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Toxicity evaluation of carbon nanotubes in J774 mouse macrophages utilizing a proteomic approach

Dharani Das, D Breznan, R Vincent and **P Kumarathasan**
Environmental Health Science and Research Bureau, Canada

Carbon nanotubes (CNTs) are increasingly utilized in consumer products, thereby increasing the possibility of human exposure. CNTs are synthesized in different forms (e.g., single- and multi-walled), sizes (e.g., length, diameter), and surface characteristics, which are considered as critical determinants of their toxicity. Toxicity of CNTs is not yet fully understood, and results reported in the literature are often not comparable, partly due to lack of sufficient physicochemical characterization. CNTs with varying physicochemical properties can induce different types of biochemical changes at both cellular and molecular (protein) levels. Thus, analyzing proteomic changes in cells exposed to CNTs can help in understanding toxicity pathways and mechanisms.The objectives of this work were: (1) to study the protein profiles of J774 cells after exposure to four well-characterized CNTs: single-walled and multi-walled (pristine and oxidized CNTs), at a dose range of 0-100 μg/cm^2; and (2) to examine the role of surface chemistry and metal impurities in CNTs-induced cellular toxicity.Shot-gun proteomic analyses were performed by MALDI-TOF-TOF-MS. Data-mining using k-nearest neighbour clustering algorithm revealed an elevation in cellular endothelin-1, a pro-inflammatory and mitogenic peptide, and a decrease in cytoplasmic LDH levels, an indicator of cell membrane damage, notably in response to the oxidized CNTs. Elevation of o-tyrosine indicated formation of reactive oxygen species. Analysis of changes in the proteomic profiles of J774 cells revealed that mechanistic pathways relevant to key cellular functions were differentially impacted by the physicochemical properties of the CNT variants.

Biography

Dharani Das has completed PhD at the age of 30 jointly from IMMT(Council of Scientific and Industrial Research), Bhubaneswar, India and University of Saskatchewan, Canada (2004). He has obtained two postdoctoral experiences at CCRI, University of Ottawa, and ECORC, Agriculture and Agri-Food Canada, Ottawa, Canada. Since 2008, he is working as a research chemist at the Analytical Biochemistry and Proteomics Laboratory, Environmental Health Sciences and Research Bureau of Health Canada. The major part of his research work involves evaluating toxicity of air pollutants and engineered nanomaterials utilizing shot-gun proteomics. He has published 19 papers in reputed journals.

dharani.das@hc-sc.gc.ca