Comparative Sensitivity of *Daphnia* spp. to Cyanobacteria

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INTRODUCTION

Management of freshwater aquatic ecosystems is one of the biggest challenges for the 21st century

The water quality degradation is mainly due to the proliferation of Cyanobacteria

Cyanobacteria are prokaryotes, blue-green color, able to perform oxygenic photosynthesis;

They promote the oxygen depletion, toxin production, alteration of the food web

Zooplanktonic organisms are the main target – primary consumer – affected by these blooms

AIM

How *Daphnia* spp. respond when using *Aphanizomenon flos-aquae* or *Microcystis aeruginosa* as a food source?

H0 - No significant effects are observed.

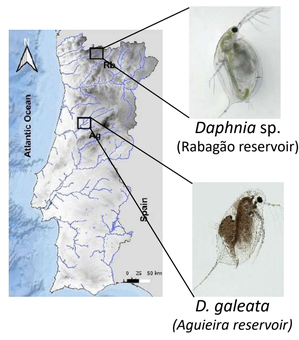
H1 - *Daphnia* spp. showed significant effects.

H2 - *Daphnia* spp. from different locations exhibited different effects to Cyanobacteria.

METHODOLOGY

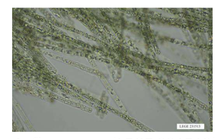
Organisms

- 3 different *Daphnia* species
- 2 Cyanobacteria from Aguieira reservoir:
  - *Aphanizomenum flos-aquae* (LEGE 231513)
  - *Microcystis aeruginosa* (LEGE 231512)

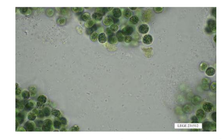




D. magna
(model species)



A. flos-aquae (LEGE 231513)



M. aeruginosa (LEGE 231512)

Daphnia feeding rate assays (24 h)

(McWilliam and Baird, 2002)

• T1 - 7.5×10⁴ cells/mL	**Medium risk**
• T2 - 1.5×10⁵ cells/mL	**High risk**
• T3 - 3.0×10⁵ cells/mL	
• T4 - 1.2×10⁶ cells/mL	**Very high risk**



Public health risk (World Health Organization, 2023)

Analysis

Feeding rate

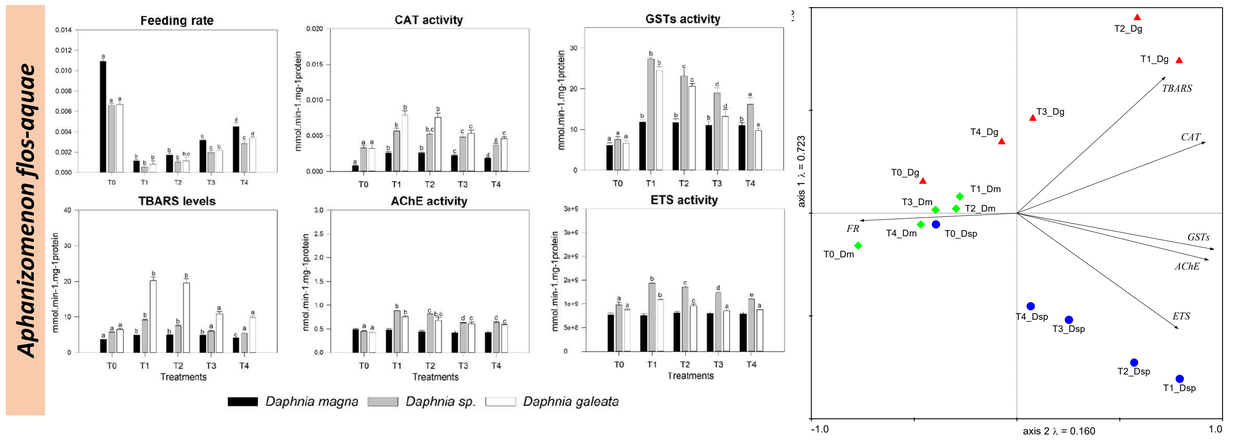
$$FR = \frac{\left(\frac{V \times (Abs0 - Abs24}{t}\right)}{n}$$

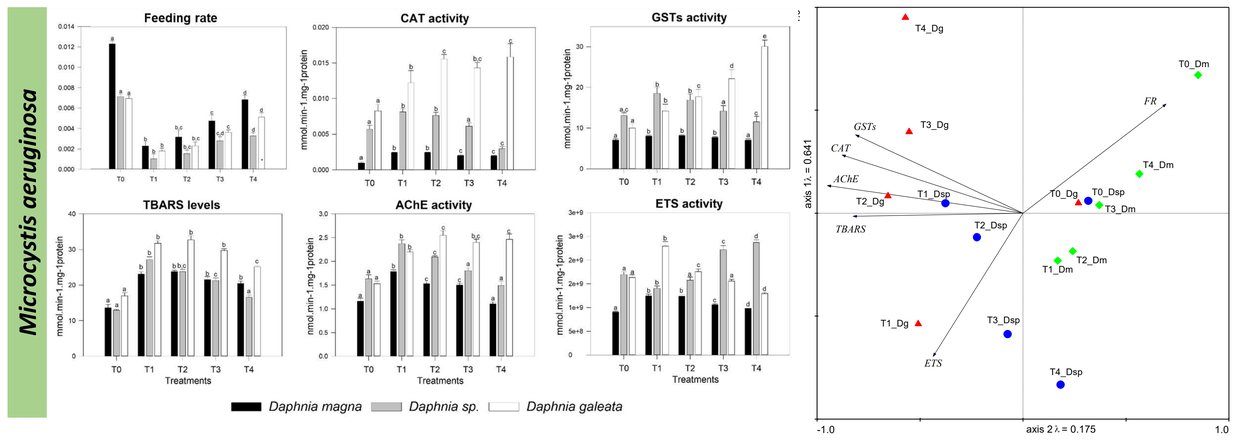
V is the volume, t is the exposure time, and n is the organism number

Biomarkers:

- Oxidative stress (CAT and GSTs activity, and TBARS levels)
- Neurotransmission (AChE activity)
- Energy reserves (ETS activity)

RESULTS





As *A. flos-aquae* concentration increases, the responses of *Daphnia* spp. improves, but remains lower than the control

No significant differences between the two field species

Feeding rate

- Validation of assay at T0 – Control group
- Significant feeding inhibition in all treatments
- Increasing trend over the treatments

Significant differences between the two field species in T4 treatment

Daphnia sp. and *D. galeata* show the **same trend with different responses**

Biomarkers

- *D. magna* affected regardless the *A. flos-aquae* concentration (CAT, GSTs, and TBARS)
- *D. magna* affected depending on the *M. aeruginosa* concentration (All biomarkers)
- *Daphnia* from field affected depending on the Cyanobacteria concentration (All biomarkers)

Daphnia sp. and *D. galeata* show **different trend with different responses**

As *M. aeruginosa* concentration increases the response of *D. magna* and *Daphnia* sp. improves, but remains lower than the control;

D. galeata response does not show an improvement

FINAL CONSIDERATIONS

The responses and effects in *Daphnia* were differently modulated depending on the cyanobacterium

	A. flos-aquae	*M. aeruginosa*
H1 - *Daphnia* spp. showed significant effects.	YES	YES
H2 - *Daphnia* spp. from different locations exhibited different effects to Cyanobacteria.	INCONCLUSIVE	YES

- *Daphnia* responses tend to improve with increasing cyanobacterial concentrations up to a point, but at higher levels (e.g., 1.2 × 10⁶ cells/mL), the risk becomes critical, raising serious ecological concerns
- Variations in species origin and exposure history appear to influence sensitivity, especially in response to *Microcystis aeruginosa*

To enhance our understanding of cyanobacterial impacts, future research should incorporate extended exposure durations, detailed life-history traits, and multiple *Daphnia* species from diverse geographic origins.

REFERENCES

- McWilliam, R. A., & Baird, D. J. (2002). Postexposure feeding depression: A new toxicity endpoint for use in laboratory studies with Daphnia magna. Environmental Toxicology and Chemistry. https://doi.org/10.1002/etc.5620210612
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