CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)

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Project Number

J0406

Project Title

How Do Substrate Amount, Temperature, pH, Enzyme Amount, and Inhibitor Affect Catalase Activity?

Abstract

Objectives/Goals

The purpose of my experiment is to determine the effect of hydrogen peroxide amount, temperature, pH, enzyme amount, and inhibitor on catalase activity. The independent variables are: substrate amount (ml), temperature (celsius), pH, enzyme amount (ml), and copper sulfate (mmoles). The dependent variable is rate of oxygen production (mmoles/sec). The hypothesis is: 1) If the substrate amount increases, the rate of reaction will increase, until point of catalase saturation. 2) If the temperature increases, the rate of reaction will increase, until point of enzyme denaturation. 3) Catalase activity has an optimum pH. 4) If the enzyme amount increases, the rate of reaction increases. 5) Adding copper sulfate decreases rate of reaction

Methods/Materials

Catalase (from dry yeast) catalyzes hydrogen peroxide to produce water and oxygen . The amount of the substrate (3% H(2)O(2)) used ranged from 20-240ml. Temperatures used ranged from 10-70 degrees celsius in increments of 10. pH used ranged from 2-12 in increments of 2. Amounts of enzyme used: 5, 10, 15ml. Amount of CuSO(4) used ranged from 0.063-3.125mmoles The rate of reaction was measured by the rate of oxygen production in mmoles/sec.

Results

1) Rate of reaction was directly proportional to H(2)O(2) amount used until point of catalase saturation at 180ml. 2) Rate of reaction was directly proportional to the temperature until catalase denaturation at 60 degrees celsius. 3) Optimum pH for catalase was 6. 4) Rate of Reaction was directly proportional to enzyme amount. 5) Increasing Copper Sulfate amount decreased rate of reaction until point of maximum enzyme inhibition at 0.313 mmoles. My hypothesis was supported for all categories tested.

Conclusions/Discussion

Catalase is made of a central heme and four polypeptide chains. Its active site binds to hydrogen peroxide and decomposes it to oxygen and water. My data suggests that enzyme activity depends on several modifiable variables. Factors that increase binding of H(2)O(2) to catalase, such as increasing substrate and enzyme amounts, and increasing temperature, will increase the rate of reaction. After all active sites are occupied, adding more hydrogen peroxide will not affect the rate of reaction. Factors that cause catalase denaturation, such as high temperatures, extreme pHs, and non-competitive inhibitors, can change its 3-dimensional structure, rendering it less active.

Summary Statement

I tested the effect of hydrogen peroxide amount, temperature, pH, catalase amount, and the inhibitor copper sulfate on catalase activity.

Help Received

Parents guided me through experiment and purchased necessary equipment and chemicals.