TOXIC EFFECTS OF ORGANIC EXTRACTS BOUND TO ULTRAFINE FRACTION OF SIZE-SEGREGATED AEROSOL IN ACELLULAR AND CELLULAR MODELS

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Abstract

We investigated toxic effects of extractable organic matter (EOM) from size fractions (1 – 10 μm; upper accumulation, 0.5 – 1 μm; 0.17 – 0.5 μm; ultrafine, < 0.17 μm) of particulate matter (PM) collected in Ostrava, Czech Republic, in acellular calf thymus (CT) DNA system and in A549 cells. For the CT-DNA system we obtained 26 samples corresponding to individual sampling days; for the A549 model we pooled the samples into groups representing inversions, periods between inversions and warm weather. EOMs were incubated 24h with CT DNA and A549. DNA adducts, oxidative damage and the aryl hydrocarbon receptor (AhR)-mediated activity were analyzed.

In the CT-DNA system, the upper accumulation fraction contained 44% of total carcinogenic polycyclic aromatic hydrocarbons (c-PAHs); the ultrafine fraction contained 11%. The highest DNA adduct levels were observed after incubation with the upper accumulation fraction. The AhR activity was driven by c-PAHs. Oxidative DNA damage was not related to c-PAHs. In the A549 model, the cumulative inversion sample normalized per volume of air contained the highest total PM and exhibited higher genotoxicity compared to other samples. When normalized to PM mass, ultrafine fraction was the most toxic in all measured parameters.

In conclusion, the upper accumulation fraction exhibited the most pronounced genotoxic effects. However, normalization to PM mass emphasized the significant toxic potential of ultrafine fraction. Thus, despite the low contribution of ultrafine fraction to a total PM mass in aerosol, it represents a serious health risk. Supported by Ministry of Education (LO1508) and the Czech Science Foundation (P503-12-G147).

Keywords: Ultrafine fraction, DNA adducts, oxidative damage, AhR activity

Author did not supply full text of the paper.