Potential Roles of Omics Data in the use of Adverse Outcome Pathways for Environmental Risk Assessment

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The current approach to assessing adverse effects of chemicals in the environment is largely based on a battery of *in-vivo* study methods and a limited number of accepted *in-silico* approaches. For most substances the pool of data from which to predict ecosystem effects is limited and often only short term data are available. The EC Scientific Committee Consultation paper 'Addressing the New Challenges for Risk Assessment' (2012) highlights some of the main deficiencies of current risk assessment approaches. The report also outlines the potential advantages and challenges of conducting effects assessments using data from lower hierarchical (biological) levels of organization, such as molecular, biochemical and histological responses, to infer impacts at the individual, population and, perhaps, even community levels. The adverse outcome pathway (AOP) framework provides a conceptual basis through which linkages can be explicitly assessed across biological levels of organization. There are substantial international efforts to develop and catalogue AOPs and develop implementation guidance for risk assessment. 'Omics approaches offer potential for use in environmental risk assessment when applied as part of a systems toxicology or integrative approach, and considered in the context of the AOP framework. For example, omics can provide mechanistic information about the effects of chemicals and have the potential to increase confidence in species extrapolation. These techniques have the potential to be combined with i) mechanistic effect models that can (begin to) account for some of the complexity of populations, communities and ecosystems and ii) provide insights as to toxic mechanisms for both defined and, importantly, defined pathways via which unacceptable effects occur. A recent workshop drawing together experts from the academic, industry and regulatory authority communities discussed the role and highlighted the key challenges of employing 'omics' techniques as part of the AOP framework to support environmental risk assessment of chemicals.