Proinsulitron: a new device for type 1 diabetes treatment

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Introduction
“Every 7 seconds one person dies from diabetes” (IDF, 2014).

Diabetes Mellitus: Chronic disorder characterized by hyperglycemia

- Type 1 Diabetes
- Type 2 Diabetes

Destruction of pancreatic B cells leads to insulin deficiency

Ortho proposal

Uncomfortable

Expensive

Insulin pumps or multiple daily insulin injections

Our proposal

Proinsulitron

Diabetes in the world

382 million people have diabetes

Type 1 diabetes is one of the most common chronic diseases in children

Deaths caused by diabetes per year

Methodology

Biobrick Design

gBlock synthesis

Gibson assembly

Restriction analysis

Transformation

Western Blot

Experimentation and Characterization

- Our constructs were assembled correctly and verified by restriction analysis.

- LISPRO expression in Rosetta-gami and SHuffle E. coli strains

- Western blot of bacteria with or without LISPRO was performed. Proinsulin synthesis is detected in the strains transformed with the construct. Further analysis is required to verify disulphide bond formation. SIGMA insulin AB was used.

- Single colony minipreps were digested with XbaI to verify the Gibson assembly. TrgZ construct was expected to have a 3.7 Kb and LISPRO 2.7 Kb approximately.

Design

A biocompatible device was designed for treatment implementation. The device is composed by a modular mechanism that takes into account mathematical models from the interstitial fluid and simulated loads act on the device by applying the method of finite element analysis. It allows the passage of interstitial fluid through its pores and aims to confine bacteria.

- a) iris gate (innovative catheter) made of surgical metal.
- b) bacterial container, made of porous biocompatible polymer similar to that used in hormonal subdermal implants.
- c) 5 bar mechanism with eccentric gear, this allows mechanical movement to dispense bacteria.
- d) external device is used for extraction and exchange of bacteria (3D printing).

Model

Our model explains the dynamics regarding insulin and glucose in the organism. The underlying system could be generalized to a system that regulates the insulin production. The implementation of our mathematical model could facilitate the configuration of the system according to a biological basis, using experimental data to accomplish the correct regulation of glucose.

As the main function of insulin is to decrease the glucose values, we evaluated different scenarios with different initial conditions showing the effect on glucose levels

The people, Human Practices

It is important for us to get younger people and our fellow citizens involved with science to take it off as a taboo. To accomplish that, we got involved in many activities like:

- Open a workshop with curricular value in the science faculty to present to students the importance of synthetic biology
- Planning a nationwide project of popularizing science, in collaboration with AIESEC
- Presentation on innovation forums that allowed us to define objectives and perspectives on the needs of patients with diabetes.

We were also pleased to help our friends from the UNAH iGEM Team and hope their project to be successful.

Advisors and Attributions

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