Original Article

Hydrated Fullerene C₆₀ Decreases Oxidative Damage of Human Bronchial Epithelium Cells DNA

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Abstract

Background: Hydrated Fullerene C₆₀ is a 60 carbon atoms symmetrical molecule that can be found in nature. Being transferred into aqueous solution, a hydrophobic C₆₀ establishes Hydrated Fullerene C₆₀ (HyFnC₆₀) water solutions that possess oxidation balancing properties in a wide range of concentrations (2.5×10^{-6} – 2.5×10^{-19} M). Nano-particles of silica (SiO₂) can initiate reactive oxygen species (ROS) production in aqueous solutions. As silica is a common pollutant and a component of manufactured goods, one of the most probable ways of its penetration into human body is inhalation followed by an increased risk of chronic inflammation and cell degeneration due to ROS production inside the cells and in the extracellular space.

Aims: In this study we focused on the possibility of DNA protection of human bronchial epithelial cells (HBEpCs) of oxidative damage by silica nanoparticles with HyFnC₆₀ in a wide range of concentrations.

Methodology: Cultivated cells were treated with 50 mg/ml nano-sized SiO₂. HBEpCs DNA strand breaks were accessed by comet assay. Intracellular ROS production was measured by DCFH-DA fluorescent spectrophotometry. HyFnC₆₀ were added to the cell culture medium before treatment with silica. The calculated concentrations of HyFnC₆₀ in the medium were 1×10^{-7} M 1×10^{-11} M, 1×10^{-14} M and 1×10^{-17} M. The solutions of HyFnC₆₀ were prepared by 10- and 100-fold serial dilutions of HyFnC₆₀ stock solution in pure water. Results were evaluated statistically by Student's t-test and variance analysis by Statistica® software.

Results and discussion: We have found that in case of pre-treatment of cells with 1×10^{-7} M and 1×10^{-17} M HyFnC₆₀ prior addition of silica DNA damage was decreased. According to DCFH-DA fluorescent microscopy a significant decrease of ROS was observed in case of addition of HyFnC₆₀ to the concentration of 1×10^{-7} M only. In case of simultaneous treatment of cells with silica and HyFnC₆₀ cell damage was decreased at HyFnC₆₀ concentration of 1×10^{-17} M. This data proves that DNA was damaged by ROS induced by silica nanoparticles. Moreover, the data confirm that HyFnC₆₀ works as regulator of redox and free radical processes at low concentrations.

Key words: DNA oxidation, ultra-low concentrations, hydrated fullerene C₆₀, HyFnC₆₀, reactive oxygen species, silica, human bronchial epithelial cells, comet assay, water.

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