

Synthetic Bacterial Computing

& applications in environmental biosensors

A project by

Kaitek Labs

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Funding

Prize money: - USD 50 K
(IBMC by BYU, GIST by AAAS, Jump Chile
by EmpreundeUC, Aplica tu idea by
CopecUC)
Seed: - USD 340 K
(InnovaChile CORFO)

Technology & Innovation

Bacteria have a natural capacity to gather and process information about its surroundings. This computer-like function has been overlooked for many years, and never before has there been an initiative that harnesses such capacity. By giving this natural functionality both a purpose and a human interface, we can turn bacteria into information gathering machines, capable of expressing their findings to human users by simple organoleptic changes.

RTDK is an example of this bacterial computer or new generation biosensor approach. Using Synthetic Biology tools, our team has been capable of devising a pathway that allows a cell culture to measure the amount of a certain targeted toxin and then display an optical change in order to inform the results to the user.

Team

Kaitek labs was founded on 2013 by Emilia Díaz (CEO), bioentrepreneur with a background in Engineering, Biotechnology and Computer Science. She leads the administrative and economic sector of the company, while Cristóbal Aller and Felipe Varea (CTO & COO, both Environmental Biotech Engineers) lead its technical area. The company aims to become a reference in R&D&I in biotechnology both at national and international level, and a pioneer in bacterial computing and environmental biosensors.

Kaitek has the support of the Chilean government through CORFO, granting Kaitek U\$D 350K for the development of their product. The project has been awarded many prizes both in national and international contests, including BYU's "IBMC" (USA, 2015), AAAS's "GIST" (Morocco, 2014), Copec-UC's "Aplica tu idea" (Chile, 2014), Empreunde UC's "Jump" (Chile, 2012) totaling over U\$D 50K in prize money in three years, and enabling the founder to attend programs such as Singularity University's GSP 2015.

Elevator Pitch

Kaitek Labs harnesses the computing power of bacteria, turning them into in vivo testing assays for virtually any target metabolite. Kaitek has developed three basic synthetic pathways that allow bacteria to identify, measure and ultimately translate the assessed information to the user. These routes will be materialized in the company's first product: a red tide detection kit known as RTDK.

First Market Opportunity: Red Tide

Red tide is a worldwide phenomenon characterized by blooms of neurotoxin-producing micro algae. These toxins are accumulated by bivalve mollusks that are then rendered poisonous for human consumption. Eating contaminated shellfish can result in a wide variety of syndromes ranging from minor intoxications to respiratory paralysis and death.

28 countries are gravely affected by Red Tide. The associated economic loss ranges from U\$D32M in the Health industry in the USA to U\$D1B in Europe's Tourism industry. Isolated blooms that could last only a couple of days can inflict losses of up to a billion dollars in the Fishing industry in countries like Japan and the US.

The data on red tide poisoning is scarce, Reliable statistical data on these cases is largely unavailable, because cases are frequently misdiagnosed and infrequently reported. Mortality rates depend on the major toxin species present, and it may vary from 6% to 50% in the case of young children. In the US, there's an average of 1600 registered cases of intoxication due to ingestion of contaminated seafood per year, and at least 300 of said cases end up in death. In Europe, the cases of intoxication per year are 60.000 in average. We estimate global mortality to be around 100.000 cases per year.

Problem

There are currently no methods that provide a fast and easy identification of seafood and water contaminated by red tide toxins, while remaining cost-effective. Current detection techniques are based on the mouse bioassay, where one to ten mice per tested sample are injected with a mix of water and shellfish, and the time of their deaths (which takes from 24 to 72 hours) is mapped to correlate to the toxicity of the samples. Not only does it continue to propagate animal testing, but it is also slow, expensive, unreliable and impossible to use in remote locations, as it needs a specialized laboratory to operate.

Solution

The red tide detection kit currently being developed by our team will be able to indicate by a simple color change whether or not a certain sample has been contaminated by red tide toxins. This will be accomplished by generating a genetically engineered cell culture known as a biosensor that will have the ability to measure the amount of certain toxins present in said sample. This test will be easy to apply, and will display results in no longer than an hour, time we hope to reduce to minutes. It will also be applied *in situ*, eliminating the necessity of special laboratories and also making it possible for someone with no background on biology to understand the results. The user interface will be as simple as a pregnancy test: a color change will indicate contamination, no further indications needed.

During the project's first stage, the team will focus on developing the H-RTDK, that is, a detection kit for the hydrophilic toxins of red tide. On the next stage, the L-RTDK will be developed (for lipophilic toxins), completing the RTDK as a whole.

Competitive Advantage

Unlike traditional methods such as mouse bioassays, the Red Tide Detection Kit will be used in situ, therefore avoiding the necessity of specialized laboratories. This kit will also provide an immediate identification of contaminated samples, whereas the mouse bioassays and other similar methods may take from 24 to 72 hours. Lastly, the kit is devised in such way that anyone will be able to use it, without need for specific knowledge, therefore making it useful even in artisan fishing.

Market Validation

RTDK has gathered the support of over 30 interested parties both in the industry and academia throughout the world, including fisheries, national health organisms, research institutes and key opinion leaders. Some of our alliances include Chile's Ministry of Health, Cawthron Institute (New Zealand), Fraunhofer (Germany-Chile) and AFBI (UK).

The team has also submitted a provisional patent in the US to protect our technology.

Why Invest

We can assure RTDK will be the most cost-effective solution in the market. The use of our technology will diminish intoxication and death cases throughout the world caused by the red tide, while also preventing the associated economic loss.

