D. ABSTRACT

Research Category: Ecology and Oceanography of Harmful Algal Blooms
Sorting code: EPA-G2006-STAR-B1
Title: Investigating chronic toxicity and bioaccumulation of microcystins in freshwater fish using toxicogenomics and histopathology
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Project Period: September 1, 2006 – August 31, 2009 (proposed)
Project Cost: $436,967

Project Summary

Objectives/hypothesis: During the last 10 years, *Microcystis spp.* blooms have occurred in Western Lake Erie, and elevated levels of microcystins have become a concern for both human and ecosystem health. Our objective is to investigate the predominant microcystin found in this system (microcystin-LR) in model fish species and to relate laboratory results to chronic low-level toxin exposure and bioaccumulation found in higher trophic level fish in W. Lake Erie. We hypothesize that (1) specific genes that respond to microcystin-LR exposure in larval and adult zebrafish can be identified and selected as biomarkers; (2) effects of chronic, low concentration exposure of microcystin-LR can be detected by changes in biomarker gene expression, tissue histology, and reproduction in zebrafish; (3) bioaccumulation of microcystin in channel catfish is affected by route of exposure and effects can be detected in biomarker gene expression and histopathology; and (4) bioaccumulation and effects of chronic low, concentration exposure to microcystins can be detected in higher trophic level fish collected from W. Lake Erie by tissue analysis and the evaluation of biomarkers resolved from lab and mesocosm experiments.
b. Approach: Commercially available microarrays will be used to interpret differences in global gene expression for nearly 15,000 genetic transcripts in zebrafish exposed to microcystin-LR. A subset of differentially expressed biomarker genes (≈20-40) will be selected for larval and adult fish and adapted to a quantitative real-time PCR format for monitoring specific exposure variables. Subsequently, zebrafish will be exposed to chronic low concentrations of microcystin-LR throughout development (age 2-150 days), and survival, biomarker gene expression, histopathological lesions, and reproductive success will be evaluated. Selected biomarker genes will be adapted for use in channel catfish to evaluate effects of bioaccumulation of microcystin in channel catfish after aqueous and dietary exposure. Fish from higher trophic levels (including channel catfish) will be collected from W. Lake Erie to assess bioaccumulation of microcystin and effects on biomarkers resolved in lab experiments.
c. Expected results: Genes selected from microarray experiments will improve our understanding of the mechanisms of microcystin toxicity and enable more specific probing into the factors that influence bioaccumulation and toxicity in fish via *in vitro*, mesocosm, and *in situ* approaches. Our focus on chronic, low-concentration exposures to will begin to address an important knowledge gap regarding the long-term effects of algal toxins on ecological health. We expect to determine toxin concentrations that cause negative effects in fish during chronic exposure and to demonstrate toxicogenetic and histopathological approaches that can be employed in ecological forecasting of system health.
Supplemental Key Words: zebrafish, gene expression, microarray, blue-green algae, toxin