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Evaluation of Cytotoxicity and Genotoxicity of Nano-sized Plastic Particles

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Polystyrene nanoparticles (PS-NPs) are one of the most represented plastic NPs in the environment and one of the main concerns of PS-NPs exposure is their genotoxic potential [1]. In this study, we continued the investigation of PS-NPs genotoxicity and cytotoxicity. For in vitro studies, lymphocytes of healthy donors were treated with 80 nm size PS-NPs. Cytotoxicity was evaluated using an acridine orange/ethidium bromide stain mix, and primary DNA lesions were investigated by comet assay after short-term (3 h) and long-term (24 h) incubation with PS-NPs. Chromosomal damage was assessed by micronucleus assay and chromosome aberration assay. For in vivo studies, Somatic Mutation and Recombination Test (SMART) in Drosophila Melanogaster was applied.

Tested PS-NPs concentrations were not cytotoxic in human peripheral blood lymphocytes. However, a negative correlation between the nuclear division index and NPs concentrations was observed, suggesting that PS-NPs could have a cytostatic effect. The comet assay results revealed that after long-term incubation, all tested PS-NPs concentrations induced a statistically significant increase in %TDNA (% Tail DNA). Also, the majority of selected PS-NPs concentrations induced a statistically significant increase in the frequency of micronuclei, besides that it was dose-related. However, the chromosome aberration test and SMART results showed that none of the tested PS-NPs concentrations induced a significant increase in chromosome aberration number in vitro or somatic mutations in vivo. Overall, results suggest the genotoxic potential of polystyrene nanoparticles, yet highlight the need for additional studies to assess the bio-accumulation and genotoxicity of these NPs in different cell lines and organisms.

Keywords:
Nanoplastic, Comet Assay, Micronucleus Assay, Somatic Mutation and Recombination Test, Chromosome Aberrations.