

Bioavailability of thallium in soil, uptake by crops and its environmental impact

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This study draws attention to the fact that natural processes can mobilize thallium (Tl), a highly toxic metal, which may enter the food chain with severe health impacts on the local human population. A rural area having independent Tl mineralization in southwestern Guizhou, China, was chosen for a pilot study. Tl contents of soils extracted by HNO₃ in the study area range from 35–165 mg/kg in soils from the mining area, 14–78 mg/kg in alluvial deposits downstream, and <0.2–0.5 mg/kg in soils from the background area. Tl contents in ammonium acetate EDTA-extracted fraction are 0.013–1.3 mg/kg, less than 1% of concentration in HNO₃-extracted fraction. The amounts of Tl in NH₄Ac-extracted fraction were thought to be more exchangeable and bioavailable, i.e., immediately available to plants and/or available to plant roots over a period of years. Tl concentration in crops exhibits species-dependent preferences. The enrichment of Tl in edible cropspecies decreases in the following order: green cabbage>chili>Chinese cabbage>rice>corn. The highest level of Tl in green cabbage is up to 500 mg/kg (DW), surpassing the values of Tl in the soils (13–69 mg/kg). The enrichment factor for Tl in green cabbage is up to 1–10 when considering the HNO₃-extracted Tl, but the factor highly rises to 30–1300 while considering the NH₄Ac-extracted Tl. The average daily uptake of Tl by the local villagers through consumption of locally planted crops was estimated at about 1.9 mg per person, which is 50 times the daily ingestion from the Tl-free background area. The high ingestion amount of Tl (1.9 mg/day) is far above its "Oral RfD"of 0.056 mg/day and the world average daily intake 2 µg/day. This study points out that Tl is the main metal triggering a chronic poisoning of human health in the study area.

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