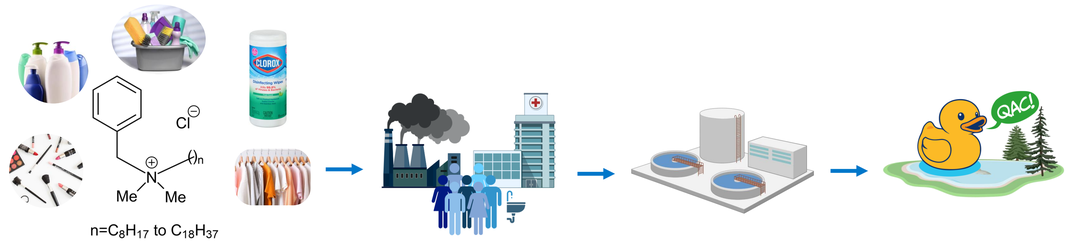
Environmentally Relevant, Chronic Benzalkonium Chloride Exposure Impacts the Fathead Minnow (*Pimephales promelas*) Proteome

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Background

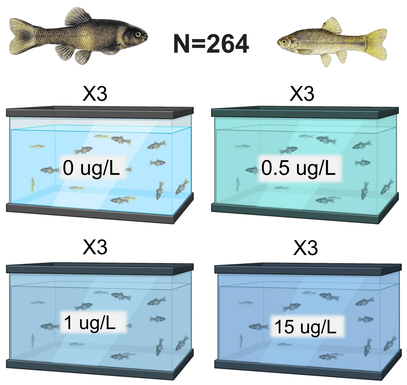
- Quaternary ammonium compounds (QACs) are antimicrobial disinfectants with increased consumer usage primarily due to the COVID-19 pandemic[1,2,3]
- Benzalkonium chloride (BAC) is the most utilized QAC in Canada[3]
- BACs persist in water bodies at µg/L concentrations, but few studies have examined their chronic effects on fish[4]
- We utilize non-targeted proteomic analysis to determine how an organism's protein abundance changes in response to a toxicant, such as BAC, and identify potential biomarkers



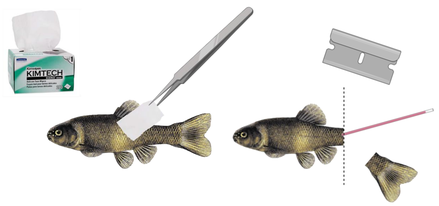
Objectives

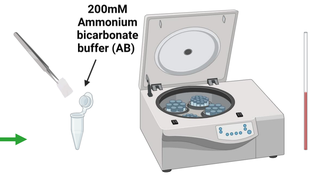
1. Determine the sex-specific biological responses of fathead minnows exposed to BAC
2. Utilize a proteomic approach to determine which fish organs and biofluids are adversely affected by BAC
3. Identify candidate biomarkers of BAC exposure in fish epidermal mucus

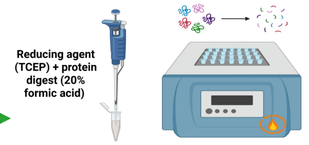
Methodology

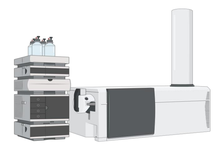


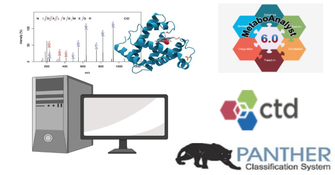
28 Days



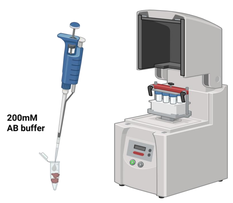












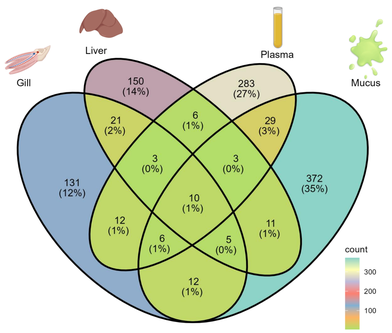
Scan the QR Code to See Mucus Collection in Action!



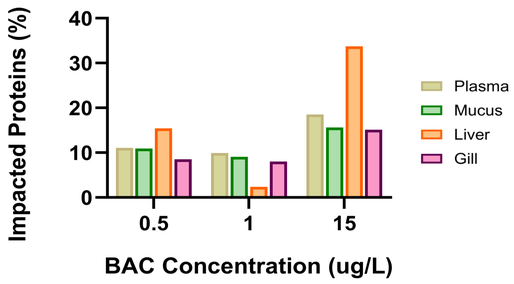
Results

There was no Significant Sex Bias Due to BAC Exposure (2-way ANOVA P>0.05)

The Mucus Proteome had the Most Unique Proteins



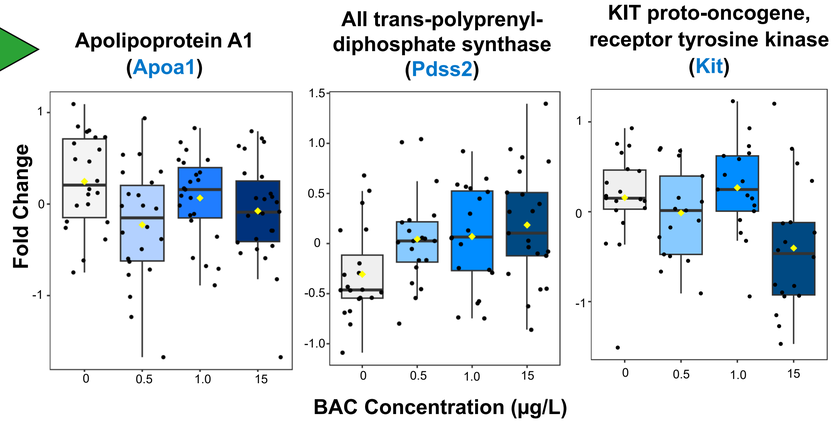
BAC Exposed Fish had Impacted Proteins at Every Exposure Concentration and for Each Sample Type



Decreased abundance of Apoa1 is associated with benzalkonium compounds.

Apoa1 maintains lipid homeostasis, and when altered, can contribute to neurodegenerative and cardiovascular diseases.

All Sample Types Had Impacted Proteins Related to Neurotoxicity



Altered abundance of Pdss2, Syt14, Nop56, and Kit support the development of ataxia. QACs may target the blood brain barrier (BBB) to cause neurotoxic effects in fish. Ptprb and Actn1 were both impacted and are key players in BBB integrity.

We Identified 54 Unique Mucus Proteins with Altered Abundance That Were Related to Several Key Functions:

- *Locomotor Rhythm* (*Mtor*)
- *Pain & Environmental Sensing* (*Ntrk1 & Npas2*)
- *Nerve Impulse Transmission* (*Cntnap1, Mtor, S1pr1, Ank3*)
- *Wound Healing & Immune Response* (*Mtor & Coro1a*)
- *Programmed Cell Death* (*Akap1, Pde3a, Mtor, Ntrk1*)
- *Stress & Fear Response* (*Npas2*)

Conclusions

- Environmentally relevant, chronic BAC exposure significantly impacts fathead minnow health
- There was no significant sex-bias due to BAC exposure
- Apoa1 abundance is a candidate biomarker of BAC exposure
- Impacted proteins were associated with neurotoxicity, lipid metabolism, and immunity
- Epidermal mucus sampling is a valuable non-invasive tool for QAC exposure biomonitoring

Acknowledgements & References

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