CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
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Project Number
S1307

Project Title
Inducing Ultraviolet Light Resistance in E. coli

Abstract

Objectives/Goals
The objective is to determine whether exposing E. coli to a short burst of ultraviolet light before a longer exposure will increase survival by triggering the production of constitutive DNA repair enzymes.

Methods/Materials
Two strains of E. coli, K-12, or wild type, and LexA3(Ind-), a strain incapable of inducing enzyme production necessary for SOS DNA repair, were split into three groups each. Each group was exposed to one of three conditions: No UV light, 30 minutes of UV light, and five minutes of UV light followed by 30 minutes of UV light. All plates were kept out of visible light to assure photoreactivation repair was not induced. Five plates of E. coli were used for each of the six conditions in five trials, for a total of 25 plates for each condition. Plate coverage was evaluated based on histograms of digital photographs.

Results
Exposing the K-12 strain to the extra five minutes of UV light increased survival by an average of 10.2% plate coverage, while exposing LexA3(Ind-) bacteria decreased survival by an average of 2.4%. The controls, with no UV exposure, grew nearly equivalently, assuring that the only difference between the strains was their ability to fix DNA damage caused by UV.

Conclusions/Discussion
There are three basic sources of DNA repair enzymes: enzymes that exist in the cell constitutively, enzymes that are triggered by exposure to visible light, and SOS repair enzymes, which are produced when the other two sources are inadequate. In this project, photoreactivation was disabled in all bacteria, while SOS repair was disabled in the LexA3(Ind-) bacteria. Constitutive production of SOS DNA repair enzymes was triggered with a shorter UV exposure prior to a longer exposure. My results are applicable in the field of water purification, as they prove that decontaminating E. coli in water is more effective with a long, single exposure than several shorter exposures.

Summary Statement
A short exposure to ultraviolet light prior to a longer exposure increases E. coli survival by triggering the production of constitutive DNA repair enzymes.

Help Received
Mary Berlyn from the Yale E. coli bank helped me obtain the LexA3(Ind-) strain. Dr. Kendric Smith elucidated my understanding of repair enzyme control in E. coli. Tim Hanna gave suggestions and helped with statistical analysis.