

Assessment of Airborne PM_{0.5} Mutagenic and Genotoxic Effects in Five Different Italian Cities: The MAPEC_LIFE Project

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Abstract : Air pollution is one of the most important worldwide health concern. In the last years, in both the US and Europe, new directives and regulations supporting more restrictive pollution limits were published. However, the early effects of air pollution occur, especially for the urban population. Several epidemiological and toxicological studies have documented the remarkable effect of particulate matter (PM) in increasing morbidity and mortality for cardiovascular disease, lung cancer and natural cause mortality. The finest fractions of PM (PM with aerodynamic diameter <2.5 µm and less) play a major role in causing chronic diseases. The International Agency for Research on Cancer (IARC) has recently classified air pollution and fine PM as carcinogenic to human (1 Group). The structure and composition of PM influence the biological properties of particles. The chemical composition varies with season and region of sampling, photochemical-meteorological conditions and sources of emissions. The aim of the MAPEC (Monitoring Air Pollution Effects on Children for supporting public health policy) study is to evaluate the associations between air pollution and biomarkers of early biological effects in oral mucosa cells of 6-8 year old children recruited from first grade schools. The study was performed in five Italian towns (Brescia, Torino, Lecce, Perugia and Pisa) characterized by different levels of airborne PM (PM₁₀ annual average from 44 µg/m³ measured in Torino to 20 µg/m³ measured in Lecce). Two to five schools for each town were chosen to evaluate the variability of pollution within the same town. Child exposure to urban air pollution was evaluated by collecting ultrafine PM (PM_{0.5}) in the school area, on the same day of biological sampling. PM samples were collected for 72h using a high-volume gravimetric air sampler and glass fiber filters in two different seasons (winter and spring). Gravimetric analysis of the collected filters was performed; PM_{0.5} organic extracts were chemically analyzed (PAH, Nitro-PAH) and tested on A549 by the Comet assay and Micronucleus test and on Salmonella strains (TA100, TA98, TA98NR and YG1021) by Ames test. Results showed that PM_{0.5} represents a high variable PM₁₀ percentage (range 19.6-63%). PM₁₀ concentration were generally lower than 50µg/m³ (EU daily limit). All PM_{0.5} extracts showed a mutagenic effect with TA98 strain (net revertant/m³ range 0.3-1.5) and suggested the presence of indirect mutagens, while lower effect was observed with TA100 strain. The results with the TA98NR and YG1021 strains showed the presence of nitroaromatic compounds as confirmed by the chemical analysis. No genotoxic or oxidative effect of PM_{0.5} extracts was observed using the comet assay (with/without Fpg enzyme) and micronucleus test except for some sporadic samples. The low biological effect observed could be related to the low level of air pollution observed in this winter sampling associated to a high atmospheric instability. For a greater understanding of the relationship between PM size, composition and biological effects the results obtained in this study suggest to investigate the biological effect of the other PM fractions and in particular of the PM_{0.5-1} fraction.

Keywords : airborne PM, ames test, comet assay, micronucleus test

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