A test of the role of polyunsaturated fatty acids in phytoplankton food quality for Daphnia using liposome supplementation

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ABSTRACT: We conducted a series of experiments using the herbivorous zooplankter *Daphnia pulex* to investigate the nutritional importance of dietary polyunsaturated fatty acids (PUFAs). *Daphnia* were fed three different diets: (1) a PUFA-deficient cyanophyte mixture, (2) a cyanophyte mixture with fatty acid (FA) amendments, or (3) a PUFA-rich cryptophyte mixture. We devised a novel method using customized phosphatidylcholine liposomes to deliver specific FA amendments in a pure and bioavailable form that closely mimics their form in natural diets. We added FA-impregnated liposomes to the cyanophyte mixtures at levels equivalent to the observed differences in FA concentrations between the cyanophyte and cryptophyte mixtures. Liposome control amendments (without FAs added) had no effect on *Daphnia* growth. Eicosapentaenoic acid (EPA)-impregnated liposome amendments accounted for 30% of *Daphnia* somatic growth-rate differences and 38% of clutch-size differences between the cyanophyte and cryptophyte diets. Liposome supplementation of a FA mixture, which included a saturated fatty acid and the four 3 PUFAs most prevalent in cryptophytes but rare in cyanophytes, accounted for 59% of Daphnia somatic growthrate differences and 47% of clutch-size differences between the cyanophyte and cryptophyte diets. Our study suggests that phytoplankton 3 PUFA, and especially EPA, content plays an important direct role in herbivorous zooplankton nutrition.