

## Estimation of inhalation bioaccessible fraction of As, Cd, Zn and Pb from settleable dust samples from Mediterranean mine towns under arid-semiarid climate

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### Actes de conférence:

ESOF (EuroScience Open Forum): Contaminations, Environnement, Santé et Société: de l'évaluation des risques à l'action publique: Francia, del 4 al 6 de julio de 2018

**Éditorial:** Université Toulouse - Jean Jaurès, Francia

**Année de publication:** 2018

**Pages:** 32

**Type:** Communication dans un congrès

Exporter

GOOGLE SCHOLAR

### Résumé

The bioaccessibility and human health risks of trace elements (TE) Pb, Zn, As and Cd in settled dust samples collected from seven towns located in the mining district of Cartagena-La Unión (SE Spain), including educational areas (EA), residential areas (RA), recreational areas (REA) and industrial and mining areas (IMA), were investigated in order to improve our understanding of their potential impact on risks due to inhalation. The settled dust was collected taking into account several factors which can influence in the concentration of TE like, distance to unconfined and confined mine waste, ephemeral channels, paved and unpaved roads, arable land etc. Samples were collected over blinds, doors or sledges made with PVC material with the aim to avoid an overestimation of TE in the final results. Then, samples were air dried and sieved through 10µm nylon sieve to get the inhalable dust fraction (PM10). Particles size were measured using laser diffraction technique (Mastersizer Malvern 2000 SM) before and after sieved the collected dust. The goal of this procedure was, on one hand, to verify that the desired particle size was achieved after sieving process and, on the other, establishing the percentage of PM10 that is contained in bulk samples. Gamble's solution (pH 7,4) and artificial lysosomal fluids –ALF– (pH 4,5) based bioaccessibility extraction test were used to simulate human respiratory system. Total concentration of TE in samples were measured after acid wet digestion on a hot plate. The concentration of TE were measured by means of ICP-MS (Agilent-7500) instrument equipped with a collision-reaction interface using hydrogen as reaction gas to minimize carbon- and chlorine-based polyatomic interferences. TE concentration in PM10 in all the areas exceeded the guideline of WHO, and followed the order of IMA > EA > REA ≈ RA. Pb and Zn were the most abundant metals with a total concentration range of 8901–504.6 and 6730–594 mg/kg respectively, followed by As 527.19–35.51 mg/kg and Cd 32,01–1,09 mg/kg. In respiratory system, TE bioaccessibility for PM10 varied within the range for Pb 0.32%–10.89 %, Zn 0.57%–92,88%, As 0.41%–4.41% and Cd 3.8%–95.9%. The bioaccessibility of TE was much higher, in all the areas and all the towns, in the in vitro ALF fluid than in Gamble's solution. Based on the bioaccessibility analysis, the hazard quotient values of TE in PM10 via inhalation exposure were upper than the safe level, for both adults and children. These high values could be related with a higher rate of some health disorders observed in the population of towns more strongly exposed to these TE. The obtained results indicated that the air quality of towns located in the surrounding area of the mine district of Cartagena-La Unión need to be improved. Moreover, the health risks to humans via inhalation exposure to atmospheric Pb, Zn, Cd and As, should be taken into account in the urban and social development management by authorities.

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