PM pollution: taking into account of bioaccessibility into acellular assays for health impact assessment.

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In vitro studies have shown that effects of airborne particles (aerosols) on human health can be mainly attributed to their inflammatory potential due to the oxidative species they carry (Kelly, 2013). Particulate matter (PM) can transport or induce the production of reactive oxygen species in the airways and, if these exceed the available defenses, oxidative stress ensues (Kelly, 2013).

To predict aerosol toxicity, a key parameter to investigate is the oxidative potential of PM. In this respect several, non–invasive screening assays (in vitro) have recently been developed (Cho, 2005; Uzu, 2011; Kelly, 2011; Janssen, 2014).

However, in those tests, whether in studies concerning ambient particles or chemicals species, particles are mostly extracted in methanol, in Milli-Q water (Yang, 2014), or sometimes in a mixture of lung antioxidant (RTLF model) (Kelly, 2011). Those extractions don't seem to be representative of physiological conditions. We propose, here, an improvement of OP assays using solutions of extraction mimicking more closely the lung fluid composition so as, to take into account the bioaccessibility in the OP assays. Regarding the simulated lung fluids (SLF) solutions, three solutions have been tested; the Gamble's solution, the ALF's solution and Gamble's solution which is added the dipalmitoylphosphatidylcholine (DPPC) i.e. the main phospholipid of the lung surfactant.

Hereby, three acellular methodologies for OP are compared after physiological extraction: two of them are based on the consumption of a reductant agent which mimic lung antioxidant: OP_{DTT} using Dithiothreitol as reductant, was developed to simulate the in vivo generation of superoxide radicals, and OP_{AA} using ascorbic acid and are based on spectrophotometric measurements. The third one is OP_{ESR} using Electron spin Resonance to evaluate a specific reactive oxygen species, hydroxyl radical (OH°), generated by the PM. Each of these assays present specificities and no consensuses have been made for the more appropriate assays (Janssen, 2014).

Is OP assays and the extraction of aerosols in SLF's solutions compatible? Are there differences in OP results between the three solutions of extraction? Is there a linear response between concentration of atmospheric compounds and oxidative stress response? (Fig 1). Here, we propose to answer to these few questions by studying OP on isolated compounds of aerosols (reference material) and PM environmental samples.

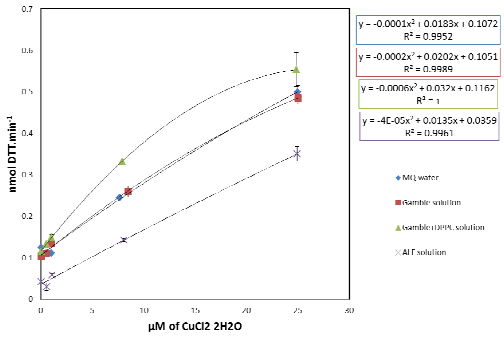

Figure 1: DTT depletion vs molar concentration of $CuCl_2.2H_2O$.

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Kelly, F.J. (2003) *Oxidative stress: its role in air pollution and adverse health effects*, Occupational and environmental medicine, 60(8), 612-616.

Cho, A.K. (2005) *Redox activity of airborne particulate matter at different sites in the Los Angeles Basin*, Environmental Research, 99 (2005), 40-47.

Uzu, G. (2011) *In vitro assessment of the pulmonary toxicity and gastric availability of lead-rich particles from a lead recycling plan*t, Environ. Sci. Technol. 45, 7888-7895.

Yang, A. (2014) *Measurement of the oxidative potential of PM2.5 and its constituents: the effect of extraction solvent and filter type*, Atmospheric environment 83 (2014) 35-42

Kelly, F.J (2011) *The Impact of the congestion charging scheme on air quality in London*, Research report 155, Health Effects Institute, Boston, Mass., U.S.A.

Janssen, N.A.H. (2014) *Oxidative Potential of particulate matter collected at sites with different source characteristics.* Science of the total environment 472 (2014) 572-581.