Faculty of Science - Papers (Archive)
Faculty of Science, Medicine and Health

2007

The importance of slime: does living in a community matrix save algal cells from the toxic effects of copper?

Jacqueline Levy
University of Wollongong, jl53@uow.edu.au

Dianne F. Jolley
University of Wollongong, djolley@uow.edu.au

Jenny L. Stauber
Csiro, jenny.stauber@csiro.au

Recommended Citation
Levy, Jacqueline; Jolley, Dianne F.; and Stauber, Jenny L.: The importance of slime: does living in a community matrix save algal cells from the toxic effects of copper? 2007, 11-11.
https://ro.uow.edu.au/scipapers/4723

The importance of slime: does living in a community matrix save algal cells from the toxic effects of copper?

Abstract

Microscopic algae are often used to assess the toxic effects of chemicals to the environment. They are good indicators of ecosystem health because they form the basis of the aquatic food chain and many algal species are sensitive to metals, like copper, at concentrations which occur naturally in the environment. Most toxicity tests with algae use planktonic species, that is, alga that live in the water as free-living species. To date, little research has been done on the toxicity of metals to attached algal species living in a community matrix known as biofilms, because of the difficulties in quantifying changes in such a complex community.

Keywords

save, algal, cells, importance, toxic, slime, effects, copper, does, living, community, matrix, CMMB

Disciplines

Life Sciences | Physical Sciences and Mathematics | Social and Behavioral Sciences

Publication Details

Levy, J., Jolley, D. F. & Stauber, J. L. (2007). The importance of slime: does living in a community matrix save algal cells from the toxic effects of copper?. Rhizome, 1 11-11.

The importance of slime: Does living in a community matrix save algal cells from the toxic effects of copper?

Ms Jacqueline Levy
PhD student
Collaboration with the Department of Chemistry UoW (Dr Dianne Jolley) and CSIRO Land and Water, ANSTO (Dr Jenny Stauber)

Microscopic algae are often used to assess the toxic effects of chemicals to the environment. They are good indicators of ecosystem health because they form the basis of the aquatic food chain and many algal species are sensitive to metals, like copper, at concentrations which occur naturally in the environment.[1] Most toxicity tests with algae use planktonic species, that is, alga that live in the water as free-living species. To date, little research has been done on the toxicity of metals to attached algal species living in a community matrix known as biofilms, because of the difficulties in quantifying changes in such a complex community.

Biofilms are an important part of aquatic ecosystems. Biofilms are wide ranging in nature and are a community consisting of live and dead bacterial, fungal and, where light is available, algal cells; for example, the 'slime' on rocks in rivers. These cells live in a slime matrix of extracellular organic material that consists mostly of sugars, which can be excreted by the cells in the biofilm or can be deposited from external sources (Figure 1). The high concentration of cells and organic material could help shield the algae from the toxic effects of metals such as copper.[2]

The water quality guideline for copper in marine water is 1.4 µg Cu/L.[3] In the current investigation, eleven species of planktonic marine microalgae were screened for their response to copper. There was a toxic effect on growth for over half of these species at concentrations less than the stated guideline. Whilst it appears that the guideline is not protective enough, it must be considered that most algae do not live in isolation, but in communities, which could affect toxicity.[1,2] Further research considered the toxicity of copper to simple algal-bacterial communities sourced from laboratory cultures. Contrary to expectation, in three of the four different species tested the presence of the bacteria made no significant difference to the sensitivity of the algal species to copper, despite an increased surface area capable of binding metals to inactive sites, which would be predicted to reduce the concentration of copper in solution. However, for a species of *Chlorella* (a tropical freshwater alga), toxicity was reduced when bacteria were present. The next step in this research will focus on the response of laboratory cultured algae to copper when in the presence of natural marine biofilms collected from the field.

Figure 1. (A) A sampling device retrieved from the Woronora River with 10 glass microscope slides covered in biofilms. (B) An image of a biofilm collected from Bass Point. (Insert an overlay image of all the features with magnification and scale bar). The image was taken using a confocal laser scanning microscope, where fluorescence of different groups is detected and displayed as a colour in the image. The green colour is the autofluorescence of chlorophyll a in the algal fraction, the orange-blue colour is the fluorescence of bacteria stained by a DNA dye (SYTO-9, Molecular Probes) while the red indicates extracellular organic substances, e.g. sugars, dyed using Concanavalin-A (Sigma).

---

[1] Jennifer Stauber and Marc Davies, 'Use and limitations of microbial bioassays for assessing copper bio-availability in the aquatic environment', *Environmental Reviews*, 8, 2000, 413-47.

[2] Sergei Sabater, Helena Guasch, Marta Ricart, Anna Romaní, Gemma Vidal, Christina Klünder and Mechthild Schmitt-Jansen, 'Monitoring the effect of chemicals on biological communities. The biofilm as an interface', *Analytical and Bioanalytical Chemistry*, 387, 2007, 1425-34.

[3] Australia and New Zealand Environment and Conservation Council/Agricultural and Resource Management Council of Australia and New Zealand, *Australia and New Zealand guidelines for fresh and marine water quality*, ANZECC/ARMCANZ, Canberra, Australia, 2000.