生活史（Life cycle）

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1. Introduction

The dinoflagellate *Cochlodinium polykrikoides* Margaref is the most notorious causative species of the red tide that have occurred recently and regularly in Korean coastal waters. Since 1995, harmful blooms of this species have been an annual feature along the southern coast of Korea in late summer, leading to serious effects on fin-fish farms covering huge areas.

The characteristics of the initial progress of the outbreak have promoted a hypothesis that *C. polykrikoides* is transported to Narodo via an offshore, marine current. However, there are a number of unsolved questions concerning this hypothesis. In addition, little is known about the species life cycle, except for the planktonic unarmored vegetative stage found during the bloom-forming period Kim et al. (2002).

Species movements during migration in water masses are unknown, therefore, knowledge of the blooming mechanism and a full understanding of the life cycle could yield measures to counter red-tide outbreaks. The present study reports the life cycle of *C. polykrikoides* with a pertinent discussion on bloom dynamics of the species.

2. Hyaline cysts formation and regeneration

During a study of *C. polykrikoides* blooms along the Korean coast, we found hyaline cysts produced by this species. The hyaline cysts were immobile, pale in colour, and nearly lacked chloroplasts (Fig. 1).

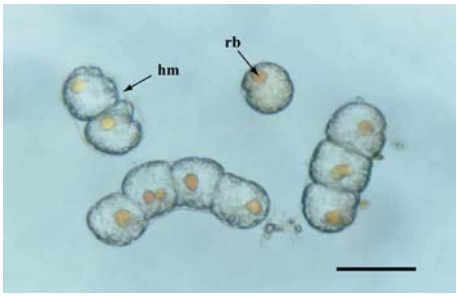

Fig. 1. Chains of hyaline cysts of *C. polykrikoides*. rb, red body; hm, thin hyaline membrane. Scale bar = 40 μm.

Their size was similar to that of the motile cells. Only faint traces of the sulcus and the cingulum were present on the cysts surface; all hyaline cysts were surrounded by a transparent, thin hyaline membrane.

After being preserved for 6 months at 4ºC in darkness, *C. polykrikoides* cells regenerated successfully from the hyaline cysts when moved into the light and higher temperature. Regeneration of individual motile cells occurred one by one from the chain of hyaline cysts. The hyaline cysts can be considered as a kind of temporary cyst. However, the formation of hyaline cysts in the life cycle of *C. polykrikoides* may act as an overwintering survival strategy, the cysts being able to initiate harmful blooms when favourable conditions return.

3. The armoured types of *C. polykrikoides*

The armored types observed from Saryang-do seawater samples were also found in the Saemangeum samples. Living, armored types from net samples collected at Saemangeum station were monoclonally isolated and placed into individual wells of a 96-well plate containing f/2-Si medium. Among the isolates, SMG11 was established as a culture. When the temperature of 10–15°C was abruptly increased to 25ºC, the isolated types developed into vegetative cells with a large red lipid body (red body) within 2 h.

To investigate the development of armored cells into, morphologically, more normal vegetative cells, as seen during the initial bloom-forming period, an armored type isolated from Saemangeum (SMG11) was cultured for 1 year. The culture was then exposed to room temperatures (20–25°C) in August, assuming that the armored type would be a planomeiocyte of *C. polykrikoides*. Addition of f/2-Si medium to the culture caused active cell divisions, but development into an unarmored vegetative cell occurred rarely, except for a single morphological change into four-cell chain unarmored vegetative cells within 2 days (Kim et al., 2007).

4. Resting cyst generation

Armored types (SMG11) were also subjected to resting cyst formation in a 6-well plate at temperatures of 15–20°C. Culture produced a quite different morphological type, round but folded at one side and flat, from the armored type. These types were also found predominantly in sediment samples collected around Naro-do in mid-Oct, suggesting that the laboratory type, produced from the armored type, could be the resting cyst of *C. polykrikoides* (Kim et al., 2007).

References

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