



**CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY**

Name(s) Arpita Singhal	Project Number S0697
Project Title Herbalism as an Anticancer Agent: Characterization and Evaluation of the Bioavailability of Curcumin Nanoparticles	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Goal: To create nanoparticles by encapsulating hydrophobic Curcumin in PLGA, an FDA-approved, biodegradable polymer, and to characterize and evaluate its bioavailability. 7.6 million people die from cancer each year. Curcumin, an anticancer polyphenol, interferes with cell signaling pathways involved in apoptosis, metastasis, and oncogene expression. Curcumin decreases the expression of inflammatory cytokines, so the growth of cancer cell lines is inhibited and inflammation-mediating enzymes, such as protein kinase C, are down-regulated. However, clinical use of Curcumin is limited due to its poor bioavailability; its instability and biodegradation in physiological pH limits its delivery to cancerous tissue.</p> <p>Methods/Materials Curcumin nanoparticles were prepared. Nanoparticles were characterized using DSC, FTIR, an optical microscope, and Fluorescence. The loading and encapsulation efficiencies were calculated. Solubility and stability tests for Curcumin and the nanoparticles were conducted. The bioavailability of the nanoparticles was evaluated using an in vitro release study.</p> <p>Results FTIR results showed that PLGA and Curcumin did not chemically react. DSC results showed that the nanoparticles became amorphous. Curcumin's peak corresponded to the melting point of its crystalline regions; a small relaxation peak was seen for PLGA. The microscope identified the nanoparticle size from 100 to 200 nm. Fluorescence data showed that Curcumin did not lose its photophysical properties in nanoparticle form. The loading efficiency was 5.79%, and the encapsulation efficiency was 89.7%. Curcumin stability decreased by 85% in 12 hours, whereas the nanoparticle stability decreased by 15% in 12 hours. Curcumin solubility was 0.06 mg/mL; the nanoparticle solubility was 3.42 mg/mL. The highest Curcumin release in intestinal juice was 81%; the highest Curcumin release in gastric juice was 47%.</p> <p>Conclusions/Discussion Creating Curcumin nanoparticles increased Curcumin's solubility, stability, and bioavailability. Encapsulating a hydrophobic drug in PLGA may result in sustained and controlled drug delivery for efficient treatment. Using nanoparticles helps increase the uptake into cells, such as those present in cancerous tissues. Further research: Once characterized and evaluated, the nanoparticles can be tested in cancer cells; also, other hydrophobic drugs can be encapsulated in PLGA to increase their bioavailability.</p>	
Summary Statement PLGA was used to create biocompatible Curcumin nanoparticles to improve Curcumin's bioavailability, and this test identified Curcumin nanoparticles as a potential alternative for cancer and inflammation.	
Help Received I thank Dr. Roger Terrill from San Jose State University for his guidance and allowing me to work in his laboratory and use his equipment; my science teacher for her guidance; and my family for their support.	