CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

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Project Number

S1512

Project Title

E. diabli: A Synthetic Biological Approach for Tackling Type 2 Diabetes

Abstract

Objectives/Goals

Type 2 diabetes is an illness where an adequate amount of insulin is not produced.Current treatments for diabetes require constant monitoring of blood glucose through injections of insulin or other hormones. My goal was to engineer an E. Coli that would live in the human gut to sense high levels of glucose and then produce and secrete the hormone GLP-1 which would stimulate the production of insulin which lowers blood glucose levels. I designed two plasmids: one that can sense high levels of glucose and generate and secrete GLP-1 and a control that would generate and secrete GLP-1 constitutively.

Methods/Materials

First, I performed the transformation to insert my plasmids into the E. coli. Next, I cultured the transformed bacteria on plates that contained the antibiotic Ampicillin which allowed only the transformed bacteria to grow to check if the transformation had worked. Next, I subcultured the transformed bacteria in 5 different conditions which corresponded to different levels of blood glucose. After this, I centrifuged the bacteria to separate the supernatant from the pellet which I then lysed. Lastly, I performed the ELISA to find exactly how much GLP-1 had been produced and secreted.

Results

The E. Coli with the constitutive promoter constantly produced an average of 600 pmol of GLP-1 and secreted an average of 180 pmol of GLP-1. It was not affected by the amount of glucose in which the E. coli was given to grow in. However, E. diabli (E. coli with the glucose sensing) produced varying amounts of GLP-1 based on the amount of glucose it grew inside. When the bacteria was grown in the medias that corresponded to none and low amounts of glucose, it secreted around 20 pmol of GLP-1, a very small amount. When it was grown in the medias corresponding to normal, diabetic, and extremely high amounts of glucose, it secreted up to 200 pmol of GLP-1, an ideal amount.

Conclusions/Discussion

My hypothesis was fully supported since E. Diabli secreted an ideal amount of GLP-1 when it was subjected to normal, high, and diabetic levels of glucose. Since only around 10%-15% of the GLP-1 (20 pmol) will actually reach the liver, this solution is perfect. On the other hand, my control plasmid with the constitutive promoter generally produced a constant amount. Clearly, this work is very promising and opens up a very new way of treating Type 2 diabetes.

Summary Statement

This project was about engineering a bacteria to constantly monitor the blood glucose levels diabetic patients by changing the behavior of an E. coli to make it sense high levels of glucose and secrete a hormone to control the high levels.

Help Received

Mother helped me conduct research; Used lab equipment in Schmahl Science; Dr. Aru helped answer questions; Dr. Sam watched over my experiment