
Unravelling the knot: Microplastic properties and their correlation with the cellular response

Matthias Völkl^{*1}, Julia Jasinski², Valérie Jérôme¹, Alfons Weig³, Thomas Scheibel², and Ruth Freitag^{†1}

¹University of Bayreuth, Process Biotechnology – Universitätsstraße 30, 95447 Bayreuth, Germany

²University of Bayreuth, Biomaterials – Prof.-Rüdiger-Borman-Straße 1, 95447 Bayreuth, Germany

³University of Bayreuth, Genomics and Bioinformatics – Universitätsstraße 30, 95447 Bayreuth, Germany

Abstract

Background and novelty Due to its worldwide spread, microplastic (size range: 1 μm – 5 mm) has become a major concern in the past decade. It is proven, that microplastic particles (MP) accumulate in the food chain and most probably enter the human body via this path as well. After absorption (i.e., through the gastro-intestinal or pulmonary pathway), MP might be transferred more deeply into tissues increasing the potential of hazardous effects, e.g. local inflammation as well as cellular uptake associated with disturbance of the cellular homeostasis. Numerous studies in the recent years analysed the effect of commercial MP *in vitro* using model cell lines. Surprisingly, the results showed different and often even contradictory outcomes even when same polymers or size ranges were used. In our work, we aimed to correlate cellular uptake and induced biological responses with well-characterized physico-chemical properties of MPs (e.g., surface chemistry and size range)

Results and discussion Uptake as well as noxiousness of particles were hereby highly dependent on their physico-chemical properties and also cell type-related. While epithelial cells showed only little PCI, macrophages engulfed a high number of particles. This interaction process is proved to be size-dependent and related to the respective surface charge. Interestingly, not only surface charge but also the surface charge density plays a crucial role for PCI. Subsequently, the number of engulfed MPs critically influenced the intensity of induced biological responses. While there was little to non-noxiousness effects of the particles to epithelial cells, macrophages showed a PCI-dependent noxiousness in various biological effects. Furthermore, besides surface chemistry, MP morphology and weathering status seemed to play an important role in inducing noxious effects at a wide level of biological effects.

Keywords: toxicity, biological effects, cell culture, cellular effects

^{*}Speaker

[†]Corresponding author: Ruth.Freitag@uni-bayreuth.de