Primary organic aerosol emissions and chemical composition from biomass and cow dung burning characterized using extractive electrospray ionization mass spectrometry

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Primary organic aerosol (POA) emitted from combustion processes (including biomass, waste and cow dung, etc...) may contribute a large fraction of organic aerosol (OA; including brown carbon (BrC)) on regional and global scale. POA from various sources has been closely linked to adverse health effects. However, comprehensive chemical characterization of POA emission is rarely reported due to its complexity and limitations of current instrumentation. The recently developed extractive electrospray ionization time-of-flight mass spectrometer (EESI-TOF) achieves real-time and near-molecular (i.e., molecular formula) measurement of water soluble constituents of POA[1], which improves our understanding of the composition of POA. In this work, a series of experiments were conducted to investigate the emission factors (EFs), chemical composition, and marker ions of the POA from different combustion sources including wood, straw, and cow dung. The EFs of CO, CO_2, non-methane hydrocarbon, and POA are 63.5±6.8, 1668.9±26.7, 10.4±2.7, and 3.7±1.1 g kg^{-1} for wood open burning and 73.2±15.4, 1661.7±30.3, 11.7±2.9, and 1.7±0.4 g kg^{-1} for wood stove burning, generally equivalent to straw burning (except for POA EF which is only 0.86 g kg^{-1}) and lower than cow dung emissions. The carbon and oxygen distributions of POA vary between different burns and fuel types. Levoglucosan is the main marker for wood combustion, while its contribution to straw and cow dung burning is lower. In contrast, the total abundance of compounds with carbon number > 10 in the emission of straw and cow dung is higher than wood combustion. The proportion of nitrogen-containing compounds for cow dung burning is around 7%, which is higher than the proportion for wood and straw combustion with an average around 4%. The evaporation of main components of POA with temperature was analysed, providing insights into the volatility of POA and the effects of gas-particle partitioning on POA chemical composition.

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[1] Lopez-Hilfiker FD, et al. *Atmospheric Measurement Techniques*, 2019, 12, 4867-4886.