Quantitative uptake of nanoplastics with different physico-chemical properties in lettuce (Lactuca sativa) and transfer to snails (Cantareus aspersus)

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Abstract

Nano- and microplastics (NMPs) are ubiquitous in agricultural soils. Recently, there have been concerns about the transfer of NMPs into the food web via crops and invertebrates. We investigated how different physico-chemical properties of nanoplastics (NPs) impact the uptake by lettuce (*Lactuca sativa*). Lettuce was exposed to three types of Europium-doped polystyrene (Eu-PS) particles – two negatively charged (100 nm and 300 nm), and one positively charged (200 nm) – at three exposure concentrations: 15 μg/L, 150 μg/L and 1,500 μg/L. For both negatively charged particles, NPs were taken up by the roots at all three concentrations, and subsequently transported to the shoots but this was only detected at the highest concentration (translocation factor: TF $<$ 1). In contrast, the positively charged NPs of 200 nm were only detected at the highest concentration in the roots, and no transfer to the shoots was observed. A decrease in root and shoot biomass of lettuce was noted for all three particle sizes. For the 100 nm particles, the shoots were also fed to snails for three weeks to quantify the trophic transfer within a terrestrial food chain from lettuce to garden snails (*Cantareus aspersus*). No Eu-PS was observed within the digestive gland, nonetheless Eu-PS were detected within the feces. Moreover, a consistent decrease in the growth rate of the shell of snails was observed upon exposure to the plastics. Overall, our findings shed light on the uptake of positively and negatively charged particles of different sizes in lettuce, providing insights into the dynamics of NMPs with plants. In addition, our results show no transfer of NPs into the tissue of snails, but direct excretion via their feces.

Keywords: plastics transfer, uptake, plant, invertebrate, human food basket

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