# THE ROLE OF DISSOLVED ORGANIC MATTER RELEASED BY PHYTOPLANKTON IN THE HYPEREUTROPHIC RESERVOIR OF BARRA BONITA (SP, BRAZIL)

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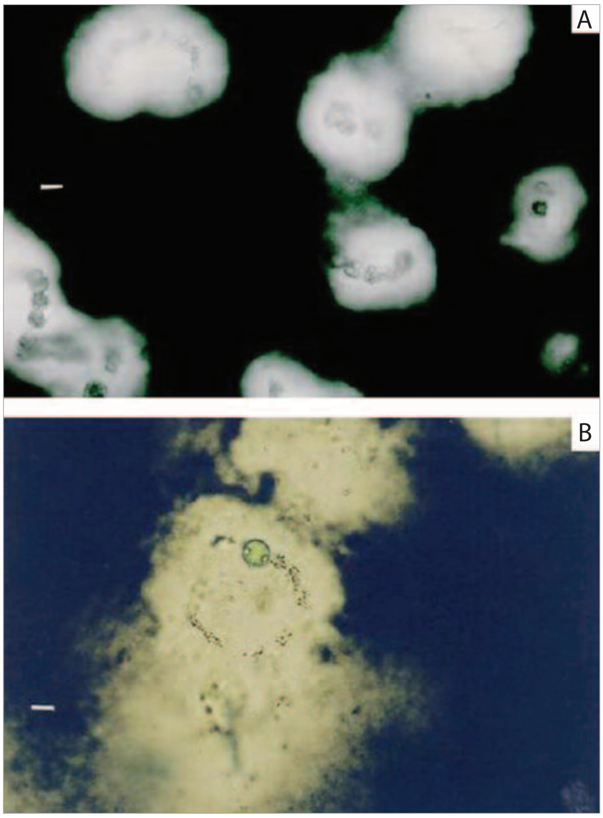
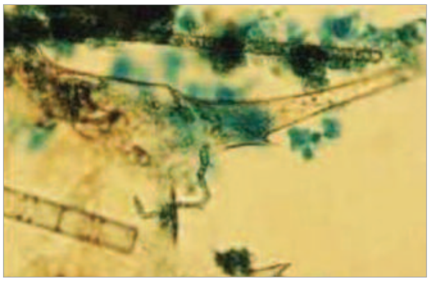


*Details of biotic production of TEP by* Anabaena spiroides. *(a) In the senescent growth phase, the cells burst inside the capsules, which are transformed into TEP. (b) Detail of cell remains, including a heterocyst within the former capsule. Scale bars: (a) 50 µm and (b) 10 µm. The formation of TEP potentiates the transport of intracellular toxins into the food web,* via *TEP filtering by the zooplankton*

There are approximately 30,000 artificial water reservoirs in the world, holding around 10,800 km$^3$ of water. Unfortunately, the eutrophization of the water arising from human activity leads to recurring episodes of excessive proliferation of microalgae and cyanobacteria, affecting the use of local water and placing the health of the population at risk. This is the situation at Barra Bonita Reservoir, created at the confluence of Tietê and Piracicaba Rivers, which covers an area of 384 km$^2$. Blooms of toxic cyanobacteria such as *Anabaena spiroides* and *Microcytis spp.*, besides eukaryotes such as the diatom *Aulacoseira spp.*, are common around the years, being recently becoming heavier. These organisms produce an enormous biomass which, after death and decomposition, cause appreciable changes, for the worse, in the water quality. Even so, much of the biomass generated by photosynthesis is released directly, by active or passive excretion, into the pool of dissolved organic matter (DOM) in the body of water, without cell death intervention. The general aim of the present project is to determine how this excreted part of the DOM interacts with physical and biological environments. The specific objectives of the project are to investigate the roles of organic compounds as substrates for heterotrophic bacteria and zooplankton. The organic compounds would act as complexing agents for heavy metals producing heavy particles aggregates and transparent exopolymer particles (TEP) out of colloidal polysaccharides, which can carry adsorbed toxins into the food chain via filter-feeding zooplankton. The project will also analyze the action of the specific bacteria/cyanobacteria associations in raising or lowering the compounds concentrations involved in allelopathic interactions. Finally, it is also under investigation, the effect of UV-B radiation on the DOM released bioavailability, by *Microcystis aeruginosa* cells.

## SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

Most of the DOM released by the phytoplankton consists of extracellular polysaccharides (EPS). Around 11,500 tons of carbon is produced in this form annually in the Barra Bonita reservoir. About 7% of the EPS are readily broken down by heterotrophic bacteria and the activity of various glycosidases can be quantified in the water column. Non-glycosidic organic compounds are also utilized by bacteria. At the surface, natural UV-B irradiation on such compounds leads to variation in their bioavailability and even selection among bacterial species. The EPS released by *Anabaena spiroides* supports the entire life-cycle of the cladoceran *Ceriodaphnia cornuta* when used as the unique substrate. In the form of mucilaginous capsules, these substances act as a protective buffer against high concentrations of toxic metals. For example, the chlorophycean *Kirchneriella aperta* is protected from copper by this way. These capsules also behave as a selective barrier, regulating the transport of molecules into the cell, as we confirmed in electron paramagnetic resonance experiments. The capsules of several phytoplankton species allow associations with species of bacteria immersed in the mucilage, which succeed one another as cell aging. After the death of a cell-forming-capsule, the empty capsule can become a TEP (quantified by a technique developed by this project), enabling the transport of trapped toxins into the food chain. In the case of the diatom *Thalassiosira duostra*, we have discovered that selective bacterial degradation can alter the hydrophobicity of the EPS by increasing their fraction of methylated monosaccharide units, such as rhamnose and fucose, making them stickier and thus promoting cell aggregation. The diatom *Aulacoseira granulata* has a sticky film of EPS coating the cells: when chain-to-chain collisions are provoked by shear rates, in the environment, the cells clump together, forming aggregates heavy enough to allow them to sink or to avoid being washed away. Thus, a part of the population is retained for seeding by easy resuspension due to the turbulence. A sensor array with nanostructured conducting polymers, for the identification and quantification of cyanotoxins in the reservoir waters, is under development.



*Natural gelatinous aggregate formed by EPS and other colloidal polysaccharides. Two filaments of the diatom* Aulacoseira granulata *can be seen, as well as filaments of the cyanobacterium* Planktothrix *sp. and zooplankton fragments. The films of hydrophobic EPS covering the diatom cells promote aggregation, resulting with this species being present in more than 90% of aggregates found in the reservoir*

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