PHOSPHORUS UPTAKE KINETICS AND GROWTH OF MARINE OSMOTROPHS

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ABSTRACT

Steady-state phosphate limited growth rate relationships were examined for model marine phytoplankton species *Pavlova lutheri* and *Dunaliella salina* to determine the most appropriate model of nutrient limited growth. The classic Monod hyperbolic function of growth rate as a function of external nutrient concentration was tested against both a null linear model and the more complex Droop internal quota storage model for phosphate limited phytoplankton cultures grown in steady-state chemostats. The Monod model was determined to be the most appropriate model of phytoplankton growth rate, accounting for over 90% of the variance in the growth rate data. Ambient external phosphate concentrations in the chemostats were determined by a novel steady-state bioassay approach using ^{33}P -radiotracers. Phosphate uptake kinetics were determined at both slow and fast steady-state growth rates to determine variability of the kinetics system. Maximum uptake rates of phosphate at high phosphate concentrations were consistently found to be two-to-three orders of magnitude above the steady-state phosphorus requirements for growth for the phytoplankton cultures. A theoretical relationship for the Monod half-saturation constant for growth in terms of the maximum specific growth rate and phosphorus specific uptake affinity is derived and found to be quite consistent with Monod model fits to the observed steady-state growth rate vs. phosphate data. Finally the SAR11 sub-clade IIIa alpha-bacterium strain HIMB114 was grown in both continuous and batch culture and phosphate uptake rates were determined to be insufficient to supply more than 30% of the phosphorus requirements for growth, indicating the cultures were able to fulfill a majority of their phosphorus demands from as yet unknown dissolved organic phosphorus compounds in the natural seawater minimal media in which they were grown. Bacterial production and oxygen respiration measurements were performed and indicate that HIMB114 has a growth efficiency of 13%, similar to natural, open-ocean bacterial communities.