Cytotoxic and Oxidative Stress Responses to Differently Charged and Sized Microparticles in Caco-2 Cells

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Nanoparticles and microparticles are increasingly utilized in various fields, including biomedicine and environmental science. It is essential to assess their potential cytotoxicity and ability to induce oxidative stress to ensure their safe application. This study explores the effects of five engineered microparticles, differing in charge and size, on Caco-2 cells, a human epithelial colorectal adenocarcinoma cell line.

Cytotoxicity was evaluated using the CCK-8 (Cell Counting Kit-8) assay to measure cell viability following exposure to five distinct microparticles: positively charged MF, neutral PS, negatively charged SD, and two PS particles of varying sizes (1 µm and 0.1 µm). Cells were treated with each particle, and the results were quantified based on absorbance readings, allowing for the determination of the relative viability of the cells in response to each treatment.

To assess oxidative stress, the Cell Meter™ Fluorimetric Intracellular Total ROS Activity Assay Kit was used. ROS production in Caco-2 cells was measured via flow cytometry following microparticle exposure, with a specific focus on correlating particle characteristics (charge and size) with their ability to induce ROS generation.

The cytotoxicity data revealed distinct particle-specific effects, with variations in cell viability observed based on particle charge and size. Positively charged and smaller particles exhibited a more pronounced reduction in cell viability compared to neutral or larger particles. Similarly, the ROS measurements demonstrated a differential induction of oxidative stress, with charged particles, particularly those with positive surface charges, showing higher ROS generation compared to neutral and negatively charged particles.

This study aimed to explore the varying cytotoxic and oxidative stress profiles of engineered microparticles in Caco-2 cells, highlighting the influence of particle charge and size. There are few reports for differently charge nano- or micro-particles inducing cytotoxicity in cell lines. Therefore, this study aimed to better understand the cytotoxicity of differently charged nano- or micro-particles in Caco-2 cells.

These findings provide important insights into the biological impact of these particles, with potential implications for their use in pharmaceuticals, consumer products, and environmental applications.

Keywords: Nanoparticles, microparticles, cytotoxicity, Caco-2 cells, particle charge, particle size, ROS .

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