Oral and lung bioaccessibility of trace elements in dust particles under the influence of forest fires

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Forest fires have been an increasingly frequent phenomenon worldwide. In 2017, the forest fires were of extreme severity in Portugal, devastating huge forest and urban areas, causing a dramatic number of deaths and high economic losses.

The fire ashes are usually characterized by its easy wind dispersion, high alkalinity (mainly composed by (hydr) oxides of base cations), and by the significant amounts of trace metal(loid)s. Therefore, they may exert harmful effects to humans and animals not only from local, but also from populations hundreds of kilometres away from the source.

The lung bioaccessibility (LB) and oral bioaccessibility (OB), defined as the metal(loid)'s solubility in alveolar lung fluids and in gastric fluids from inhaled or ingested particles, respectively, are known to be important parameters for health risk assessment. Thus, this study aims at identify and quantify the trace elements present in dusts from an area affected by forest fires, and to assess its oral and lung bioaccessibility.

Samples were collected in sidewalks (inside and outside burned area) and represent a mixture of ash (resulted from forest fires), soil, street dust and airborne particles (Fig. 1). The samples were separated in two grain size fractions (<250 µm and <10 µm) for chemical analysis. Artificial lysosomal fluid (ALF) was used to measurement the LB in the <10 µm particle size fraction (inhaled fraction), whereas the UBM method was used to assess the OB in the <250 µm fraction (hand-to--mouth ingested particles) (Fig. 2).

The concentration of metals (Cu, Ni and Zn) was higher in the <10 µm particle size fraction than in the <250 µm fraction, which is of high concern not only because these particles represent more than 1% of the total mass, but also due its importance as an exposure route. The bioaccessibility percentages (lung and gastric phases, respectively) were: 42% and 33% for Cu; 27% and 31% for Ni; 60% and 54% for Zn. The lower Ni extraction is probably related to the local geology. No spatial correlation was found between the OB and LB values and the distance to the burned area. The high variability on the bioaccessiblity data between sampling sites may indicate: (1) significant heterogeneity in the composition and in the specific surface area of dust particles; (2) the ease of transport of the fire particles by the wind promotes a rapid dispersion and mixture with the particles of unburned zones.

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