PM Oxidative Potential:

response of acellular assays to predict PM-induced oxidative stress activity

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Review of oxidative potential of atmospheric aerosol in urban and rural sites across Italy measured with acellular assays

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This work reviews the oxidative potential (OP) values associated with size-segregated airborne PM in different urban and rural areas across Italy. The aim is to provide a picture of the spatial and seasonal variability of OP in the various geographical areas, in order to advance our understanding of sources and chemical elements contributing to aerosol OP.

The review summarizes OP responses measured to date using the common acellular assays based on target antioxidants simulating the PM−cell interaction generating ROS, namely dithiothreitol (DTT), acid ascorbic (AA) and 2′,7′-dichlorofluorescin (DCFH) assays.

The reviewed data concern different sites located in Continental and Peninsular areas (Figure 1).

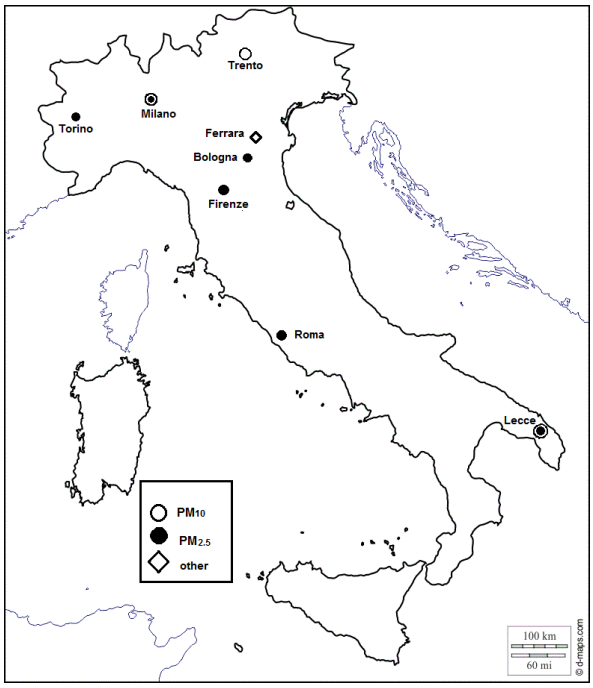

Figure 1. Location of the reviewed sites across Italy. Symbols indicate different PM size fractions.

The paper describes the sensitivities of the various acellular OP assays to PM composition, emission sources, and size. Information on species and sources mostly associated with ROS activity were also reported. Water-soluble transition metals (e.g., Fe, Ni, Cu, Cr, Mn, Zn and V), secondary ions, and carbonaceous component (water-soluble organic carbon, organic and elemental carbon) showed significant correlations with the PM OP across different urban and rural areas and size ranges.

The major PM sources associated with these species include biomass combustion, traffic emissions, and secondary organic aerosol formation, indicating that these sources are the major drivers of PM-induced oxidative properties.

Based on the reviewed data, the three OP assays differ in the association with PM chemical composition, seasonality and particle size distribution, even if they are sensitive to the same redox-active species in PM samples. In particular, smaller size fractions are generally associated with higher intrinsic OP responses compared with larger PM size fractions. Moreover, comparison of ROS activity levels across different seasons indicated that photochemical aging increases the intrinsic OP of airborne PM.

Our synthesis indicates a generally greater intrinsic PM oxidative potential as well as higher levels of exposure to redox-active PM in the Po Valley, due to the high density of anthropogenic sources, and the orographic and meteorological characteristics particularly unfavourable for pollutants dispersion.

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