INDOOR AIR POLLUTION FROM SOLID COOKING FUELS: A FIELD STUDY IN A PERUVIAN HIGHLAND COMMUNITY AND CHARACTERIZATION OF A NEW AEROSOL IMPACTOR

By

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ABSTRACT

Exposure to indoor air pollution (IAP) caused by the combustion of solid fuels is recognized as a global health threat. Worldwide, over three billion people rely on these fuels for heating and cooking, making IAP the second greatest environmental contribution to poor health in developing countries and leading to two million deaths each year (WHO, 2000). Additionally, solid fuel users who are exposed to biological aerosols in the home may be at risk for additional health problems, as exposure to these biological aerosols in combination with combustion byproducts may exacerbate respiratory and allergic responses. This thesis seeks to further the understanding of IAP levels present in homes cooking with solid fuels, and to characterize a new instrument for the sampling of biological aerosols. This work was carried out through two separate studies.

First, a pilot study was conducted in the highland community of Langui, Peru where levels of four combustion byproducts: fine particulate matter ($PM_{2.5}$), black carbon (BC), carbon dioxide (CO_2) and formaldehyde (HCHO) were measured in 25 households that rely on dried dung and wood as their primary cooking fuels. Results of this study showed that homes consistently exceeded the WHO and EPA's recommended exposure levels for all pollutants measured. In addition, an improved traditional stove was evaluated and showed significant potential as an IAP reduction strategy, achieving over 90% reduction in BC and $PM_{2.5}$ concentrations.

Second, laboratory testing was conducted to characterize a microtrap inertial impactor for use as an area or personal sampler. The ultimate intended application for this impactor is for aeroallergen sampling, and further investigation of the interaction between combustion byproducts and aeroallergens in homes. The microtrap utilizes a jet plate to direct airflow and a well plate to impact and collect particles for extraction, reducing the high-pressure drop typical of inertial impactors. Results of this characterization showed that the microtrap achieved collection efficiencies above 97% for particles larger than 2 μm in diameter (at a 10 L/min flow rate and a pressure drop of 0.125 kPa) and maintained

this efficiency for extended periods of time and without any coating on the impaction surface, allowing for the extraction and analysis of biological samples.