

Genome-wide transcriptional responses to Deepwater Horizon oil in Mahi-Mahi (*Coryphaena hippurus*) embryos

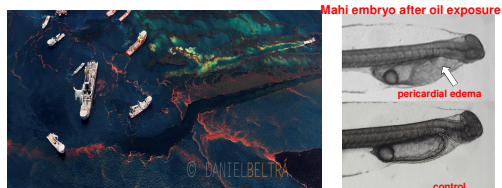
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Background

The Deepwater Horizon disaster resulted in the release of more than 600 million L of oil into the offshore waters of the northern Gulf of Mexico between April 10 and July 14, 2010. This resulted in extensive oiling of the pelagic zone and fouling of shoreline habitats. The timing of the DWH spill also coincided with the spawning seasons for many commercially important pelagic fish species, such as mahi-mahi, tunas et al. It has been established that the developing fish heart is a sensitive target organ for the toxic effects of crude oil-derived PAHs.



Objectives

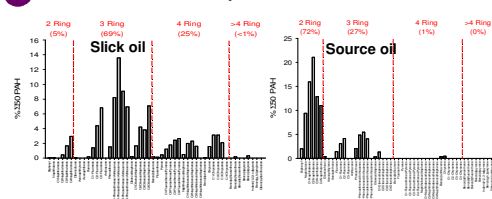
- The main objective of this study was to investigate the transcriptomic profiles in mahi-mahi (*Coryphaena hippurus*) embryos reflective of the different DWH oil (source and artificially weathered oil) toxicity at different critical windows of development using Next-generation sequencing (NGS).
- The chemical composition and cardiotoxicity of different DWH oil types was also measured with the intent of anchoring the links among molecular, functional and morphometric endpoints during embryonic development.

Methods

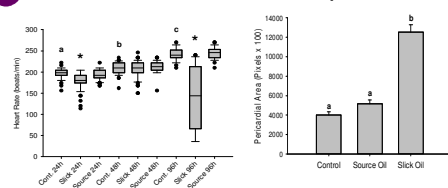
Water chemistry: gas chromatography/mass spectrometry – selective ion monitoring (GC/MS-SIM; based on EPA method 8270D)
Exposure: Slick oil: HEWAF of surface slick oil (2.1%); Mass oil: HEWAF of source oil (0.09%); 25 Mahi mahi embryos in each treatment (3 X); Time points: 24, 48, 96 h
Image analysis: imaged at 24, 48 and 96 h for assessment of heart rate and pericardial edema using Fire-i530c digital camera mounted on a Nikon SMZ800 stereomicroscope.
Sequencing: Illumina HiSeq2500 for Single Read 1X50 cycle sequencing
Bioinformatic analysis: ToppGene Suite, Advaita Bio's iPathwayGuide, Ingenuity Pathway Analysis (IPA; Qiagen)

Results

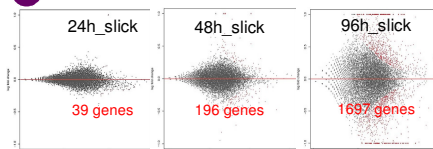
1 Different chemical composition of slick and source oils



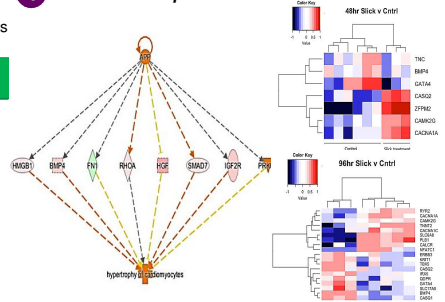
2 Decreased heart rate and increased pericardial area



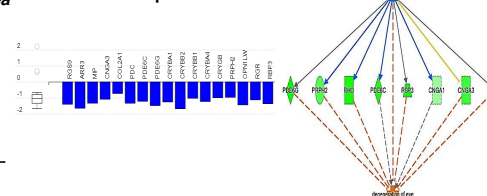
3 Time and type of oil-dependent DE gene profiles



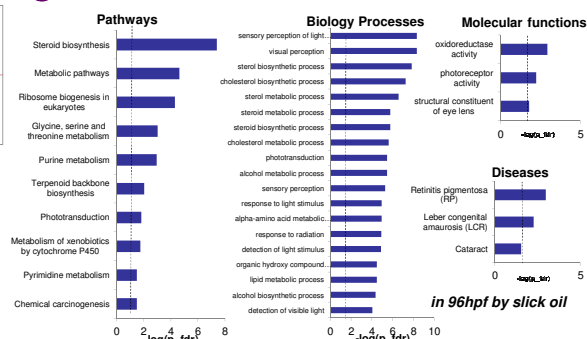
4 Differential Expression of Cardiac Genes



5 Perturbation in visual perception and eye development



6 Top impacted biological pathways and biological processes



Conclusions

- The first study to investigate the time-course transcriptomic responses in marine fish embryos exposed to two types of DWH oil.
- Slick and Mass oil exposure induced similar transcriptional responses at early developmental stages, but transcript profiles were different at later developmental stages in mahi.
- Informatic analyses with TOPPGene, Advaita, and IPA indicated slick oil exposure resulted in significant perturbation in purine metabolism, steroid biosynthesis, visual and cardiac-associated genes at later embryonic developmental stages.
- Comparisons of these pathways with phenotypic responses revealed reduced heart rate and increased pericardial edema in larvae exposed to slick oil but not source oil.

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