CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
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Project Number
S1324

Project Title
The Effect of Ultraviolet Radiation on the Tetracycline-Resistant Gene in XL1-Blue Bacteria

Abstract

Objectives/Goals
Many bacteria have become antibiotic-resistant, making bacterial diseases harder to treat. The purpose of my experiment was to test if ultraviolet radiation could disrupt the antibiotic-resistant gene in bacteria.

Methods/Materials
I used a strain of XL1-Blue bacteria that has been genetically modified to be tetracycline-resistant. I exposed a saturated culture of the bacteria to ultraviolet radiation for increasing lengths of time ranging from 0 seconds (control) to 3.5 minutes at 30 second intervals. After each exposure, a small amount of the culture was diluted (500,000X # 1X) and plated on 4 LB-agar plates: 2 plates with tetracycline and 2 plates without tetracycline. After incubating the plates overnight, I counted the number of bacterial colonies on them and calculated the bacterial density in the culture. The experiment was repeated with a second culture. Negative controls (plates without bacteria) were included to ensure that contamination was not present. The dilution and exposure time required were determined in preliminary experiments.

Results
I found that the bacterial density in the culture decreased exponentially with exposure time in all cases. Regression analysis showed that the average bacterial density followed the model log10(d) = 9.433-0.0366t where d is the bacterial density in bacteria/ml and t is the exposure time in seconds. The models for bacteria plated with tetracycline and the bacteria plated without tetracycline were log10(d) = 9.429-0.0372t and log10(d) = 9.436-0.0361t respectively. R^2 values for all three models were greater than 0.98, showing an excellent fit to data. An analysis of variance showed that the null hypothesis (decay rates of the two models are equal) could be rejected with p=0.06.

Conclusions/Discussion
My hypothesis was that if UV radiation disrupted the tetracycline-resistant gene, then the exposed XL1-Blue bacteria would die at a faster rate in the presence of tetracycline. My experiment validated this hypothesis: UV radiation reduced the resistance of bacteria to tetracycline by a small but statistically significant amount. Further research is needed, however, to identify mutagens that are more effective than ultraviolet radiation.

Summary Statement
When a tetracycline-resistant strain of XL1-Blue bacteria is exposed to ultraviolet radiation, it becomes slightly less resistant to tetracycline.

Help Received
Dr. Julia Prescott gave me the bacteria and tetracycline for my experiment and checked my procedures. Ms. Seawell and Mr. Rodriguez of Gene Connections supplied me with the materials and equipment for my experiment and Ms. Seawell gave me suggestions for improving my project.