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Can phytoplankton blooming be harmful to benthic organisms? The toxic influence of *Anabaena* sp. and *Chlorella* sp. on *Chironomus riparius* larvae

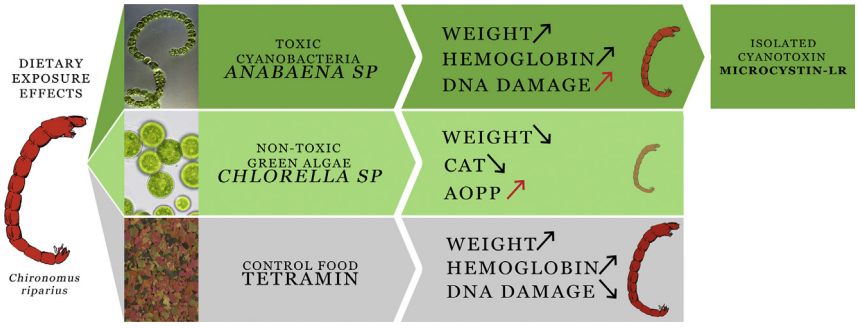
Nikola Stanković [a,*], Ivana Kostić [b], Boris Jovanović [c], Dimitrija Savić-Zdravković [a], Sanja Matić [d], Jelena Bašić [f], Tatjana Cvetković [f], Jelica Simeunović [e], Djuradj Milošević [a]

[a] Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia
[b] Department of Chemistry, Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia
[c] Department of Natural Resource Ecology and Management, Iowa State University, Ames, IA, USA
[d] Department of Sciences, Institute for Information Technologies, University of Kragujevac, Jovana Cvijića bb, 34000 Kragujevac, Serbia
[e] Department of Biology and Ecology, Faculty of Science, University of Novi Sad, Dr Zorana Đinđića 1, 21000 Novi Sad, Serbia
[f] Department of Biochemistry, Faculty of Medicine, University of Niš, Blvd. Dr Zorana Djindjica 81, 18000 Niš, Serbia

HIGHLIGHTS

- Phytoplankton is available food for benthic macroinvertebrate in aquatic ecosystems
- We assessed the influence of phytoplankton on *Chironomus* larvae using toxicity tests
- *Anabaena* sp. caused oxidative stress and moderate DNA damage on *Chironomus* larvae
- Enzyme biomarkers revealed that *Chlorella* sp. caused oxidative stress to *Chironomus* larvae

GRAPHICAL ABSTRACT



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ABSTRACT

Cyanobacteria and microalgae are abundant biota groups in eutrophic freshwater ecosystems, serving as a food source for many aquatic organisms, including the larvae of non-biting midges (Chironomidae). Many species of cyanobacteria are toxin producers, which can act as stressors to other organisms. The present study aimed to analyze and compare the effects of dietary exposure to the common toxic cyanobacteria *Anabaena* sp. and non-toxic microalgae *Chlorella* sp. in *Chironomus riparius* larvae. Microcystin was detected and quantified in the methanolic extract of *Anabaena* sp. using the HPLC-DAD technique, and it was identified as microcystin-LR. Both *Anabaena* sp. and *Chlorella* sp. were suitable food sources to enable the survival of *C. riparius* larvae in laboratory conditions, causing negligible mortality and significant differences in the larval mass (ANOVA and Post hoc LSD test; $p < 0.05$) and hemoglobin concentration (Student's *t*-test; $p < 0.05$). Oxidative stress parameters such as advanced oxidation protein products (AOPP), thiobarbituric acid reactive substances (TBARS), catalase (CAT) and superoxide dismutase (SOD) activity, and DNA damage, were also investigated. One-way ANOVA, followed by the Post hoc LSD test, showed a significant increase in AOPP and CAT for the group of larvae fed with *Chlorella* sp. The same test showed moderate DNA damage in both groups of larvae, with greater damage in the group fed with *Anabaena* sp. Thus, *Chlorella* sp. and microcystin-LR producing *Anabaena* sp. are food sources that did not result in any drastic acute effect on the population level of *C. riparius* larvae. However, sub-individual-level

* Corresponding author at: Višegradska 33, 18000 Niš, Serbia.
E-mail address: nikola.stankovic@pmf.edu.rs (N. Stanković).

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