CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

S1516

Project Title

Toward a Strategy for Extending Antibiotic Effectiveness Indefinitely: Introducing Antibacterial Bio-Restriction

Abstract

Objectives/Goals

The objective is to see if antibacterial bio-restriction (a combination of conjugation inhibition, bacterial interference, and antibiotic) will inhibit the proliferation of the model resistant pathogen (E. coli TOP10F' tetR).

Methods/Materials

With TOP10F' (tetR donor) as the model resistant pathogen and TOP10 + pVIB (ampR recipient) as the model symbiotic, these two strains were co-cultured at an initial ratio of 1:1000 (F':pVIB). In this media was also 25% MIC of Ampiciliin and non-lytic phage M13 (independent variable). This culture was incubated for 24 hours, and then a 2 µL inoculation was added into a fresh media with all the same additional compounds (excluding cells). This process continued over 4 days. Selective plating was used to calculate number of transconjugant, donor, and recipient cells. The differentiating factor between CONTROL and EXPERIMENTAL was the addition of phage M13. In a pilot study, phage M13 showed no significant lytic effect on the model pathogen (TOP10F').

Results

In the EXPERIMENTAL, the model symbiotic grew to an astounding 3.02 x 10^11 cells/mL while the model pathogen lowered to negligible levels after just 2 days. In the CONTROL, the model symbiotic only grew to 1.98 x 10^11 cells/mL, while the model pathogen and transconjugant grew to about 2.2 x 10^7 cells/mL and were still on the rise.

Conclusions/Discussion

The greatest danger of antibiotic resistance is the proliferation of resistant pathogens caused by selective pressure. Unlike previous therapies, the new strategy of antibacterial bio-restriction holds the hopes of extending antibiotic effectiveness indefinitely due to the fact that it targets the amount of space/ nutrients available for pathogen growth, a factor that pathogens have limited evolutionary control over despite natural selection. In addition, there are ramifications that may make this approach revitalizable if resistance was ever to occur. However, while only time can tell how "indefinite" this strategy may be, I believe that it's worth a try.

The results suggest that bio-restriction may be feasible and was effective within a controlled environment. Note that the model resistant pathogen wasn't targeted by any direct bactericidal compounds, but rather most likely died due to competition for nutrients.

Summary Statement

By rethinking antibiotic resistance through the use of a combination of antibacterial methods, extending the effectiveness of antibiotic indefinitely may be within reach.

Help Received

Universal Biopharma Research Laboratory supplied materials and minor troubleshooting assistance for the experiment.