CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
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Project Number
J0402

Project Title
Alzheimer's Disease: Inhibitory Effects of Metals and Metal-EDTA Complexes on Peroxidase Activity

Abstract

Objectives/Goals
There are two main physical symptoms of Alzheimer's disease: plaque formation resulting from the aggregation of beta-amyloid protein and abnormal deposits of tau protein called neurofibrillary tangles. The plaques have been found to mediate the formation of hydrogen peroxide in the presence of some metal ions. Peroxidase enzyme breaks down reactive hydrogen peroxide into oxygen and water and may be useful in the prevention of Alzheimer's disease.

Methods/Materials
I tested the effects of metal salts and their EDTA complexes on peroxidase activity using the Guaiacol method. Guaiacol is readily oxidized by oxygen in the presence of the heme iron of peroxidases to yield a colored product, tetraguaiacol, which can be measured at 470 nm using a spectrophotometer. A total of 14,640 absorbance readings were made in 240 tests performed with five metal ions and their EDTA complexes. A microplate spectrophotometer was used to allow rapid absorbance measurements as a function of time.

Results
Three of the metal ions tested: aluminum, zinc, and manganese had a concentration dependent effect on peroxidase activity. Aluminum lowered peroxidase activity by 36%, while zinc and manganese enhanced activity by 12% and 8%, respectively. Two other metals, calcium and magnesium, had no significant effect. EDTA alone did not have a significant effect on peroxidase activity, but when combined with manganese and zinc, it nearly shut down peroxidase activity, reducing it by 93% and 98%. EDTA complexes of aluminum, calcium, and magnesium also significantly lowered enzyme activity by 67%, 43%, and 14%, respectively. These observations are consistent with my earlier findings in which metal-EDTA complexes had a devastating effect on the activity of catalase, another enzyme that breaks down hydrogen peroxide.

Conclusions/Discussion
My results from this two-year study show that the widely suggested EDTA chelation therapy for Alzheimer's disease may not be helpful, but may in fact be detrimental. Metal-EDTA complexes consistently inhibited peroxidase and catalase activity, which may have implications on the ability of catalases and peroxidases to protect cells from death.

Summary Statement
The aim of this project was to evaluate the effects of various metal ions and a chelating agent (EDTA) on peroxidase activity using an automated microplate reader to accurately measure the rate of reaction.

Help Received
I would like to thank my father for teaching me correct lab technique and explaining how to operate the microplate reader. I would also like to thank my mother and my science teacher for their constant support of me and my project.