Multi-approach risk assessment of TiO2-NPs in the terrestrial system: soil-plant-snail trophic transfer and environmental modeling.

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Abstract :

Nanomaterials, particularly TiO2 nanoparticles (TiO2-NPs), are widely used in commercial products, raising environmental concerns as they accumulate in ecosystems and can be transferred along food chains. Indeed, TiO2-NP concentrations in the environment can reach several hundreds of mg/kg in sludge-treated soils. In our study, the risk of TiO2-NPs in the terrestrial system was assessed using multiple approaches. First, a screening experiment using nine plant species and two exposure concentrations in soil (60 mg/kg and 500 mg/kg of P25 TiO2, representing both a currently realistic scenario and an extreme scenario, respectively) was performed in soil Lufa 2.1. The results demonstrate that dicotyledonous crops seem to be more impacted by the 500 mg/kg concentration compared to monocotyledons. Subsequently, the effect and uptake of TiO2-NPs by *Lactuca sativa* and its trophic transfer to snails (*Cornu aspersum*) at different developmental stages and after different depuration periods were studied. The results show that the growth of juvenile snails exposed to contaminated lettuce leaves was inhibited compared to the control. Moreover, both adult and juvenile behaviors were affected by the consumption of contaminated lettuce. Finally, to take into consideration results from the literature, a modeling study using a comprehensive dataset built from results from the screening experiment and the literature allowed us to model the hazard using species sensitivity distributions and to determine the Predicted No-Effect concentration (PNEC) to be 2.6 mg.kg-1. Such a low value highlights the risk related with the dissemination of TiO2 nanomaterials in the environment.