Background

• Worldwide many sturgeon species (Acipenseridae) have faced marked population declines with some species nearing extinction.
• These declines are attributed to human activities such as overfishing, contamination of dams, habitat alteration, competition from introduced species, and pollution.
• Pollutants, including dioxins and PCBs, have contaminated sediments of some water bodies inhabited by sturgeon.
• Sturgeon are uniquely susceptible to bioaccumulation of lipophilic contaminants relative to other fish species because they:
  • are extremely long lived
  • have a high lipid content
  • mature late
  • have a diet rich in benthic prey
• Although deformities and enzyme induction have been observed in sturgeon collected from some contaminated sites, little is known about sensitivity of sturgeon to dioxin-like chemicals.

Methods

Biochemical and molecular endpoints were characterized in white sturgeon in order to better understand how sturgeon respond to AhR agonists.

• Ethoxyresorufin-O-deethylase (EROD) activity was measured using hydroxycoumarin (HC) resorufin as a substrate.
• EROD activity was normalized to protein content in tissue homogenates.
• CYP1A transcript abundance in liver, gill, and intestine from white sturgeon (WS) and rainbow trout (RT) following 3-days exposure to 50 or 500 mg/kg of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD).
• The white sturgeon AhR clusters closely with those of other cartilaginous fish species, however it differs from sequences of salmonids and most teleost species.

Results

• White sturgeon have moderate hepatic EROD responsiveness following exposure to TCDD at either 50 mg/kg or 500 mg/kg compared to other fish species such as the rainbow trout (Table 1).
• EROD activity observed in gill and intestine of exposed white sturgeon was surprising. No publication was found presenting gill or intestinal tissue with equal or greater inducibility following ip injection as that observed in this study on white sturgeon. Similarly, no EROD activity was detected in rainbow trout gill or intestine in this study.

Table 1: Comparison of hepatic EROD activity following ip injection of 50 mg/kg TCDD in different species of fish (nmol/mg/min).

Species | Weight (g) | EROD Activity (nmol/mg/min)
--------|-----------|------------------------
Largemouth Bass | Avg. 120 | 30 ± 3 (0.05)
Rainbow Trout | Avg. 80 | 450 ± 15 (0.01)
Atlantic Salmon | Avg. 100 | 1000 ± 50 (0.001)

• The white sturgeon AhR clusters closely with those of other cartilaginous fish species, however it differs from sequences of salmonids and most teleost species.

• Continued work on AhR dynamics in white sturgeon studying other fish species.

• Although the liver is the main location of these responses, other organs such as the gill and intestine have the capacity to respond as evidenced by induction of EROD activity and both CYP1A and AhR transcripts.

• AhR dynamics could be both species and tissue-specific in piscine systems and are present in ancient fishes.

• It is currently unclear whether AhR autoregulation has an impact on species or tissue sensitivity to AhR agonists.

Ongoing Research

• Development of an AhR agonist dose-response in white sturgeon utilizing hepatic, intestine, and gill primary cultures.

• Continue work on AhR dynamics in white sturgeon studying other concurrent AhR isoforms.

• Investigate responsiveness of other sturgeon to AhR agonists.

References