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Uptake and Translocation of Radioactive Labelled Nanoparticles in Plants

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Statement of the problem: The use of nanoparticles has been extremely increased in technological and consumer products in recent years. After use the nanoparticles can contaminate environment and living organisms. The uptake and translocation in plants is important because the food chains of aquatic and terrestrial organisms can be contaminated. The investigation of plant uptake and translocation is needed because certain adverse effects of nanoparticles were described. In our work we combine the study of medically attractive 223-Ra labelled nanoparticles with uptake and translocation experiments. It allows us a relatively simple study of nanoparticles uptake and translocation and also at the same time the assessing of environmental risk associated with the labelled medical nanoparticles use. Nanoparticles labelled with 223-Ra are study for the treatment of prostate cancer and related bone metastasis. Methodology and theoretical orientation: In vitro cultivated plants of Zea mays and Avena sativa were grown on liquid media containing 223-Ra labelled nanoparticles (hydroxyapatite, titanium dioxide). After two weeks radioactivity distribution visualization by electronic autoradiography and liquid scintillation counting analysis were performed. Additional experiments were carried out using cross nanoparticle labelling with 223-Ra/32-P. For comparison the same experiments were performed with ionic form of 223-Ra. Findings: The obtained results show that the radioactivity is extracted from cultivation medium. Roots are strongly contaminated, what may be caused by adsorption. The radioactivity was translocated also into shoot parts. The extraction efficiency was at experiments with labelled nanoparticles much lower than in experiments with 223-Ra ions (ca. 90 % uptake vs. 30-50 % at nanomaterials). Translocation of radioactivity in experiments with nanomaterials is slightly higher at both plants species. It is possible, that nanoparticles are ab/adsorbed, dissolved and radioactivity translocated or whole nanoparticles are transported to leaves. In any case, these materials pose a safety risk to the ecosystem and their use should be thoroughly monitored.

Figure 1. Distribution of radioactivity after cultivation of Zea mays seedling with 223-Ra-hydroxyapatite nanoparticles. (Activity decreases in order red-yellow-blue.)

Biography

Stanislav Smrcek (Assoc. Prof.) deals with basic research of the uptake and biotransformations of organic xenobiotics in plant and plant cell cultures as phytoremediation models concerning pharmaceuticals, personal care products and engineered nanoparticles in wastewaters and environment. Further activities are synthesis of labelled compounds, ecological projects, environmental chemistry, and teaching activities (nuclear chemistry, pharmacology) including training of students in bachelor and diploma theses.

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