Combined effects of polyethylene microplastics and nanoparticles on Lemna minor

Amadeja Sajovic Žulovec*[1], Gabriela Kalčíková[1], and Ula Rozman[1]

[1]Univerza v Ljubljani, Fakulteta za kemijo in kemijsko tehnologijo – Večna pot 113, 1000 Ljubljana, Slovenia

Abstract

Metal- and metal/oxide-based engineered nanoparticles and especially ZnO and TiO2 are very useful nanomaterials due to their excellent physio-chemical properties which can be used in many industrial applications. They are also commonly used as UV-filters in personal care products and therefore follow the same path as the so-called primary microplastics used in cosmetics. After application, they both end up in wastewater and eventually in the aquatic ecosystem. There they can interact with each other, which also changes their bioavailability and toxicity. In this context, ZnO and TiO2 nanoparticles were separately adsorbed on polyethylene microplastics extracted from cosmetics. The adsorption of TiO2 lasted for 12 hours until maximum adsorption capacity of 823.0 μg TiO2/g MPs was reached, while ZnO was adsorbed rapidly and reached the maximum adsorption capacity of 285.7 μg ZnO/g MPs after already 3 hours. The toxicity of microplastics with adsorbed ZnO and TiO2 was investigated using duckweed *Lemna minor* and the effects on specific growth rate, the chlorophyll *a* and *b* contents and root length were investigated. In addition, the concentration of desorbed nanoparticles was determined during the experiment. The results showed that microplastics with adsorbed TiO2 and ZnO nanoparticles did not affect the specific growth rate and chlorophyll *a* content. However, they inhibited root growth and chlorophyll *b* content. The negative effect may also be associated with the desorbed particles/ions, as 15.7 % and 53.0 % of the TiO2 and ZnO, respectively, were desorbed from the microplastics into the water after 7 days of incubation.

Keywords: aquatic ecosystem, duckweed, metal oxides, microplastics, nanoparticles

*Speaker