Best Analytical Chemistry Poster at Environ 2025 Winner

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Impact of Microwave-treated Polypropylene Microplastics on Caco-2 Cells

Plastic materials in the environment are highly susceptible to degradation by a variety of mechanisms, ultimately resulting in the formation of microplastics (MPs) fragments. These degradation processes include photo, mechanical and chemical degradation - where reactions with environmental oxidants or other chemical agents compromise the material integrity (Fig.1).

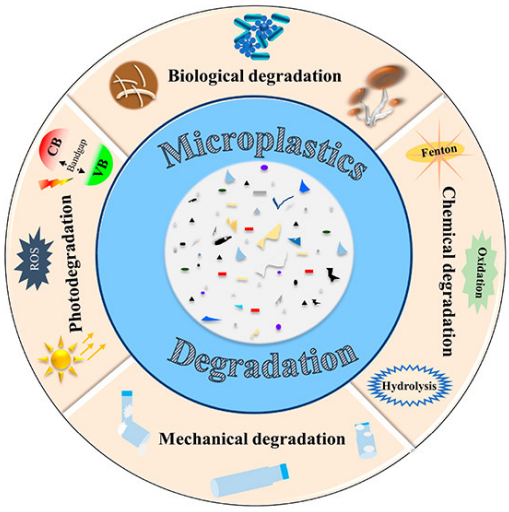

Fig 1. *Schematic diagram - types of microplastics degradation (Bacha, Nabi and Zhang, 2021).*

Once formed, MPs become pervasive in the environment, entering ecosystems and human habitats through multiple exposure routes. MPs can enter the human body during routine activities via dermal contact, inhalation of airborne particles, and ingestion - commonly through contaminated food and water (Prata et al., 2020). When MPs enter the digestive system, they may trigger various responses, as illustrated in Fig 2. To investigate these effects, researchers commonly use Caco-2 cells, an *in vitro* cell model that closely replicates the intestinal epithelium.

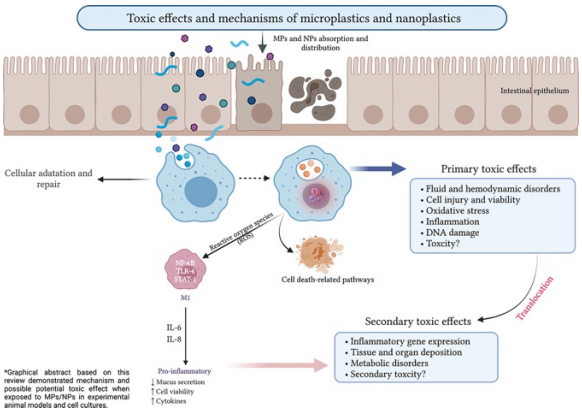

Fig 2. *Schematic diagram – Toxic effect and mechanisms of Microplastics and Nanoplastics (Sangkham et al., 2022).*

In this study, we investigated the cellular effects of thermally processed polypropylene - one of the most widely produced polymers in Europe (Plastics Europe, 2023) - using a human intestinal epithelial model. A fixed concentration of degraded polypropylene particles was applied to Caco-2 cells to simulate domestic conditions. We evaluated key indicators of cellular health, including metabolic activity, membrane integrity, and oxidative stress, using established biochemical assays. Our results suggest that shorter exposures may lead to an increase in cellular metabolic activity, while extended exposure is associated with a reduction in cell viability, accompanied by signs of membrane disruption and pronounced oxidative stress. These findings indicate that oxidative stress is potentially a central mechanism governing the cellular response to these degraded

polypropylene particles. Overall, our work underscores the need for further research to unravel the long-term implications of environmental plastic degradation on human health and enhances our understanding of the risks posed by MP contamination.

Acknowledgements:
This research has been undertaken with the financial support of Science Foundation Ireland (SFI)-Irish Research Council Pathway Programme Proposal ID 21/PATH-S/9290.

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