Systems biology in sentinel species: a case study and perspectives in ecotoxicology

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Abstract

Environmental risk assessment is becoming more and more challenging because of the multitude of produced chemicals and their possible combinations that may occur in the ecosystem. Molecular approaches used to measure the biological responses of organisms exposed *in natura* may provide valid tools to investigate the mechanisms of action of chemical pollution, thus providing a predictive framework for the early detection and diagnosis of chemical hazard. The freshwater amphipod *Gammarus fossarum* has been established in France as a sentinel species to assess the bioavailable contamination levels of a great variety of aquatic systems. Complementarily to chemical indicators, and thanks to the advances in nucleic acid high-throughput sequencing and in mass spectrometry, proteogenomics has allowed developing the measurement of hundreds of proteins in this species. In this context, I will present different case studies showing the potential of -omics approaches in gammarids to provide fundamental biological knowledge and mechanistic clues of toxicity of aquatic contaminants, even in the absence of sequenced genomes in these species. I will first show how data-driven protein network analyses may help to shed light on the molecular physiology of the reproductive system of *Gammarus fossarum* and on the molecular mechanisms involved in the effects of trace metals and insecticides in gammarid male gonads. I will also show how the integration of current transcriptomic and proteomic resources allow the identification of the metabolic pathways and the organ-specific metabolic profiles in *G. fossarum*. In this context, a particular focus on the identification of key molecular players involved in the gammarid endocrine signalling pathways will be presented. The perspectives of this work in fostering systems ecotoxicology in sentinel species and in contributing to comparative environmental genomics in aquatic invertebrates will be presented and discussed.

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