Controlling silver nanoparticle exposure in algal toxicity testing - A matter of timing

The aquatic ecotoxicity testing of nanoparticles is complicated by unstable exposure conditions resulting from various transformation processes of nanoparticles in aqueous suspensions. In this study, we investigated the influence of exposure timing on the algal test response to silver nanoparticles (AgNPs), by reducing the incubation time and by aging the AgNPs in algal medium prior to testing. The freshwater green algae Pseudokirchneriella subcapitata were exposed to AgNO₃, NM-300K (a representative AgNP) and citrate stabilized AgNPs from two different manufacturers (AgNP1 and AgNP2) in a standard algal growth inhibition test (ISO 8692:2004) for 48h and a short-term (2h) ¹⁴C-assimilation test. For AgNO₃, similar responses were obtained in the two tests, whereas freshly prepared suspensions of citrate stabilized AgNPs were less toxic in the 2-h tests compared to the 48-h tests. The 2-h test was found applicable for dissolved silver, but yielded non-monotonous concentration–response relationships and poor reproducibility for freshly prepared AgNP suspensions. However, when aging AgNPs in algal medium 24h prior to testing, clear concentration–response patterns emerged and reproducibility increased. Prolonged aging to 48h increased toxicity in the 2-h tests whereas aging beyond 48h reduced toxicity. Our results demonstrate that the outcome of algal toxicity testing of AgNPs is highly influenced not only by the test duration, but also by the time passed from the moment AgNPs are added to the test medium. This time-dependency should be considered when nanomaterial dispersion protocols for ecotoxicity testing are developed.

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