Title: Effects of hydrogen peroxide (H_2O_2) on the growth of different bloom-forming cyanobacteria

Overview

Water bloom refers to a disastrous ecological phenomenon consisting of algae or zooplankton in freshwater, or explosive growth and high concentrations of bacteria, causing discoloration of water bodies (Zhou, 2020). Among the various kinds of blooms, cyanobacteria bloom has the widest range, causes the most harm, and represents the greatest danger to human health. Hydrogen peroxide (H_2O_2) is an environmentally friendly algaecide with good prospects for cyanobacterial bloom control (Jiang 2022). In this study, we aimed to evaluate the effects of hydrogen peroxide (H_2O_2) on three different bloom forming toxic cyanobacteria namely *Microcystis sp., Planktothrix sp.,* and *Fischerella sp.,* which live in three different water depth in the environment. All the cyanobacteria cultured at 25 °C under a 12:12 h light:dark cycle with a light intensity of 30 µmol m^{-2} s^{-1} photosynthetically active radiation (Yang et al., 2018). The herbicide PAK 27, a source of hydrogen peroxide, used at environmentally relevant concentrations ranging from low 2 mg/L to high 6 and 10 mg/L, based on previous studies demonstrating selective suppression of cyanobacteria (Akther & Cutright, 2024). We measured the chlorophyl-a and phycocyanin concentration as a growth parameter daily for seven (07) days by CyanoFluor meter (Turner Design, San Jose, CA, USA).

To visualize treatment effects, chlorophyl-a and phycocyanin concentration data analyzed and plotted in R Studio using the tidyverse, readxl, dplyr, and ggplot2 packages. The dataset imported from an Excel file using the read_excel() function. A multi-panel graph then created using ggplot(), where cyanobacterial growth over time illustrated with points and lines (geom_point(), geom_line()), and error bars (geom_errorbar()) will indicate standard deviations (Ito and Merphy, 2013). The facet_grid() function used to generate separate panels for each pigment–phytoplankton combination, enabling clear comparisons across treatment groups (Mirman, 2017). In addition, growth rates were calculated to perform ANOVA and assess the significance of differences among treatments (Faraway, 2002).

In this experiment we found that hydrogen peroxide treatment significantly suppressed chlorophyll-a and phycocyanin pigment production in *Microcystis LE21* and *Planktothrix 1808* in a dose-dependent manner, with higher concentrations (6 and 10 ppm) showing the strongest inhibitory effects. In contrast, *Fischerella 1.5* displayed minimal sensitivity across treatments, maintaining consistent or slightly increased pigment levels. These results suggest differential tolerance to oxidative stress among cyanobacterial species. ANOVA results indicated a statistically significant effect of hydrogen peroxide treatment on pigment production in *Microcystis LE21* and *Planktothrix 1808* ($p < 0.05$), while no significant differences were observed among treatments in *Fischerella 1.5* ($p > 0.05$).

References

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