



CALIFORNIA SCIENCE & ENGINEERING FAIR 2018 PROJECT SUMMARY

Name(s) <p style="text-align: center;">Daniel Feng</p>	Project Number <p style="text-align: right;">38604</p>
Project Title <p style="text-align: center;">Discovering Antibacterial Properties of "Old" Cultural Herbs Using a New Simulation-Aided Approach</p>	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The identification of new antibiotics and new methods for antibiotic testing can fight the antibiotic resistance crisis. The goals of this project are to (1) find antibacterial effects among traditional cultural herbs, and (2) develop a new and efficient approach to quantify the antibacterial strength of these herbs and identify synergistic combinations.</p> <p>Methods/Materials I identified promising antibacterial activity in traditional herbs from Chinese and Southern Californian Native American cultures. By combining experimental data with a computer simulation, I developed a new method to quantify antibacterial strength and synergies. First, I tested 13 traditional herbs to identify those with the most promising antibacterial properties. Aqueous extracts from them were tested against E. coli using a disk diffusion assay. I then wrote a Python computer program to simulate the diffusion of extracts on a petri dish. By combining this simulation with experimental data, I found the MIC (Minimum Inhibitory Concentration) of each. Lastly, I tested the antibacterial strength of herb combinations by pairing a double-disk diffusion assay with my simulation. This new method achieves in one assay what would require ~64-100 separate tests using conventional methods.</p> <p>Results Of the 13 herbs tested individually, Huang Lian, Huang Qin, Ishwish, and garlic showed strong signs of antibacterial activity. The identification of Ishwish is exciting, as the antibacterial properties of this Native American herb have never been determined previously in the literature. Huang Lian and Huang Qin had the strongest effect, with MICs at 4.8 mg (herb)/mL. Other antibacterial herbs had MICs ranging from 9.0 to 31.0 mg/mL. Finally, I found that all tested combinations had FICs (Fractional Inhibitory Concentrations) ranging from 1 to 2.5, classifying all of them as "indifferent" or "additive."</p> <p>Conclusions/Discussion Overall, I identified several cultural medicinal herbs with antibacterial properties, with Ishwish being a new result never recorded before. I then quantified the antibacterial strength of these herbs and combinations of herbs by developing a novel method that quantifies the antibacterial strength of a drug with much more efficiency than conventional methods. With further research, these herbs and this simulation aided-approach may be used to find new medicines to fight against antibiotic-resistant bacteria.</p>	
Summary Statement This project identified traditional herbal medicines with antibacterial properties and developed a novel, very low-resource method to quantify the antibacterial strength of substances and find synergistic combinations.	
Help Received I received help in bacteria culturing and conducted disk-diffusion assays at UC Irvine under the supervision of graduate student Tae Il Kim. Thanks to the UCI Arboretum and the "Tongva Hidden Garden" (Pitzer College) for permission to gather Native American plants.	