NSF Award to Help Develop Mighty Mini Protein Factories

Duke University

The specialized bacteria developed by Lingchong You have one of two inevitable fates – they will remain addicted to themselves or they will die of loneliness.

While that may not be the best of choices for the bacteria, the products of their existence could be a boon for humans and the environment. The bacteria in question may start off as garden-variety Escherichia coli, better known as E. coli, but You has tinkered with their genetic makeup to make them unique in their own way. Genes are the like software that direct the actions of the cell – You just tweaked their programming to make the cells do what he wants.

This is important, explains You, assistant professor of biomedical engineering at Duke's Pratt School of Engineering, because his goal is to encapsulate hordes of these genetically manipulated bacteria in tiny spheres. Within this confined space they can produce proteins or other molecules, depending on how You rewrites their software. In effect, he plans to create miniscule cellular factories that create and pump out whatever he likes, such as a protein that the body cannot produce itself.

He has dubbed these mighty mini-manufacturers "swarmbots." Each swarmbot is about 100 microns – about the diameter of a human hair – in size, containing up to 10,000 reprogrammed bacteria.

The bacteria's entire existence is spent within these tiny worlds, protected by a membrane that allows the passage of nutrients into the sphere, but nothing else, like immune system cells. The protective wall, made of the ubiquitous polymer alginate, also permits the exit of whatever the bacteria produces.

"These bacteria are programmed so that they will flourish if the population within the capsule remains high, but if the capsule breaks for whatever reason, and the population drops, they commit cellular suicide," You explains. "It's like they die of loneliness."

This engineered cellular suicide is a crucial safety net, especially if these bacteria are someday used therapeutically in people or in bioremediation efforts in the environment.

To date, You believes he has achieved two major goals of the project – creating colonies of bacteria that monitor and regulate their own populations, and the method for encapsulating the colonies in alginate. The next step is to optimize the system before giving the bacteria the blueprint for the production of proteins or whatever.

The National Science Foundation believes that this approach has potential, and recently bestowed upon You a five-year, $400,000, CAREER award to carry this line of research to the next level. You is collaborating closely with fellow Pratt biomedical engineer Kam Leong.

“These engineered cell-based sensors could have great potential for diverse applications in medicine, environmental cleanup and biotechnology,” You says.

In the addition to the cellular “dead man’s switch,” You has built into the system another safeguard. By containing the bacteria within their spherical ecosystems, the probability of mutants taking over the population is significantly reduced, You says, enhancing overall genetic stability of gene circuits.

You would ultimately like to create swarmbots that can actually replicate the colony within the capsule as well as the capsule itself.

SOURCE [1]

Links:
[1] http://prattpress.pratt.duke.edu/duke_you_swarmbots_den