



Testing for toxic effects of prey on zooplankton using sole versus mixed diets

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ABSTRACT: Negative effects of prey species on consumers could be due to deterrence, nutritional insufficiency, or toxicity of the prey. These effects can be discerned in experiments in which the suspect prey is offered to the consumers in a food mixture containing another prey item that is not toxic and in which the ingestion rates on the prey and the grazers' responses (e.g., egg production) are measured. We used this framework to determine whether several algae that have been reported to have harmful effects on grazers (*Prorocentrum minimum*, low- and high-toxin *Alexandrium* sp., *Heterosigma carterae*, *Thalassiosira rotula*, and *Phaeodactylum tricorutum*) are toxic to females of the calanoid copepod *Acartia tonsa*. Ingestion, egg production, and egg-hatching rates were measured for *A. tonsa* offered sole diets of the suspect alga and mixed diets containing the suspect alga and a control alga (the green flagellate *Tetraselmis* sp.) at an ecologically relevant concentration (250 $\mu\text{g C L}^{-1}$) and duration (3 d). With the exception of the *Alexandrium* strain with the high-toxin content (16.3 $\mu\text{g Saxitoxin [pgSTX]}$ equivalents cell $^{-1}$), none of the diets studied can be considered toxic. The high-toxin *Alexandrium* reduced *A. tonsa*'s total ingestion rate, and thus egg production, as the proportion of *Alexandrium* increased in the diet. *A. tonsa* exhibited significantly reduced ingestion and egg production rates when feeding on sole food diets of *H. carterae* and *P. tricorutum* relative to the mixed food diets. However, a comparison of ingestion rates among the diet mixtures revealed that *H. carterae* and *P. tricorutum* acted as feeding deterrents when provided as sole foods. These results stress the importance of using mixed food diets when examining putative toxic effects of preys on consumers.

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