



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Daniel Feng	Project Number S1506
Project Title Discovering Antibacterial Molecules in a Previously Uninvestigated Native American Medicinal Herb	
<p style="text-align: center;">Abstract</p> <p>Objectives Antibiotic-resistant bacteria have rendered many modern antibiotics ineffective. Plants, however, have traditionally provided a rich source of medicines. In a previous project, I discovered that the Native American herb Ishwish (<i>Ceanothus leucodermis</i>) showed antibacterial properties. This year, my goals were to (1) purify the antimicrobial molecules in Ishwish from the thousands of other compounds present, (2) determine their identities, and (3) quantify their antibacterial strength.</p> <p>Methods To determine the optimal method to extract compounds from plant mass, I obtained several liquid extracts by changing the plant part, solvent, and heat applied. Antibacterial strength was tested using disk diffusion assays. I purified the optimal crude extract with C8 and silica gel chromatography columns. I then evaluated the effectiveness of my purification by using a low-resource method that I developed. This method can find the antibacterial strength (Minimum Inhibitory Concentration, MIC) of a sample by combining data from disk diffusion assays together with a diffusion simulation that I wrote in Python. After purification, I applied my most antibacterial fractions to LC-MS (Liquid Chromatography-Mass Spectrometry) analysis to identify the antimicrobial compounds. I compared my LC-MS data to molecular data found in the database METLIN.</p> <p>Results The extract from Ishwish stems in ethanol yielded the most antibacterial activity. I found that a C8 chromatography column, followed by a silica gel chromatography column, significantly purified my crude extract. By simulating disk diffusion assays in my Python program, I determined MICs using very small amounts of my active fractions and found that this purification was successful. Using LC-MS analysis, I determined that the active compounds were polymers of the molecule catechin. This antimicrobial class of compounds is also found in green tea.</p> <p>Conclusions I successfully isolated and identified the antibiotic molecules present in <i>C. leucodermis</i> as catechin and its polymers, and I demonstrated a real-life application of my computer simulation to determine antibacterial strength. This project provides a scientific basis for the Native Americans' use of Ishwish as an anti-infective. The strategies developed here can be applied to identify active compounds in other Native American herbs while using limited amounts of plant material.</p>	
Summary Statement I purified the antibiotic molecules in <i>C. leucodermis</i> , identified them to be members of the catechin family, and characterized the effectiveness of my purification procedure by applying my simulation-aided method to determine MICs.	
Help Received Prof. N. Da Silva hosted me in her lab at UC Irvine, T. Kim helped with bacterial work, Drs. F. Grun & B. Katz (UCI Mass Spectrometry Facility) gave advice on chromatography and taught me about LC-MS, and R. Crowe (UCI Arboretum) allowed me to gather <i>C. leucodermis</i> .	