

Source Identification and Health Risk Assessment of Particle Phase Organic Compounds in Urban and Rural Areas of Bangladesh

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Abstract

Particle phase organic compounds (PPOCs) constitute a significant portion of suspended organic compounds in the atmosphere, impacting human health. Limited research on sources, seasonal variations, and health effects in Bangladesh motivated this study, where particulate matter samples were collected in Dhaka, Rajshahi, Narayanganj, and Bhola from January 2016 to February 2020. Sixteen PPOCs concentrations were measured using a Gas Chromatography-Mass Spectrometry (GC-MS). Average PPOC concentrations were $11.60 \pm 0.1 \mu\text{gm}^{-3}$ in Dhaka, $8.69 \pm 0.3 \mu\text{gm}^{-3}$ in Rajshahi, $11.84 \pm 0.4 \mu\text{gm}^{-3}$ in Narayanganj, and $7.22 \pm 0.2 \mu\text{gm}^{-3}$ in Bhola, with 2 to 18 times higher concentrations in winter than monsoon season. Positive Matrix Factorization (PMF) identified major PPOCs sources as diesel exhaust, biomass burning, industrial emissions, and gasoline exhaust. Urban areas were dominated by industrial emissions, while rural regions had significant biomass burning contribution. Backward air mass trajectory analysis by HYSPLIT indicated that during winter more than half of the wind direction (60%) comes entirely from the Africa region through India to Dhaka. In monsoon, half of the wind direction (50%) comes entirely from the Indian Ocean through the Bay of Bengal to Dhaka. Health risk assessment indicated a hazard index (HI) of 30.2, signifying severe non-carcinogenic effects, with Dimethoate contributing significantly (32%). The average lifetime cancer risk (2.94×10^{-3}) exceeded USEPA guidelines, suggesting heightened cancer risk. Naphthalene posed the highest carcinogenic risk. As particle phase organic compounds mostly emit from anthropogenic source and pose severe health impact, so public awareness should be raised and more detailed research should be conducted in local and regional level.

Early Career Scientist

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