

The effect of TiO₂ and ZnO nanoparticles on the bioaccumulation of strontium ions by aquatic plants *Salvinia natans* and *Elodea canadensis*

Asztemborska Monika*, Jakubiak Małgorzata, Bembenek Marcin, Stęborowski Romuald

Isotope Laboratory, Faculty of Biology, University of Warsaw, Miecznikowa 1, 02-096 Warsaw, Poland

* asztemborska@biol.uw.edu.pl

Introduction

Nanotechnology is a dynamically developing field of scientific and industrial interest in the entire world. Nanoparticles (NPs) are increasingly used in many types of consumer products. Among the most commonly used are titanium oxide NPs (titania NPs, TiO₂ NPs) and zinc oxide NPs (ZnO NPs). The interactions of nanostructures with the biosphere may have unpredictable consequences and many studies focus on the potential hazards of NP contamination (nanotoxicology). Besides the toxicity, the influence of NPs on the chemical and physical behavior of soil or water components must also be considered. One of the possible effects caused by NPs is modification in the uptake of metal ions and other substances.

The aim of undertaken studies was examination of bioaccumulation of strontium ions (⁹⁰Sr²⁺) by aquatic plants: *Salvinia natans* and *Elodea canadensis* in the presence of nanoparticles with sorption capacity: TiO₂ and ZnO NPs.

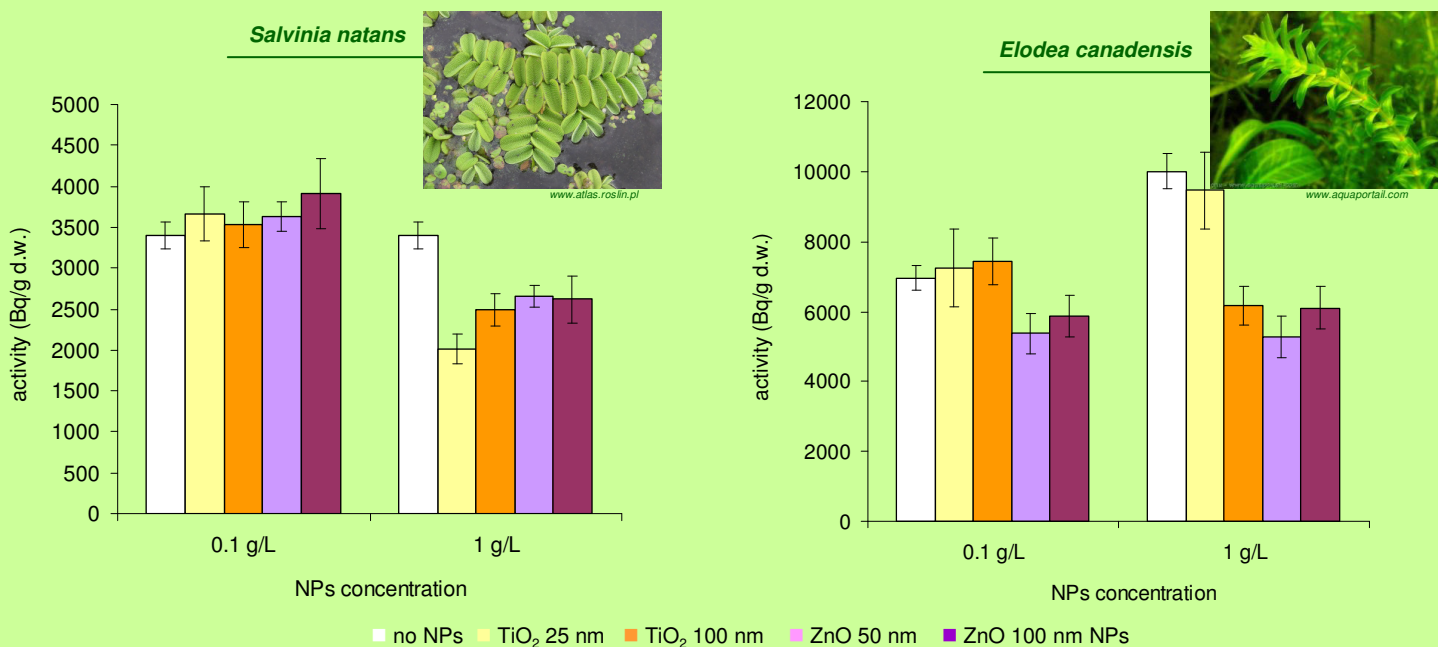
Materials and methods

Plants used for bioaccumulation studies – adult *Salvinia natans* and *Elodea canadensis*, obtained from the Botanical Garden of the Warsaw University, were cultivated in containers with solution containing metal oxide nanoparticles at 0.1 and 1 g L⁻¹ and ⁹⁰SrCl₂ at 0.01 mg L⁻¹ under controlled conditions for 8 days. Reference cultivation with Sr ions without any NPs was carried out in parallel.

After finishing the bioaccumulation experiments, plants were rinsed with deionized water, dried, homogenized, and analyzed for the radioactivity of radioisotopes. The activities of Sr were measured in a Geiger-Muller detector equipped with an SPF-32 plastic scintillation probe, and 5-cm-thick lead housing. Measurements of each sample were carried out within 10 min and these were referred to reference material with a known activity of ⁹⁰Sr.

Results

Bioaccumulation of Sr by *S. natans* and *E. canadensis* in the presence of nanoparticles.



SUMMARY

- ❖ NPs of titanium and zinc oxides have significant sorption capacity toward divalent ions of Sr
- ❖ The examination of the bioaccumulation of Sr(II) ions by *S. natans* and *E. canadensis* in the presence of metal oxide nanoparticles has led to the conclusion that NPs affect the bioaccumulation of metal ions. The effect depends on the chemical composition, size, and concentration of NPs, and plant species.
- ❖ Sorption of ions onto the surface of NPs is one of the possible mechanisms of ion bioavailability reduction. Nevertheless, some other mechanisms are also possible.
- ❖ The results have shown that NPs can modify the bioaccumulation of ions. The effect is positive if ions are toxic, but it is negative if the uptake of essential ions is reduced.