Physiological and proteomic responses of tobacco seedlings exposed to silver nanoparticles

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\section*{INTRODUCTION}

Nanoparticles (NPs) with three dimensions between 1 and 100 nm show unique electrical, chemical and physical properties. Because of that they are often found in various consumer products. Silver nanoparticles (AgNPs) are the most commonly used nanomaterial because of their antibacterial and antifungal properties that are used in production of medical applications and devices, textiles, food packaging and healthcare and household products. Studies have shown detrimental effects of AgNPs on bacteria, algae, plants, animals and human cells, but the mechanisms of AgNP toxicity are not yet fully clarified. To examine whether toxicity of AgNPs is nanoparticle-specific or comes as a result of ionic silver released from AgNPs, we investigated physiological and proteomic changes in seedlings of tobacco (Nicotiana tabacum L.) exposed to AgNPs and AgNO\textsubscript{3}.

\section*{RESULTS}

Experiments were performed using commercial citrate-coated AgNPs (nanoComposix, San Diego, USA). Tobacco (Nicotiana tabacum L.) seedlings were grown in solid Murashige and Skoog medium supplemented with AgNP or AgNO\textsubscript{3}, stock solutions to obtain 25, 50, 75 and 100 μM concentrations. The exposure period lasted for 30 days. Silver uptake in plant tissue was determined with inductively coupled plasma mass spectrometry (ICP-MS). To examine the oxidative stress response, the content of malondialdehyde (MDA)\textsuperscript{2} and protein carbonyls\textsuperscript{3} as well as the activity of antioxidant enzymes (pyrogallol peroxidase (PPX), ascorbate peroxidase (APX), catalase (CAT)\textsuperscript{3} and superoxide dismutase (SOD))\textsuperscript{3} was spectrophotometrically measured. Dihydroethidium (DHE) test was used to determine the ROS level.\textsuperscript{2} For the genotoxicity assessment, alkaline version of Comet assay was applied.\textsuperscript{2} Tobacco seedlings treated with 100 μM AgNP and AgNO\textsubscript{3} were used to study morphological and ultrastructural changes and to detect the uptake of AgNPs in plant cells, using light and electron microscopy.\textsuperscript{2} Same treatments were used to detect changes in protein expression. To separate the proteins two-dimensional (2-DE) electrophoresis was conducted; excised and digested peptides were analysed with matrix-assisted laser desorption/ionization-time of flight mass spectrometer (MALDI TOF/TOF) and proteins were identified using global protein server explorer software for Mascot search against National Center for Biotechnology Information protein database (NCBIprot).\textsuperscript{3}

\section*{CONCLUSION}

AgNP content was measured in seedlings exposed to AgNPs than to AgNO\textsubscript{3} of the same concentration obtained results on oxidative stress parameters revealed that in general higher toxicity was recorded in AgNO\textsubscript{3}-treated seedlings compared to those exposed to nonsilver presence of silver in the form of nanoparticles was confirmed in the root cells, which may explain the lower toxicity of AgNPs proteomic study showed that both AgNPs and AgNO\textsubscript{3} can affect photosynthesis majority of the proteins involved in the primary metabolism were up-regulated after both types of treatments, indicating that enhanced energy production, which can be used to reinforce defensive mechanisms, enables plants to cope with silver-induced toxicity

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
 Treatment & AgNP & AgNO\textsubscript{3} \\
\hline
 1 & 0.172 & 0.172 \\
\hline
 100 & 0.166 & 0.166 \\
\hline
 10,000 & 0.166 & 0.166 \\
\hline
\end{tabular}
\caption{Silver content in tobacco seedlings treated with AgNPs and AgNO\textsubscript{3}. Values are means ± SE of three different experiments, each with three replicates. Values marked with different letters represent significant difference (p < 0.05) according to Duncan test.}
\end{table}

Table 2. Specific activities of SOD, PPK, API and CAT in tobacco seedlings treated with AgNPs and AgNO\textsubscript{3}. Values are means ± SE of three different experiments, each with three replicates. Values marked with different letters represent significant difference (p < 0.05) according to Duncan test.

Reference:
\textsuperscript{3} This work was supported by the Croatian Science Foundation [grant number IP-2014-09-6488] and University of Zagreb [grant number 20281222]