

Physicochemical and Biological Characterization of Fine Particulate Matter in Ambient Air in Capital City of Pakistan

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Abstract : Fine particulate matter with an aerodynamic diameter of less than 2.5 μm (PM_{2.5}) was collected in Islamabad from November 2022 to January 2023, at urban sites. The average mass concentrations of PM_{2.5} varied, ranging from 90.5 to 133 $\mu\text{g m}^{-3}$ in urban areas. Environmental scanning electron microscopy (ESEM) analysis revealed that Islamabad's PM_{2.5} comprised soot aggregates, ashes, minerals, bio-particles, and unidentified particles. Results from inductively coupled plasma atomic emission spectroscopy (ICP-OES) indicated a gradual increase in total elemental concentrations in Islamabad PM_{2.5} in winter, with relatively high levels in December. Significantly different elemental compositions were observed in urban PM_{2.5}. Enrichment factor (EF) analysis suggested that elements such as K, Na, Ca, Mg, Al, Fe, Ba, and Sr were of natural origin, while As, Cu, Zn, Pb, Cd, Mn, Ni, and Se originated from anthropogenic sources. Plasmid DNA assays demonstrated varying levels of potential toxicity in Islamabad PM_{2.5} collected from urban sites, as well as across different seasons. Notably, the urban winter PM_{2.5} sample exhibited much stronger toxicity compared to other samples. The presence of heavy metals in Islamabad PM_{2.5}, including Cu, Zn, Pb, Cd, Cr, Mn, and Ni, may have synergistic effects on human health.

Keywords : islamabad particulate matter pm_{2.5}, scanning electron microscopy with energy-dispersive x-ray spectroscopy(sem-eds), fourier transform infrared spectroscopy(ftir), inductively coupled plasma optical emission spectroscopy(icp-oes)

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