CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Adam J. Protter

Project Number
S0617

Project Title
Rapid Colorimetric Melamine Detection via Gold and Silver Nanoparticles

Abstract

Objectives/Goals
Melamine is a nitrogen rich organic base chemical used in wood, plastics, and adhesives that has recently been in the center of a food adulteration scandal in Asia. Recent scientific papers have concluded that gold nanoparticles can be used to detect melamine. The purpose of this project is to determine if silver nanoparticles, alone or in combination with gold nanoparticles can detect melamine in a colorimetric assay.

Methods/Materials
The aggregation and absorption properties of silver nanoparticles, as well as a gold/silver nanoparticle mixture were tested and compared with a published method of melamine detection utilizing unmodified gold nanoparticles. In order to test the effectiveness of the nanoparticles, varying sizes of nanoparticles were mixed with melamine, and any color changes observed visually, and quantitatively using spectrometry. Cyanuric acid, which complexes with melamine to form a precipitate, provided further visual confirmation of the presence of melamine.

Results
10nm silver nanoparticles consistently indicated the presence of melamine, yet were slower to aggregate than gold nanoparticles. Gold nanoparticles proved inconsistent in certain trials. The 20-50 nm silver nanoparticles did not aggregate in the presence of melamine.

Conclusions/Discussion
Unmodified 10nm silver nanoparticles, as well as a mixture of 10nm silver and 10nm gold nanoparticles are effective in detecting melamine in a colorimetric assay. My research concurred with a previously published paper, with 10 nm gold immediately indicating a color change, showing the presence of melamine. However, in my research, I found that gold nanoparticles were inconsistent. In several trials, the unmodified gold nanoparticles did not aggregate. The 10 nm silver nanoparticles were reliable and consistent, although they took a longer time to aggregate, approximately 30 minutes. The mixtures of gold and silver nanoparticles were effective in detecting melamine, and produced consistent qualitative data. The results were rapid, within 6 minutes, and there were no trials in which they failed to aggregate. However, the mixture provided very inconsistent quantitative data. The 20-50 nm silver nanoparticles did not yield any positive results for melamine.

Summary Statement
I created a novel method of detecting melamine in a colorimetric assay using silver nanoparticles.

Help Received
Used lab equipment at UCLA under the supervision of Dr. Fang Wei. Additional guidance provided by Dr. Malhotra, Thousand Oaks High, Science Advisor.