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Abstract

Living organisms are exposed to mixtures of pollutants in the wild. Inland aquatic ecosystems contain many compounds from different sources that pollute the water column and the sediment. However, majority of toxicological research is focused on the effects of single exposures to toxicants. Furthermore, studies have been principally oriented toward ecologically relevant effects of intoxication, and lack an analysis of the cellular and molecular mechanisms involved in the response to toxicants. Effects of single, binary, and ternary mixtures of three compounds, bisphenol A, octocrylene, and 2'-ethylhexyl 4- (dimethylamino)benzoate, were assessed using a Real-Time PCR array. Forty genes, and additional six reference genes, were included in the array. The genes were selected based on their association with hormone responses, detoxification mechanisms, the stress response, DNA repair, and the immune system. The study was performed on Chironomus riparius, a benthic dipteran with an essential role in the food web. Transcriptional responses were assessed both 24 and 96 h post-exposure, to determinate short- and medium-term cellular responses. Individual fourth instar larvae were exposed to 0.1 and 1 mg/L of each of the toxic compounds and compound mixtures. A weak response was detected at 24 h, which was stronger in larvae exposed to mixtures than to individual toxicants. The response at 96 h was complex and principally involved genes related to the endocrine system, detoxification mechanisms, and the stress response. Furthermore, exposure to mixtures of compounds altered the expression patterns of an increased number of genes than did individual compound exposures, which suggested complex interactions between compounds affected the regulation of transcriptional activity. The results obtained highlight the importance of analyzing the mechanisms involved in the response to mixtures of compounds over extended periods and offer new insights into the basis of the physiological responses to pollution.

Keywords: Aquatic insect; Chironomids; Invertebrates; Mixture toxicity; Multi-stress; Transcriptional alterations.

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