

The role of diatom-based film as an inducer of metamorphosis in larvae of two species of sea urchin, *Pseudocentrotus depressus* and *Anthocidaris crassispina*

Siti Akmar Khadijah Ab Rahim^{1)*}, Jing-Yu Li¹⁾, Cyril Glenn Satuito¹⁾ and Hitoshi Kitamura²⁾

¹⁾ Graduate School of Science and Technology, Nagasaki University, 1-14 Bunkyo-machi, Nagasaki-shi, Nagasaki 852-8521, Japan

²⁾ Faculty of Fisheries, Nagasaki University, 1-14 Bunkyo-machi, Nagasaki-shi, Nagasaki 852-8521, Japan

*corresponding author (SAKAR) E-mail: fl252@cc.nagasaki-u.ac.jp

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Abstract

Diatom-based film grown on plastic plates, consisting of several species of periphytic diatom and multispecies of bacteria, is used to induce larval metamorphosis during mass production of sea urchin juveniles. This study attempted to elucidate the roles of diatoms and bacteria in larval metamorphosis of the sea urchins *Pseudocentrotus depressus* and *Anthocidaris crassispina*, and to clarify the characteristics of the metamorphosis-inducing cue(s) in the film. Laboratory-grown diatom-based films induced larval metamorphosis in both species of sea urchin, but the response rate was higher in *P. depressus*. Diatoms collected on glass-fiber filters induced metamorphosis in larvae of both species, although the inducing activity was significantly less than that of the diatom-based films. By contrast, no larva metamorphosed on bacterial films that formed from the filtrates. These results suggest that bacteria alone cannot induce metamorphosis and that diatoms play a major role in the induction. Antibiotic treatment reduced the inducing activity in diatom-based films, even though the treatment did not control bacterial growth. None of five isolated species of periphytic diatom induced larval metamorphosis by itself. Glutaraldehyde (5%), HCl (1 N), and heat treatment (45 °C) destroyed the inducing activity of the films, but lectin treatments (LCA, SBA, and WGA) had no effect. This suggests that the metamorphosis-inducing cue(s) in diatom-based films is (are) unstable and that carbohydrates do not play a main role in inducing metamorphosis.

Key words: diatom-based film, periphytic diatoms, bacterial film, sea urchin, metamorphosis

Introduction

The formation of microbial films is a prerequisite for the larval metamorphosis of marine invertebrates such as bryozoans, hydrozoans, polychaetes, oysters, abalones, and sea urchins (Pearce and Scheibling, 1991; Pawlik, 1992; Wicczorek and Todd, 1998). The succession of the microbial film is typically described as beginning with the formation of a layer of organic molecules consisting of amino acids, glycoproteins, and humic materials, followed by colonization by bacteria,

diatoms, fungi, and protozoans (Costerton *et al.*, 1995; Bhosle and Wagh, 1997; Tsurumi and Fusetani, 1998).

In mass-production of juvenile sea urchins, sea cucumbers, and abalones, diatom-based film propagated on plastic plates ("nami-ita") is used to induce larval metamorphosis (Ito *et al.*, 1991; Kawamura and Kikuchi, 1992; Kawahara, 1996; Ito and Kitamura, 1997). Diatom-based film is mainly composed of several species of diatom and multispecies of bacteria, but the role of both the diatoms and the bacteria in the