
Understanding the solid-phase fractionation of lead in house dust samples and its role in oral bioavailability and human exposure: a challenging task

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Abstract

A pilot survey focusing on potentially toxic elements (PTE) in house dust and toenails of residents from the industrial city of Estarreja was carried out for purposes of human exposure assessment studies. A total of 21 households and 30 individuals were recruited for the pilot study. This study aims at: 1) assessing the influence of lead's solid-phase fractionation on its bioavailability and 2) investigating relationships between dust Pb contents and Pb levels in the toenails. Ethics approval was obtained from the National Committee for Data Protection (Proc. n° 1241/2013). Average indoor dust Pb concentration (174 mg kg⁻¹) for Estarreja is slightly above the one of the control sites (75 mg kg⁻¹). Whilst levels of Pb are higher in toenail clippings from the exposed group (mean: 404 µg kg⁻¹), the differences are not statistically significant ($p > 0.01$). In this study, the solid phase fractionation of Pb in the indoor dust was investigated on a subset of 4 samples using a non-specific sequential extraction method coupled with chemometric analysis (CISED), while its bioaccessibility was estimated using the Unified BARGE Method (UBM). Dust components identified using the CISED are similar in number and chemical composition among the studied samples. Furthermore, Pb shows an identical solid-phase distribution in three of the four samples under study. The element is extracted with Ca, Al-Fe and Fe-Al-Si components of the dust, some of which are assigned to anthropogenic materials probably derived from indoor sources, extracted by average to high acid concentrations. Combining chemical extractions and oral bioaccessibility data, it is noted some evidence that the Pb associated to Ca and Al-Fe components is likely to be dissolved by the gastric fluids of the UBM protocol. The relationship between dust Pb contents and Pb levels in the residents' toenails seems to be gender dependent.

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