1.148 Toxicological and Chemical Characteristics of Fine Particles from Burning of Crop Residues in China.

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Abstract:

Crop residue burning is a major source of fine particulate matter and arouses significant concern in China and worldwide due to its adverse impacts on environment and human health. Five types of crop residue (rice straw, wheat straw, corn straw, sugarcane straw and sorghum straw) were selected and burned in a laboratory combustion chamber to mimic the combustion process. Total 28 sets of $PM_{2.5}$ samples were collected to determine their chemical and toxicological characteristics. Human lung alveolar epithelial A549 cells were exposed to $PM_{2.5}$ at concentrations of 0, 20, and 150 µg/ml for 24 hours. Burning of wheat straw emitted the highest level of $PM_{2.5}$ while sugarcane and sorghum straw emitted the lowest. Carbonaceous species, organic carbon (OC) and elemental carbon (EC), were the dominant components in all samples which contributed ~50% of $PM_{2.5}$ in total. Potassium (K^+) and chloride (Cl^-) are dominant water-soluble ions from crop residues burning, with an average abundance of 6.4 ± 4.4% and 14.5 ± 8.2% in $PM_{2.5}$, respectively. Exposure to $PM_{2.5}$ at the concentration of 20 µg/ml to 150 µg/ml decreased cell viability and increased LDH / IL-6 release. Strong negative correlations were found between cell viability and OC ($R = -0.66$) and some heavy metals such as Cr, Mn, Fe, and Ba ($R < 0.65$). Moreover, OC, Cr, Mn, Fe and Ba also showed strong positive correlations with LDH and IL-6 responses. In conclusion, our data indicate that $PM_{2.5}$ emitted from biomass burning contained high concentrations of OC and toxic metals which were strongly correlated to cell viability and inflammatory responses. The findings suggest a need to control the burning of crop residues which can induce significant health impact on human being.