



**CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY**

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| Name(s) Ryan K. Ebrahimi | Project Number S1608 |
| Project Title Combating Antibiotic Resistance among Gram-Negative Bacteria through Inhibition of AHL-mediated Quorum Sensing | |
| <p style="text-align: center;">Abstract</p> <p>Objectives/Goals The experiment sought to determine a novel method for combating antibiotic resistance among gram-negative strains by targeting the quorum sensing signaling pathway responsible for biofilm formation, which was done through identifying an analogue to the N-acyl homoserine lactone (AHL) signaling molecule. Three analogues - bergamottin, cinnamaldehyde, and proanthocyanidin - were observed for their effect on biofilm development.</p> <p>Methods/Materials Materials included 100 mm (diameter) x 15 mm (depth) sterile petri dishes, nutrient agar, 4 dead California market squid (<i>Doryteuthis opalescens</i>), pure cinnamaldehyde, bergamot oil derived from bergamot oranges, and grape seed extract with 95% proanthocyanidins. When prepared in synthetic seawater, the exterior mantle of the squid provided a growth site for the gram-negative bacterium <i>Vibrio phosphoreum</i>. Four groups of nutrient agar culture media, including a control group and three experimental groups incorporating an AHL analogue, were prepared and inoculated with the experimental strain, and the petri dishes were cultivated for four days until visible colony forming units (CFUs) developed.</p> <p>Results Culture media that included nutrient agar and bergamottin had a mean CFU count that was 35.8 CFUs fewer than the mean of the control group, with agar media containing cinnamaldehyde and proanthocyanidin having 30.8 and 10.3 fewer CFUs than the control, respectively. Furthermore, bergamottin had the lowest dispersion value of visible colonies with 0.89 CFUs/cm².</p> <p>Conclusions/Discussion Bergamottin was indicated as the most effective AHL analogue as biofilm development was reduced the most significantly compared to the other compounds, which is a result of mimicking binding patterns between AHLs and the active site of the LuxR-type receptor. Competitive inhibition and disruption of the quorum sensing pathway can reduce cell aggregation so as to prevent horizontal gene transfer and other mechanisms that contribute to resistance.</p> | |
| Summary Statement I identified an effective analogue to the AHL signaling molecule capable of disrupting the quorum sensing pathway necessary for biofilm formation, allowing for gram-negative strains to exhibit increased susceptibility towards antibiotics. | |
| Help Received I devised the experimental design myself and conducted the experiment independently. My AP Biology teacher Mr. David Knight gave constructive criticism regarding my final report, and my Chemistry teacher Mrs. Julie Pomerleau allotted space in her laboratory for culturing the bacteria. | |