

Hazard assessment of nanoplastics is driven by their surface-functionalization. Effects in human-derived primary endothelial cells

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In the process of breaking down plastic waste into micro/nanoplastics (MNPLs), various aspects of their physical and chemical characteristics, such as surface properties (charge, functionalization, biocorona, etc.), may undergo changes, potentially influencing their biological impacts. This study specifically investigates the surface functionalization of MNPLs to ascertain its potential direct effects on toxicokinetic and toxicodynamic interactions within human umbilical vein endothelial cells (HUVECs), across different exposure durations.

Pristine polystyrene nanoplastics (PS-P NPLs), alongside their carboxylated (PS-C NPLs) and aminated (PS-A NPLs) counterparts, each approximately 50 nm in size, were subjected to an extensive array of toxicological assessments. These evaluations encompassed analyses of cell viability, internalization within cells, generation of intracellular reactive oxygen species (iROS), and assessment of genotoxicity. The experiments were conducted at a concentration of 100 µg/mL, chosen to ensure a high rate of internalization across all treatments while maintaining a sub-toxic dose. Results indicate that all types of PS NPLs are internalized by HUVECs, with the dynamics of internalization varying depending on the particle's specific functionalization. Both PS-P and PS-C NPLs induce modifications in cell morphology, increasing inner complexity/granularity. However, only PS-A NPLs demonstrated a reduction in cell viability. Intracellular ROS generation was triggered by all three types of PS NPLs, albeit at different time intervals. Genotoxic damage was observed with all PS NPLs after short exposures (2 h), except for PS-C NPLs at 24 h. Overall, this study underscores the surface-dependent toxicological effects of PSNPLs on HUVEC cells, emphasizing the importance of employing human-derived primary cells as a target in such investigations.

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