Response of nonprotein thiols to copper stress and extracellular release of glutathione in the diatom Thalassiosira weissflogii

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ABSTRACT: We studied the dynamic changes of cellular thiols and the extracellular release of glutathione (GSH) during growth of the marine diatom *Thalassiosira weissflogii* under varying levels of copper (Cu) addition in both metalbuffered (with EDTA) and unbuffered (without EDTA) media. The cell quotas of both thiols and pigments decreased with growth time; however, pigment-normalized cellular thiol concentrations at a given Cu exposure level were more or less conservative. In both media, specific growth rates of greater than 1 per day were obtained at total inorganic Cu concentrations of less than 80 nmol L^{-1}; however, at higher Cu levels, cell growth was significantly suppressed. A dose-response relationship was observed between the phytochelatin-2 :GSH ratio and the Cu exposure level during the exponential growth period. GSH was released from the phytoplankton cells at similar concentrations in both media; therefore, the presence of a synthetic metal chelator does not affect thiol release, substantiating the premise that algae respond to inorganic species of Cu. GSH release was closely related to Cu-induced cell membrane damage. The extracellular GSH release rate was higher in normally grown cultures than in growth-limited cultures but lower than in growth-suppressed cultures. The excretion of GSH apparently reflects physiological conditions during algal growth rather than an enzymatic response of the algae to control trace metal speciation in the media. Therefore, the role of GSH in metal complexation in ambient waters is probably an inadvertent by-product of this process, although it could contribute a significant portion of Cu-complexing ligands in open ocean waters.

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