One Can Act Without Group Support; Even in the Bacterial World

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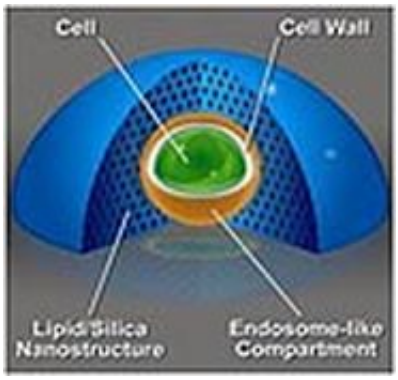

(PhysOrg.com) -- A single bacterium can act alone, performing the same kinds of actions that a group normally does. The behavior of that bacterium can be manipulated at the cellular level. That's the intriguing finding by a group of researchers from UNM, the Dartmouth Medical School, the New Mexico Veterans Health Care System, and Sandia National Laboratories. The results are reported in the Nov. 22 issue of *Nature Chemical Biology*. A possible application is halting drug resistant bacteria found in hospital settings.

The experiment completely isolated both chemically and physically, the individual Staphylococcus aureus bacteria in nanostructured droplets. UNM lecturer and former graduate student Eric C. Carnes and former undergraduate student DeAnna Lopez, the lead authors of the paper,

examined thousands of cells as they searched for signs that an isolated bacterium could sense its surroundings by sending out and detecting chemical signals.

Detection of signals can trigger the switching of bacterial behavior from harmless to virulent.

“It is generally recognized that large populations, a quorum, of cells are necessary to turn on bacterial virulence, but by confinement of individual cells within a nanostructure we were able to show that this behavioral switch occurs at the individual cell level,” said Carnes.

The students were working as part of a research group led by C. Jeffrey Brinker, a Chemical and Nuclear Engineering Professor at UNM and collaborators Hattie Gresham from the New Mexico Veterans Administration Health Care System and UNM adjunct professor in Infectious Disease and Graham S. Timmins, an Associate Professor at the College of Pharmacy. Niles P. Donegan and Ambrose Cheung from the Dartmouth Medical School provided the bacterial strains for the experiment.

The researchers showed not only can bacterium sense isolation; it can react on its own to the isolation by genetically reprogramming itself to adapt and thrive. The researchers then introduced a very low density lipoprotein, (that Professor Gresham’s group had shown to inhibit quorum sensing last year in Cell Host & Microbe) and were able to stop the reprogramming process.

Most research into bacteria behavior looks at how they behave as a group and general thought in the field has held that bacteria need a group, or quorum to become virulent and initiate infection. There are computer generated behavior models that predict the possibility of bacterium reacting as individuals to an isolated environment, but the researchers

believe this is the first time behavior of an individual bacterium has been observed definitively.

The research is more than scientific curiosity. Each researcher is looking for something different. Brinker is interested in cell behavior.

“Can they live for a long time outside a body and in isolation? What mechanisms do they use to survive? And can we in general use nanostructures to influence cellular behavior,” Brinker asks.

The tests were carried out in an environment that was similar to a membrane that might be found in the tissue of a mammal, and that is what interested Gresham, who is interested in how diseases develop.

Timmins is interested in using the system to study tuberculosis, and maybe even creating a stable live tuberculosis vaccine. He has funding from the National Institutes of Health to study latency models for disease and says he has been very interested in the Darwinian aspects.

He says, “It seems like it would be very important for an individual cell to behave in a way that is important to its own interests. But cells are normally studied as a group, and this research puts the focus on the individual behavior of a bacterium in an interesting way.”

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