Ecotoxicity of various types of urban particulate matter

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Keywords: PM_{10}, ecotoxicity, health effects
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The health effects of urban air pollution are evaluated on the basis of time-weighted average concentrations of criteria pollutants (e. g. NO_x, CO, SO_2, O_3, $PM_{2.5}/PM_{10}$). The PM_{10} is identified as one of the most dangerous pollutants on human health by the EU new directive on air quality (2008/50/CE). The hazard posed by urban PM is generally linked to the presence of toxic metals, carcinogenic and mutagenic compounds, thus it depends on the sources of PM that vary by season.

Bioluminescence inhibition bioassays were successfully deployed for the assessment of potential health effects of organic extracts of particulate matter collected from vehicular exhaust (Vouitsis *et al*, 2009). However, these studies only assess the ecotoxicity of a subfraction of $PM_{2.5}/PM_{10}$, and the deployment of organic solvents such as dimethyl-sulphoxide or dichloromethane, combined with Soxhlet extraction does not represent a realistic environmental exposure route.

Therefore a simple method was developed for the direct assessment of the bulk ecotoxicity of $PM_{2.5}/PM_{10}$ (Kováts *et al*, 2012). This method is based on the kinetic version of the *Vibrio fischeri* bioluminescence inhibition bioassay (Lappalainen *et al*, 1999). Contrary to previous other measurements, the bulk samples are assayed without prior extraction, and no organic solvents are applied.

During different aerosol sampling methods aerosols of various types were collected: winter and summer urban PM_{10}, diesel engine emission aerosol of passenger cars and buses, biomass and cigarette smoke samples and resuspended road dust.

During ecotoxicity bioassays aqueous suspensions of aerosol samples were measured with Thermo Luminoscan Ascent unit. Ecotoxicity (EC_{50} values) of samples were calculated using Ascent Software provided by Aboatox Co. EC_{50} of a sample was determined as the absolute mass of aerosol particles that causes 50 % reduction in the bioluminescence output of the test organisms relative to the control under the given experimental conditions. EC_{50} is expressed in units of mg. The lower EC_{50} value indicates higher ecotoxicity of the sample.

Fresh biomass and cigarette smoke samples proved to be the most ecotoxic among all aerosol types. Surprisingly, the most diesel engine emission samples were less ecotoxic than biomass smoke samples. EC_{50} values of diesel emission samples of passenger cars showed more scatter due to different engine types, conditions and fuel qualities. Ecotoxicity of diesel engine emission samples of buses showed very high correlation with engine standards: ecotoxicity of EURO 0 and 1 engines were found to be the highest and that of EURO 4 engine was not measurable. Resuspended road dust was the least ecotoxic due to the high fraction of inert mineral phases (Jancsek-Turóczi *et al*, 2013).

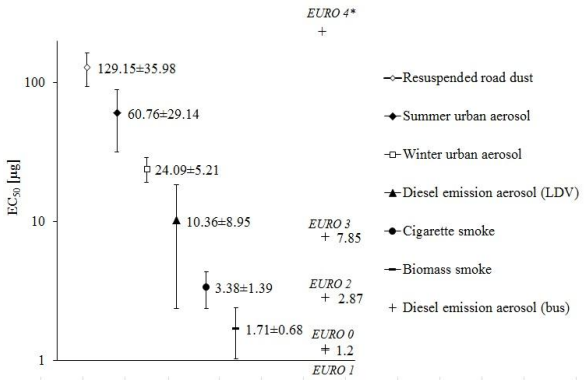

Figure 1. Comparison of EC_{50} values of aerosols of various types.

Winter urban PM_{10} samples showed significantly higher EC_{50} values than summer PM_{10} due to high contribution of vehicular and wood burning emissions which were also ecotoxic. In summer the biomass burning emission is substituted with secondary organic aerosol which reduces the ecotoxicity. Furthermore, the higher degree of atmospheric mixing in summer reduces the share of primary emission particulates and increases the contribution of atmospheric transport. Bioaerosol particles of probably negligible ecotoxicity are also more abundant in summer than in winter (Turóczi *et al*, 2012).

The authors are grateful for the financial support of the grants of the Hungarian Research Fund OTKA K 101484.

Jancsek-Turóczi, B., Hoffer, A., Nyírő-Kósa, I. and Gelencsér, A. (2013*) J. Aerosol Sci.* (in review)

Kováts, N., Ács, A., Kovács, A., Ferincz, Á., Turóczi, B. and Gelencsér, A. (2012) *Environ. Toxicol. Pharmacol*. **33**, 223–228.

Lappalainen, J., Juvonen, R., Vaajasaari, K, and Karp, M. (1999) *Chemosphere*, **38** (5), 1069–1083.

Turóczi, B., Hoffer, A., Tóth, Á., Kováts, N., Ács, A., Ferincz, Á., Kovács, A. and Gelencsér, A. (2012) *Atmos. Chem. Phys.* **12**, 7365–7370.

Vouitsis, E., Ntziachristos, L., Pistikopoulos, P., Samaras, Z., Chrysikou, L., Samara, C., Papadimitriou, C., Samaras, P. and Sakellaropoulos, G. (2009) *Environ. Pollut.* **157**, 2320–2327.