INDUCTION OF LARVAL SETTLEMENT AND METAMORPHOSIS OF HALIOTIS DISCUS HANNAI INO (GASTROPODA, MOLLUSCA)

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Abstract

Conspecific foot mucus, excessive [K⁺] and gamma-aminobutyric acid (GABA) showed different metamorphosis-inductive effect on the veliger of Haliotis discus hannai. The inductive effect of excessive [K⁺] and GABA was developmental stage-dependent and dose-dependent, while that of conspecific foot mucus was only developmental stage-dependent. At 20 °C the veliger larvae became competent within 4 days after fertilization. H. discus hannai larvae showed gregarious settlement pattern on the conspecific foot mucus under the conditions of either presence or absence of KCl or GABA. The present studies showed that the effect of conspecific foot mucus on abalone larva metamorphosis could be dose-independent.

Key words: Haliotis discus hannai, veliger, settlement, metamorphosis, inducer

INTRODUCTION

Most benthic marine invertebrates have pelagic larvae that develop to competent stage and then settle on the bottom in response to physical, biological and/or chemical factors. Many previous investigators focused on exploring the inductive effects of chemical cues on larval settlement and metamorphosis (Morse, 1990; Pawlik, 1990).

Chemical cues can be divided into natural and artificial inducers. The former include those substances associated with conspecific individuals (Jensen et al., 1984; Pawlik, 1986; Hadfield, 1986; Highsmith, 1982; Seki et al., 1981; Slattery, 1992); microbial films (Maki et al., 1988) and prey species (Morse et al., 1984; Barnes et al., 1973). The artificial inducers include neurotransmitter (e.g. gamma amino butyric acid, catecholamines), neurotransmitter precursors (choline) and ions (e.g. potassium, Hirata et al., 1986).

It has been reported that conspecific foot mucus, gamma-aminobutyric acid (GABA) and potassium all can induce abalone larvae to settle and metamorphose (Seik et al., 1981; Slattery, 1992). However, effectiveness and consequences of these inducers on Haliotis discus hannai have not been compared yet. The present studies were aimed: (1) to compare the metamorphosis-inducing efficiency of conspecific foot mucus, GABA and KCl on Haliotis discus hannai larvae, (2) to compare the settlement rate of H. discus hannai larvae on conspecific foot mucus, diatom film and clean glass slide in the presence and

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absence of GABA and excessive potassium, (3) to discuss briefly the research status and future lines of research on larval settlement.

MATERIALS AND METHODS

1. Larval culture

The experiment was conducted from April to June, 1992 in Rongcheng of Shandong Province in China. Male and female adults of *H. discus hannai* were reared separately and the matured ones were selected and induced to spawn by ultraviolet-irradiated seawater. Only the eggs from the same female were inseminated and used in the experiment. Thirty min after fertilization, eggs were rinsed with seawater to remove extra sperms. The fertilized eggs were incubated and developed to swimming veligers in 36 h at 20 °C. The abalone veligers were lecithotrophic, so no additional food was used. Swimming veligers were maintained at 10 larvae/ml in static culture at 20 °C. The culture water, which was sieved through 50 μm nylon mesh, at pH 8.0 and salinity 34, was changed at 2 h intervals. The competence of larvae was tested by using K+, GABA and conspecific foot mucus respectively. No antibiotics were used in the experiment.

2. Bioassay of metamorphosis inducers

Conspecific foot mucus, GABA and KCl were used as larval metamorphosis inducers in the present experiment. Two abalones of 10–15 mm shell length were selected and maintained with flowing seawater in a 50 ml beaker for 24 h without food. The foot mucus was secreted and deposited on the wall and bottom of the beaker while abalones were crawling around. Prior to the experiments the abalones were removed and then the beakers were rinsed gently 3 times with seawater. KCl was dissolved in distilled water to make a 0.5 mol/L concentration stock solution which was then diluted in seawater to give 5, 10, 15, 20, 25, 30, 40, 50 mmol/L concentrations in 50 ml breakers respectively. The concentration of 10^-2 mol/L of stock solution of GABA was prepared with distilled water and diluted to 10^-7, 10^-6, 10^-5, 10^-4 mol/L with seawater in 50 ml beakers. Seawater was used as control. Forty healthy veligers per beaker were exposed to the above solutions for 24 h and then were transferred to seawater for another 24 h. The number of total larvae, metamorphosed larvae and dead larvae was counted under compound microscope. Metamorphosed larvae refers to those showing development of adult shell. The experiment was repeated every day from day 3 to day 7 after fertilization.

To investigate the effect of the amount of mucus on the rate of larval metamorphosis, 1, 2, 3, 4, 5 young abalones were maintained in 50 ml breakers respectively and allowed to crawl in the beakers for 24 h before being removed, then 40 healthy (day 5) larvae after fertilization were put into each beaker and the metamorphosis rate was determined as above.

3. Bioassay of larval gregarious settlement

Four glass slides were placed for 1 week in each of 3 breakers containing 500 ml