# Antibiotics wrapped in nanofibers turn resistant disease-producing bacteria into ghosts

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This nanospider machine is used to spin the fibers that deliver antibiotics to disable disease-producing bacteria and fungi. Credit: Elmarco s.r.o.

Encapsulating antibiotics inside nanofibers, like a mummy inside a sarcophagus, gives them the amazing ability to destroy drug-resistant bacteria so completely that scientists described the remains as mere

"ghosts," according to a report today at the the 241st National Meeting & Exposition of the American Chemical Society (ACS).

Mohamed H. El-Newehy, Ph.D., leader of the nanofibers research team, said the new technology has potentially important applications in the on-going battle against antibiotic-resistant infections. Estimates suggest that more than 100,000 people in the United States alone develop such infections each year, with nearly 20,000 deaths. Health care costs from those infections may exceed $20 billion annually.

"The rapid emergence of bacteria resistant to commonly used antibiotics has become a serious public health problem," said El-Newehy. "There is an urgent need to identify new antibiotics that work in different ways that can overcome resistance. Our approach is not a new antibiotic, but a new way of delivering existing antibiotics."

That approach, El-Newehy explained, could make new treatments available to patients much faster than trying to discover and develop brand-new medicines, a process that typically takes 10-12 years and costs $800 million to almost $2 billion. It could be used against a broad range of bacteria to fight disease, prevent bacterial and fungal contamination in the food industry, inhibit the growth of microorganisms in drinking water and enhance the effects of chemotherapy, he added.

It involves putting common antibiotics inside nanofibers made of polyvinyl alcohol and polyethylene oxide — wisps of plastic-like material so small that peach hair or a strand of spider silk are gigantic by comparison. Nanofibers can't even be seen under a regular microscope, and almost a billion could be lined up side-by-side along the length of a yard stick.

El-Newehy's group knew that nanofibers have special properties due to

their high surface area to weight ratio. Those properties have kindled research on multiple biomedical applications nanofibers, including wound dressings, medical textiles, antibacterial materials to control post-operative inflammation, and new ways of delivering drugs. They decided to test the effects of nanofibers with multiple antibiotics encapsulated directly into fiber, using laboratory cultures of various microbes. Antibiotics wrapped inside nanofibers were highly effective in killing a variety of disease causing bacteria and fungi, including Escherichia coli and Pseudomonas aeruginosa, two increasingly drug-resistant microbes.

"When treated with antibiotics wrapped in nanofibers, the microbes were severely damaged and many cells were enlarged, elongated, fragmented, or left as just empty ghosts," El-Newehy said. "The fibers by themselves, without antibiotic did not affect the bacteria. They seem to work by boosting the power of the antibiotics. By wrapping the anti-microbial agents in the fibers, it makes the drug action more focused and the agents are effective for longer period of time than with conventional delivery techniques."

El-Newehy, with the Petrochemical Research Chair, Department of Chemistry College of Science, King Saud University, Riyadh, Riyadh, Saudi Arabia, said that besides drug delivery, nanofibers are being used for tissue engineering, wound dressing, medical textiles and antimicrobial materials that can be used to control post-operative inflammation, promote wound healing and dressing, especially for diabetic ulcers.

Salem Al-Deyab, Ph.D., the supervisor of Petrochemical Research Chair at King Saud University, said that this study was funded by the Petrochemical Research Chair at King Saud University, Saudi Arabia. In addition, Petrochemical Research Chair has the lead in the possession of the first machine (Nanospider) for producing nanofibers in Saudi Arabia, said Al-Deyab. Officials plan a major effort to develop the

Nanofibers Research Center at Petrochemical Research Chair to become a major center for Nanofibers Research for different applications at King Saud University, said Al-Deyab.

Provided by American Chemical Society