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RESPONSE TO LETTER

The Substantial Role of Cell and Nanoparticle Surface Properties in the Antibacterial Potential of Spherical Silver Nanoparticles [Response to Letter]

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Dear editor

Responding to the recently published letter by Danfeng Shen,[1] which raises important points regarding our article, "The Substantial Role of Cell and Nanoparticle Surface Properties in the Antibacterial Potential of Spherical Silver Nanoparticles", published in Nanotechnology, Science and Applications,[2] we greatly appreciate the author's engagement with our work and welcome the opportunity to clarify and elaborate on the methodological and interpretive aspects raised.

The composition of nanoparticles has a profound impact on their properties and biological behavior.[3] In our study, we focused on spherical silver nanoparticles with varying zeta potentials, whereas the study of Niu et al[4] focused on nanoparticles with charge-switchable surfaces, which enabled the formation of either negatively or positively charged nanoparticles, selectively targeting Gram-positive and Gram-negative bacteria, respectively. The nanoparticles in their study were composed of molybdenum disulfide—a material with properties distinct from those of silver—and their biological activity was driven by enzymatic-like processes. Since the composition of nanoparticles influences their properties, findings observed for one material cannot be broadly applied to others,[3] thereby distinguishing our findings from those of Niu et al.[4] Additionally, the methodological approach used in Niu et al's study,[4] namely plate counting (viable cell count) and bacterial viability assay, is particularly sensitive to subtle differences in antimicrobial efficacy. In contrast, the broth microdilution method employed in our study[2] detects only more significant differences, providing robust evidence of variations between the compounds and bacterial species tested.

Moreover, contrary to the findings of Niu et al,[4] our results show that Gram-positive bacteria, as well as Gram-negative bacteria with an external polysaccharide capsule, exhibit greater susceptibility to silver nanoparticles with highly positive or moderate surface charges compared to those with highly negative charges. In contrast, Gram-negative bacteria without a polysaccharide capsule are more susceptible to silver nanoparticles with highly negative or moderate charges than to those with a highly positive charge. Regardless of the specifics of the cell surface, silver nanoparticles with moderate charges (slightly negative, slightly positive, or both) tend to exhibit the most significant antibacterial activity across all bacterial species tested (as shown in Figure 1 of our paper).[2]

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We agree that expanding the range of nanoparticle colloids tested, with varying surface charges and ligand chemistries across the spectrum of zeta potentials, would be beneficial. However, we must emphasize a key finding from our study that does not support the proposed critical role of lipophilic groups in enhancing bacterial inhibition or killing. Specifically, silver nanoparticles stabilized with citrate—lacking lipophilic groups—demonstrated equal or greater effectiveness against Gram-negative bacteria such as *Escherichia coli, Pseudomonas aeruginosa*, and *Acinetobacter baumannii* (which have easily accessible external cell membrane), compared to nanoparticles stabilized with ligands containing lipophilic groups (as shown in Figure 1 of our paper).[2]

Finally, we wish to clarify that none of the references cited in our paper (14–20)[2] address nanoparticle surface potentials that span the broad range from negative to positive charge, nor do they simultaneously encompass the wide range of bacterial species tested in our report.

We hope this explanation resolves any misunderstandings and offers a clearer understanding of our findings.

Disclosure

The authors report no conflicts of interest in this communication.

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