Redox activity of fine particle matter $PM_{2.5}$ samples collected at a bus station in Salvador City, Brazil

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Abstract

Redox activity from ambient particulate matter $PM_{2.5}$ was studied to measure its oxidative potential due to adverse effects in human health.

Introduction

Vehicle emissions are a major source of air pollution in urban areas throughout the world[1]. Vehicles moved by fossil fuels, especially diesel, emit a complex mixture of toxic pollutant gases and particulate matter (PM)[2]. Redox activity from PM can be measured by reduction of oxygen through DTT assay[3]. The rate of DTT consumption is increasingly used to measure the oxidative potential from PM, which has been linked to adverse human health effects[4]. The present study aims to evaluate the redox activity using the dithiothreitol (DTT) assay from metals and organic compounds contained in SRM 1649b Urban Dust and particulate matter samples ($PM_{2.5}$) collected at a bus station in city of Salvador, Brazil.

Results and Discussion

This work carried out tests with SRM 1649b and SRM 1649b spike tests in order to better understand the DTT front of the oxidation rate behavior to chemical species: PAHs, nitro-PAHs, quinones and metals contained in the SRM. We then use these results to evaluate and compare the DTT oxidation rates by metals and organic species contained in ambient particulate matter. The metals present in SRM 1649b showed higher redox activity to produce reactive oxygen species (ROS) as compared to the absence of these species due to complexation reaction with DTPA, which significantly suppresses the response of redox activity of metals. DTT activities from SRM 1649b and SRM 1649b spike tests expressed as mass (of PM) and based in DTT activities are shown in Figure 1.

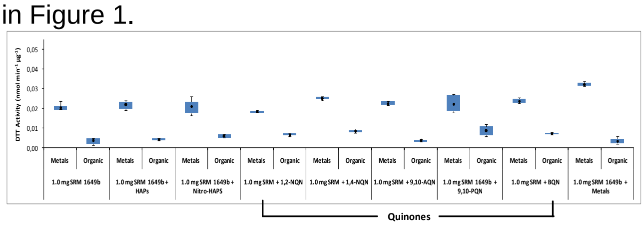

Figure 1. DTT activities expressed as nmol of DTT min^{-1} μg^{-1} from SRM 1649b and spike tests in SRM 1649b.

$PM_{2.5}$ samples (n=24) collected in eight days were analyzed; every day three samples were evaluated: one in the morning, one in the afternoon and one at night. Total DTT activities ranged 0.020-0.069 nmol min^{-1} μg^{-1}, in which the median is 0.040 nmol min^{-1} μg^{-1}. DTT activities from metals and organic compounds contained in $PM_{2.5}$ measured by DTT assay are shown in Figure 2.

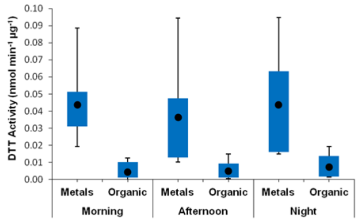

Figure 2. Average of DTT activities (n = 24) expressed as nmol of DTT min^{-1} μg^{-1} of particulate matter mass collected at Lapa bus station.

DTT activities from organic compounds and metals contained in the SRM 1649b are similar to DTT activities from organic compounds and metals present in atmospheric particulate matter $PM_{2.5}$ collected at Lapa bus station. The net result is that metals appear to dominate the DTT response for typical ambient $PM_{2.5}$ samples. Approximately 80% correspond to the redox activity from metals, front the low contribution of the organic compounds. Other studies are being performed to assess the effect of using ultrason and the role of metals in the direct reaction with DTT.

Conclusions

Comparisons between soluble metallic species and organic compounds were performed to evaluate their relationship with redox activity in $PM_{2.5}$. It became clear that the metallic species contained in $PM_{2.5}$ has greater ability to catalyze reactions that generate reactive oxygen species. The execution of assays that quantify and/or identify species able to form reactive oxygen species are important to better assess the potential risks to human health that the population is exposed daily.

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[1]Colvile, R. N.; et al. *Atmos. Environ.* **2001**, 35, 1537-1565.
[2]Kerminen, V. M.; et al. *Environ. Sci. Technol.* **1997**, 31, 1883-1889.
[3]Cho, A. K.; et al. *Environ. Research.* **2005**, 99, 40-47.
[4]Charrier, J. G.; Anastasio, C. *Atmos. Chem. Phys.* **2012**, 12, 9321-9333.