CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

S2118

Project Title

Genotoxicity Investigation by Measuring the Effect of Metals on Garlic Bioassays by Observing Chromosomal Aberrations

Abstract

Objectives/Goals

The purpose of this experiment is to study how metal contamination impacts biological organisms at a cellular level and how the growth properties of cells are impacted. The biological organisms react to the negative metal stimulus by producing genetic mutations that could lead to cancer. My hypothesis states that certain concentrations of metal ions inside a bioassay cause genetically mutated cells, which detrimentally impact the health of an organism and could lead to cancer in animal tissue.

Methods/Materials

Genotoxic effects in garlic root tips are observed using a very direct method. First, garlic gloves need to be exposed to test chemicals for 72 hours. The test chemicals I used were copper sulfate and lead nitrate. Then, a squash preparation is made by placing garlic roots into fixation solution (9 parts 95% acetic acid and 1 part 1 M HCL) and staining them with Aceto-Orcein stain (1% aqueous solution). Lastly, the freshly created slides are investigated under a microscope and scored for chromosomal aberrations and micronuclei.

Results

As the concentration increases, the number of genotoxic effects increases for both copper sulfate and lead nitrate. Those genotoxic effects were already visible at 2.5% of the EC50 value for both copper sulfate and lead nitrate. The microscopic impact of lead and copper ions was observed by the increase of the number of genotoxic effects. The macroscopic impact was also observed by the descending trend in the macroscopic analysis graphs, which means that as the concentration rises the growth of the garlic roots are negatively impacted.

Conclusions/Discussion

A direct link between microscopic and macroscopic properties of a garlic bioassay were found, confirming the hypothesis. The genotoxic effects observed at a microscopic scale correspond to DNA damage, while the root growth inhibition observed at a macroscopic scale is possibly caused due to protein damage. More research is necessary in order to connect damages that happen in the genome with damages that occur in the proteome. Even at low concentrations, genotoxic effects were detected. Therefore the direct exposure to even small amounts of lead and copper should be kept at a minimum. These genotoxic effects could lead to cancer inside animal/human tissue if the impacted cells do not trigger programmed cell death (apoptosis).

Summary Statement

My project is about the genotoxicity of metal concentrations on garlic root bioassays measured by the observations of chromosomal aberrations, found in cells undergoing mitosis, that can lead to cancer in animal/human tissue.

Help Received

I am a member of the STEM research class from Lynbrook High School. I received equipment and knowledge from science teachers: Mr. Jason Lee and Mrs. Carol Fong. Professor Muhsin Konuk and Professor Ruth Sofield were kind enough to reply to my emails with answers to my questions.