Science of the Total Environment 694 (2019) 133794

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Internalization and toxicity: A preliminary study of effects of nanoplastic particles on human lung epithelial cell

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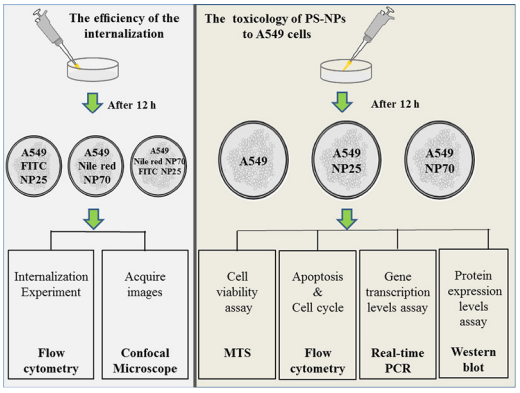
HIGHLIGHTS

- Polystyrene nanoplastics (PS-NPs) are rapidly internalized by A549 human lung epithelial cells.
- PS-NPs significantly affect the viability, apoptosis, and cell cycle of A549 cells.
- Gene transcription and protein expression in A549 cell are disturbed by PS-NPs.
- Effects of PS-NPs to A549 are size, exposure time, and concentration dependent.
- Environmental risk of nanoplastic to respiratory system should be concerned.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 11 May 2019
Received in revised form 4 August 2019
Accepted 4 August 2019
Available online 05 August 2019

Editor: Damia Barcelo

Keywords:
Nanoplastics
Toxicological effect
Alveolar epithelial cells
Cell viability
Apoptosis
Cell cycle

ABSTRACT

As a kind of newly emerging pollutant, nanoplastics are easily to be ingested by organisms, and cause severe damage to biological functions because of their small size, high specific surface area, and strong biological penetration. Recently, there are increasing reports of numerous airborne microplastics, including polystyrene (PS), being detected in atmospheric samples, which implies a potential risk to the human respiratory system. In this work, we evaluated the effects of polystyrene nanoparticles of two different sizes (PS-NP25: 25 nm diameter and PS-NP70: 70 nm diameter) on the human alveolar epithelial A549 cell line including internalization, cell viability, cell cycle, apoptosis, and associated gene transcription and protein expression. Results showed that PS-NP25 was internalized more rapidly and efficiently into the cytoplasm of A549 than PS-NP70. PS-NPs significantly affected the cell viability, caused cell cycle S phrase arrest, activated inflammatory gene transcription, and changed the expression of proteins associated with cell cycle and pro-apoptosis. PS-NPs induced significant up-regulation of pro-inflammatory cytokines such as IL-8, NF-κB, and TNF-α, as well as pro-apoptotic proteins such as DR5, caspase-3, caspase-8, caspase-9, and cytochrome *c*, which revealed that PS-NPs triggered a TNF-α-associated apoptosis pathway. This study suggests that exposure duration, diameter, and concentration are

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https://doi.org/10.1016/j.scitotenv.2019.133794