

## silver nanoparticles trigger hormetic response of *Pseudomonas aeruginosa*

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### Abstract

Hormesis refers to a dose-response relationship in which a large dose of a toxic substance has an inhibitory effect, whereas a low amount has a stimulatory effect. This study investigates the hormetic effect of low concentrations of silver nanoparticles (Ag NPs) on *Pseudomonas aeruginosa*.

Samples of *P. aeruginosa* clinical strains (PA1-6) recovered from cystic fibrosis patients were exposed to decreasing concentration of biosynthesised Ag NPs. The micro-titer plate technique was employed to investigate the impact of Ag NPs on the growth, biofilm formation, and metabolic activity of *P. aeruginosa*. In addition, a real-time polymerase chain reaction (RT-PCR) was conducted to investigate the impact of ZnO NPs on the expression of biofilm-encoding genes. Ag NPs had a bactericidal effect that varied with the concentration, showing higher effectiveness at concentrations exceeding 1.8 µg/mL. When the concentration of *P. aeruginosa* (reference strain ATCC 2873, PA 3 and PA 4) was below 0.45 µg/mL, it showed significant growth stimulation compared to the negative control. Similarly, ATCC, PA 2, PA 4, and PA 5 exhibited favorable growth at concentrations of 0.45 and 0.225 µg/mL. Nevertheless, there was no notable increase in growth observed at dilutions below 0.113 µg/mL. The biofilm biomass and metabolic activity of the bacteria were affected by the hormetic response at the intermediate concentration of Ag NPs.

The results of this study suggest that *P. aeruginosa* exhibits hormetic proliferation in response to low levels of Ag NPs. These findings emphasize the significance of further investigating the impacts and potential outcomes of exposing *P. aeruginosa* to small amounts of nanoparticles.