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# REVIEW OF AMBIENT PARTICULATE MATTER OXIDATIVE POTENTIAL MEASURED IN ITALY WITH ACELLULAR ASSAYS

M. Russo, E. Zagatti, M.C. Pietrogrande

*Department of Chemical and Pharmaceutical Sciences, University of Ferrara, Ferrara, Italy*

An emerging hypothesis in the field of air pollution is that oxidative stress is one of the important pathways leading to adverse health effects of airborne particulate matter (PM). Therefore, the oxidative potential (OP) - defined as the capacity of PM to oxidize target molecules generating reactive oxygen species (ROS) - has been proposed as a biologically relevant metric for assessing PM toxicity [1,2].
This work reviews the OP values measured to date in Italy, with the aim to provide a picture of the spatial and seasonal variability of OP in Italy, and give an insight into sources, processes and effects of meteorological conditions.
The paper summarizes the results obtained with the most common OP acellular assays based on target antioxidants simulating the PM−cell interaction generating ROS. The dithiothreitol ($OP^{DTT}$) and ascorbic acid ($OP^{AA}$) are based on low-cost spectrophotometric UV-Vis measurements of the depletion rate of DTT and AA, while the dichlorofluorescein assay ($OP^{DCFH}$) allows for the detection of PM–induced ROS via fluorescence spectroscopy [1].
The reviewed data concern different sites located in Continental and Peninsular areas, as shown in Figure 1.

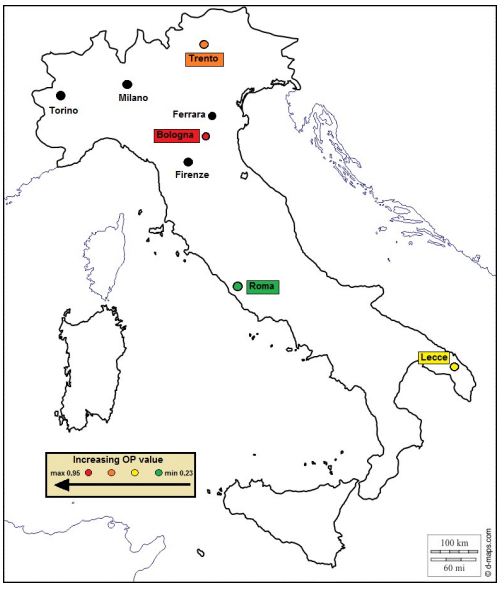


Figure 1. Location of the investigated sites reviewed in the paper. Coloured points describe the $OP^{DTT}$ measured average responses (nmol $min^{-1}$ $m^{-3}$).

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Most of the available data were measured with the DTT assay. Overall, it provided mean $OP^{DTT}_V$ values (volume normalized responses) ranging from 0.22 ± 0.18 to 0.95 ± 0.18 nmol $min^{-1}$ $m^{-3}$. The AA assay has been used on PM samples collected at Bologna and Lecce and produced $OP^{AA}_V$ responses varying from 0.24 ± 0.2 to 1.41 ± 0.2 nmol $min^{-1}$ $m^{-3}$. The DCFH assay has been used in two studies to obtain OP values from 1870 ± 1861 µg ZYM/mg PM to 14882 ± 1861 µg ZYM/mg PM.

Overall, our synthesis indicates a generally greater PM OP in Po Valley, mainly related to emission sources and atmospheric conditions.

Moreover, on the basis of our observations, the three OP assays differ in the association with PM chemical composition, in seasonality and particle size distribution, even if they are sensitive to the same redox-active species in PM samples.

Another important outcome of our study is the identification of major species and sources that are associated with ROS activity. Water-soluble transition metals (e.g., Fe, Ni, Cu, Cr, Mn, Zn and V) and water-soluble organic carbon (WSOC) showed consistent correlations with the PM oxidative potential across different urban areas and size ranges.

The major PM sources associated with these chemical species include residual/fuel oil combustion, traffic emissions, and secondary organic aerosol formation, indicating that these sources are major drivers of PM-induced oxidative potential.

**References**

[1] Bates, J.T., Fang, T., Verma, V., Zeng, L., Weber, R.J., Tolbert, P.E., Abrams, J.Y., Sarnat, S.E., Klein, M., Mulholland, J.A., Russel, A.G., 2019. Review of Acellular Assays of Ambient Particulate Matter Oxidative Potential: Methods and Relationships with Composition, Sources, and Health Effects. Environ. Sci. Technol. 53, 4003-4019.

[2] Pietrogrande, M.C., Bertoli, I., Manarini, F., Russo, M., 2019. Ascorbate assay as a measure of oxidative potential for ambient particles: Evidence for the importance of cell-free surrogate lung fluid composition. Atmos. Environ. 211, 103-112.