P33. A toxicological indexing study of urban air quality samples using an in vitro bioassay

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In this study, the ecotoxicity of atmospheric particulate matter < 10 µm (PM_{10}) from urban samples was assessed using a rapid and cost-effective bioluminescence assay, the Vibrio fischeri bioluminescence inhibition assay. Sampling was carried out in the city of Coimbra (Portugal) in two different locations (urban background and roadside site). Ambient air samples were collected on quartz fibre filters by high-volume air samplers. Twenty-eight filters (14 from each location) were chosen from a sampling campaign which took place from 1 December 2018 to 19 June 2019. The chemical characterisation of about 50 species (carbonaceous compounds, ions, metals and saccharides) was done to assess the toxicological potential of specific chemical components. Each sample was extracted into a hydrophilic phase and the ecotoxicity testing was carried out using the direct contact test system (ISO 21338:2010). The Toxicity Unit (TU) index, used to assess the ecotoxicity, showed that 64% of the samples from the urban background site were toxic and 14% very toxic. Regarding the roadside site, 50% and 7% of the samples were toxic and very toxic, respectively. Vibrio fischeri responses were significantly correlated with species characteristic of biomass combustion (carbonaceous compounds and anhydrosaccharides) and with some metals (Cu, Zn, As, Pb), likely from traffic sources, in both locations. Overall, results revealed the occurrence of ecotoxicity levels in PM_{10}, dependent on sampling location, highlighting the contribution of carbonaceous compounds, anhydrosaccharides and metals.

Este estudo avaliou a ecotoxicidade de partículas atmosféricas < 10 µm (PM_{10}) provenientes de amostras urbanas, utilizando um ensaio rápido e económico de bioluminescência, o ensaio de inibição de bioluminescência de Vibrio fischeri. A amostragem foi realizada na cidade de Coimbra (Portugal) em dois locais diferentes (fundo urbano e local de tráfego). As amostras de ar ambiente foram recolhidas em filtros de fibra de quartzo com amostradores de alto volume. Foram escolhidos 28 filtros (14 de cada local) de uma campanha de amostragem que decorreu entre 1 de dezembro de 2018 a 19 de junho de 2019. Foi feita a caracterização química de cerca de 50 espécies (compostos carbonáceos, iões, metais e sacarídeos) para avaliar o potencial toxicológico de determinados componentes químicos. Cada amostra foi extraída numa fase hidrofílica e os testes de ecotoxicidade foram realizados utilizando o sistema de teste de contacto direto (ISO 21338:2010). O índice de Unidade de Toxicidade (UT), utilizado para avaliar a ecotoxicidade, mostrou que 64% das amostras do local de fundo urbano eram tóxicas e 14% muito tóxicas. Relativamente ao local de tráfego, 50% e 7% das amostras eram tóxicas e muito tóxicas, respetivamente. Em ambos os locais, as respostas de Vibrio fischeri apresentaram correlações significativas com compostos característicos da combustão de biomassa (compostos carbonáceos e anidrossacarídeos) e com alguns metais (Cu, Zn, As, Pb), provavelmente provenientes de emissões do tráfego. Globalmente, os resultados revelaram a ocorrência de níveis de ecotoxicidade nas partículas PM_{10}, dependentes do local de amostragem, destacando-se a contribuição dos compostos carbonáceos, anidrossacarídeos e metais.

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BACKGROUND:

Air quality in urban areas is, at present, a major concern for many European countries, including Portugal. Airborne particulate matter (PM) is composed of primary and secondary compounds arising from anthropogenic and biogenic sources. Urban atmospheric particles, as a reservoir of toxic compounds, are typically dangerous for human health due to their physicochemical composition and their ability to affect the respiratory system. Toxicity refers to the degree to which a substance can cause a negative effect on a whole organism, as well as the effect on a substructure of the organism, such as a cell or an organ[1]. A toxicological indexing provides useful information about the effects of chemical pollutants and their bioavailability, complementing in this way physico-chemical analyses of environmental matrices[2].

ACKNOWLEDGMENTS

This work was supported by the ISY-AIR project (MIT-EXPL/IRA/0023/2017) and also by the POCI-01-0145-FEDER-029574 (SOPRO) project funded by FEDER, through COMPETE2020 - POCI, and by OE, through FCT/MCTES. An acknowledgment is also given to the Portuguese Science for Science and Technology (FCT) and to the POHP/FSE funding programme for supporting Estela Alexandra Domingos Vicente through a PhD fellowship (SFRH/BD/117993/2016). The authors are also grateful for FCT/MCTES for the financial support to CESAM (UIDB/50017/2020+UIDP/50017/2020), through national funds.

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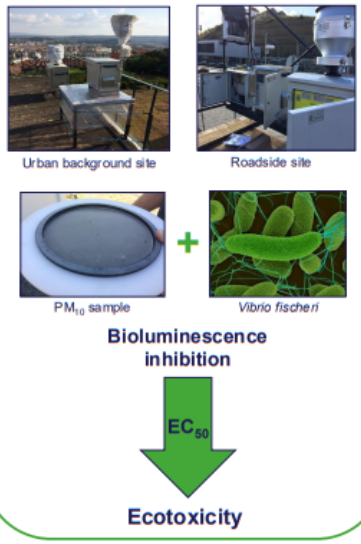
OBJECTIVE:

- Ecotoxicity assessment of atmospheric particulate matter < 10 µm (PM_{10}) from urban samples using a rapid and cost-effective bioluminescence assay, the *Vibrio fischeri* bioluminescence inhibition assay.

METHODS AND RESULTS:



- Sampling was carried out in the city of Coimbra (Portugal) in two different locations (urban background and roadside site).
- Ambient air samples were collected on quartz fibre filters by high-volume air samplers.
- Twenty-eight filters (14 from each location) were chosen from a sampling campaign that took place from 1 December 2018 to 19 June 2019.
- The chemical characterisation of about 50 species (carbonaceous compounds, ions, metals and saccharides) was done to assess the toxicological potential of specific chemical components.
- Each sample was extracted into a hydrophilic phase and the ecotoxicity testing was carried out using the direct contact test system (ISO 21338:2010) following the protocol developed by Kováts et al. [3].

- The Toxicity Unit (TU) index showed that 64% of the samples from the urban background site were toxic and 14% very toxic. Regarding the roadside site, 50% and 7% of the samples were toxic and very toxic, respectively.

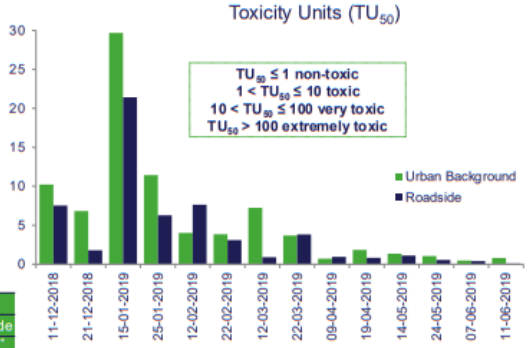


Figure 1 - Toxicity Units (TU_{50}) obtained with *Vibrio fischeri* bioassay.

Table 1 - Spearman correlation coefficients.

	EC_{50}	
	Urban Background	Roadside
OC	-,785**	-,798**
EC	-,858**	-,877**
TC	-,836**	-,846**
Cu	-,818**	-,767**
Zn	-,719**	-,640*
As	-,704**	-,881**
Pb	-,592*	-,758**
Xylitol	-,634*	-,650*
Levoglucosan	-,659*	-,729**
Mannosan	-,685**	-,740**
Galactosan	-,689**	-,689**

OC, EC and TC – organic elemental and total carbon. Significant correlation coefficients at the p-level < 0.05 and 0.01 are marked with * and **, respectively.

- *Vibrio fischeri* responses were significantly correlated with species characteristic of biomass combustion (carbonaceous compounds and anhydrosaccharides) and with some metals (Cu, Zn, As, Pb), likely from traffic sources, in both locations.

CONCLUSIONS:

- Overall, results revealed the occurrence of ecotoxicity levels in PM_{10}, dependent on sampling location, highlighting the contribution of carbonaceous compounds, anhydrosaccharides and metals.