Use of photoautotrophic microorganisms in bioremediation of surface waters

Mušálková, Petra
2023

Use of photoautotrophic microorganisms in bioremediation of surface waters

Student: Mgr. Petra Mušálková
Supervisor: Ing. Irena Brányiková, Ph.D.

Eutrophication, an excess of nutrients (especially phosphorus) in water, has negative consequences, including massive harmful algal blooms, oxygen deficiency and toxin production, which can lead to the total collapse of water ecosystems. Although there are several procedures for dealing with eutrophication, they are expensive, have limited efficiency and/or involve the introduction of chemicals. Thus, we have been investigating phosphorus uptake by the cyanobacteria *Tolypothrix tenuis* as a potential agent for bioremediation. At the same time, we are developing a floating photobioreactor which would be placed on the eutrophic water body surface, and which will enable an exchange of water between its inner volume and the bulk water. In this bioreactor, intently cultivated harmless cyanobacteria will uptake the available nutrients, making them unavailable for the harmful species of algae. Afterwards, the obtained biomass will be harvested and used as a fertilizer in ecological agriculture.

Extensive experimental work has been executed to examine suitability of the proposed approach. Firstly, a study of *T. tenuis* growth and phosphorus uptake under the following conditions was conducted; *T. tenuis* was grown in standard BG media differing in initial biomass concentration (0.3, 0.8, 1.7 g/L), pre-inoculation conditions (0 mg/L of phosphorus for 0, 3, 6, 9 days), temperature (11, 15, 20, 25 °C), light intensity (60, 15, 250, 350 $\mu E \cdot m^{-2} \cdot s^{-1}$) and light regime (12:12h DLC). Secondly, we tested the suitability of floating bioreactor models for this bioremediation method. Throughout the experiments, phosphorus concentration in the media was measured spectrophotometrically; to confirm the amount of phosphorus uptake, the intracellular phosphorus concentration was analyzed by ICP-OES spectrophotometry. It was found out that *T. tenuis* was able to efficiently reduce the phosphorus concentration in the cultivation media, even to 0.02 mg/L which is considered a threshold for eutrophy. The reduction rate was proportional to the *T. tenuis* biomass concentration. The phosphorus-starved cultures had lower amounts of intracellular phosphorus, leading to a higher phosphorus uptake rate. Regarding temperature, lower temperatures slowed phosphorus uptake and biomass growth, but increased intracellular phosphorus concentration. Increased light intensity positively affected the phosphorus uptake and biomass growth, and finally day/night mode did not affect the phosphorus uptake rate. Overall, our results suggest that *T. tenuis* is a suitable organism for the water bioremediation.