



HE: Health & Environment

Cytotoxicity and genotoxicity of size-fractionated fly ashes from biomass combustion



Ali Talib Arif ⁽¹⁾, Christoph Machowski ⁽²⁾, Richard Gminski ⁽¹⁾, Irina Nazarenko ⁽¹⁾, Patxi Garra ⁽³⁾, Gontrand Leyssens ⁽³⁾, Reto Giere ⁽²⁾, Volker Mersch-Sundermann ⁽¹⁾

(1) Department of Environmental Health Sciences and Hospital Infection Control, Medical Center - University of Freiburg D-79106 Freiburg

(2) Institute of Earth and Environmental Sciences - Geochemistry, University of Freiburg D-79104 Freiburg

(3) Gestion des Risques et Environnement (GRE) Laboratory, Mulhouse, 68200, France

Fly ash may be a major anthropogenic component in ambient particulate matter and is derived mainly from industrial sources, including biomass combustion. In the frame of the European INTEREG research project "BIOCOMBUST", we explore a potential impact of particulate emissions from biomass combustions on human health in the Upper Rhine region. The investigated fly ash samples were obtained from two sources: a biomass power plant (burning wood chips) in St. Peter, Germany, and a laboratory boiler (burning miscanthus as fuel) in Mulhouse, France. The fly ash particles used in the exposure experiments were characterized by mineralogical and chemical techniques. Then three fractions of fly ashes (bulk, fine and ultrafine) were investigated for their *in-vitro* cytotoxic and genotoxic effects on human lung cells, namely, the human lung adenocarcinoma cell line A549 and the immortalized human bronchial epithelial cell line BEAS-2B. As controls, calcium carbonate (CaCO₃) and potassium sulphate (K₂SO₄), identified as main components of the fly ash particles were used in the experiments. After 24 hours of exposure, the cytotoxicity of particles from the wood fly ash and of ultrafine particles of reference materials (diesel particulate matter (DPM) and dioxide (SiO₂)) appeared first at high concentration. However, no cytotoxic effect was observed upon application of particles from the miscanthus fly ash on the lung cells, as assessed by WST-1 and the Alamar Blue assays. Genotoxic effects analysed by the DNA alkaline unwinding assay, were observed at high concentrations of studied DPM and SiO₂ reference materials, but none of the studied fly ash fractions showed genotoxicity after 24 hrs of exposure.

Altogether, these experiments suggest that fly ash particles from wood combustion can cause cytotoxic effects at the concentration of 50µg/ml, albeit no genotoxic effects were observed. They further suggest that miscanthus fly ash was neither cytotoxic nor genotoxic

for human lung cells. Further experiments are needed to corroborate these results and to find out which components of the wood fly ash and which biological mechanisms are responsible for observed toxic effects.