CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Alexander C. Young

Project Number

J1616

Project Title

Investigating the Rate at which Bacteria Develop Resistance to Antibiotics under Different Conditions

Abstract

Objectives/Goals

Antibiotic resistance is becoming an increasingly serious threat to public health in nearly every region of the world, as resistant strains of bacteria force patients to resort to higher-risk procedures and further shorten the list of effective drugs. The objective of this project was to determine if the misuse of antibiotics led to the accelerated development of antibiotic resistance over the course of several applications. I originally hypothesized that incomplete or incorrect dosages would not necessarily lead to accelerated selection, as suboptimal levels of antibiotic in the bloodstream would place less selective pressure on the population.

Methods/Materials

Mixed suspension of B. subtilis, M. luteus, and R. rubrum, nutrient agar plates, nutrient broth tubes, inoculating loops, cotton swabs, incubator, ampicillin solution, blank antibiotic disks, micropipettes, forceps, rulers

I began by streaking nutrient agar plates with mixed bacterial strains (B. subtilis, M. luteus, R. rubrum), placing down antibiotic disks impregnated with full strength ampicillin (simulated correct dosages), 1:10 serial dilution, 1:100 serial dilution, 1:1000 serial dilution (dilutions simulated incomplete dosages), and pure water (the control), and incubating the plates. After measuring the diameters of the zones of inhibition produced by the Kirby Bauer Disk Susceptibility tests, I subcultured the bacteria from around the edges of the zones of inhibition in nutrient broth, incubated them, and plated them. I repeated the process two more times to produce three generations with two rounds of selection.

Results

For each case and generation, I took the averages of the three replicates and compared the Generation 1 diameters to the Generation 3 diameters. The full strength case had a 31% decrease in diameter, the 1:10 dilution case had a 50% decrease in diameter, the 1:100 dilution case had a 53% decrease in diameter, and the 1:1000 dilution case had a 67% decrease in diameter.

Conclusions/Discussion

This evidence did not support my hypothesis; clearly, bacteria exposed to lower concentrations of antibiotic develop resistance at a faster rate over the course of several generations compared to those exposed to higher concentrations of antibiotic. Thus, patients taking antibiotics must be careful not to take incomplete or incorrect dosages, as the misuse of such drugs can accelerate the development of resistance.

Summary Statement

This project examines the rate at which populations of bacteria develop resistance over the course of several generations when exposed to different concentrations of antibiotic.

Help Received

My advisor, Dr. Thomas Artiss, provided advice and guidance throughout the process.