CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

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Project Number

J0595

Project Title

Targeting Postprandial Hyperglycemia: Novel Use of Cyanidin and Eugenol to Inhibit alpha-Glucosidase for Type 2 Diabetes

Abstract

Objectives/Goals

Diabetes is a lifelong chronic disease where high levels of glucose are in the blood. The American Diabetes Association states that in 2011, 25.8 million Americans had diabetes. In Type 2 Diabetes, postprandial hyperglycemia, an exaggerated rise of blood sugar after a meal, occurs. To reduce postprandial hyperglycemia, the activity of the enzyme alpha-glucosidase, which catalyzes the hydrolysis of maltose to glucose units, must be lowered. The goal of my research project was to test the in vitro enzyme inhibitory activity of alpha-glucosidase by the novel, plant based inhibitors, the anthocyanin cyanidin and the phenylpropane eugenol, and comparing inhibition to the FDA approved drug acarbose.

Methods/Materials

An enzyme solution was prepared at the concentration of 6.7 mg/mL. A solution containing assay buffer, substrate, and 10 µL eugenol was prepared, and that solution was pipetted into a micro cuvette for the spectrophotometer reading. After adding enzyme, activity was measured at 2, 5, and 10 min with the wavelength of the spectrophotometer at 405 nm. The previous step was repeated using 15 µL of eugenol, 5 and 10 µL of cyanidin, and all three concentrations of positive control acarbose. Cyanidin and acarbose were dissolved at the concentration of 2 mg/mL. The assay was also tested with the enzyme only to compare data. This experiment was repeated in triplicates, and total of 19 assays were conducted to determine results.

Results

For data analysis, the overall enzyme activity rate over 5 minutes was calculated. Cyanidin worked best, reducing the enzyme catalyzing rate from 101.59 U/L to 16.15 U/L at 3.1 mM over 5 minutes. At 6.2 mM, the rate was reduced to 25.99 U/L. Eugenol also inhibited the enzyme, reducing the rate to 93.33 U/L at 256 mM and to 3.13 U/L at 384 mM. Cyanidin worked better than acarbose by almost 3.5 times.

Conclusions/Discussion

This research has discovered that both eugenol and cyanidin are novel inhibitors of the enzyme alpha-glucosidase, and both can, with additional experimentation, be used to reduce postprandial hyperglycemia, leading to a possible solution to Type 2 Diabetes. Both of these inhibitors possibly work through the process of uncompetitive inhibition, where the inhibitor binds onto the enzyme-substrate complex, which displaces the equilibrium created. More amounts of substrate are therefore needed to produce the product, which lowers the activity of the enzyme.

Summary Statement

My research identified two novel and natural alpha-glucosidase inhibitors as potential therapeutic agents for postprandial hyperglycemia, and were successfully tested with in vitro spectrophotometric assays.

Help Received

My mentor, Dr. Stephens from Santa Clara University, guided me through my project; my science teacher, Ms. Nguyen, and my parents supported me.