Sydney rock oysters respond to contaminants in a complex matter

Polycyclic aromatic hydrocarbons (PAHs) can be produced naturally and through human activities and enter aquatic environments through, for instance, oil spills or surface runoff. These contaminants can persist for a long period of time in the environment and are able to be taken up and bioaccumulated (= accumulation of chemicals/toxic substances/contaminants in a living organism) by oysters. While PAHs have been shown to affect, for example, physiological functions like respiration and filtration rates in oysters and other molluscs, with high mortalities observed in response to long-term PAH exposure, little is known about the effect of PAHs on the underlying transcript expression in oysters. In order to address this knowledge gap, Sydney rock oysters were exposed to pyrene and fluoranthene (both considered highly toxic to toxic PAH compounds) for seven days and transcript expression determined with RNA-Seq (a next-generation sequencing technology that allows the close examination of the expression profile of transcripts actively expressed in a tissue/species).

Analysis of the RNA-Seq data showed a total of 765 transcripts differentially expressed between control and PAH-stressed oysters, with overall more transcripts down-regulated than up-regulated in response to the contaminants. More specifically, results indicate that Sydney rock oysters employ a small set of enzymes (e.g. cytochrome P450, carbonyl reductase) to carry out pyrene and fluoranthene detoxification and to limit potential detrimental downstream effects of molecules such as reactive oxygen species (ROS) that can be produced during the detoxification process. Innate immunity, which protects oysters from pathogens in their aquatic environment also appeared to be affected by the PAH stressor, with the overall transcript expression pattern suggesting a suppression of pathogen recognition and an induction of transcripts encoding proteins involved in the clearance of cell debris. Transcripts putatively involved in a range of protein synthesis and modification processes were also found to be differentially expressed in Sydney rock oysters in response to PAHs. While many of these processes appeared to have been impaired in PAH stressed oysters, energy was extended to ascertain that the expressed proteins were correctly folded and could carry out their respective functions. In conclusion, PAH stressed oysters show a complex molecular response to the contaminants, with the results suggesting that oysters focus on removing the stressors from their system and dealing with the downstream effects of PAH exposure, potentially at the exclusion of other, less immediate concerns (e.g. protection from infection).

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Publication

Combined exposure to pyrene and fluoranthene and their molecular effects on the Sydney rock oyster, Saccostrea glomerata.

Ertl NG, O'Connor WA, Brooks P, Keats M, Elizur A

Aquat Toxicol. 2016 Aug