Cooking PM2.5 Emissions in Kazakh Households and Their Contribution to Indoor Levels

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Abstract

The present study proposes an exposure model for indoor PM2.5 levels during cooking activities in poorly ventilated Kazakh houses with high emission levels. It aims to identify influencing factors of PM2.5 concentration patterns during cooking and explain the mechanisms underlying the build-up and downtrend of PM2.5 concentrations. The methodology integrates PM2.5 sampling, monitoring, and modeling to predict household PM2.5 levels and estimate daily concentrations, employing USEPA's IAQX v1.1 for simulating the one-zone concept for cooking-related PM2.5 concentrations in multiple households. During cooking, PM2.5 concentrations varied between 13 and 266 μg/m3. Kitchen size, air exchange, type of food, and cooking methods were key factors influencing the observed concentrations. The model demonstrated high accuracy (R>0.9). The contribution of cooking to household air pollutant (HAP) PM2.5 levels ranged from 9% to 94%. This impact was more pronounced in warmer months. In colder months, outdoor PM levels and household ventilation were the primary factors regulating indoor air concentrations. The present study is among the first attempts to assess exposure to HAP in Central Asia, providing foundational insights into the poorly understood indoor air quality of Kazakh houses. Future research should refine models to account for individual behaviors and house types, improving accuracy and representativeness.

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