MESO- AND MICROZOOPLANKTON FEEDING RATES ON TOXIC AND NON-TOXIC DINOFLAGELLATES CULTURED AT DIFFERENT N/P RATIO

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Abstract
An experimental study was carried out to investigate meso- and microzooplankton (*Acartia margalefi* and *Oxyrrhis marina*) feeding rates on a toxic dinoflagellate (*Gyrodinium corsicum*) cultured at different N/P ratios. We tested whether P-limitation enhances dinoflagellate toxicity repressing grazing rates and inducing predator mortality. Feeding rates of *Acartia margalefi* on *G.corsicum* cultured at P-limitation conditions are lower than growing at Redfield N/P ratio, while *Oxyrrhis marina* did not graze on it at any N/P ratio. However, mortality and losses of motility of grazers were not detected at any N/P ratio.

Key words: micro-and mesozooplankton, toxic dinoflagellate, grazing rates, P-limitation.

Introduction

Copepods and Protozoa are considered potential grazers of dinoflagellates, and they can select their prey according to different factors, such as size, abundance, toxicity, etc. (1). Recent studies showed that toxic dinoflagellates found in systems with P-limitation conditions are more toxic than dinoflagellates living at Redfield N/P ratio (2). We tested whether two dinoflagellates: *Gyrodinium corsicum* (responsible for massive fish and zooplankton mortality in the Mediterranean sea) (3), and *Gymnodinium sp. 1* (a non-toxic algae) cultured at different N/P ratio were differently consumed by a phagotrophic dinoflagellate (*Oxyrrhis marina)* and a copepod (*Acartia margalefi*). Both of them are very common in semi-enclosed marine areas of the Catalan Sea (Barcelona harbour, Ebro delta bay). We hypothesized that predator feeding rates on *G. corsicum* at P-limitation conditions will be lower than at Redfield N/P ratio. Also, we should detect higher mortality and losses of motility of grazers in the presence of *Gyrodinium corsicum* at P-limitation conditions.

Material and Methods

The copepod *Acartia margalefi* (0.55 mm) and the phagotrophic dinoflagellate *Oxyrrhis marina* (22 µm) were isolated from Barcelona harbour. Strains of *Gyrodinium corsicum* and *Gymnodinium* sp1 (with similar size ~14 µm) were provided by the ICM phytoplankton collection and were cultured in f/2 media at different N/P ratios (Redfield N/P = 15; P-limitation N/P >15). Triplicate 75 ml tissue bottles were inoculated with 50 ml samples containing four different concentrations of each dinoflagellate species (100, 300, 1000, 2000 cells ml^{-1}) cultured at N/P =15 and N/P>15 ratios. These bottles were used as controls. The same experimental set up was repeated twice, in one set we added 300 cells ml^{-1} of *Oxyrrhis marina* and in the other 3 *Acartia margalefi* in each bottle. We enumerated at t_0 and t_{24} the abundance *of Gyrodinium corsicum*, Gymnodinium sp1, and the phagotrophic nanoflagellate *Oxyrrhis marina*. Subsamples were fixed with lugol acid and allowed to settle for 24 h in 50-ml sedimentation chambers. Dinoflagellates were counted in an inverted microscope (400X, Zeiss). *Acartia margalefi* were counted at the end of the experiment using a stereomicroscope. In extra tissue bottles we observed in live samples direct mortality or motility losses of grazers during the first 24 h under the stereomicroscope and microscope, respectively.

Results and Discussion

Oxyrrhis marina only ingested *Gymnodinium* sp1 cultured at NP = 15 (Fig. 1A), while *Acartia margalefi* showed similar feeding rates on *Gymnodinium* sp1 at different N/P ratios, and lower ingestion rates on *Gyrodinium corsicum* at P-limitation conditions than at Redfield N/P ratio (Fig.1 B). Indeed, the lowest response of ingestion to food concentration corresponded to *G. corsicum.* for both potential predators (Fig. 1). These results provide further evidences that *G. corsicum* is negatively selected by the considered predators (4). Nevertheless, an increase in mortality and losses of grazers' motility were not observed at any of the N/P ratio tested, suggesting that P-limitation did not increase toxicity sufficiently to induce fatal effects on grazers.

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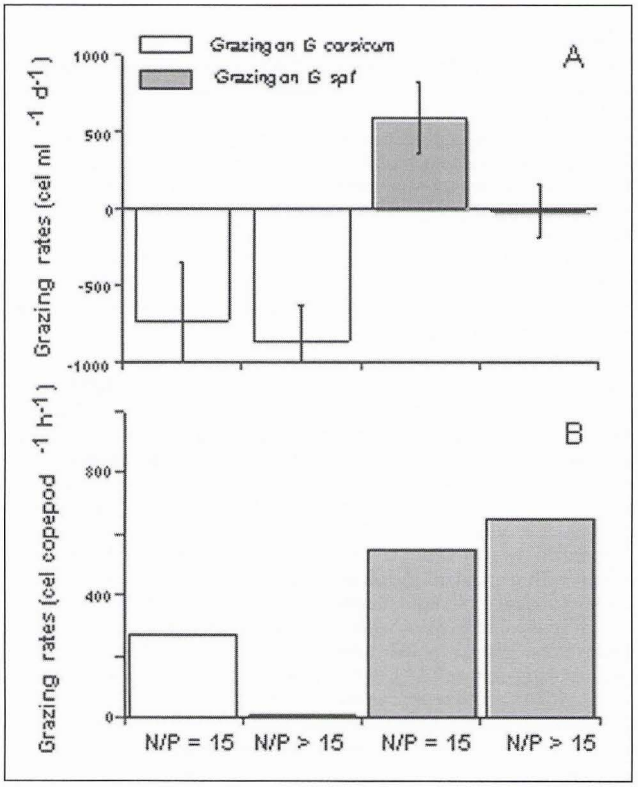

Fig. 1. Maximal grazing rates of *Oxyrrhis marina* (A) and *Acartia margalefi* (B) on *Gyrodinium corsicum* and *Gymnodinium* sp1 at different N/P ratios. Dinoflagellate food concentration: 2000 cells ml^{-1}

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