Abstract

Monitoring air pollution using conventional methods can require a large number of resources, both economically and in terms of experienced personnel. The use of seasonal and edible plants can be a solution that implements multifunctionality: air-pollution monitoring and hitspots for biodiversity.

Four planter boxes were planted at several locations along a gradient starting from one side of Lyngbyvejen and moving across the highway up Emdrupvej, in collaboration with ARUPs Living Lab. The goal of placing these boxes starting from the highway moving away was to study how particulate air pollution may linger away from the primary source of pollution. Each box housed 4 individual kale replicants, with the space to plant other plants if desired. After 45 days of the mature plants living at each test site, samples have been sent back to a laboratory at København Universetet, where unwashed samples will be analyzed and tested for particulate matter commonly caused by air pollution. The elevated surface area of kale leaves act as a net for airborne pollutants, especially particulate matter like heavy metals.

The overall aim of this project is not only to research the air pollution of the area but to try to understand if kale could be a possible alternative for monitoring air pollution in urban contexts. Beside each box were placed educational information that could help locals learn more about the methods being used as well as what can be done in the future to further monitor and improve air quality.

1. Literature background

Assessment of lettuces grown in urban areas for human consumption and as bioindicators of atmospheric pollution (Izquierdo-Díaz et al 2024)

In this study, 30 lettuces specimens were exposed to different degrees of air pollution in five locations in the city of Copenhagen, six were placed at each site (Figure 1) and, after the exposure period, harvested. Subsamples were then digested by a total extraction method and a bioaccessible extraction method, and the concentration of 23 elements subsequently measured by ICP-MS. The results showed that exposed samples in areas of higher atmospheric pollution accumulated a larger amount of trace elements associated with typical urban sources.

Instead of using sample points in and out the city, the scope of this project is to understand if the use of plants as bioindicators could be feasible in a smaller area, scaling down the 2024 study. Emdrupvej has

been chosen as the study area, to assess if the close proximity with a highway can influence the deposition of particulate matter onto the kale leaves. Kale has been chosen instead of lettuce because of its overall tolerance to external factors, leaf surface area, and how easy it is to grow.

2. Methods

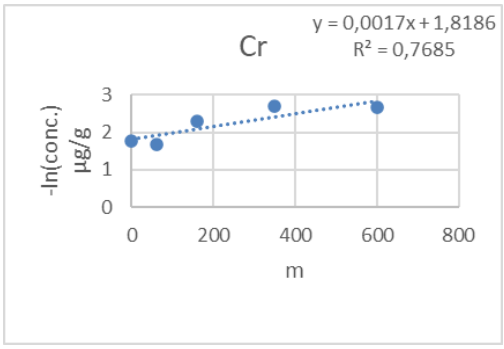
Four planter boxes were planted at several locations along a gradient starting from one side of Lyngbyvejen and moving across the highway up Emdrupvej. Each box housed 4 individual mature kale replicants, with the space to plant other plants if desired. Kale was chosen because the elevated surface area of kale leaves acts as a net for airborne pollutants, especially particulate matter like heavy metals. They also require little intervention to keep alive, and are less likely to be eaten by pests than other broadleaf plants. After 45 days of residence at each test site, samples were collected and sent back to the Plant and Environmental Sciences (PLEN) laboratory at København Universetet. Unwashed samples were then analyzed and tested for particulate matter commonly caused by air pollution. Plants were first oven-dried and then digested by IC-MS. Left over heavy metals and particularist where then weighed and compared.

Sample points:

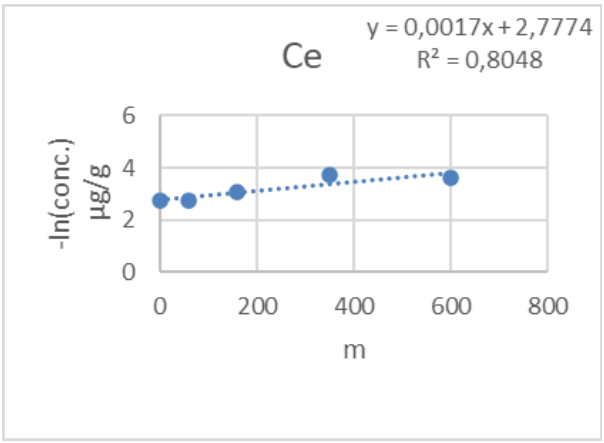
3. Results

Analysis shows concentration of 20 different elements, for each sampling point. Analysis of correlation between concentration (μg/mg) of one analyte and the distance from the source point (sample 0) provides two key insights. Cerium and Chromium show a statistically significant ($p<0,05$) exponential correlation between the distance from the source point and the concentration of both elements. Presense of both Cerium and Chromium, found in automobile catalytic converters, suggesting a cause-effect relationship between the more elevated presence distance to the source point.

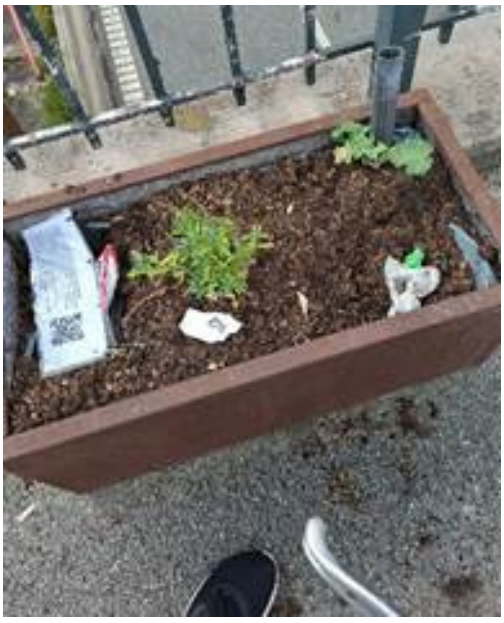
	Cr
Meters	Conc.
0	0,1705165
60	0,1855622
160	0,1005848
350	0,0674958
600	0,0699503



	Ce
Meters	Conc.
0	0,0654795
60	0,0629901
160	0,0463931
350	0,0241603
600	0,0268412



4. Discussion



The success of this project to produce any statistically significant value is promising for the future of community monitoring, as it proves air pollution can be tracked by the residents that are most effected by pollution sources, without having to appeal to the municipality. It also shows the value of multifunctional space, wherein any green space or planter box can be used for so much more than a food source or a aesthetic attraction, but as a genuine tool for the betterment of a community. While analysis is not cheap, costing around 600 kr a sample, valid results like this will hopefully show the scientific community and the local municipality that that investment in cheaper methods of analysis are crucial to replicating something like this on a larger scale. If there had been more replicants and more boxes, this study would have likely produced more significant results.

Public facing projects in an urban context are heavily influenced by human interactions with samples. In the photos above they show the same planter box, photographed 10 days apart. We can see how the kale has been taken by somebody, and trash found in the planter box, although the presence of information labels. This could both show the obstacles in implementing strategies of biomonitoring, but can also be an opportunity to underline the need of urban gardening in the area.

5. Conclusion

Air monitoring for pollution from cars is important for informing residents and elected officials of the environmental quality of their neighborhood, making the prospect of low cost monitoring via easy to grow plants exciting. This studdy successfully used kale plants as a bioindicator for pollution by cars. Multiple replicants where planted in several planter boxes for 45 days, after which, plants where analyzed for heavy metal content in the lab. A statistically significant presence of Cr and Ce, commonnly found in catalytic converters, was found along a gradient from sample point 0 to 4.