GLUTAMINE SYNTHETASE ACTIVITY IN MARINE PHYTOPLANKTON

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ABSTRACT

A variety of marine phytoplankton, including Pavlova lutheri, Phaeodactylum tricornutum, Amphidinium carterae and Cricosphaera carteri, were grown in batch or continuous culture to determine the presence of glutamine synthetase activity. Glutamine synthetase activity was determined using a new assay technique which assessed rates of ATP hydrolysis. This assay method was found to be as sensitive as the γ-glutamyl hydroxamate transferase assay and at least three times as sensitive as the γ-glutamyl hydroxamate synthetase assay method. Continuous cultures of Pavlova lutheri were grown at a number of different growth rates and input N:P ratios with nitrogen supplied as either NO_3^- or NH_4^+. Extracts of P. lutheri were assayed to determine the correlation between in vitro glutamine synthetase (GS) activity and in vivo nitrogen assimilation rates. GS activity in P. lutheri was approximately twice the rapid uptake rate for a 20 μM ammonium spike at growth rates greater than 0.012 hr^{-1}. At the lower growth rates, the ratio of GS activity to the ammonium spike uptake rate decreased. At the lowest growth rate examined (0.0064 hr^{-1}) Gs activity and the rapid ammonium uptake rate were approximately equal. The characteristics of GS from P. lutheri are similar to those previously published for higher plants, Caulerpa simpliciuscula, and Chlamydomonas rienhardii. Short term increases in GS activity in P. lutheri could be induced by high (20 μM) external ammonium concentrations, but darkness had little effect on extractable glutamine synthetase activity over a 3 hr time period.