Antibacterial effects of silver nanoparticles on *Escherichia coli*: influence on the growth and biofilms formation

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Abstract

Biofilms are complex bacterial communities that resist the action of antibiotics and the human immune system. Bacteria within biofilms are the cause of numerous, almost impossible to eradicate, persistent infections. Biofilms can form on many medical devices and implants, and so have an enormous impact on medicine. Due to the lack of effective anti-biofilm antibiotics, novel alternative compounds or strategies are urgently required [1]. New anti-biofilm technologies target different stages in the biofilm formation process. Some act to modify the colonized biomaterials to make them resistant to biofilm formation. One potentially important candidate treatment uses silver nanoparticles that show anti-bacterial and anti-biofilm activity. The biological action of nano-silver is complex and seems to involve a number of pathways. However, there have been few reports on the anti-biofilm activity of silver nanoparticles and the precise mechanism underlying their action remains unresolved [7].

Antibacterial action of silver nanoparticles (AgNP) on Gram-negative bacteria (planctonic cells and biofilms) is reported in this study [8]. AgNP of 8 nm in diameter stabilized by hydrolyzed casein peptides strongly inhibited biofilms formation of *Escherichia coli* in concentrations of 4-5 μg/ml. The viability of *E. coli* PTCC 1763 cells in biofilms was considerably reduced by AgNP concentrations above 100-150 μg/ml. *E. coli* strains with mutations in genes responsible for the repair of DNA containing oxidative lesions (mutY, mutS, mutM, mutT, nth) were less resistant to AgNP than wild type strains. This suggests that these genes may be involved in the repair of DNA damage caused by AgNP [4,6]. *E. coli* mutants deficient in excision repair, SOS-response and in the synthesis of global regulators RpoS, CRP protein and Lon protease present similar resistance to AgNP as wild type cells. *E. coli* mutant strains deficient in OmpF or OmpC porins were 4-8 times more resistant to AgNP as compared to the wild type strain [5]. This suggests that porins have an important function related AgNP antibacterial effects. The diameter of pores formed by porin proteins is ~1.0–1.1 nm. Silver-ions pass through these pores, but not AgNP of 8 nm [2,3]. It is known that the pores formed by OmpF and OmpC porins pass cations [2]. In view of these considerations the antibacterial effect of AgNP is mainly due to silver ions penetration the cell walls.

References

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