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Bacterial resistance to silver nanoparticles

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More and more bacterial infections fail to respond to conventional treatment and therefore, new ways how to overcome bacterial resistance need to be developed. An option might be application of antibacterial nanomaterials (e.g. silver nanoparticles), which has been thanks to their high antimicrobial properties (at concentration ranging tents of ppm) successfully applied in biomedical and antimicrobial technologies. Silver nanoparticles are able to fight against a broad range of bacteria through multi-level mode of action, which is much more difficult to overcome. However, thanks to the constant changes of bacterial genome and their ability to adapt to negative conditions, it is apparent that bacteria will be able to counter the antibacterial effects of metal and metal oxide NPs as well. A few recently published papers have confirmed that bacteria are able to develop resistance due to small genomic changes1, and in some cases only by phenotypic adaptation2 without the need to change the genetic information to resist the effects of nanoparticles. Here we report the development of bacterial resistance of gram-negative and gram-positive bacteria induced by repeated exposure to subinhibitory concentrations of silver nanoparticles. The difference of mechanism for Gram-positive and Gram-negative bacteria in the way how they resist to strong antibacterial effect of silver NPs was observed and described. These findings help us to understand the mechanism of resistance of certain bacteria and to find some approaches how to combat the bacterial resistance, which is important to know for the future use of those nano-antibacterial agents. The authors gratefully acknowledge the support provided by project LO1305 of the Ministry of Education, Youth and Sports of the Czech Republic, the Czech Science Foundation (project No. 19-22720S), and the Internal Grant of Palacky University in Olomouc (IGA PrF_2019_033) Gunawan, C., Teoh, W. Y., Marquis, C. P. & Amal, R. Induced Adaptation of Bacillus sp. to Antimicrobial Nanosilver. Small 9, 3554–3560 (2013). Panacek, A. et al. Bacterial resistance to silver nanoparticles and how to overcome it. Nat. Nanotechnol. 13, 65–71 (2018).

Biography

Mgr Lucie Hochvaldova has completed her Mgr in Material Chemistry by Palacky University, where she has focused on synthesis of metal nanoparticles and their characterization. Currently she studies her PhD which is focusing on antibacterial properties of those nanomaterials and their use in treatment of bacterial infections. Together with her supervisor doc. RNDr. Aleš Panáček, Ph.D., who has published more than 50 papers in reputed journals, are focusing on *in vitro*, *in vivo* and in silico studies on overcoming bacterial resistance via combination of antibiotics with silver nanoparticles and silver compounds. They are trying to understand interaction of those nanomaterials with the bacteria, their mechanism of action, the mechanism of resistance and possible ways how to overcome it.

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