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Monitoring of Environmental Trace Elements in the Industrial-Urbanized Zone of East Algiers by Means of *Epiphytic Lichens* and *Tree Bark*

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ABSTRACT

In eastern Algiers (Algeria), a passive biomonitoring research was conducted in the urban-industrial area of Reghaia. To use the ubiquitous olive tree bark in large-scale biomonitoring of trace metal air pollution, we evaluated its bioaccumulation efficiency in a comparative study with the epiphytic lichen Xanthoria parietina. With the use of the effective, non-destructive multi-element approach known as X-ray fluorescence analysis (XRF), the amounts of 12 trace elements in samples of lichen and tree bark were effectively measured. The results revealed that both biomonitors displayed a consistent pattern of element accumulation, and the correlation between average concentrations exhibited substantial agreement, despite tree bark performing somewhat better than lichen. To distinguish between the accumulation rates of elements by lichens and tree bark, the contamination factor (CF) was calculated. Overall, CFs varied considerably depending on the elements assessed and the sampling sites, the highest values for Cd being found in Xanthoria parietina and Olea europaea bark, at 256 and 294.5 respectively. In order to identify where the trace elements under investigation originated from, enrichment factors were also determined. The results obtained suggest contamination of anthropogenic origin for As, Br, Cu, Pb, Cd and Zn, generated from road traffic, industrial activities, and agricultural practices, in contrast to Al, Cr, Fe, Mn, Ti, and V, which are believed to have lithogenic origins. These findings reveal extreme metal pollution in the Reghaia region, and demonstrate that the bark of Olea. europaea can be as reliable a bioindicator as lichens for assessing levels of atmospheric pollution by trace elements in urban and industrial areas, where harsh environmental conditions can lead to the scarcity or even disappearance of lichens.

Keywords: Biomonitoring, Olea europaea, tree bark, Xanthoria parietina, trace elements, X-ray fluorescence.

1 Introduction

Over the last few decades, air pollution in urban and industrial areas has become a serious environmental challenge as well as one of the harshest human problems. Hence, it has been singled out as one of the factors leading to a decline in life expectancy. Globally, cities with air pollution levels below World Health Organization (WHO) guidelines are home to only 12% of the world's population (Moreira et al. 2016). Atmospheric pollution can be generated from multiple sources, such as steel factories, power plants, vehicle traffic, dust, and manufacturing facilities (Masri et al., 2015). In numerous studies, tree bark has been employed as a biomonitor instantly, with lichens. In eastern Algiers (Algeria), a passive biomonitoring research was conducted in the urban-industrial area of Reghaia. To use the ubiquitous olive tree bark in large-scale biomonitoring of trace metal air pollution, we evaluated its bioaccumulation efficiency in a comparative study with the epiphytic lichen *Xanthoria parietina.*

2 Material and Methods

From November 2018 to January 2019, thalli of the foliose lichen *Xanthoria parietina* and bark of olive tree were collected at the 3 sampling sites reported. The samples were gathered in 3 stations, the urban areas of Reghaia (UR), the reserve natural of Reghaia (RNR) and the control at Chrea park at (50 km at Saouth of Algiers. With the use of the effective, non-destructive multi-element approach known as X-ray fluorescence

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analysis (XRF), the amounts of 12 trace elements in samples of lichen and tree bark were effectively measured. To evaluate the level of air pollution in the study area, calculations of environmental indices were conducted for each monitoring site and species, such as the contamination factor (CF), the pollutant loading index(PLI) and the enrichment factor (EF).

3 Results and discussion

The results revealed that both biomonitors displayed a consistent pattern of element accumulation, and the correlation between average concentrations exhibited substantial agreement, despite tree bark performing somewhat better than lichen. To distinguish between the accumulation rates of elements by lichens and tree bark, the contamination factor (CF) was calculated. Overall, CFs varied considerably according to the elements assessed and the sampling sites, in particular Cd reached the highest values in the bark of Xanthoria parietina and Olea europaea (256 and 294.5 respectively), whereas CF values for chromium (Cr) were only 25.8 for X. parietina and 27.6 for olive bark (Cr). In order to identify where the trace elements under investigation originated from, enrichment factors were also determined. The results obtained suggest contamination of anthropogenic origin for As, Br, Cu, Pb, Cd and Zn, generated from road traffic, industrial activities, and agricultural practices, in contrast to Al, Cr, Fe, Mn, Ti, and V, which are believed to have lithogenic origins. Overall, concentrations were consistent with those observed in similar suburban and urban areas (Sorbo et al., 2008). The PLI values vary from 3.3 at the RNR site to 13.4 at the UR site for Olea europaea and from 5.2 at the RNR site to 17.9 at the UR site for Xanthoria parietina. These results reveal extreme metallic pollution at both sites.

4 Conclusion

The contrasting results from the different sites highlighted the accumulation properties of the biomonitors used and revealed extreme metal pollution at both sites. These results also demonstrate that the bark of *Olea europaea* can be as reliable a bioindicator as lichens for assessing levels of atmospheric pollution by trace elements in urban and industrial areas, where difficult environmental conditions can lead to the scarcity or even disappearance of lichens.

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