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Filtration of Three Nontoxic Red-Tide Dinoflagellates by an Intertidal Bivalve, *Glauconome chinensis* Gray: Implication to the Dynamics of Tidal Flat

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Introduction

There were many studies on the interactions between suspension-feeding bivalves and red tide dinoflagellates (Lesser and Shumway, 1993; Luckenbach *et al.*, 1993). Most of these studies focused on the adverse effects of toxic red tide dinoflagellates on commercially important bivalves. The nontoxic red tide dinoflagellates can serve as food for suspension-feeding bivalves and the bivalves can effectively mitigate the red tides by their filtering activities. The purpose of this study is to know how much of the nontoxic red tide dinoflagellates can be filtered by the suspension-feeding bivalves. We selected a small intertidal bivalve, *Glauconome chinensis* Gray (Glauconomidae) and three nontoxic dinoflagellates *Prorocentrum minimum*, *Cochlodinium polykrikoides*, and *Scrippsiella trochoidea* as the test organisms. Hitherto, there were no studies on the functional aspects of this bivalve on the tidal flats of Korea. Rates of clearance and ingestion of *G. chinensis* were measured as a function of algal concentration, when the bivalve was fed on unialgal diet of the red tide dinoflagellates.

Materials and Methods

Glaconome chinensis were collected from Sura tidal flat near Gunsan, west coast of Korea. *Prorocentrum minimum*, *Cochlodinium polykrikoides*, and *Scrippsiella trochoidea* were grown at 20℃ in enriched f/2 seawater medium (Guillard and Ryther, 1962) without silicate under continuous illumination of 100 $\mu E/m^2/sec$ provided by cool-white fluorescent light. Clearance rate and ingestion rate were measured by indirect method described by Coughlan (1969). Maximum clearance rate and maximum ingestion rates were estimated by fitting data to an exponential or a Michaelis-Menten equation.

Results and Discussion

In general, the weight-specific clearance rate of *G. chinensis* fed on one of the tested algae rapidly increased with increasing low algal concentration and after reaching a peak, the rate decreased with further increase in algal concentration. The maximum clearance rate (C_{max}) was estimated as 2.61, 2.21 and 2.38 l/g/hr for *P. minimum*, *C. polykrikoides* and *S. trochoidea*, respectively. The weight-specific ingestion rate of *G. chinensis* fed on *P. minimum* rapidly increased ($p<0.001$), with increasing concentration from 0.29 to 1.76 mgC/l. As the concentration increased further, the ingestion rate showed no significant difference ($p=0.062$). The maximum ingestion rate (I_{max}) and the algal concentration sustaining 50% of I_{max} (K_{IR}) were estimated as 3.90 mgC/g/hr and 0.92 mgC/l, respectively. The trends for the weight-specific ingestion rates of other algae, namely *C. polykrikoides* and *S. trochoidea* were similar. The I_{max} and K_{IR} were estimated as 0.99 mgC/g/hr and 0.22 mgC/l for *C. polykrikoides,* and 10.13 mgC/g/hr and 3.26 mgC/l for *S. trochoidea*. The maximum filtration capacity (the maximum volume of water that *G. chinensis* in 1 m^2 can clear per day) calculated by combining the ingestion rate from laboratory experiments and the abundance data from fields for the bivalve and for three red tide dinoflagellates is as high as 4.7, 1.4, and 25.3 t/m^2/day for *P. minimum*, *C. polykrikoides*, and *S. trochoidea*, respectively. Hence, substantial quantities of red tide dinoflagellates can be removed from water column by *G. chinensis*. From this result, it can be assumed the abundant suspension-feeding bivalves in tidal flats can mitigate the outbreak of red tides. To understand the potentials of bivalves as grazers of the red tide dinoflagellates and their role in tidal flat ecosystems, we need more detailed and systematic studies on the natural abundance and grazing rate of the other bivalves on the tidal flats of Korea.

References

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