Effects of particle-bound polycyclic aromatic hydrocarbons from different traffic sources in human alveolar epithelial cell line A549

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The pollutant responsible for most deaths from air pollution is particulate matter (PM). Particulate emissions from traffic represent a major source of atmospheric pollution in cities (Amato *et al*., 2016). In addition to engine exhaust PM, traffic non-exhaust emissions (wear processes and resuspension) also represent an important contributor to the atmospheric levels. The composition of PM and the resulting toxicity largely depend on the emission sources. Among PM-bound constituents, polycyclic aromatic hydrocarbons (PAHs) have received special attention due to their proven carcinogenicity and mutagenicity (Kim *et al.*, 2013). The aim of the present study was to evaluate the cytotoxicity of PAHs extracted from samples of particulate matter emitted by different traffic sources.

A549 human lung epithelial cells were exposed to PAH extracts (Table 1) dissolved in culture medium for 24 h. Different biological endpoints were investigated: cytotoxicity, cell cycle alterations and levels of reactive oxygen species (ROS).

Table 1. Extracts of PM-bound PAHs from different traffic sources tested.

Source	Type of sample
Brake wear	NAO 1, 120-80 km/h NAO 1, 200-170 km/h NAO 2, 120-80 km/h NAO 2, 200-170 km/h Low Steel 1, 120-80 km/h Low Steel 1, FADE High Steel, 120-80 km/h High Steel, 200-170 km/h Low Steel 2, 120-80 km/h Low Steel 2, 200-170 km/h
Exhaust from heavy-duty vehicles (HDV)	- Vehicle I, Euro V, tested over the VTT and WHVC driving cycles, fuelled with diesel or GTL - Vehicle II, Euro VI, tested over the WHVC driving cycle with cold and hot start, fuelled with diesel - Vehicle III, Euro VI, tested over the Braunschweig hot driving cycle, fuelled with diesel
Urban road tunnel (João XXI) in Lisbon	Samples from weekdays and weekend; traffic mainly composed of light vehicles

NAO - Non-asbestos organic; FADE – driving cycle with more severe braking and higher temperature and pressure; VTT - Technical Research Centre of Finland; WHVC - World Harmonized Vehicle Cycle

The PM extracts from NAO and one of the low steel brake pads caused a statistically significant decrease in A549 cell viability (Figure 1). Regardless of the driving cycle, the only vehicle that caused a statistically significant reduction in cell viability was the 2013 Euro V. The fuel that proved to be the most harmful to the cells was the GTL. The imposition of much tighter emission limits by the Euro VI standard appears to have resulted in a substantial reduction in PM and its toxicity. According to the traffic patterns, the tunnel samples showed higher toxicity during weekdays compared to the weekend. Although in all sample groups several PM extracts have shown a decrease in cell viability, cell cycle analyses and ROS quantification were not significantly affected.

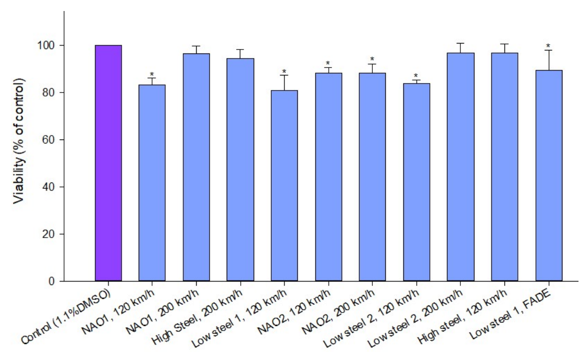

Figure 1. Cell viability after 24 h exposure to PM-bound PAH from brake wear.

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