

CITIZENS INVOLVEMENT IN THE ASSESSMENT OF ATMOSPHERIC CONTAMINATION IN AN INDUSTRIAL AREA

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Keywords: particulate matter, urban-industrial, biomonitoring, strawberry leaf

1. Introduction

Biomonitoring offers advantages over standard sampling methods, since biomonitors can be used in vast areas with many monitoring points (Almeida, 2012). The most commonly used biomonitors are lichens (Canha, 2014), but leaves have been used as a reliable approach to explore air quality in urban environments because they are efficient collectors of atmospheric particles (Castanheiro, 2020).

Citizen science (CS) involves citizens and professionals in the same project, aiming to create a collective action that can help solve environmental problems, favoring behavioral changes in individuals (Constant, 2018)(Conrad, 2011). A recent example is the AIRbezen project, which aimed to assess air pollution in Antwerp, using strawberry plants distributed to the population (Van Dyck 2019).

In the last years, in Seixal municipality, an urban-industrial area with a high influence of steelworks, the episodic deposition of airborne particulate onto homes and property were common complaints of the residents, and the local Council promoted a set of actions, such as to assess the chemical composition of the settled dust, in order to understand its sources and potential health hazards (Justino, 2019). In this previous study, the influence of the nearby industrial area was identified due to the content of Fe, Cr and Mn, which are typical tracers of steel industries (Calvo, 2013), along with a minor traffic influence. Continuing the actions promoted by the local Council, the present study applies biomonitoring of atmospheric particulate matter using strawberry leaves, in a CS project, aiming to map and identify pollution hot spots in Seixal.

2. Methodology

This study was carried out in União de Freguesias do Seixal, Arrentela e Aldeia de Paio Pires (UFSAAPP), in the municipality of Seixal (Portugal), an urban-industrial area near Lisbon, with 167294

inhabitants in 95.5 Km² (PORDATA, 2021). The sampling area is in a grid of 77 cells of 650 m x 620 m, coordinates -9.11,38.65 to -9.05,38.59 (Figure 1).

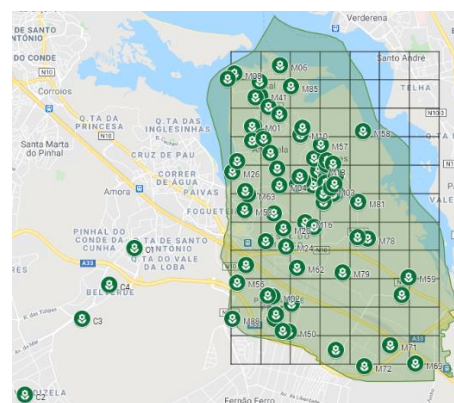


Figure 1. Spatial distribution of strawberry plants exposed at UFSAAPP and controls outside the grid

A local meeting was held on February 1 2020, to engage the population in the biomonitoring program and to explain the procedures that were expected from the population for taking care of the strawberry plants during the exposure period. A total of 78 strawberry plants (*Fragaria ananassa*) were distributed among the volunteers. From February 1 to June 16, the strawberry plants were exposed to the open air, in a ground or first floor of the volunteers' houses. Afterwards, branches of each strawberry plant were collected, lyophilized, grinded to powder and pelletized, for analysis by micro-X-Ray Fluorescence, to assess the mass fractions of 25 elements. The uncertainty was 2-5% for the main and 10-15% for the trace elements. The ArcGIS 10.5 software was used, with the IDW interpolation.

3. Results and Discussion

The spatial distribution of the elements Cr, Fe, Mn and Zn, typically associated with steel industries

(Almeida, 2015), presented higher concentrations in the area of the steelworks (SN) (Figure 2).

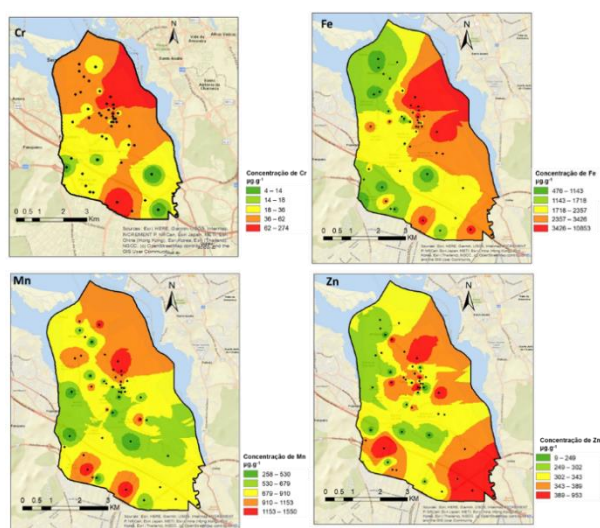


Figure 2. Spatial distribution of Cr, Fe, Mn and Zn measured on the exposed strawberry leaves

Figure 3 shows the relation between Cr and Fe determined in the strawberry leaves, evidencing a very good correlation ($r^2=0.85$) and the existence of a common emission source. Comparing to the ratio in the settled dust ($Cr/Fe=0.05$) (Justino, 2019), there is a difference, which may indicate the influence of additional sources, such as the soil that also contributes to the emission of Fe (Calvo, 2013). The ratio $Mn/Fe=0.12$ determined in the strawberry leaves is similar to the ratio $Mn/Fe=0.14$ found in the settled dust (Justino, 2019).

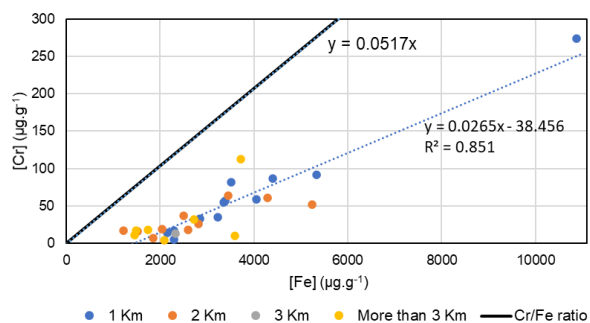


Figure 3. Cr and Fe concentrations in the exposed strawberry leaves and in the settled dust

A sharp decrease in the concentration of Fe and Cr with the distance to SN (49% and 57%, respectively) was found.

4. Conclusions

In the elemental characterization of the strawberry leaves, a significant association between Fe and Cr was found, along with a decrease in their concentrations with the distance to the steelworks. These facts indicate the possibility of the steelworks

being a source for the degradation of the local air quality in Seixal.

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Acknowledgments

Are due to FCT/MCTES for the financial support to C2TN-IST-UL (UIDB/04349/2020), to the project LIFE Index-air (LIFE 15 ENV/PT/000674) and project GINOP-2.3.3-15-2016-00029. To the Municipality of Seixal and UFSAAPP, for funding and all the support given in the sampling process.