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環境

# Effects of light and dark cycles on the growth and geosmin production in *Dolichospermum smithii*

TECHNOLOGY SHOWCASE



## ■ はじめに

The secondary metabolite geosmin, produced by cyanobacteria, is widely considered to be the most dominant bio-induced taste and odour in freshwater environments. Odour events pose a serious threat to the quality of drinking water and aquatic products. Hence, identifying the key factors affecting geosmin synthesis is of particular importance. Light, as the main driver of photosynthesis, is one of the most important factors affecting the growth and odor synthesis of cyanobacteria. However, to our knowledge, no previous studies have explored the impact of light/dark cycles on geosmin production and gene expression. In this study, we established three light/dark cycle conditions to investigate the influence of light/dark cycles on the growth of the known geosmin producer *Dolichospermum smithii* (*D. smithii*) NIES-824 and the expression of geosmin synthase gene *geo*A, as well as the concentration of geosmin.

## ■ 活動内容

1. Design of work and culture conditions

The light/dark cycle was set to 16:8 h for the long illumination experimental group and 9:15 h for the short illumination group. A light/dark cycle of 12:12 h was used as the control group.

2. Growth curve of *D.smithii*

As shown in the Figure 1, *D. smithii* growth entered the exponential and decay phases more rapidly with increasing light duration. However, the peak Chl-a of *D. smithii* in the long illumination group (2606 μg/L) was smaller than that of the control (3018 μg/L) and short illumination groups (2829 μg/L).

3. Expression of *geo*A gene

The analysis of geoA copy number is shown in Figure 2. Combined with the growth curve analysis, the extended daily light duration (16 h/day) caused *D. smithii* to enter a rapid growth phase, while *geo*A expression also peaked in a short period of time (day 3). The prolonged illumination contributed to the rapid expression of the geosmin synthase gene of *D. smithii* at the early stage of the experiment.

4. Release of metabolites

The optimal growth conditions (medium illumination) in the later part of the experiment made the total geosmin much higher than the other two groups (Figure 3A). The analysis of the amount and percentage of extracellular geosmin showed that long light helped the cyanobacteria to release more geosmin (Figure 3B and 3C).

The DOC changes (ΔDOC) of the three groups showed an overall upward trend, even in the decay phase (Figure 3D). It can be assumed that cell decay or rupture releases more intracellular metabolites, which increase with prolonged illumination. This corresponds with the observed changes in geosmin.

## ■ まとめ

Prolonged exposure to light can cause temporary surges in odor release. However, we overlooked the potential consequences of extended odor release periods under short illumination. Furthermore, the risk of releasing intracellular geosmin due to cell rupture increases over time. Thus, the most effective method to mitigate the release of intracellular organisms is to remove intact cyanobacterial cells.

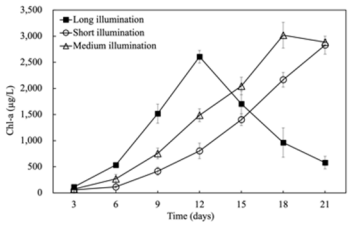


Figure 1 The growth curve of *D. smithii* under the different light/dark cycles

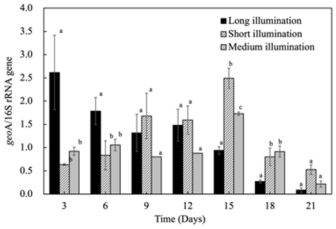


Figure 2 Effect of different light/dark cycles on relative expression of *geo*A. Different letters represent significant differences between the three treatments ($p < 0.05$).

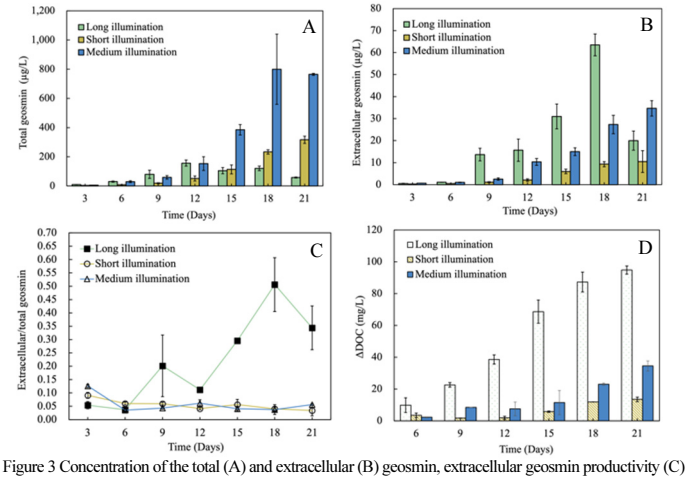


Figure 3 Concentration of the total (A) and extracellular (B) geosmin, extracellular geosmin productivity (C) and release of ΔDOC (D) at different illumination conditions.

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