CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

36787

Project Title

A Novel Silk Fibroin Derived Paper Sensor for the Noninvasive Detection of Diabetes

Abstract

Objectives/Goals

The purpose of this project was to create a novel, completely noninvasive diagnostic test for diabetes.

Methods/Materials

Silk fibroin was extracted from Bombyx mori silk cocoons in the form of a viscous liquid solution. A Sodium Assay Kit (Colorimetric) was completed as per assay kit instructions. A silk fibroin concentration paper dilution test was performed to determine the optimal silk fibroin concentration for coating of the strips. The variables of type of strip preparation, amount of silk fibroin solution, enzyme concentration, and volume of reagents were tested within each diagnostic test strip to determine the optimal qualities for efficiency and accuracy. A total of 52 different types of diagnostic test strips were tested.

Results

Arguably the most important data collected from this process was that all of the strips that were dipped in silk fibroin solution with ßG 4x (diluted at 1:49 ratio) enzyme concentration and 50 µl of total reagents produced color change in 100% of the test strips. The color change produced by these test strips was clearly proportional to the amount of sodium in the sample, as determined by visual assessment. These strips had the highest success rates as well as the greatest color intensity. In addition, no control test strips (no sodium in sample) changed color.

Conclusions/Discussion

This novel, noninvasive approach to detect diabetes eliminates many of the inconveniences occurring in the current diagnostic tests available to consumers. This diagnostic test does not need nearly as much time, equipment, and training as current tests require. The sensor uses 5 micro-liters of sweat, costs $1.55 and takes 45 minutes to conduct and generate results.

Summary Statement

This study devised a novel sensor for the completely noninvasive detection of diabetes; it uses 5 micro-liters of sweat, costs $1.55, and takes 45 minutes to conduct and generate results.

Help Received

I performed all steps in this protocol entirely on my own. Dr. Robert Edwards at University of California, Irvine allowed me to access his laboratory to use several pieces of scientific equipment. In addition, I also conversed with Dr. Shane Ardo and his graduate student David Fabian for insight on my project.