Silver Nanoparticles and Their Effect on Arabidopsis thaliana Cell Viability



ABSTRACT

Silver nanoparticles (AgNPs) are unique due to their anti-microbial efficacy and ability to be synthesized in various sizes. The scope of their industrial uses ranges from drug delivery and band-aids to cosmetics and socks. As research and development of AgNP-related products increases, so does the bioaccumulation of AgNPs in the environment. This study was designed to test the effects of AgNP concentrations on plants, specifically A. thaliana cells to understand the effects of the increasing amount of AgNPs that are accumulating in the environment. Based on the data extracted from the experiment it is determined that the concentrations of AgNPs that were used had no significant impact on A. thaliana cell viability.

HYPOTHESES

- HO: AgNPs have no effect on plant cell culture either with bacteria or not.
- H1: Antimicrobial activity of AgNPs will kill bacteria in plant cell culture.
- H2: Antimicrobial activity of AgNPs will substantially decrease the cell viability of A. thaliana cells.

EXPERIMENTAL SETUP

- Arabidopsis thaliana cell culture was purchased from Arabidopsis Biological Research Center. 20 nm silver particles (AgNPs) were purchased from Ted Pella. Trypan Blue (0.4%) was purchased from Sigma.
- 0.8 mL of *A. thaliana* cell culture was distributed into a 24-well plate. The cells were treated with three concentrations of AgNPs, either with bacteria or without. Each treatment has three biological replicates.
- A: control (no AgNPs)
- B: 3.04 ng/ μ L AgNPs
- C: 0.304 ng/ μ L AgNPs
- D: 0.0304 ng/ μ L AgNPs
- The plate was incubated C for 10 days at 24 ^oC with 14 hours light.



Cells were treated with Trypan Blue at 3 and 10 days, and observed.

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RESULT- Cell viability

• No significant difference in AgNP treatments, no matter what concentration (0-3.04 ng/ μ L) in *A. thaliana* cell culture, either with bacteria or not. Same letters mean no difference.



Morphology of A. thaliana cells after being treated with 0.4% Trypan Blue.

- A: control, 3 days
- B: 3.04 ng/ μ L AgNPs, 3 days
- C: control, 10 days
- D: 3.04 ng/ μ L AgNPs, 10 days



Blue = dead cells / debris Non-blue = live cells Scale bar = 200 nm

DISCUSSION

No significant difference in cell viability between treatments (with AgNPs or with AgNPs/bacteria) to prove the hypothesis.

Potential problems are derived from the experiment are: Pipetting

- Concentrations of AgNPs used
- Media chemistry with AgNPs
- Cell death occurred naturally amongst cells that were not exposed to AgNPs.
- Although no significant impact occurred, this data is still significant to our understanding of the repercussions behind increased industrial application of AgNPs, and thus increased bioaccumulation into the environment.

FUTURE DIRECTIONS

- Retesting the experiments to rule out the abovementioned possible problems.
- Implementing silver nanoparticles into herbicides to combat phytopathogenic microbes
- Increasing the concentration to determine what levels are needed to harm Arabidopsis thaliana cell viability
- Testing of silver nanoparticle on *Arabidopsis thaliana* root cell viability.

LITERATURE CITED

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