ABSTRACT
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN ATMOSPHERIC PARTICULATE MATTER FROM A TRAFFIC SITE IN QUEZON CITY, PHILIPPINES

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Polycyclic Aromatic Hydrocarbons (PAHs) are persistent organic pollutants which come primarily from the incomplete combustion of fossil fuel and other organic materials. These compounds are of great concern due to their toxic, mutagenic, teratogenic and carcinogenic effects, making PAHs among the hazardous air pollutants classified by the International Agency for Research on Cancer (IARC, 2013). In urban environments, PAHs can be detected in the atmosphere mainly due to anthropogenic sources such as vehicle emissions. The Metro Manila vehicle fleet has rapidly grown, increasing traffic-generated emissions that contribute to urban air pollution. This study is part of the Manila Aerosol Characterization Experiment (MACE 2015), an intensive research campaign between the Leibniz Institute for Tropospheric Research (TROPOS, Germany) and Researchers for Clean Air (RESCueAir, Philippines), which aimed to gather data on the physical and chemical characteristics of aerosol particles in urban outdoor air. The objectives of this study are: to determine the concentration of PAHs in size-segregated particulate matter (PM) in air samples collected from a traffic site in Katipunan Avenue, Quezon City in Metro Manila; to develop a method for extracting and analyzing PAHs from atmospheric PM; to identify the types of emission sources of detected PAHs using diagnostic ratios; and to demonstrate the assessment of the indicative carcinogenic potential of detected PAHs using toxicity equivalence factors (TEF) and the WHO quantitative risk assessment (QRA) methodology, from observed data in an urban traffic site in the Philippines. Size-segregated atmospheric PM samples were collected through 5-stage Berner impactors using aluminum foil substrates, installed from April to May 2015 in a roadside and in a general ambient site for comparison. The developed Solvent-Extraction has been shown to have high recovery efficiency, and uses less time and resources compared to conventional solvent-based methods. From the Curie-Point pyrolysis-gas chromatographic/mass spectrometric analysis of the samples, results show an average PM10 total PAH (ΣPAHn=21) level of 118.7 ± 27.4 ng/m3 and 95.2 ± 23.2 ng/m3 (n=8), in the roadside and general ambient site, respectively. In the roadside, majority of the PAHs (34%) were found in the ultrafine fraction while the fine fractions comprise the most PAHs (32% in Stage 2 and 34% in Stage 3) in the general ambient site. Source apportionment showed that 78% and 81% of the PAHs were from combustion sources in the roadside and general ambient site, respectively, mainly from diesel or gasoline emissions. In addition, carcinogenic PAHs were found to be higher in the ultrafine and fine fractions for both the roadside (39% to 41% of total) and general ambient site (43% to 46% of total). The results of this study confirm the association of motor vehicle-related PAH emissions to finer particle size fractions that have higher lung deposition rates. As based from the WHO QRA, a lifetime exposure to the same level of PAHs found in this study can lead to additional 1.1 and 1 cases of lung cancer for every 1,000 people exposed in the Katipunan roadside and general ambient site, respectively, if such values will be observed all throughout the year. This could entail a high health risk for all individuals exposed to this level of ambient pollution, and affirms the necessity of properly managing the Philippine vehicle fleet by implementing more stringent motor vehicle standards; establishing local Air Quality Guideline (AQG) values for PAHs; and regular monitoring of this pollutant. Informing the public of the results can also push for adherence to traffic policies, and exertion of more conscious effort to reduce mobile emissions and to minimize exposure to air pollution.