Responses of elemental and biochemical composition of Chaetoceros muelleri to growth under varying light and nitrate:phosphate supply ratios and their influence on critical N : P

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ABSTRACT: The critical nitrogen-to-phosphorous ratio (N:P) defines the transition between N and P limitation of growth rate and is not a biological constant. To test the effect of environmental conditions on the critical N:P, we cultured the diatom *Chaetoceros muelleri* in chemostats with inflow nitrate : phosphate ratios ranging from 5 to 90 mol N (mol P)$^{-1}$ at two photon flux densities (PFDs; 50 and 700 µmol photons m^{-2} s^{-1}). The nitrate : phosphate ratio marking the transition between N and P limitation increased from between 15-30 mol N:mol P at the high PFD to 45 mol N: mol P at the low PFD. The particulate ratio marking this transition increased from 16-23 mol N:mol P at low PFD to 35 mol N:mol P at high PFD. Cell phosphorus and RNA contents decreased with increasing N:P ratio up to the critical N:P ratio for each PFD, above which they remained stable. In contrast, cell dry weight, chlorophyll a, C, N, and protein were not influenced by nitrate : phosphate in the inflow medium, although they were influenced by PFD. Total protein per RNA increased with increasing N:P ratio at the low light conditions, suggesting increased ratio of protein synthesis per RNA. Our results showed the effect of PFD, growth rate, or both on the critical N:P ratio. Agreement was found in the assessment of the transition between N and P limitation on the basis of nutrient enrichment bioassays, cellular elemental (N and P) quotas, and cell RNA content. Our results are consistent with theoretical predictions of higher N requirements under low light conditions due to the coupling of the photosynthetic mechanism with N uptake. In contrast, P-rich cellular components, such as RNA, were dependent on P availability rather than light.

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