Use of photoautotrophic microorganisms in bioremediation of surface waters

Mušálková, Petra
2022

Use of photoautotrophic microorganisms in bioremediation of surface waters

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

Water eutrophication is one of the current problems of water ecosystems (including waterbodies used for recreation and as potable water sources). Since the 1980s there is an increase of eutrophication due to human activity, pollution and increaseds usage of fertilization in agriculture. Nutrients such as different forms of nitrogen and phosphorus, enter the water environment in great amount, affecting the whole ecosystem. These excessive pools of nutrients are favorable for massive seasonal harmful cyanobacterial blooms. The negative consequences of which are production of toxins and depletion of oxygen, which is dangerous for human health and could eventually lead up to a total collapse of the ecosystem. Although there are several procedures on how to deal with water blooms, or to prevent them, these procedures are expensive, have limited efficiency, or they introduce chemicals in the ecosystem (i.e. dredging lake beds, coagulation, sonication, mixing, use of herbicide or metals, aeration etc.). The aim of my thesis is to develop an alternative method of removing this overplus of nutrients from surface waterbodies in a biological way, with the use of microalgae and cyanobacteria. The first main task is a construction of a floating open reactor, which would be placed on the eutrophic water surface, the design of the reactor will enable exchange of water between its inner volume and the bulk water. In this bioreactor, nontoxic, strictly filamentous cyanobacteria will be cultivated in order to uptake the available nutrients into biomass, making them unavailable for the harmful species. Afterwards, the obtained biomass will be harvested and used as a fertilizer in ecological agriculture. The second task is to get understand the mechanisms of nutrient, especially phosphorus, uptake in the selected appropriate species and make use of them in designing the method of surface water bioremediation.

My first experiments were carried out with the filamentous cyanobacteria *Tolypothrix tenuis*. During the batch cultivation experiments carried with suspended biomass, the time course of concentration of phosphorus in the cultivation medium, the concentration of the intracellular phosphorus and biomass production, were determined.

Preliminary results confirmed that *Tolypothrix tenuis* is capable of reducing of the phosphorus in a medium efficiently down to 0.02 mg/L which is generally considered as preventing harmful algal blooms. Additionally, the rate of the reduction was proportional to the concentration of *T. tenuis* biomass. To further increase the rate of nutrients removal, phosphorus starved cultures were prepared by cultivating *Tolypothrix tenuis* in a medium without phosphates for different time period. These cultures had lower content of intracellular phosphorus leading to a higher rate of phosphorus uptake from the medium. In the near future, the same experiments will be carried out in the prototypes of the floating bioreactors.