CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)

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Project Number

J1729

Project Title

A Conductometric Biosensor for the Detection of Food-Borne Pathogens

Abstract

Objectives/Goals

Current detection methods for pathogens such as Salmonella are time consuming and laborious. Biosensors are a fast, portable, and user friendly test method that could potentially replace current laboratory techniques; my project aimed to design, build, and test a polyaniline-based conductometric biosensor for the detection of Salmonella, while using the FDA method as a reference. I hypothesized that the biosensor will give higher accuracy, a lower detection limit, and a faster response time than the FDA method.

Methods/Materials

First, I built a conductometric biosensor by preparing the individual membranes of the biosensor and placing them over a copper wafer fabricated on a microscope slide. I serially diluted a liquid culture of Salmonella enterica from 10^6 to 10^1 CFU/ml. I applied the sample to the application pad of the biosensor and recorded the resistance at 15 sec, 30 sec, 1 min, 2 min, and 3 min intervals. I also tested the biosensor with a mixed culture of Staphylococcus epidermidis and Salmonella. For the FDA method, I plated each concentration of Salmonella onto McConkey plates and incubated overnight.

Results

In the presence of the target antigen, a working biosensor should show a reduction in resistance. The conductometric biosensor showed significant resistance reductions from about 10 K-ohms (negative control of broth) to 2-3 K-ohms from the concentrations 10^3 to 10^6 CFU/ml, confirming the presence of Salmonella. At concentration of 10^2 CFU/ml, only one sample showed a decrease in resistance; the other sample showed resistance above that of the negative control sample. During the mixed culture experiment, the biosensor could detect Salmonella even in the presence of non-target antigens.

Conclusions/Discussion

The biosensor, which can detect the target antigen 15 seconds after the sample is applied, is a much more rapid test than the FDA method, which takes at least overnight to obtain results. Since the biosensor showed resistance reductions for all samples from 10^3 to 10^6 CFU/ml but only one sample of 10^2, the lower detection limit must lie between 10^2 to 10^3 CFU/ml. In my experiment, the resistance reductions were not proportional to the concentration of Salmonella, so I concluded that my biosensor can only detect Salmonella qualitatively. The FDA method proved the presence of Salmonella through a color change and appearance of growth.

Summary Statement

In this experiment, I designed, built, and tested a conductometric biosensor for its effectiveness in the detection of common food-borne pathogen, Salmonella, in pure and mixed culture.

Help Received

Professor Ouverney from SJSU for advice, materials, and lab space; Professor Alocilja and Dr. Okafor from Michigan State University helped me understand principle of biosensor; Ms. Sarah Thaler for her insigtful discussions and lab assistance; My science teacher and parents for support.