

NanoFATE Deliverable 3.5

Report on application of mixture toxicity models of combined stressors: Assessment of the applicability of existing mixture toxicity principles for assessing the joint effects of mixtures of ENPs, and ENPs in combination with other environmental stressors.

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Research Report Summary

The aim of this deliverable is to assess the combined effects of engineered nanoparticles (ENPs) and natural stressors or with other ENPs or components that can co-occur in the environment. Experiments were carried out to evaluate how aquatic organisms (*Daphnia magna* and *Danio rerio* embryos) responded to combined exposures. In addition, the MIXTOX toolbox was used to predict patterns of response for combined exposures. A first approach was carried out by adjusting experimental data to the conceptual models of Independent Action or Concentration Addition, and possible deviations for synergism or antagonism explored.

First ZnO ENPs were tested under different Ultra Violet Radiation (UVR) levels to infer if ZnO toxicity to *D. magna* and *D. rerio* embryos changed upon combined exposure. In addition, several binary mixtures with ZnO ENPs, Ag ENPs, ZnCl₂ and AgNO₃ were also tested using *D. magna*.

Results showed that the conceptual models may not represent the best fit and deviations for synergism were obtained. In addition, the co-occurrence of ENPs and their ionic counterparts showed that their combined effects may not be additive and further studies need to be carried out to infer how ENPs can interact with their ionic forms.

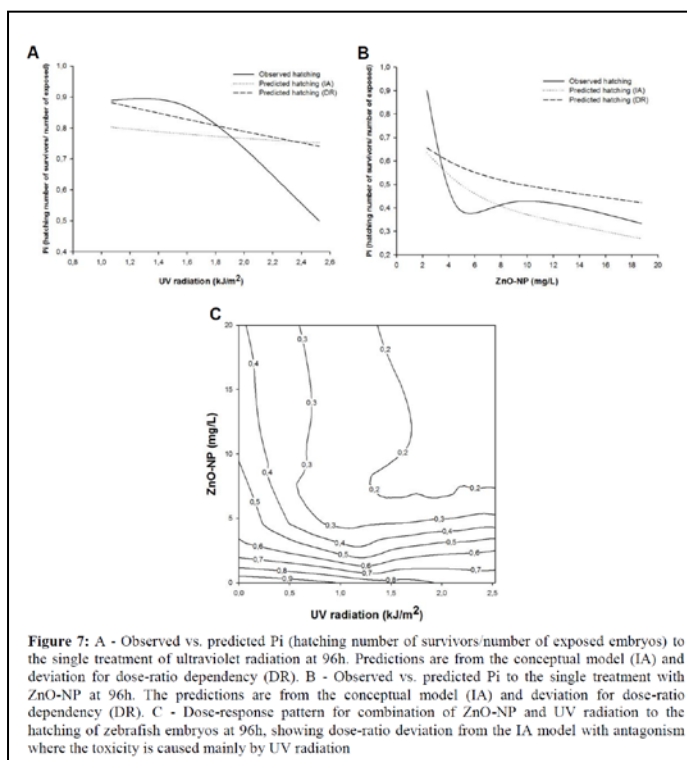


Figure 7: A - Observed vs. predicted Pi (hatching number of survivors/number of exposed embryos) to the single treatment of ultraviolet radiation at 96h. Predictions are from the conceptual model (IA) and deviation for dose-ratio dependency (DR). B - Observed vs. predicted Pi to the single treatment with ZnO-NP at 96h. The predictions are from the conceptual model (IA) and deviation for dose-ratio dependency (DR). C - Dose-response pattern for combination of ZnO-NP and UV radiation to the hatching of zebrafish embryos at 96h, showing dose-ratio deviation from the IA model with antagonism where the toxicity is caused mainly by UV radiation

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