

**QUALITATIVE ASPECTS OF BIOMONITORING: *SPHAGNUM AURICULATUM*
RESPONSE VS. AEROSOL METAL CONCENTRATIONS
(Pb, Ca, Cr, Cu, Fe, Mn, Ni and Zn) IN THE PORTO URBAN ATMOSPHERE***

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Abstract

Bags of *S. auriculatum* and a low-volume aerosol sampler provided with 0.8 μm pore size filters were exposed, in parallel, to the atmosphere of Porto, at different sampling points and in different periods of time, between 1991 and 1997. The levels of lead in the moss (weekly samples) and in the filters (daily samples) were determined by atomic absorption spectrophotometry and the results were compared. Living *S. auriculatum* exposed in bags to the Porto atmosphere died in several weeks (about a month), but continued to sorb metals from the atmosphere for about another month. In dry weather periods (relative humidity $\leq 76\%$) the rate of lead uptake by moss was approximately constant and proportional to the levels of the metal in atmospheric aerosols. A converting factor [$CF = |Pb|_{\text{moss}} (\mu\text{g/g.day}) / |Pb|_{\text{air}} (\mu\text{g/m}^3)$] allowed conversion of the lead levels in *S. auriculatum* to those in the atmospheric aerosols. Because the moss fixed lead from gas, aerosol and particulate matter, the rate of sorption depends markedly on the distance to the lead sources (mainly traffic) and on surrounding obstacles which retain particles. Therefore, specific calibration by mechanic monitoring, at each sampling point is required in a first stage of biomonitoring, when moss bag samplers are used to provide quantitative information about lead levels in the atmosphere. The mean Pb levels were $\leq 0.5 \mu\text{g/m}^3$ and approximately constants at each sample point up to January 1996. After that date it decreased about 50 %, in consequence of the reduction of the Pb concentration in leaded gasoline. In wet weather periods, higher but irregular rate of lead uptake was observed. In contrast, the lead levels in atmospheric aerosols decreased when the humidity increased due to wet deposition. Therefore, no proportionality between lead levels in the moss and in air were found. For about two months, in 1994, during a dry weather period, the levels of Ca, Cr, Cu, Fe, Mn, Ni and Zn were also biomonitoring and monitored in parallel. For all the heavy metals, the rate of metal uptake by moss was significantly correlated with the metal concentration in atmospheric aerosols. The results indicated that moss bags of *S. auriculatum* can provide quantitative estimation of the concentration of different heavy metals in urban atmosphere since the present methodology is used. *S. auriculatum* showed not to be a good quantitative bioindicator for Ca. The mean aerosol metal concentrations found in Porto atmosphere were similar to those observed in other urban atmospheres in different countries. The relative order of the mean metal concentrations was Fe ($1.8 \mu\text{g/m}^3$) > Ca > Zn > Pb > Cu > Cr > Mn > Ni (20 ng/m^3). **Key words:** Urban atmosphere, Heavy metals, Aerosols, Moss bags, Low-volume sampler, Atomic absorption spectrometry.

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