CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Mythri Ambatipudi

Project Number

34864

Project Title

Break the AGE Barrier! Inhibit Advanced Glycation End-products to Combat Atherosclerosis, Cancer and Diabetic Disorders

Abstract

Objectives/Goals

Advanced Glycation End-products (AGEs) have been identified as the root cause of atherosclerosis, cancer, Alzheimer's and diabetic neuropathy, retinopathy and nephropathy. AGEs alter the structures and functions of vital proteins and lipids. The objective of this project is to identify conditions for AGE formation, identify solutions for inhibiting AGE formation and to provide a potential breakthrough cure for many life-threatening diseases. The objective is to test and compare the inhibitory effects of 9 natural additives containing phenols, anthocyanins, chelators and GLUT1 monopolizers on AGE formation.

Methods/Materials

AGE formation due to non-enzymatic endogenous (endo) and exogenous (exo) protein glycation (PG) and lipid peroxidation (LPO) was simulated with 4 in vitro tests (5 trials in each test) with and without equal concentrations of the 9 additives. PG tests used ribose, maltose, fructose, lactose and glucose sugars. Endo-PG tests were conducted at 37 deg. C with collagen and sugars. Exo-PG tests were conducted at 100, 80 and 60 deg. C with lysine and sugars. A home-made smartphone spectrophotometer (constructed with a DVD diffraction grating and injection molded plastic parts) and Beer Lambert's Law were used to compute solution absorbance. LPO tests used safflower oil (monounsaturated fatty acid-MUFA) and olive oil (polyunsaturated fatty acid-PUFA). Fenton's Reagent created reactive oxygen species in the oils. Iodometric titration was used to compute their peroxide values (PV). Changes in absorbance values, reaction rates, PV and IC(50) values (versus the control) were used to rank the additives.

Results

Ribose produced the most AGEs (55.2% more than maltose). Ascorbic acid inhibited PG the best (68% endo, 62.6% exo), followed by blueberry. PUFAs produced 73.9% more AGEs than MUFAs. Resveratrol inhibited LPO the best (58.5% endo, 64.2% exo), followed by carnosine and tocopherol. However, the anomalies, niacinamide for PG and blackcurrant for LPO, didn't inhibit or increased AGE formation in some cases. AGE formation increased at higher temperatures. PG increased and LPO decreased with increasing alkalinity.

Conclusions/Discussion

This project has identified a potential breakthrough treatment for AGE inhibition to combat cancer, atherosclerosis, Alzheimer's and other diabetic disorders. The AGE inhibitory properties of all the additives, except blackcurrant and niacinamide, have been identified.

Summary Statement

My project aims to identify several inexpensive AGE inhibitors, discover several critical factors for controlling AGE formation, and provide breakthrough remedies for several life-threatening diseases.

Help Received

My science teacher, Mrs. Makhijani provided valuable guidance. My parents purchased all the materials and provided encouragement.