Characterization of indoor dust from Minas Gerais, Brazil, and evaluation of the cytotoxicity in A549 lung cells

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Over the past decade ambient air particulate matter (PM) has been clearly associated with adverse heath effects. There has been an increasing concern within the scientific community over the health effects of indoor air quality. There is a lack of studies defining the relationship between personal exposure and complex natural inorganic indoor dust. Most of the studies are related to outdoor organic compounds or were carried out with synthetic materials.The high complex nature of atmospheric suspended particle components and the source of origin are strong barriers to understand the significance of ambient PM exposure. A review of literature focused on health related effects caused by inhalation of ambient air level of fine particulated matter containing metals concluded that the health implications of exposure depend on particulate material composition and particle size. In Brazil small and poor communities are exposed to indoor dust derived from both natural sources identified with blowing soil dust and anthropogenic particles from mining activities. This study investigates the physicochemical and mineralogical composition of indoor PM10 dust samples collected in Minas Gerais, Brazil in August 2011 over a time period of 280 h and evaluates its cytotoxicity. The mean PM10 mass concentration was 206 µg/m^3. The high dust concentration in the air was due to high dust concentration on surfaces in the interior of the residences which source is strongly related to blowing soil dust and compatible to living conditions of the communities.The elemental and mineralogical composition were determined by EDS and XRD and pointed out that the most prominent minerals are clays, feldspar, Fe-oxide, quartz, calcite and Al-oxide and highlighted the transition metals as Fe, Cr, V, Ni, Cu, Zn, Ti and Mn as well as the metaloid As. The indoor dust samples presented a low water solubility to about 6%, which is in accordance with the mineralogical composition. In vitro experiments were carried out with human lung alveolar carcinoma cells (A549) to study the toxicological effects. The responses of the cells were analysed by LDH activity assays, alamarBlue, as well as assays to detect reactive oxygen species (ROS). The indoor dust showed little effects on proliferation and viability at concentration below 100 µg/ml within 24 and 48 h. However exposure to high concentrations at 250-500 µg/ml for the same time period resulted in 60 and 80% of LDH release indicating cytotoxicity. The alamarBlue experiment related to the relative metabolic activity of the cells did not show a response. Experiments on ROS formation are in progress as well as detection of the cytokines IL-6 and IL-8 as indicators for inflammation. This study will support the implementation of mitigation actions in the investigated area in Brazil.

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