Dissecting Radionuclide Uptake Pathways: Investigating Radionuclide Transport Mechanisms in Model Plants

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A mechanistic understanding of radionuclide uptake in plants is essential for accurately assessing risks to the food chain and enabling dose calculations for environmental safety and regulatory frameworks.This study aims to identify specific membrane transporters involved in the uptake of trivalent americium (Am^{3+}), focusing on the iron-regulated transporter 1 (IRT1) and glutamate receptor-like channels (GLRs) in *Arabidopsis thaliana*, *Nicotiana tabacum*, and *Solanum lycopersicum*. Hydroponic uptake assays were performed under iron-deficient conditions in both wild-type and irt1 knock-out lines of *A. thaliana*. No significant difference in Am^{3+} accumulation was observed between the genotypes, a slight increased accumulation was observed in the leaves of the plants cultivated under iron deficient conditions suggesting that IRT1 is not the major pathway for Am^{3+} uptake. Consistently, *N. tabacum* BY-2 suspension cells cultivated under similar conditions also did not show elevated uptake although an increased expression of IRT1 was observed in mRNA level under Iron deficiency, These findings point toward alternative or compensatory mechanisms, e.g. the GLRs. To test this hypothesis, uptake assays in *A. thaliana* GLR knock-out lines are being conducted. In parallel, CRISPR/Cas9-based knock-out lines of *S. lycopersicum* targeting *IRT* and *GLR* genes will be developed. Constructs will be designed using Modular Cloning (MoClo), verified through sequencing, and introduced into cotyledons via *Agrobacterium tumifaciens*-mediated transformation. Follow-up validation will include gene expression analysis, protein quantification, and functional screening of candidate transporters. By delineating radionuclide transport pathways at a molecular level, this work supports more accurate food chain dose assessments and informs risk evaluations in radioactively contaminated ecosystems.