

Potential source contributions and Cancer risk assessment of atmospheric Polycyclic Aromatic Hydrocarbons (PAHs) and Nitro-PAHs over a traffic Indo-Gangetic site

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Polycyclic Aromatic Hydrocarbons (PAHs) are ubiquitous organic pollutants present in atmosphere. Most of the PAHs are known as carcinogens or the precursors to carcinogenic daughter compounds. Understanding the contributions of the various emission sources is critical to appropriately managing PAH levels in the atmosphere. The atmospheric gas and particulate phase PAHs samples were collected at traffic dominated site in Agra, India from October 2015 to July 2016 using PUF air sampler (TE-1000X). During the sampling period the average sum of 16 priority PAHs in particulate phase and gas phase were 3121 ± 308.9 and $1732.5 \pm 175.1 \text{ ng m}^{-3}$ respectively whereas, the average of the sum of 2- Nitro PAHs in particulate phase and gas phase were 65.3 ± 16.3 and 24.6 ± 6.55 respectively. Receptor-oriented source apportionment model (PCA/APCS) was used to identify sources of atmospheric PAHs and to estimate source contributions to PAHs concentrations. The principal component analysis (PCA) identifies the three major pollution sources at the sampling site. The extracted pollution sources include emissions from gasoline, diesel combustion vehicles, biomass combustion and CNG. APCS receptor modeling indicated that the LMW PAHs (2- to 3- ring) were estimated to be contributed 49.4 % from natural gas combustion, 40.8% from wood and coal combustion and 9.7% from vehicular emissions. 4- Ring PAHs were almost equally contributed ($\approx 48\%$) by both wood and coal combustion and natural gas emissions. 50 % of 5- ring PAHs were emitted from gasoline and diesel-based activities whereas natural gas combustion contributes 35 % to the total concentration. 94 % of the 6- ring PAHs in ambient air were contributed by vehicular emission. The combustion (natural gas, coal and wood) related activities and vehicular emissions contribute about 65.6% and 34.4% of the total carcinogenic PAHs in both phases, respectively. The cancer risk posed by PAHs was quantified as incremental life time cancer risk (ILCR) for three age groups of infants, children and adults through inhalation, ingestion and dermal exposure pathways. The study outcomes highlighted the fact that cancer risk from ambient gas and particulate phase PAHs was mainly influenced by PAHs present in the gas phase. The contribution to the cancer risk by PAHs was mostly because of the 4 and 5 ring PAHs.

Key words: Polycyclic Aromatic Hydrocarbons (PAHs), Nitro-PAHs, Principal component Analysis (PCA), APCs receptor modeling, incremental life time cancer risk (ILCR)