CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Emily Kang

Project Number

S1514

Project Title

Turning Over a New Phage: A Novel Approach to Phage Therapy

Abstract

Objectives

The increasing incidence of antibiotic resistance in bacteria necessitates the development of a new approach to target such infections without the constant overuse of antibiotics. This project tests the viability of alternatives to phage cocktails, the current standard for bacteriophage therapy, in order to develop a more sustainable treatment option.

Methods

To test a sequential approach to phage therapy, E. coli was initially cultured with T1 phage, with a single addition of T4 phage after varying periods of time. As a model of a phage cocktail under similar conditions, both T1 and T4 phage were cultured with E. coli; kinetic growth curves were created using absorbance for both methods. Based on the results from the sequential method, a computational model was created using Matlab to map growth dynamics for phage and bacteria based on the acquisition of resistance.

Results

Both the phage cocktail and the sequential approach were effective in eradicating the bacterial population without the emergence of resistance. The phage cocktail was initially faster in killing bacteria than the sequential method, but both methods displayed a similar end result. In contrast, bacteria grown with only one phage (T1 or T4) eventually gained resistance and was capable of logistic growth in the present of the single phage.

Conclusions

Based on growth curve data, sequential phage treatment was demonstrated to be capable of successfully eliminating a population of bacteria, whereas bacteria grown with only one phage quickly developed resistance and were able to proliferate and multiply instead of being killed. Although the method of applying phage in a sequential manner may require more than two different phage in most cases, it still ensures that only the phage necessary to control an infection are used, minimizing the types of phage that the bacteria is exposed to. In contrast, the current use of phage cocktails runs the risk of exposing bacteria to all of the phage in stock, which poses a possibility for the emergence of multiphage-resistant bacteria. Future studies could build on the computational model and focus on the development of a simulation that determines the optimal interval between phage additions in order to completely eradicate a population of bacteria, based on the infection mechanisms of the phage and the specific growth rates of the bacteria and phage in question.

Summary Statement

My project addresses the problem of antibiotic resistance in bacterial infections using a novel approach that uses bacteriophage to sustainably treat bacterial populations while minimizing the long-term risk of resistance to phage.

Help Received

Primarily used the lab space and equipment at my high school. Used a plate reader and qPCR machine from Dr. Isaac Mehl for final assays and received S. platensis and S. platensis phage from Roland Liu from the Pogliano Lab in the early stages of the project.