Disinfectant Properties of *Nuphar advena*: *An Ethno-pharmaceutical Approach*

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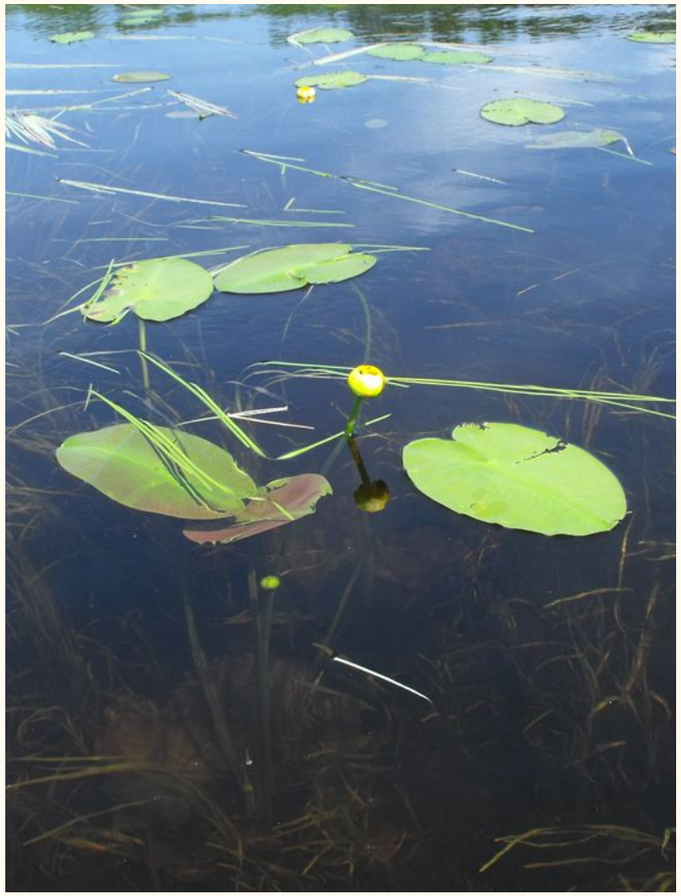
Purpose: To provide scientific support into *N. advena*, a traditional medicine of Ojibwe people, in order to provide options in the pharmaceutical resistance crisis.

Questions:What impact does shelf time have on the antibacterial properties of *Nuphar advena*?, How does *Nuphar advena* rhizome interact with Chloride, Nitrate and Phosphate anions?, What effect does dried and powdered *Nuphar advena* rhizome have on gram negative stain bacteria *Proteus mirabilis*?

Hypothesis: If antibacterial properties of *Nuphar advena* rhizome harvested in 2019 and 2022 are compared using the disk diffusion method, then rhizome from 2022 will have a larger zone of inhibition., If a solution of powdered Nuphar advena rhizome and Chloride, Nitrate and Phosphate anions is made with deionized water, then there will be no anion adsorption into *Nuphar advena*. If different dilutions of *Nuphar advena* rhizomes are applied to *Proteus mirabilis* using the disk diffusion method, then the rhizome dilutions will have a measurable zone of inhibition.



Introduction

- Chlorhexidine is an enviro-hazard and should be disposed in a hazardous waste facility (3M, 2017).

Method

- Ojibwe use yellow water lily as antiseptic (Meeker et al., 1952, 140)
- Increased pharmaceutical options aids healthcare options, providing options in the ongoing pharmaceutical resistance crisis
- Ojibwe used Nuphar advena as an antiseptic for time immemorial (Meeker, 1952)
- Taxonomic revealed that *Nuphar advena* was a sole species and had no previous research
- Harvest Method
  - Culturally, collected by women
  - Bare feet loosened sediment and toes snapped roots
- Disk diffusion in-lab research
  - Staphylococcus epidermidis culture showed that *N. advena* had notable zones of inhibition in a previous year
  - Micrococcus luteus broth
- Ion Chromatography anion adsorption test
  - Stock solutions of Chloride, Nitrate and Phosphate anions
  -About 0.1 gram of rhizome to each solution (0, 10, 50, 100, 400 mg/L)

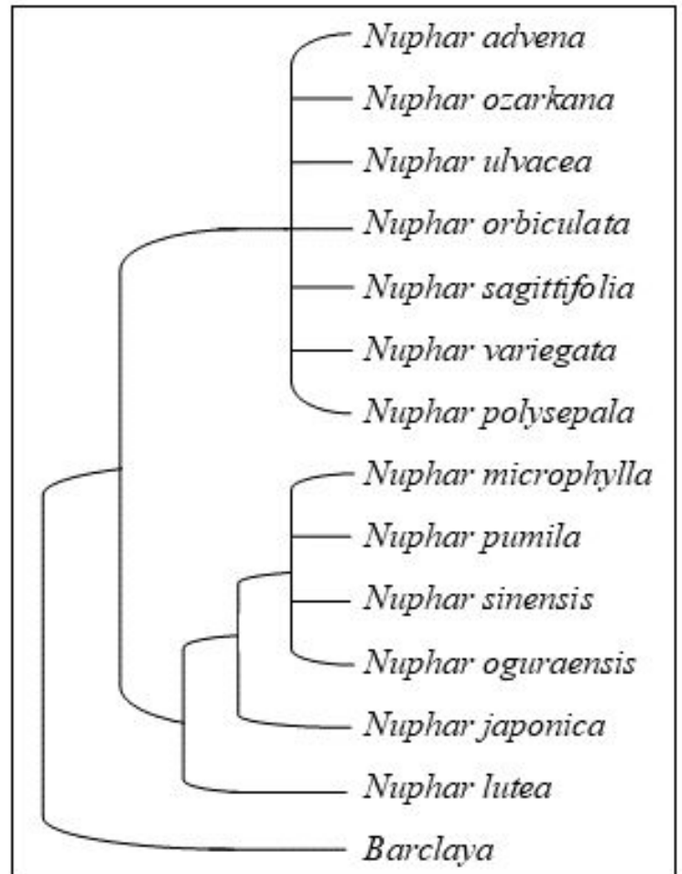
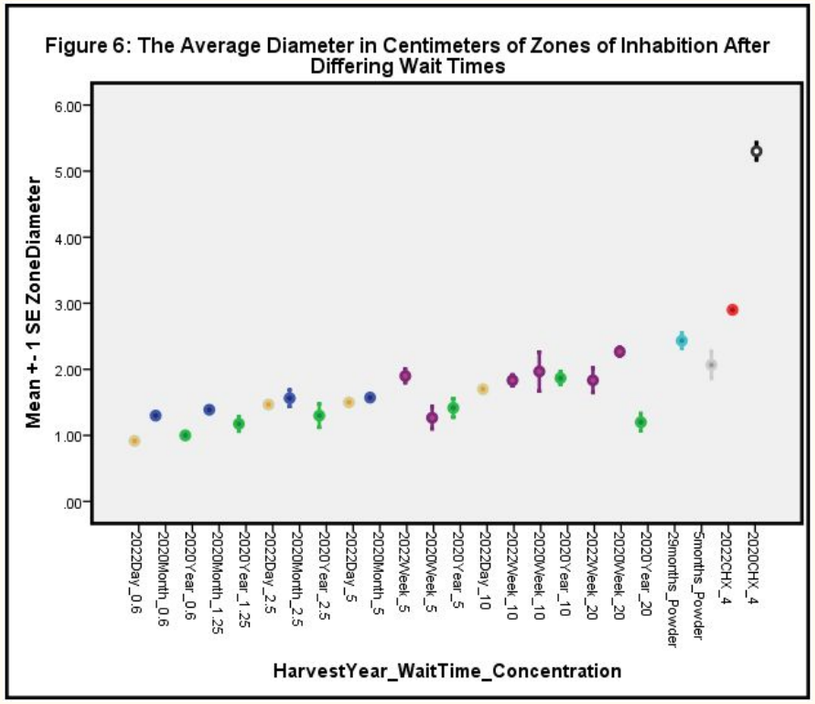
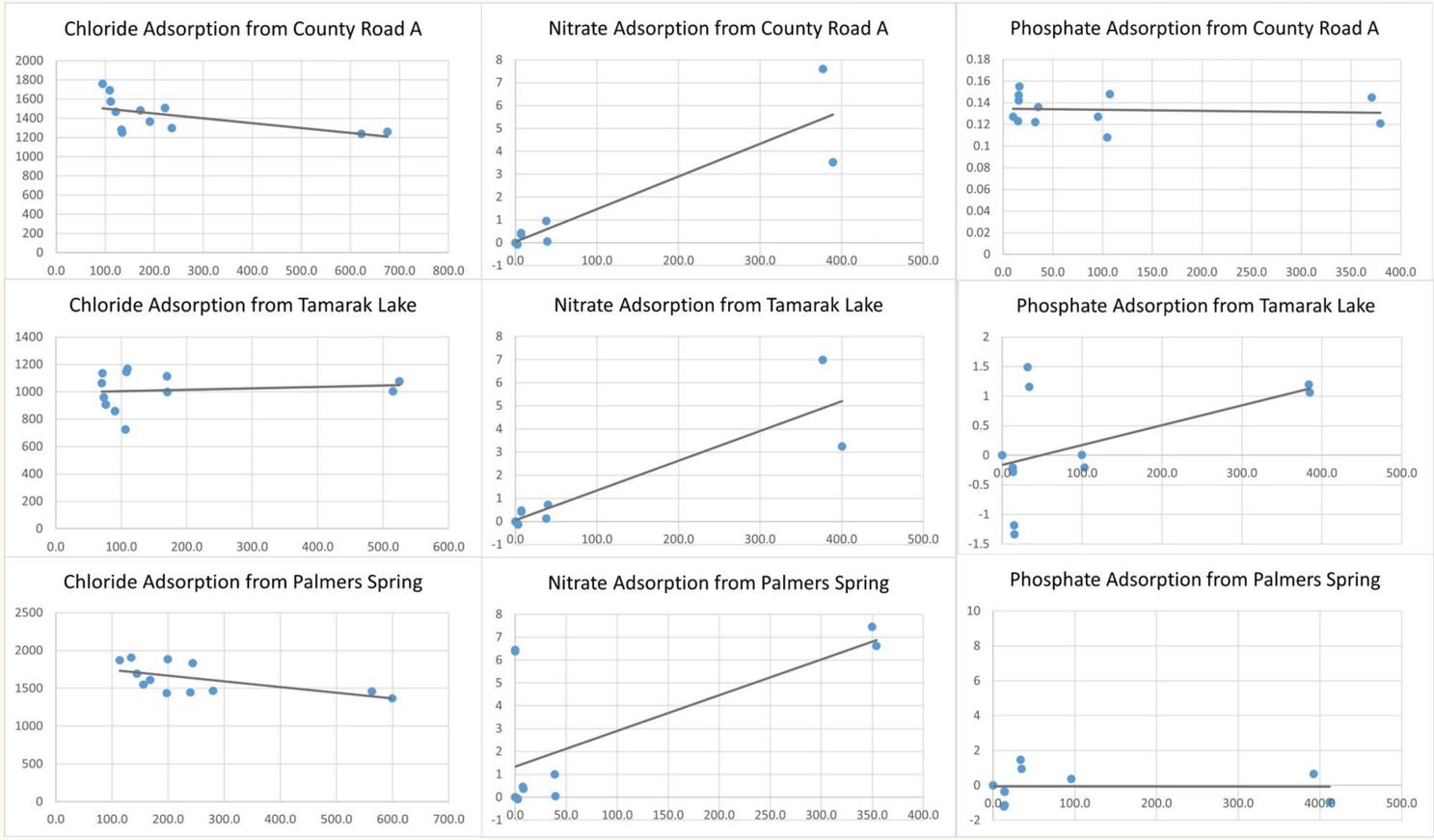


Figure 3. (Padgett, 2007). Morphology tree showing separation of Old and New World plants within the genus

Results

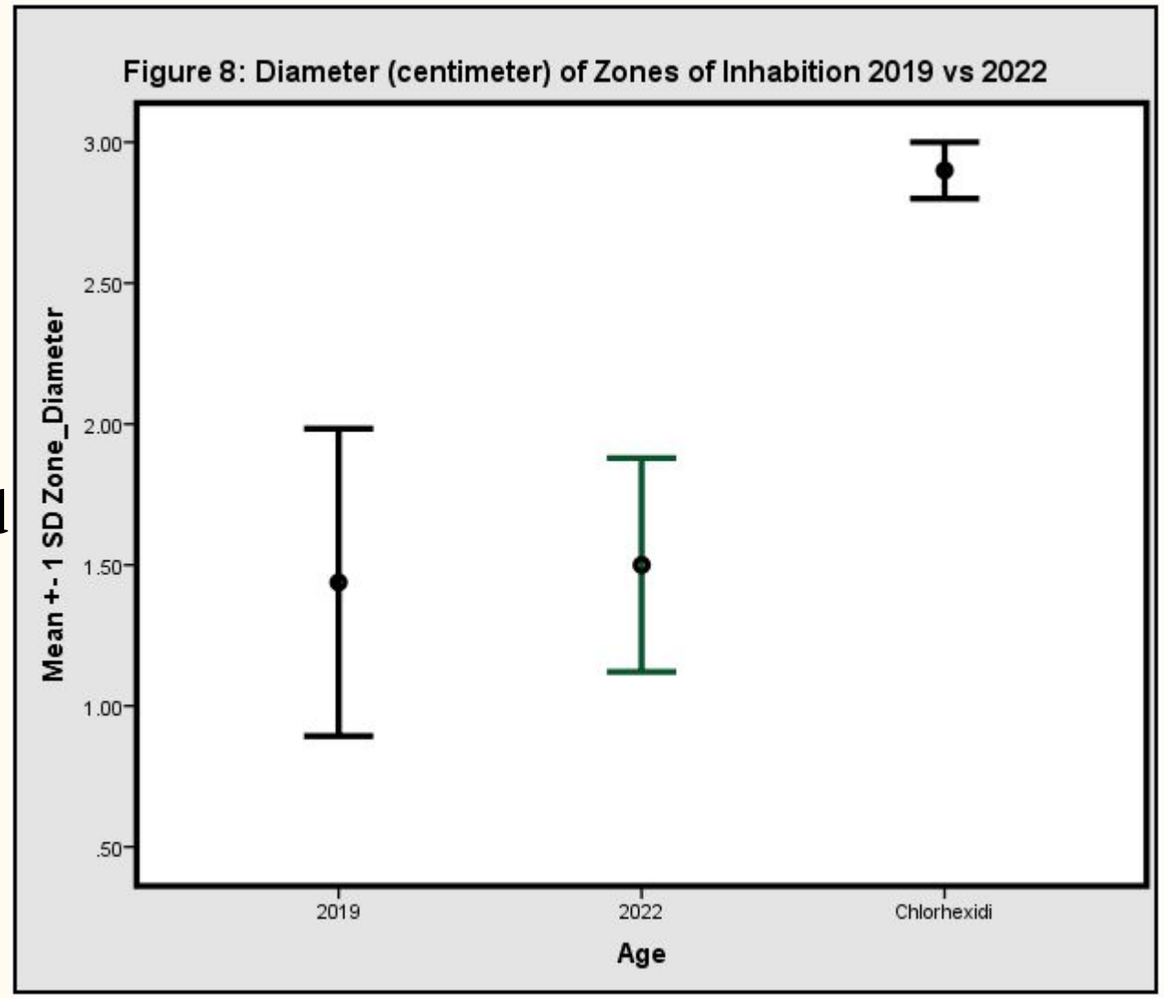
- Provides scientific research into traditional Ojibwe teachings about Nuphar advena's antibacterial properties.
- Mean zones of inhibition show that concentrations were least affective after a year. Rhizomes prepared from dried and powdered form were most affective in the 2019 sample.
- There were small interaction with Nitrates and Phosphates at high level solutions
- Rhizome concentrations had no impact on Proteus mirabilis using the disk diffusion method.





Conclusion/Discussion

- H1: partially supported. Year old mixtures were least effective p<.0001.
  - Some 2019 mixtures were most effective when compared with powdered rhizome from 2019 and 2022 with one week wait time. This
- H2: disproved. In all samples there was some interaction with Chloride, Nitrate and Phosphate anions
  - High levels of chloride already present in the rhizome, could relate to the antibacterial properties (Berand, 2011).
- Rhizomes of *Nuphar advena* can be used effectively against *Micrococcus luteus* and Staphylococcus epidermidis. However, *Nuphar advena* was not effective when tested against *Proteus mirabilis*.
  -*Proteus mirabilis* is a bacterial typically found in the human urinary tract and in fecal decomposition processes
  - Supported traditional teachings of Ojibwe people



Additional Taxonomy

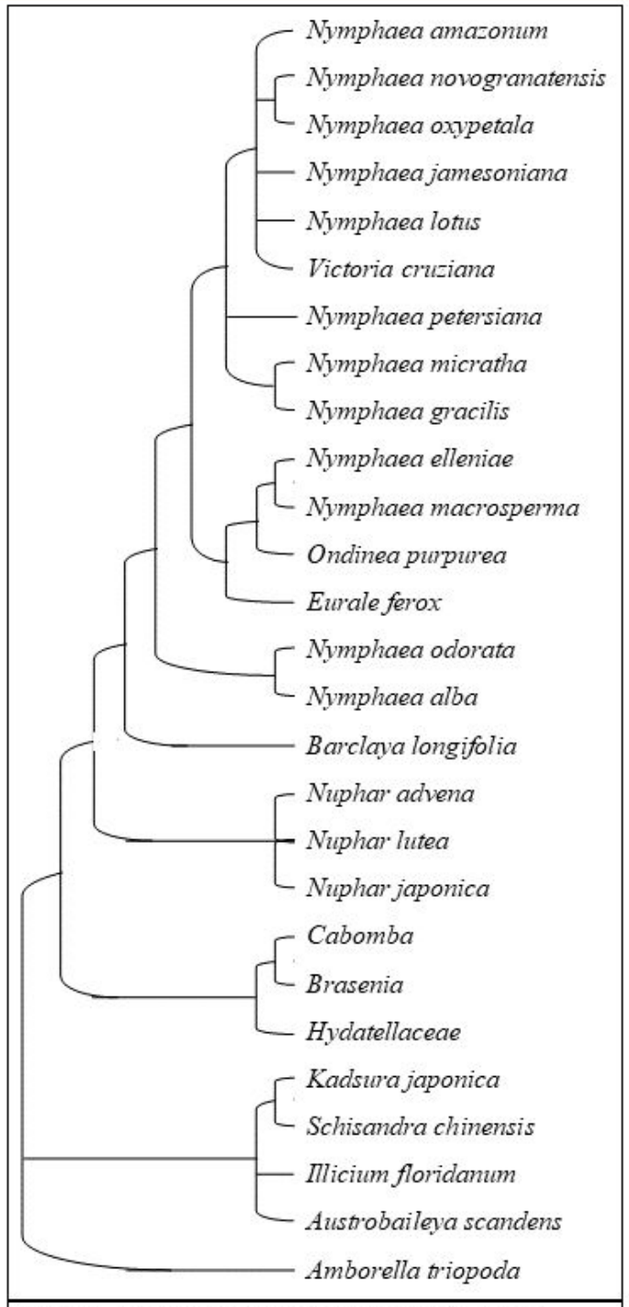


Figure 1. (Borsch, 2008). Classification based on morphology. New and Old World species are merged.

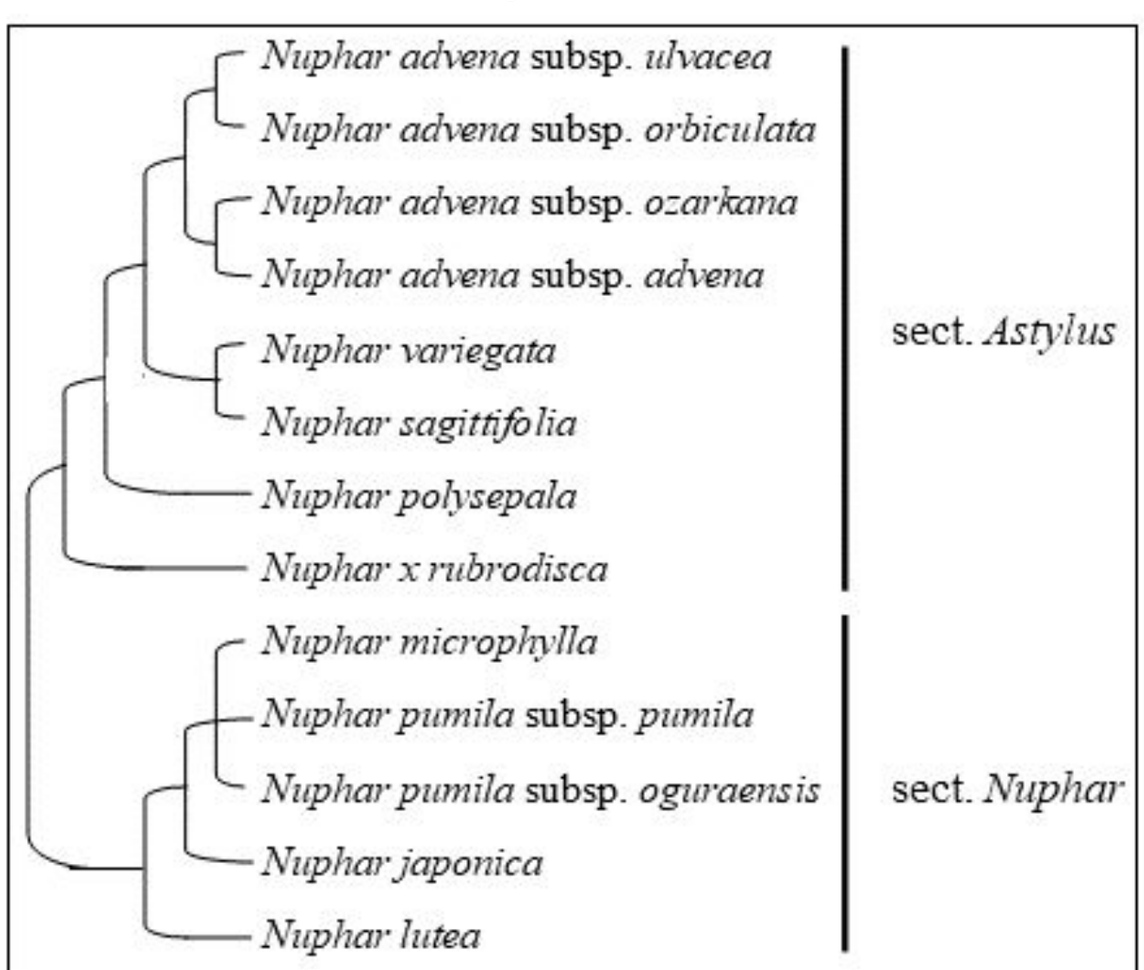


Figure 2. (Padgett, 2007). Phylogenetic tree that depicts species separation of Old and New World plants within the genus after completion of DNA testing and analysis.

Morphology trees display the relationship of the *Nuphar* genus throughout time.