Zn, Pb AND As ORAL BIOACCESSIBILITY OF LISBON URBAN SOILS

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Ingestion of dust or soil particles could pose a potential health risk due to long-term potentially harmful elements (PHE) exposure. Fourteen urban topsoil samples (public gardens and parks, playgrounds) were used to estimate the human oral bioaccessibility of Zn, Pb and As. The bioaccessibility testing was carried out through the Unified Bioaccessibility Method (UBM), validated by the Bioaccessibility Research Group of Europe (BARGE). Reference soils (NIST SRM 2711a and BGS 102), blanks and duplicated soils samples were used in order to assess the precision of the results. The comparison with the BARGE inter-laboratory values show a good precision and accuracy of the data produced by the UBM method. In the gastric phase (G), the bioaccessible fractions of Zn, Pb and As are in the ranges 31-246 mg/kg, 47-197 mg/kg and 0.86-4.78 mg/kg, respectively, and 3.3-50.5 mg/kg, 0.4-21 mg/kg and 0.98-4.39 mg/kg, respectively, for the gastro-intestinal (GI) phase. Similarly to the results obtained by the BARGE group, bioaccessibility estimates for As are similar in both phases but that is a significant decrease in bioaccessible Pb and Zn in the GI phase. The different trends in Zn and Pb bioaccessibility between simulated G and GI phases are likely to be related to pH of each phase, by possible reactions with soil matrix components and potential ligands in the extracted solutions. For risk assessment purposes and as a protective measure of human health, this study uses the bioaccessibility estimates of the G phase. Significant positive correlations were observed between bioaccessible estimates in the G phase and total PHE concentrations. Linear regression analysis shows that oral bioaccessibility is affected by some physico-chemical soil parameters. In these soils, illite and smectite play an important role in the fixation of PHE in the soil. The spatial distribution of the samples shows that: higher values of bioaccessible Pb are related to high traffic and historical gardens; higher values of bioaccessible As are related with the fertilizers used; higher bioaccessibility estimates for Zn occur in samples 16, 33 and 14, respectively a schoolyard (fertilizers), a small garden near a petrol station (tyre wear) and a public park (probably a crematorium). The unified test presents some valuable data for risk assessment. Indeed, the incorporation of oral bioaccessible concentrations into risk estimations could give more realistic information for health risk assessment.

Keywords: oral bioaccessibility, potentially harmful elements, urban soil