STUDY ON THE SOLID-PHASE FRACTIONATION OF POTENTIALLY TOXIC ELEMENTS IN HOUSE DUST WITHIN THE HUMAN HEALTH FRAMEWORK

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Introduction

The study herein described follows from a pilot survey encompassing concentration of potentially toxic elements (PTEs) in household dust samples and corresponding PTEs levels in toenails from residents of Estarreja, Portugal, which aimed at investigating exposure–biomarker relationships. The main goal of the present study is to assess the influence of the PTEs solid-phase fractionation on their bioaccessibility and its relevance to the exposure-biomarker association.

Methods

A total of 19 households and 27 individuals were recruited for the pilot study. All participants gave written, informed consent to the study. A composite indoor dust sample was collected in each home and the analysis of 55 chemical elements was carried out by Inductively Coupled Plasma - Mass Spectrometry (ICP-MS), as previously described in Reis et al., (2015). The bioaccessibility of the PTE was determined by subjecting a subset of indoor dust samples to the Unified BARGE Method (Wragg et al., 2011). The solid-phase fractionation of the PTEs was carried out by means of a non-selective sequential chemical extraction called CISED (Cave et al. 2004). Toenail clippings were provided by the study participants and a total of 36 chemical elements were analysed by ICP-MS, as previously described in Reis et al., (2015).

Results

Summary statistics for concentrations of Pb, Zn and Cr in house dust and toenails are presented in Table1. Whereas zinc (Zn) dust contents are elevated, and lead (Pb) and chromium (Cr) show levels of concern in toenail clippings of some residents, the three PTEs are further investigated.

Table 1. Summary statistics for Pb, Zn and Cr concentrations in indoor dust samples (mg kg^{-1}) and toenail clippings (µg kg^{-1}).

	dust (n= 19)			Toenails (n=27)		
	Pb	Zn	Cr	Pb	Zn	Cr
Minimum	53	582	25	60	72	70
Median	118	1110	72	190	116	420
Mean ± Standard Deviation	174 ± 250	1349 ± 1020	71 ± 21	404 ± 632	120 ± 30	832 ± 1091
Maximum	1180	5210	102	2770	191	5270

Figure 1 displays distribution plots showing the amount of Pb, Zn and Cr (mg kg^{-1}) associated with the identified soil components (residual soil-pore water, exchangeable, carbonates, Ca-dominated, Al-dominated and oxides), which are those assumed to represent the most common indoor dust components in houses from Estarreja.

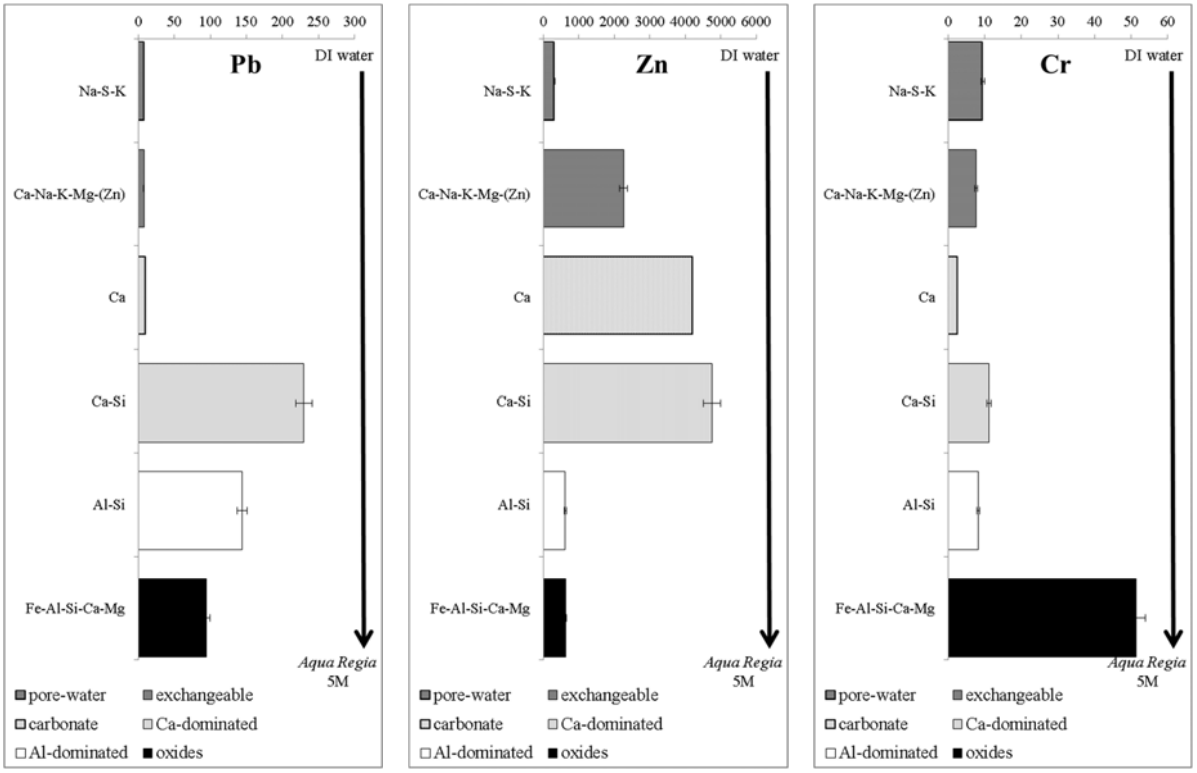

Figure 1. Distribution plots of showing the total amount of Pb, Zn and Cr (mg kg^{-1}, x-axis) associated with each component extracted by CISED (y-axis) in selected dust samples. The arrow identifies increasing acid concentrations (DI water – *Aqua Regia* 5M). The error bars represent the upper and lower 95th percent confidence limits.

Conclusion

The different solid-phase fractionation of Pb, Zn and Cr in the indoor dust largely supports the estimates obtained for their bioaccessible fraction. It further allows discriminating geogenic from probable anthropogenic sources. However, exposure –biomarker relationships are difficult to assess as a variety of factors such as gender or water consumption hamper establishing direct relationships between PTEs levels in house dust and toenail clippings. Furthermore, potential confounding factors such as vitamin intake were not taken into account in the analysis carried out. The results will be comprehensively discussed in the conference.

References

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