Characterization of reactive oxygen species in airborne particles from São Paulo Megacity

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The human exposition to atmospheric particulate matter (PM) has been associated to adverse health effects by some epidemiological studies (Pope *et al* 2009). These studies have specifically shown health issues in association to the exposition to ultrafine particles (UFP, dp < 100 nm) and fine particles ($PM_{2.5}$). Health-related issues include inflammatory processes, diverse respiratory system problems, cardiovascular diseases, morbidity, and mortality. The exact mechanisms of these processes work are currently unknown but one such hypothesis is that they are derivated from oxidative stress initiated by reactive oxygen species (ROS) within affected cells. Recent investigations show correlations among particulate matter (PM) oxidative properties, ROS production and its chemical composition. Some ROS such as hydrogen peroxide (HOOH) and hydroxyl radical (OH•) together to organic species and trace metals composing the PM are related to its oxidative properties.

In this study we investigated some ROS and related species, which are either produced and/or consumed in the Fenton reaction. The studied species were hydrogen peroxide (HOOH), hydroxyl radical (OH•), and speciated iron (Fe(II)/Fe_{total}). 24hr fine ($PM_{2.5}$) and coarse (PM_{10}) particle samples were collected once a week, using Hi-Vol samplers, during the year 2014 in the University of Sao Paulo campus (which is surrounded by intense traffic), in Sao Paulo Megacity, Brazil. Moreover, since it is known ROS production is likely to be associated to PM composition, we also determinated OC, EC, levoglucosan, mannosan, gallactosan, and major ions for observing if there was any correlation among them.

PM samples were extracted in two different aqueous solution conditions: *(i)* pH = 3.5 (H_2SO_4 solution), and *(ii)* phosphate buffer solution in pH = 7.2-7.4. While the first condition is environmentally important and ideal pH for studying of ROS production through Fenton reaction, the last one is physiologically relevant and often used for health-related cell-free ROS studies (Arellanes *et al.* 2006, Wang *et al* 2006). In the present abstract we show results for pH 3.5 only.

In pH 3.5 ROS and related species concentrations were (units in nmol mg^{-1}): 14 ± 5 (OH•), 5.8 ± 2 (HOOH), 10.6 ± 4 (Fe(II)), and 14.7 ± 5.7 (Fe_{total}) for fine particles. In turn, for coarse particles ROS levels were 7 ± 2.6 (OH•), 2.8 ± 1.7 (HOOH), 10.6 ± 4.3 (Fe(II)), and 15.4 ± 6 (Fe_{total}). Mass-corrected ROS time-series are found in Figure 1.

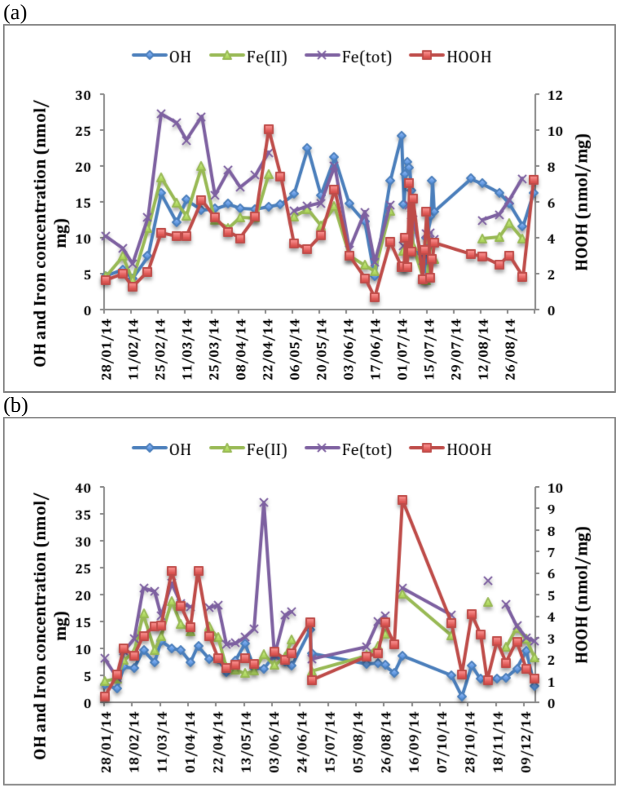

Figure 1. Mass-corrected ROS time series (in pH 3.5) for Sao Paulo, (a) PM2.5 and (b) PM10.

In regard to correlations, we found moderate associations between OH• and biomass and/or fuel burning tracers (levoglucosan, mannosan, gallactosan, K^+, OC, and EC) while both Fe(II) and Fe_{total} were correlated with OC and EC only. HOOH was not correlated with anyone else.

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