The Effect of Arsenic Contamination on the Behavior and Microbiome of Chinese Mystery Snails

TBIOMD 495 – Biomedical Research Experience

Mehakpreet Randhawa, Marc Nahmani, and Sarah Alaei

Introduction:

Arsenic (As) is a naturally occurring metalloid that has been found in local lakes, from the former ASARCO smelter. Chinese Mystery Snails (CMS) consume periphyton, aquatic biofilm, which is leading to the bioaccumulation of arsenic in their gut microbiota. Due to the arsenic exposure, CMS have reportedly induced alterations in the CMS gut microbiome's and consequently altered their neuronal function and behavior.

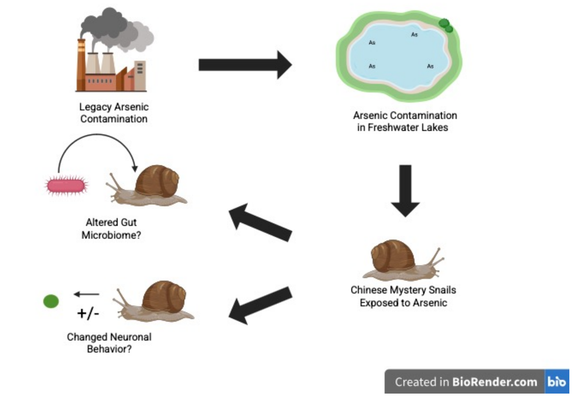

Figure 1. Arsenic Exposure to Chinese Mystery Snails in Freshwater Lakes Potentially Leads to Changed Behavior
Legacy contamination from the former ASARCO smelter has resulted in arsenic contamination in freshwater lakes in the South Puget Sound area. Chinese Mystery Snails (CMS), an invasive species, in these freshwater lakes have been exposed to arsenic which could lead to changed mobility and feeding behavior of arsenic exposed CMS.

Acknowledgements:

I would like to thank Dr. Nahmani and Dr. Alaei for their support and guidance throughout this entire experience. I would also like to thank my fellow peers and group members in TBIOMD 495 during Summer 2025. Finally, I would like to thank Dr. Heller for help and guidance with creating this poster.

Methods:

Figure 2. Experimental Arsenic Exposure Setup for Chinese Mystery Snails
Chinese Mystery Snails (CMS) were placed in 6 experimental jars with four snails per jar. Two jars served as the control group, 0.0 ppm As exposed), while 4 jars represented treatment groups groups to 0.2 ppm As or 2.0 ppm As. CMS were maintained under these conditions for a total of 2 months prior to the behavioral and microbiome analysis.

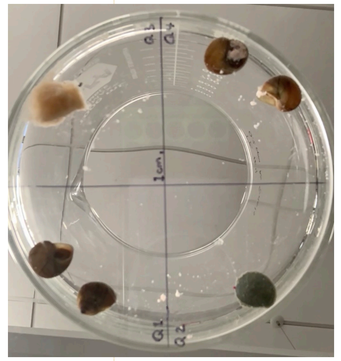

Figure 3. Behavioral Feeding and Mobility Assay Setup for Chinese Mystery Snails
Behavioral assays were conducted to evaluate feeding behavior and mobility in control and As exposed Chinese Mystery Snails (CMS). Each dish contained Snello and an algae wafer to assess feeding activity, while mobility was measured by the amount of time CMS spent outside of their shells under control and treatment conditions.

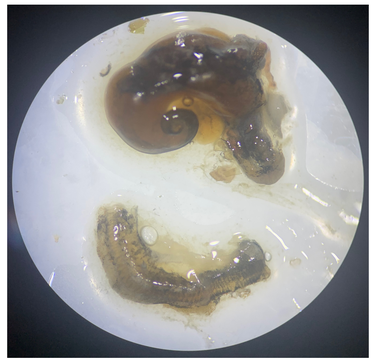

Figure 4. Chinese Mystery Snails Gut Dissection and Sample Collection for DNA Analysis
Chinese Mystery Snails (CMS) gut tissue was dissected and collected for microbiome analysis. Extracted gut samples were later used for DNA extraction, PCR, and gel electrophoresis to assess potential gut microbiome alternations associated with As exposure.

Results:

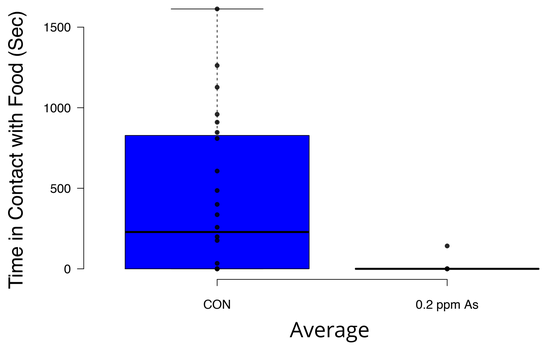

Figure 5. Arsenic Exposed Chinese Mystery Snails Showed Decreased Feeding Behavior During Behavioral Assay
Average of total time Chinese Mystery Snails (CMS) spent in contact with food under control (0.0 ppm As) and treatment (0.2 ppm As) conditions. Each point represents one CMS (n=24 for control) (n=8 for treatment). CMS exposed to arsenic, treatment CMS, spent less time in contact with food compared to control CMS. A two-tailed T test was used to calculate a p-value of 0.00055. Error bars represent ± standard deviation.

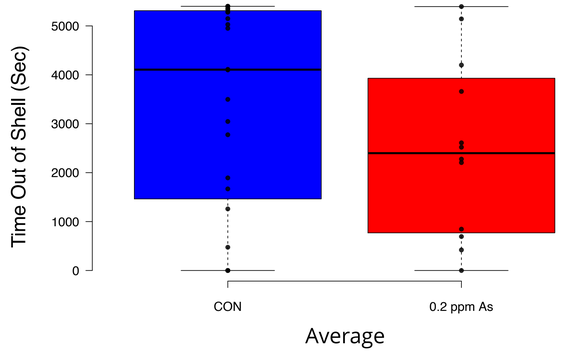

Figure 6. Arsenic Exposed Chinese Mystery Snails Showed Slightly Decreased Time Out of Shell During Behavioral Assay
Average of total time Chinese Mystery Snails (CMS) spent out of their shell under control (0.0 ppm As) and treatment (0.2 ppm As) conditions. Each point represents one CMS (n=24 for control) (n=12 for treatment). CMS exposed to As, treatment CMS, spent slightly less time out of their shell compared to control CMS. A two-tailed T test was used to calculate a p-value of 0.214. Error bars represent ± standard deviation.

Conclusion:

The results obtained in this experiment showed that As exposed Chinese Mystery Snails (CMS) experienced decreased feeding behavior compared to the control CMS, as indicated by spending significantly less time in contact with food. However, there was no statistically significant difference in mobility between the control and As exposed groups. These findings do not provide strong evidence that As exposure reduces overall movement or activity in CMS. Instead, the decreased feeding behavior may suggest altered senses or other physiological effects associated with As exposure. Additional microbiome and behavioral analyses are needed to better understand the biological mechanisms understanding these observed changes.

Future Directions:

Future research will involve additional analysis of the CMS gut microbiome to determine how arsenic exposure leads to decreased feeding behavior and mobility through quantitative data.

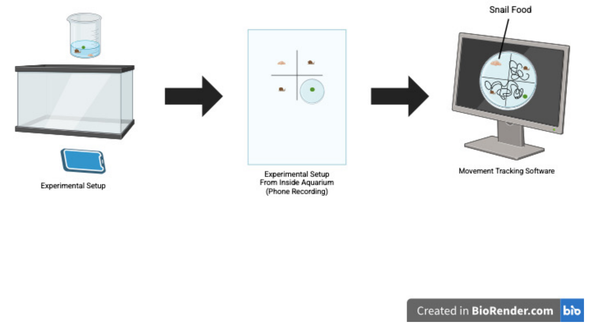

Figure 7. Future Direction: Integrating Movement Tracking Software for Control and Arsenic Exposed Chinese Mystery Snails Provides Quantitative Data for Behavioral Assay
A future approach for assessing feeding behavior in control and As exposed Chinese Mystery Snails (CMS). The data currently obtained was gathered via visual observations. Using movement tracking software will allow for quantitative data based on movement and feeding behavior. This future experiment could provide more detailed and varied data analysis on arsenic's effects on CMS and other aquatic life in contaminated freshwater lakes in the South Puget Sound area.