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Indirect effects of ocean acidification: does the effect of elevated pCO_2 on Antarctic phytoplankton influence development of Euphausia superba larvae?

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While ocean acidification may directly stress krill through decreased pH, this study examines whether increased levels of CO_2 in the ocean affect phytoplankton biochemistry and nutritional quality as food for krill. Changes in biochemical composition of phytoplankton species are known to affect such traits as survival, early development, growth rate and fecundity of grazers in higher trophic levels. The Antarctic diatom species Pseudonitzschia subcurvata was grown at four different CO_2 levels (325ppm, 430ppm, 710ppm, 895ppm) for four weeks. Analyses were then performed to determine their lipid, including constituent fatty acids, carbohydrate and protein concentrations, C:N:P ratio, pigment composition, production of dissolved organic C and growth rates. Euphausia superba calyptopis larvae were maintained at ambient pCO_2 and fed phytoplankton grown at the above range of CO_2 concentrations. Krill mortality, growth rates, intermoult periods, lipid, protein and carbohydrate concentrations and CHN composition were then determined over the course of three moult cycles. Phytoplankton growth rate significantly decreased ($p<0.001$), but there was no change in intermoult period. Larval krill fed algae grown at the highest pCO_2 contained significantly increased %C per dry weight ($p<0.03$), which was weakly reflected in and increased C:N ratio ($p=0.065$). In contrast increasing exposure of the algae to CO_2 caused the sulphur content of larvae to fall ($p<0.003$). The observed changes may reflect adjustment by the grazing krill larvae to attempt to maintain a constant ratio of C:N:P in their body tissue. Increased %C and C:N ratio of larvae fed algae grown at the highest pCO_2 may reflect increased lipid storage or a nutritional deficiency of the algae.