Peptide hydrolysis and the uptake of dipeptides by phytoplankton

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ABSTRACT: Rates of peptide hydrolysis (using the fluorescent substrate, lucifer yellow anhydride-labeled tetra-alanine) and dipeptide uptake (using dually labeled, ^{15}N and ^{13}C, dialanine) were measured in phytoplankton cultures and in natural populations during algal blooms dominated by one or two taxa. During most sampling events, both peptide hydrolysis and dipeptide uptake were greatest in the size fraction containing the dominant phytoplankter, suggesting that phytoplankton contribute substantially to or may even dominate observed extracellular peptide hydrolysis and dipeptide uptake in the environment. These are the first data suggesting that dipeptides may be taken up directly by phytoplankton and this may represent a previously unaccounted-for nitrogen source in aquatic systems. Like many other processes in phytoplankton, peptide hydrolysis appears sensitive to the diel light cycle and the nutrient environment, with rates varying depending on the dominant N source, but with no clear pattern. Uptake of dialanine, the dominant product of the hydrolysis of the peptide tetra-alanine, also varied depending on the dominant taxa and the nutrient regime. Most of the time, it appeared that low production of dialanine by tetra-alanine hydrolysis limited the uptake of the dipeptide. Close coupling between peptide hydrolysis and dipeptide uptake may also help explain the absence of correlations between rates of peptide hydrolysis and the concentration and composition of the free amino acid pool.

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