Gold Nanoparticles as a Colorimetric Sensor for Escherichia coli

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The increasing prevalence of Escherichia coli (E. coli) in our freshwater sources is a growing concern for the global community. The aim of this project is determining a faster, more cost effective method of detecting E. coli in a water sample. One method for detecting E. coli operates through the use of thiol-capped gold nanoparticles. Gold nanoparticles (AuNPs) have a slight negative charge after they are synthesized by the citrate reduction method. They are then treated with mercaptoethylamine (MEA, a positive molecule). The resulting positively-charged MEA-AuNPs are attracted to the E. coli's cell wall, which is negatively charged. As E. coli concentration increases, more MEA-AuNPs are attracted to the cell, and less remain in solution. During this experiment, six separate solutions were created: AuNPs of diameters 50 nm, 40 nm, and 15 nm, and corresponding MEA-treated solutions. E. coli K12 was cultured to OD600 of 0.454 and then used to create a serial dilution. The goal was to determine whether MEA creates a more efficient sensor of E. coli. The resulting data found that the MEA-AuNPs of 15 nm were the most effective, detecting as few as 454 E. coli cells. The MEA-AuNP method was more efficient than the current EPA standards for E. coli testing, which rely upon a seven day developing test and a complex agar. The MEA-AuNPs, however, take five minutes to thoroughly evaluate concentrations, and are synthesized by four compounds. In the future, AuNPs could determine presence of E. coli before resorting to more expensive means to determine exact concentration. If this research was extended, wild-type E. coli K12 expressing its O16 antigen would be used for a more applicable sensor and unknown samples would be tested to determine the efficacy of the MEA-AuNPs.

Awards Won:

Fourth Award of $500