

Bioaccessibility and exposure risk of arsenic and lead in urban soils: A case study from Guangzhou, China

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Abstract:

As an important human exposure pathway of contaminants, soil ingestion is of increasing concern for assessing health risk from heavy metal contaminated soils in urban environment. In vitro bioaccessibility has been developed as a method to estimate oral bioavailability of a toxicant using a physiologically-based extraction procedure.

A wide range of total arsenic(As) and lead(Pb) concentrations ranging from 10.2 to 61.0 mg•kg⁻¹ and from 38.4 to 348.4 mg•kg⁻¹ respectively in urban surface soils (0-10cm) collected from different land uses, including urban parks, roadsides, industrial sites and residential areas in Guangzhou, China, was detected. Physiologically based in vitro tests were used to evaluate the oral bioaccessibility of As and Pb in soils regarding both stimulated gastric and small intestinal conditions, and exposure risk for children was estimated. It was found that the oral bioaccessibility of As and Pb were 11.3% (ranging from 2.9% to 23.9%) and 39.1% (ranging from 16.4% to 64.9%) under simulated gastric condition, and 6.9% (ranging from 2.8% to 13.2%) and 1.9% (ranging from 0.3% to 7.0%) under simulated small intestinal condition respectively. Bioaccessibility of As and Pb under simulated gastric condition were significantly higher than those under simulated small intestinal condition.

Arsenic bioaccessibility can be predicted by soil pH and organic matter content under simulated gastric condition, and by organic matter, silt and total As contents under simulated small intestinal condition. Lead bioaccessibility can be predicted by total Fe under simulated small intestinal condition with linear regression models.

The dose of As and Pb for children exposure to urban soils in Guangzhou were 0.015 and 0.281 g•kg⁻¹•day⁻¹ respectively, far lower than their reference doses for human health. The potential risk of Pb and As in urban soil for human health was the highest in industrial areas.

Keywords: arsenic, lead, bioaccessibility, exposure risk, urban soil, Guangzhou

Topic: D. Urban soils, social and health issues

Sub-topic: D3. Urban soil education and training

Presentation type: *unpresented*

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