines demonstrated enhanced efficacies against the bacteria and decreased MICs. Combinations of cytosine and the common antibiotics revealed synergistic relationships.</p> <p>Conclusions/Discussion The results of this project illustrated that the two pyrimidine derivatives with electron withdrawing functional groups possess antibacterial properties and, when conjugated to AuNPs, can deliver antibiotics more efficiently. The presence of a structure-activity and synergistic relationship between conjugated AuNPs and antibiotics was determined. These results can be utilized for new antibiotic design predictions in the long term battle against antibiotic resistant bacteria, a key issue in the healthcare industry.</p>	
Summary Statement A compound of pyrimidine derivatives with electron withdrawing functional groups conjugated to gold nanoparticles is an effective antimicrobial agent to combat antibiotic resistance in bacteria.	
Help Received The experiment was conducted in TheLab Inc. and was supervised by Dr. Siddhartha Biswas.	