



Phytoplankton essential fatty acid and phosphorus content constraints on *Daphnia* somatic growth and reproduction

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ABSTRACT: We performed 12 experiments where the herbivorous zooplankter *Daphnia pulex* was fed three different phytoplankton food types (cyanophytes, chlorophytes, or cryptophytes) at two phosphorus (P) deficiency levels (C : P ~ 400 or 600) and with two different fatty acid (FA) supplements. Phosphatidylcholine liposome amendments were used to manipulate P availability and/or deliver FA in order to simultaneously test the relative importance of phytoplankton P and FA limitation as constraints on *Daphnia* somatic growth rate and reproduction. We used multiple regression analyses to test the data set for six main effects and three interaction terms. The six main effects tested were phytoplankton taxa, FA supplementation, FA type (EPA or FA-mix), direct (P-D) and indirect (P-ID) phosphorus limitation, and P deficiency level. Food quality was most strongly affected by phytoplankton taxa followed by P-ID, FA supplementation, the interaction between phytoplankton taxa and P-ID, and P-D. *Daphnia* fed cryptophytes grew 0.18 day⁻¹ faster and had an additional 2.6 eggs individual⁻¹ than *Daphnia* fed cyanophytes. Indirect P limitation reduced *Daphnia* somatic growth rates by 0.16 day⁻¹ and egg production by 2.6 eggs individual⁻¹. Direct P limitation reduced *Daphnia* growth rates by 0.04 day⁻¹ and egg production by 1.2 eggs individual⁻¹. FA supplementation improved growth by 0.09 day⁻¹ and egg production by 2.2 eggs individual⁻¹. These results suggest that FA supplementation exerted stronger effects on *Daphnia* somatic growth rate and reproduction than did direct P limitation. Furthermore, these results suggest that phytoplankton taxa and indirect P limitation had the greatest effects on *Daphnia* growth and reproduction.

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