

US EPA ARCHIVE DOCUMENT



Early Life History Exposures to Cadmium in Fathead Minnows: Effects on Reproduction

Environmental Issue

Cadmium (Cd) is common in the environment. It is used in several industrial processes. Cigarette smoke is a primary source of Cd, but it can be found in water, air and food. Cd may disrupt endocrine function and activates estrogen and androgen receptors (Pitt et al., 2004). Estrogenic and androgenic compounds can disrupt pattern development. Exposure to exogenous estrogens or androgens during development can cause permanent damage to reproductive organs.

Scientific Approach

Overview: The primary goal of this project is to determine if exposure to Cd during development affects the reproductive success and reproductive physiology of fish. A second objective is to determine which developmental stages are most sensitive to Cd exposure. To achieve these goals, the breeding success of fathead minnows (*Pimephales promelas*) exposed to Cd during various developmental stages will be compared to that of unexposed fish.



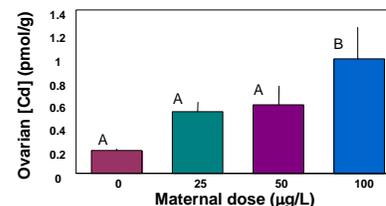
•Hypothesis: Exposure to Cd during development impairs the reproductive success and alters the reproductive physiology of fish.

•Research Plan:
Determine if exposure to Cd during development impairs reproduction
 -A 21-d breeding study will determine reproductive success (Ankley et al., 2001).

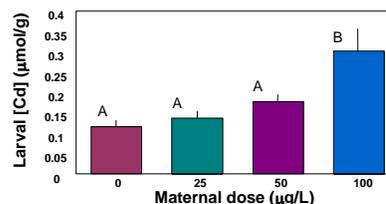
Determine if exposure to Cd during development alters reproductive physiology
 -The number of breeding tubercles, intraocular distance and plasma sex steroid concentrations of males will be determined.
 -Gonads will be removed from all fish, gonadosomatic index will be determined and histological analysis can be conducted.

Determine which developmental stages are most sensitive to Cd exposure
 -Fish will be exposed to Cd during critical developmental stages including periods of embryonic development and sexual differentiation.
 -Fish will be exposed during embryonic development by way of maternal transfer in which Cd-exposed females transfer Cd to their embryos. Fish exposed during other developmental stages will be exposed to water-borne Cd.

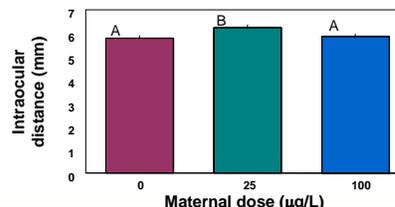
•Preliminary Results:
 -Cd-exposed females accumulate Cd in their ovaries in a dose-dependent manner.



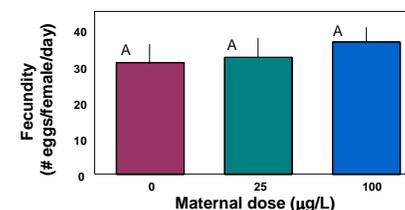
-Cd-exposed females transfer Cd to their offspring in a dose-dependent fashion.



-Exposure to Cd during embryonic development alters the intraocular distance of males.



-Exposure to Cd during embryonic development does not impair reproductive success.



Impacts

•Information from this study will:
 -enhance the current understanding of metal toxicity by showing the ability of Cd to act as an endocrine disruptor
 -identify potential population-level effects of Cd exposures in fish
 -identify developmental stages that are most sensitive to Cd exposures

Citations: Ankley, G.T., K.M. Jensen, M.D. Kahl, J.J. Korte and E.A. Makynen. 2001. Description and evaluation of a short-term reproduction test with the fathead minnow (*Pimephales promelas*). *Environ. Toxicol. Chem.* 20: 1276-1290.

Keitt, S.K., T.F. Fagan and S.A. Marts. 2004. Understanding sex differences in environmental health: a thought leaders' roundtable. *Environ. Health Perspect.* 112: 604-609.

Acknowledgements: Funding for this project provided by the following: UNO Graduate Program, UNO Biology Department, NIH grants # 1 R15 ES11788-01 and 1 P20 RR 16469 and the EPA GRO Fellowship Program. Special thanks to Dr. Alan S. Kolok and Alicia M. Diener.

US EPA ARCHIVE DOCUMENT