J Environ Anal Toxicol 2017, 7:5 (Suppl)
DOI: 10.4172/2161-0525-C1-009

Growth or reproduction? A sacrifice made by zebrafish after regenerative organic pollutants, microcystins exposure

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Statement of the Problem: Microcystins (MCs), produced by toxic cyanobacterial blooms that appeared worldwide in eutrophication waters have the potential for disrupting endocrine homeostasis in acute and subchronic toxic experiments. However, fish in natural environments are continuously exposed to MC-LR throughout their entire life cycle instead of short-term exposure.

Methodology & Theoretical Orientation: An exposure experiment in which zebrafish hatchlings (5 days post-fertilization) were exposed to 0, 0.3, 3 and 30 μg/L microcystin-LR (MC-LR) for 90 days until they reached sexual maturity, were utilized to evaluate endocrine disrupting effects of MC-LR on the growth and reproductive system.

Findings: The results for the first time showed a life cycle exposure to MC-LR caused growth inhibition, decreased gonadal index and retarded gonadal development as well as ultrapathological lesions in the brain and liver of male and female zebrafish. On one hand, delayed ovarian maturation and sperm development were obviously involved with sex hormone imbalance and related-gene expression disruption in the hypothalamic-pituitary-gonadal-liver axis (HPGL-axis). Significantly up-regulated transcription of brain *GnRH3, FSHβ, LHβ* and *cyp19a1b* (males only) suggested that a positive feedback regulation in the HPGL-axis was initiated as a compensatory mechanism. On the other hand, the retarded gonadal development was accompanied by an inhibition in the transcriptional profiles of the GH/IGFs system. Also, sex-differential impairments suggested that gonadal development of males is more vulnerable than that of female to MC-LR.

Conclusion & Significance: Our results provide evidence that MC-LR at environmentally relevant concentrations is able to induce impairments on fish growth and gonadal development, which pose a potent threat on fish reproduction and thus population dynamics in MCs-contaminated aquatic environments. It was also noted that hepatic *vtg1* mRNA expression was up-regulated in male zebrafish, which implied that MC-LR could induce estrogenic-like effects at environmentally relevant concentrations and long-term exposure.

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