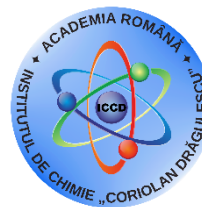




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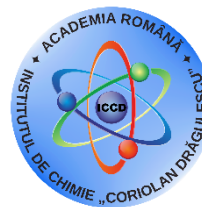
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BIOAVAILABILITY OF POTENTIALLY TOXIC ELEMENTS: IMPLICATIONS FOR SUSTAINABLE ENVIRONMENTAL AND HUMAN HEALTH RISK ASSESSMENT

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Soil contamination by potentially toxic elements (PTEs) poses a persistent environmental challenge due to their long-term stability and bioaccumulation in the food chain. Effective assessment of environmental and human health risks associated with PTEs requires a thorough understanding of the processes governing their transformation and immobilization in soil.

In this study the long-term behavior of Pb, As, Cd, and Cr in soils from a historically contaminated mining area was analyzed using both individual and integrated soil pollution indices, including the enrichment factor (EF), geoaccumulation index (Igeo), Nemerow index (NI), Pollution Load Index (PLI), Environmental Risk Index (ERI), and Potential Ecological Risk Index (PERI). A sequential extraction procedure was performed to assess the geochemical partitioning and potential mobility of these elements. In addition, a plant growth experiment was conducted under controlled conditions to evaluate the transfer of PTEs from soil to plants, their accumulation in plant tissues, and their effects on plant development. Furthermore, potential impacts on human health were evaluated through carcinogenic and non-carcinogenic risk assessments that considered multiple exposure pathways. In addition, chromium speciation was analyzed, taking into account the distinct behavior and impacts of chromium (III) and chromium (IV).

The results demonstrate that the speciation and transformation of PTEs are critical determinants of their environmental behavior, bioavailability, and potential ecological and health risks. Moreover, integrating experimental and field-based studies provides new insights into the mechanisms that control the environmental fate of PTEs and their interactions within the soil-plant system.

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