CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

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Project Number

J0615

Project Title

Green Nanotechnology: Novel Environmentally Benign Synthesis of Gold Nanoparticles for Bioapplications

Abstract

Objectives/Goals

Goal: The aim was to see if plant material could be used to produce gold nanoparticles, and, if yes, to analyze the characteristics of the nanoparticles produced. Challenge: Nanotechnology has amazingly diverse applications, from stain-resistant clothing to a potential cure for cancer. The conventional methods of producing nanoparticles utilize chemicals toxic both to the environment and the body. It is critical that nanoparticles be produced in a safe, green way so that they are environmentally friendly and biologically benign. Proposed Solution: Plants contain naturally occurring phytochemicals that give the plant antioxidant, anticancer, and antimicrobial properties. It was hypothesized that phytochemicals in plants can be harnessed to produce gold nanoparticles, and a resistance to aggregation in plant material-synthesized gold nanoparticles is expected.

Methods/Materials

The solvent was water, and the reducing and capping agent was the plant material. Three different plants were tested: cinnamon, cumin, and turmeric. The gold salt was HAuCl4. After production, nanoparticles were characterized with UV-Visible Absorption Spectroscopy and TEM analysis. In vitro stabilities of nanoparticles were tested with different dilutions, the addition of 5% NaCl, 0.5% cysteine, and Phosphate Buffer-7 to raise the pH of the solution to the physiological pH. Also, nanoparticles were produced using a conventional reducing agent, sodium citrate; the stability of these nanoparticles was tested as well. All tests were done in triplicates.

Results

UV-Vis showed that the peak wavelength was ~540 nm for cinnamon, ~531 nm for cumin, ~556 nm for turmeric. TEM showed particles were mostly spherical and had a size distribution of 13+/-6 nm. The peak wavelength did not change significantly through all stability tests. The nanoparticles had a robust coating and resisted aggregation.

Conclusions/Discussion

The hypotheses were supported. Plant material can be used to produce stable and biocompatible gold nanoparticles. Also, plant material-synthesized nanoparticles were strongly capped and resistant to aggregation, opposed to citrate-produced nanoparticles. This method uses environmentally friendly solvents, reducing, and capping agents and produces biologically benign nanoparticles. As the nanorevolution unfolds, this green method can help solve a pollution problem at the beginning state of a developing technology.

Summary Statement

This project investigated a novel, green chemistry approach to synthesize environmentally friendly and biologically benign gold nanoparticles using plant material, in an energy efficient and cost effective process.

Help Received

I acknowledge my family and teacher for their support; Dr. Terrill from SJSU for guidance with the UV-Vis; Dr. Susnitzky from EAG for use of TEM.