CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

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Project Number

34749

Project Title

A Novel Method of Mitigating Bacterial Quorum Sensing via Inhibition of Autoinducer-2 by Polyvinyl Alcohol

Abstract

Objectives/Goals

A recent trend in microbiology appears to be a rising prevalence in bacterial infection that cannot simply be resolved through standard antibiotic treatment. Bacteria communicate using a signal-transduction mechanism known as quorum sensing. Bacteria release signal molecules called autoinducers. Autoinducers increase in concentration as bacterial population increases. When the concentration reaches a threshold level, genes alter in expression, enabling the bacteria to perform specific functions. One such autoinducer, autoinducer-2 (AI-2), contains boron. This experiment seeks to impair the function of AI-2 through the use of polyvinyl alcohol (PVA),which has high affinity for boron. PVA could be a means of inhibiting the activity of AI-2, which depends on boron in its molecule for its activities.

Methods/Materials

In this experiment, Vibrio and E. coli cultures were prepared. E. coli was cultured in LB-media containing PVA. After 24 hours, Vibrio cultures were transferred to Autoinducer Bioassay Media. The E. coli cultures were centrifuged, and the supernatant was transferred to Vibrio samples. After the vibrio samples were grown overnight, bioluminescence measurements were taken and analyzed both qualitatively and quantitatively using ImageJ software, measured in Corrected Total Cell Fluorescence. As a control, vibrio were assayed for bioluminescence after being inoculated with supernatant from E. coli samples not grown in media containing PVA. The experiment was conducted using three control samples, nine samples containing 0.5% PVA, nine samples containing 1% PVA, and nine samples containing 2% PVA.

Results

Of the thirty assayed samples, all of the controls visibly displayed bioluminescence whereas only five of the nine samples containing 0.5% PVA, four of the nine samples containing 1% PVA, and two of the nine samples containing 2% PVA displayed visible bioluminescence. The average Corrected Total Cell Fluorescence of the control was 209358.33 CTCF compared to 205940.20 CTCF in samples containing 0.5% PVA, 190344.78 CTCF in samples containing 1% PVA and 130450.84 CTCF in samples containing 2% PVA.

Conclusions/Discussion

The results of my experiment proved my hypothesis correct-- PVA is effective in inhibiting the activity of AI-2. V. harveyi uses AI-2 both to regulate bioluminescence and virulence, meaning that these results demonstrate the effectiveness of boron sequestration in curtailing virulence.

Summary Statement

My project explores the signal transduction pathways that bacteria use to gage population density and seeks to disrupt those pathways by sequestering boron from signal molecules.

Help Received

Used equipment and facilities at Schmahl Science Workshop under supervision of Ms. Ibtisam Khalaf, Dr. Aru Hill; borrowed camera from Dr. Yusef Ismail; Parents provided immense love and support

Preliminary