Yale scientists use nanotechnology to fight E. coli

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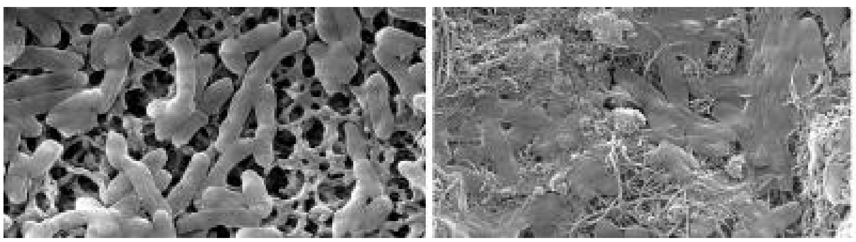

E.coli incubated for one hour on support matrix in the absence (1) or in the presence (2) of nanotubes. Credit: Yale University

Single-walled carbon nanotubes (SWCNTs) can kill bacteria like the common pathogen E. coli by severely damaging their cell walls, according to a recent report from Yale researchers in the American Chemical Society journal *Langmuir*.

“We began the study out of concerns for the possible toxicity of nanotubes in aquatic environments and their presence in the food chain,” said chemical and environmental engineering at Yale and senior author on the paper. “While nanotubes have great promise for medical and commercial applications there is little understanding of how they interact with humans and the environment.”

“The nanotubes are microscopic carbon cylinders, thousands of times smaller than a human hair that can be easily taken up by human cells,” said Elimelech. “We wanted to find out more about where and how they are toxic.”

This “nanoscience version of a David-and-Goliath story” was hailed in an ACS preview of the work as the first direct evidence that “carbon nanotubes have powerful antimicrobial activity, a discovery that could help fight the growing problem of antibiotic resistant infections.”

Using the simple E. coli as test cells, the researchers incubated cultures of the bacteria in the presence of the nanotubes for up to an hour. The microbes were killed outright – but only when there was direct contact with aggregates of the SWCNTs that touched the bacteria. Elimelech speculates that the long, thin nanotubes puncture the cells and cause cellular damage.

The study ruled out metal toxicity as a source of the cell damage. To avoid metal contaminants in commercial sources, the SWCNTs were rigorously synthesized and purified in the laboratory of co-author Professor Lisa Pfefferle.

“We're now studying the toxicity of multi-walled carbon nanotubes and our preliminary results show that they are less toxic than SWCNTs,” Elimelech said. “We are also looking at the effects of SWCNTs on a wide range of bacterial strains to better understand the mechanism of cellular damage.”

Elimelech projects that SWCNTs could be used to create antimicrobial materials and surface coatings to improve hygiene, while their toxicity could be managed by embedding them to prevent their leaching into the environment.

Source: Yale University