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New study shows bacterial resistance to nanoparticles can be averted

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The revolutionary discovery was published in the journal Nature Nanotechnology. This is also the first paper published in this journal that was written exclusively by Czech authors.

Singapore – Scientists from the Palacký University (UP) in Olomouc have discovered a unique mechanism that enables bacteria to defend themselves against silver nanoparticles, which are widely used in antibacterial therapy. This mechanism does not require the bacteria to undergo genetic changes, and differs significantly from mechanisms of antibiotic resistance. The scientists have also found a way to suppress bacterial resistance to nanosilver, which could be crucial in addressing the global antibiotics crisis. The revolutionary discovery was published in the journal *Nature Nanotechnology*. This is also the first paper published in this journal that was written exclusively by Czech authors.

The long-standing overuse of antibiotics during the second half of the last century has caused increasing levels of bacterial antibiotic resistance. Therefore, in recent years, many chemists, microbiologists, and physicians have studied the antibacterial effects of silver nanoparticles, which have gradually become incorporated into dozens of commercial products as well as successful options for local antibiotic therapy and preventing the evolution of bacterial infections. In 2006, scientists from the Palacký University in Olomouc described in detail the effectiveness of silver nanoparticles against a wide range of bacteria including highly resistant strains. This work, published in the American Chemical Society's *Journal of Physical Chemistry B*, attracted great scientific interest (it has received over 1200 citations) and prompted a flurry of work on nanosilver and its applications. However, scientists and physicians have been unable to determine whether repeated exposure to nanoparticles can cause bacteria to develop resistance similar to that seen with antibiotics. After approximately five years of work, this question has been answered by researchers from the Regional Centre of Advanced Technologies and Materials (RCPTM), the Centre of the Region Haná for Biotechnological and Agricultural Research, and the Faculty of Medicine of the Palacký University in Olomouc.

"It is well known that silver nanoparticles lose their antimicrobial activity if they come together to form larger particles known as aggregates. We have discovered that flagellar bacteria can exploit this Achilles' heel: upon repeated exposure to nanosilver, they start producing the protein flagellin from their flagella. This protein first reduces the repulsive forces between the nanoparticles and then acts like glue, causing the nanoparticles to stick to one-another and lose their antibacterial properties," said Aleš Paná?ek from RCPTM, the first author of the work, identifying it as a unique resistance mechanism.