Contribution of additive-related effects to microplastics toxicity for aquatic organisms: a case study with model metal (ZnO) and organic additives (Lubio) and LDPE

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Abstract

Microplastic particles do not only contain the polymer itself, but an unknown quantity of unidentified chemicals. Intentionally added chemicals, so-called additives, may leach and subsequently cause toxic effects in environmental organisms. However, obtaining well-defined testing material is challenging, as for most commercial polymers the identity and amount of additives is undisclosed. We present here an approach to produce well-defined additive loaded microplastics particles applicable to subsequent ecotoxicity testing. We used ZnO, and commercially available LubioÒ products as model additives, both being relevant in industrial applications. These latter two are added to polymers as "antiaging systems" and their chemical identity is undisclosed. A common amount (5 wt%) of a nanoscale ZnO (NanoTek) or (3.5 wt%) LubioÒ was homogeneously distributed in LDPE (DOW 410E), polymer sheets were cryo-milled, yielding micron-scaled irregular shaped particles. Powders were sieved to obtain a comparable particle fraction of 140 μm-300 μm for all samples. In addition to 3 different microparticles (additive-free, ZnO loaded, and LubioÒ loaded), also the single additives were tested. We performed toxicity testing with two aquatic ecotoxicity models; freshwater crustacean *Daphnia magna* and protozoan *Tetrahymena thermophila*. Particles were dispersed in test medium with added Tween 40 (25μl/L) and sonicated in water bath. As expected, the ZnO nanoparticles were toxic to *D. magna* and only slightly toxic *T. thermophila*. LubioÒ additives did not exert high toxicity T. thermophila. In daphnids, a slight toxicity of the LubioÒ was observed. None of the microplastics samples (additive-free / additive-loaded) was acutely toxic to both organisms. This is an indication that the concentrations of individual additives as used here are too low to pose an acute risk to aquatic organisms. As well, our results show that the presented approach for preparing microplastic particles with defined additive content is promising to distinguish the effects posed by microplastics and additives.

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