CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

35720

Project Title

Effects of Metal Cations on the Kinetics of Ortho-Nitrophenyl-Beta Galactoside (ONPG) Hydrolysis by Lactase

Abstract

Objectives/Goals

The project is a chemical-assay experimentation on the effects of metal cations on the hydrolysis rate of lactose by the lactase enzyme. The purpose was to determine if commonly consumed metal cations altered the reaction rate of a lactase reaction, particularly if any sped up the hydrolysis.

Methods/Materials

Photo Spectrometer
Ortho- Nitrophenyl- Beta Galactoside (ONPG)
Lactase Enzyme
Iron(iii) Chloride
Aluminium Chloride
Potassium Chloride
Zinc Chloride
pH Buffers

Reaction rates were measured in terms of percentage transmission of light through the solution using a spectrometer. Due to their water solubility, three different concentrations of aluminum chloride, iron(iii) chloride, potassium chloride, and zinc chloride were used as test variables and dissolved in distilled water.

Results

Each metals cation was tested at .25 M, .5 M, 1 M to mimic the small concentrations found in the human body for a total of 208 tests. Potassium chloride sped up the reaction by 10%, while aluminum chloride, iron(iii) chloride, and zinc chloride slowed down the reaction rate by 80%, 100%, and 120% respectively. Overall trends within the different molarities included the slowing of the reactions with higher concentrations, which may have hindered the enzyme reaction.

Conclusions/Discussion

The contributions of the project are applicable in the real world. Approximately 65% of the world suffers from mild to severe lactose intolerance. This condition is characterized by a lack of lactase enzyme in the body. Potassium intake along with lactase supplements enhances the speed of the reaction in the body, leading the deduction that lactose intolerant individuals should consume potassium-rich foods, like banana, before foods containing lactose. Further causes for investigation may include whether or not temperature or pH affects this reaction in order to find the optimal time for usage.

Summary Statement

This project describes the effects of metal cations commonly found in the human body on the process of lactase hydrolysis and its subsequent role in the digestive system.

Help Received

Used lab equipment from Silver Creek High School