CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
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Project Number
J0403

Project Title
Effects of Chelation on Catalase Activity: Implications in Alzheimer's Disease

Abstract

Objectives/Goals
The possible mechanisms of Alzheimer's disease include aggregation of proteins to form plaques and neurofibrillary tangles and metal ion mediated formation of hydrogen peroxide. Catalase breaks down hydrogen peroxide into oxygen and water and may thus be useful in Alzheimer's prevention.

Methods/Materials
I tested the impact of metal salts on catalase activity. I also studied the effect of the chelating agent, EDTA and turmeric, an antioxidant and potential chelator. I monitored the results by the floating disc method. I dropped a filter paper disc saturated with catalase solution into a hydrogen peroxide and metal ion and/or EDTA, turmeric solution. I then measured the time for the disc to rise to the surface.

Results
A total of 180 tests were performed in this experiment with five different metal ions. Three of five metal ions studied, aluminum (Al3+), zinc (Zn2+), and calcium (Ca2+), reduced catalase activity. Aluminum (Al3+) was the most damaging, slowing the reaction by 20%, followed by zinc (Zn2+) (11%), and calcium (Ca2+) (4%). Calcium impacts may not be significant because of the small drop in reaction rate. Surprisingly, manganese (Mn2+) and magnesium (Mg2+) increased the reaction rate by 18% and 20%, respectively. The addition of turmeric did not impact the reaction rate in the presence or absence of aluminum (Al3+). EDTA alone depressed the catalase reaction by 14%. The combination of EDTA and metal ions was found to consistently inhibit catalase activity, no matter whether the ion alone increased or decreased the reaction rate. The EDTA and metal combination reaction reduction rate was 79% for aluminum (Al3+), 79% for zinc (Zn2+), 60% for calcium (Ca2+), 71% for manganese (Mn2+) and 61% for magnesium (Mg2+).

Conclusions/Discussion
My results show that it is necessary to test the effects of chelation not only on metal ions, but also on key enzymes. The widely suggested chelation therapy for Alzheimer's disease using EDTA may not be helpful, but may in fact be detrimental. In this experiment, EDTA, when combined with any of the metal ions tested, consistently and potently inhibited catalase activity. This could significantly affect the breakdown of hydrogen peroxide and impact catalse's ability to protect the cell from death.

Summary Statement
This project investigated the effects of metal ions, EDTA and turmeric on catalase activity and found some metal ions depressed catalase activity, but in the presence of EDTA, all metal ions tested significantly inhibited catalase function.

Help Received
My parents and teacher helped edit my report; I used lab facilities at Accugent Laboratories; AM Chemicals provided some metal salts.