CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

35167

Project Title

Assessing the Mutagenicities of Common Herbicides Using a Novel Reverse Mutation Assay

Abstract

Objectives/Goals

The purpose of this research project is to assess the mutagenicities of three major herbicides: 2,4-D, atrazine, and trifluralin, in an effort to determine if the substances are carcinogens. In the process, this project also aims to establish an efficient and novel assay that utilizes the bacterial strain, E. coli WP2 uvrA pKM101, to identify carcinogens.

Methods/Materials

This project incorporated a reverse mutation assay to quantitatively measure the mutagenicities of the herbicides. The utilized strain, E. coli WP2 uvrA pKM101, has a mutation in the trp operon and thus cannot grow or reproduce. When placed in a petri dish, the bacteria will only form colonies if they undergo reverse mutations in their trp operons. Mutagens increase the likelihood of these reverse mutations. Therefore, using this assay, I quantitatively assessed the mutagenic effects of the herbicides on the bacteria by analyzing the resulting bacterial growth. Three concentrations of each herbicide were tested, providing data to help determine whether the substances are carcinogenic. In addition, the assay was tested on two known carcinogens, 4NOP and MMS, to ensure that the procedures were functioning properly.

Results

2,4-D demonstrated no mutagenic effects on the E. coli WP2 bacteria, while atrazine and trifluralin both produced mildly mutagenic effects, with atrazine displaying the strongest evidence of mutagenicity. In addition, both trifluralin and atrazine revealed a positive correlation between substance concentration and average colony count, indicating that concentration has a role in mutagenicity. Atrazine, in particular, demonstrated a near linear positive correlation.

Conclusions/Discussion

The results indicated that 2,4-D has a low mutagenicity while atrazine and trifluralin both have mild mutagenicities. They possess the ability to increase the reverse mutation frequencies in E. coli WP2 bacteria and thus have potential to cause mutations in human cells. This data provides valuable insight into the nature of these herbicides. Furthermore, I established an efficient and safe assay for identifying mutagens in a standard laboratory environment. This assay can potentially be used to detect a broad range of mutagens that induce base-pair substitution mutations. It can also be used in conjunction with other protocols to comprehensively assess the mutagenic and carcinogenic effects of various substances.

Summary Statement

My research project assessed the mutagenicities of three major herbicides using a novel reverse mutation assay that I established as an improvement over existing protocols.

Help Received

Research was conducted in American River College under the supervision of Dr. Kenneth Kubo and in William Jessup University under the supervision of the lab technician, Mr. Paul DeCoux.

Preliminary