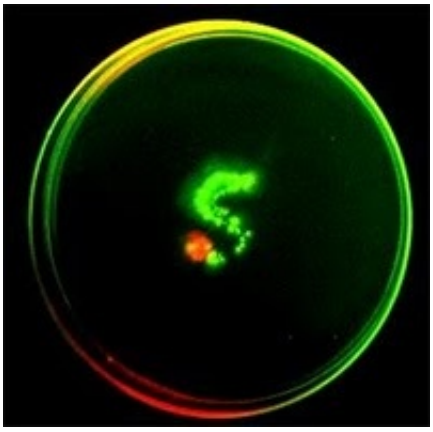
Engineering Bacteria to Clean Up Pesticide (w/ Video)

May 14 2010



(PhysOrg.com) -- Can we get bugs to do our bidding? Emory chemist Justin Gallivan has moved science another step closer to that possibility. His lab reprogrammed an innocuous strain of the bacterium Escherichia coli to "seek and destroy" the molecules of an herbicide called atrazine.

"Rather than just altering a single gene and getting a cell to do one task, we can start thinking of a cell almost like a computer that we can reprogram to do a series of things," says Gallivan.

His lab's latest findings were published in a recent issue of *Nature* Chemical Biology.

Gallivan is working at the forefront of an area known as synthetic biology. A major goal of this field is to reprogram bacteria to carry out complex tasks, such as synthesizing and delivering drugs, and tracking and cleaning up environmental pollutants.

"The bacterium E. coli swims toward things it likes and away from things it doesn't," Gallivan says. "It communicates with other cells. It synthesizes complicated compounds and replicates itself every 20 minutes. Put another way, E. coli tastes, thinks, talks, listens and makes things."

The program for all of these activities is packed into the genome of the bacterium, and is in part regulated by RNA switches, known as riboswitches. By hacking into the E. coli program and inserting a synthetic riboswitch, Gallivan's team reprogrammed the E. coli cell's chemical navigation system. The presence of atrazine flips the synthetic riboswitch, causing the bacterium to move toward high concentrations of the herbicide.

In addition, the researchers incorporated genes from atrazine-eating bacteria into the E. coli, so the bacterium performs a second task - consumption. "The E. coli essentially use the atrazine molecules as food, breaking them down into something less harmful," Gallivan explains.

Atrazine has been banned in the European Union, but remains one of the most widely used herbicides in the United States, with millions of pounds of it applied annually. "Anytime you use that much of something, some of it is bound to end up in the groundwater," Gallivan says, explaining why his lab chose to explore methods of cleaning it up.

Gallivan focuses on fundamental research at the interface of chemistry, biology and materials science. "My interest is reprogramming simple organisms to get them to do new things, in a rational and predictable

way," he says. "A revolution is going on in biology. We're really starting to understand the systems of living things at the molecular scale. Instead of asking, 'What is the nature of this organism?' We can begin asking, 'What can we do with this organism?'"

More information: Paper: www.nature.com/nchembio/journa … /nchembio.369.html#/
Listen to a talk by Gallivan for the National Academy of Sciences on reprogramming bacteria.

Provided by Emory University