

## 환경일반-P13 Induction of colony formation in planktonic algae by substances released from grazer zooplankton

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### 1. INTRODUCTION

Induction of morphological change in planktonic algae would be interpreted as a defense strategy adopted by the algae against herbivory. Infochemicals (for terminology, see Dicke and Sabelis, 1988), convey information on interaction between two individuals has been reported to induce defenses in grazer zooplankton. However, little information regarding grazer-mediated antiherbivore responses in phytoplankton. The different success of herbivores feeding on algae is mainly due to structural properties of algal species such as size, rigid cell walls, mucous sheets, spines, and colony formation, which increase grazing resistance (De Bernardi and Guissani, 1990). Also, production of toxins or repellent chemicals by cyanobacteria promote grazing resistance (DeMott and Moxter, 1991). Therefore, in this study, we performed that the effect of *D. magna* and *M. macrocopa* chemicals on growth, morphology including particle volume in clonal cultures of *Scenedesmus dimorphus* by in situ experiment. Secondly, the difference of colony information was examined according to the difference of volume of chemicals grazers released. We also observed which growth stage that induction of colonial formation in this species was occurred.

### 2. MATERIALS AND METHODS

A green alga *S. dimorphus* (Turpin) Kützing (NIES 119) obtained from the culture collection of the National Institute for Environmental Studies (NIES) (Watanabe et al., 2000). To obtain *Daphnia* or *Moina* filtered water, 300 non-egg bearing adults *Daphnia magna* (8-day after hatching) or 500 non-egg bearing adults *Moina macrocopa* (4-day after hatching) were reared in a 1.0 l suspension of *S. acutus* ( $10^3$  cell/ml, biovolume of  $1004.8 \mu\text{m}^3/\text{ml}$ ) in C medium without trace elements at 20°C. After 24 h of grazing, each medium was filtered through a 0.1  $\mu\text{m}$  membrane

filter to remove zooplankton, algae, bacteria and debris and used in the following experiments as described in Lürling and Van Donk (2000). We examined when the colony formation of *S. dimorphus* occur after the exposure of ZFW for 14 day. The exponentially growing species was put in 150 ml C media) with *Daphnia* (0, 8 and 16%) or *Moina* (0, 8 and 16%) filtered water.

### 3. RESULTS AND DISCUSSION

The cell number per colony of *S. dimorphus* did not change in a control medium during the experiment, but it increased clearly in all media with ZFW in 14-day experiment with 0, 3, 8, 14th day interval (Fig. 1). The colony formation of *S. dimorphus* was most prominent on the third day in the medium containing either 16% *Daphnia* (7.5 cells per colony on average) or 16% *Moina* (7.4 cells per one colony on average) filtered water, although one colony composed of 5.2 cells on average in a control medium. Afterwards, the degree of colony formation decreased and did not differ much on the 14th day (5.0 cells per colony in control; 5.7 cells per colony in 16% *Daphnia* treatment; 5.5 cells per colony in 16% *Moina* treatment). This colony formation was stronger in 16% ZFW than in 8% ZFW. In zooplankton treatment, highest cell per colony was observed on day 3. In the both of *Daphnia* or *Moina* treatment, clear increase of cells per colony was observed in 16% treatment rather than that of 8% treatment.

This phenomenon of colonial formation is evident defense strategy that not only abiotic factors such as nutrients, temperature, and salinity (Trainor, 1992) but also biotic factors such as the pressure of grazers, toxin production. Because grazing of zooplankton is one of the most important loss processes among algae, edible algae become to have a strong defense mechanism such as toxin producing and morphological change attributing secretion of infochemicals by zooplankton and exist on the evolution of traits that reduce grazing losses. Therefore, this colonial formation is not universal but widespread within *Scenedesmus* genus caused by an infochemical released from zooplankton as *Daphnia* or *Moina* and it would become simultaneously as a one of defense mechanism against zooplankton grazing pressure.

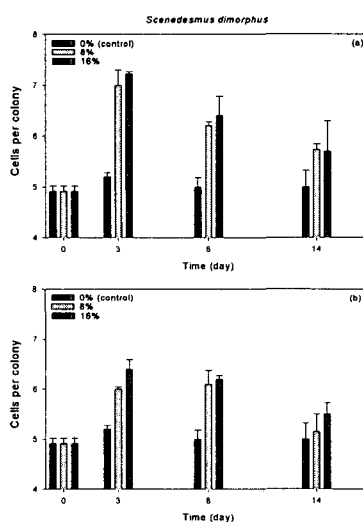


Fig. 1. Number of cells per each colony of *S. dimorphus* dosed by 0, 8 and 16% *D. magna* (a) or *M. macroscopa* (b) filtered water during the 14-day experiment.

#### 4. ABSTRACT

Grazer-induced colony formation was examined using strains of green alga *Scenedesmus dimorphus* (Turpin) Kützing. Alga was cultured in a medium with or without filtered water in which *Daphnia magna* or *Moina macrocopa* had been reared. Colony formation was obviously promoted in *S. dimorphus* by exposure to zooplankton filtered water (ZFW), showing in proportion to the volume of zooplankton filtered water in cultured media. The particle volume as well as the number of cells per one colony of *S. dimorphus* increased between 24 and 48 hours after exposure to ZFW, which were caused by an infochemical released from *Daphnia* or *Moina* probably as a part of defense mechanism against zooplankton grazing.

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