Physiological and molecular responses of springtails exposed to combined chemical and drought stress by passive dosing

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WE050 Physiological and molecular responses of springtails exposed to combined chemical and drought stress by passive dosing

S.N. Schmidt, Aarhus University / Department of Environmental Science; M. Holmstrup, Aarhus University / Department of Bioscience; C. Damgaard, J.G. Sorensen, S. Slotsbo, Aarhus University; P. Mayer, Technical University of Denmark / Department of Environmental Engineering. Organisms in the environment are exposed to multiple stressors of both natural and anthropogenic origin. Consequently, adapted organisms have developed essential physiological and molecular responses to counteract physical and chemical stress. This poster presents the results of two studies on the combined effects of phenanthrene and drought in the springtail *Folsomia candida*. Special attention was given to (1) the experimental approach for the simultaneous and independent control of chemical and drought exposure, (2) the characterization of the combined effects on survival and (3) the physiological and molecular responses to phenanthrene, drought and combined exposure. A new passive dosing system was developed and applied in order to conduct bioassays under well-defined exposure conditions: Passive dosing from silicone was used to control the chemical activity of phenanthrene (chemical stress), while saline solutions were used to control the water activity (drought stress). First, a two-factor experiment on seven levels ($7^2 = 49$ combinations/treatments) was conducted with the aim of studying the combined effects of phenanthrene and drought on the survival of *F. candida*. An "independent action" model was fitted to the observed survival data, which demonstrated an overall synergistic effect of the two stressors ($p < 0.0001$). Additionally, both chemical and drought stress was found to reduce the springtail tolerance to the other stressor. Then, the transcription of nine candidate genes was determined in one of the treatments from the full-factorial experiment (chemical activity of 0.010 and water activity of 0.988) with the aim of studying the effect of phenanthrene on physiological mechanisms involved in drought tolerance and, conversely, the effect of drought on phenanthrene detoxifying mechanisms. Phenanthrene had no effect on drought-protective accumulation of myo-inositol, and normal water conserving mechanisms of *F. candida* were functioning despite the near-lethal exposure level of the toxicant. Further, detoxifying induction of *cytochrome* P_{450} and *glutathione-S-transferase* was not impeded by drought. Both phenanthrene and drought induced transcription of heat shock protein (*hsp70*) and the combined effect of the two stressors on *hsp70* transcription was additive, suggesting that the cellular stress and lethality imposed by these levels of phenanthrene and drought were also additive.