学位論文内容の要旨

博士の専攻分野の名称：博士（水産科学）　　氏名：陳　樹河

学位論文題目

Pseudomonas sp. Go58 isolated from water–plant biofilm, genome analysis and preliminary study on its algicidal function

（水草バイオフィルム由来 *Pseudomonas* sp. Go58 のゲノム解析および殺藻活性に関する基盤的な研究）

Water blooms, particularly cyanobacterial blooms, have become a significant environmental issue worldwide. Numerous approaches have been implemented to address this problem, and among them, the use of algicidal strains is considered an environmentally friendly method. However, several aspects of algicidal bacteria, including the species of bacteria, the structures of algicidal compounds, the biosynthetic cues for active molecules, and the molecular mechanisms of algicidal actions, remain unclear. To effectively and reliably apply algicidal bacteria to water plants and minimize their impact on other aquatic organisms, this study was conducted.

In Chapter 2, algicidal strains were isolated from the biofilm of the water plant *Trapa jeholensis*, and strain Go58 which belongs to the *Pseudomonas* species was used for further study. It was revealed that this strain Go58 belongs to the *P. protegens* but potential novel species according to the genomic analysis. In addition, this strain Go58 contains many secondary gene clusters biosynthesizing various secondary metabolites, including pyoluteorin, 2,4-diacetyl phloroglucinol, orfamide, rhizoxin, pyoverdin, thiazostain, arylpolyene and pyrrolnitrin, giving hints on the algicidal compound exploration and isolation, and bioactivity research in another study.

In Chapters 3 and 4, it was found that strain Go58 can inhibit the growth of *Microcystis. aeruginosa* by indirect contact, and two compounds, pyoluteorin (**1**) and its analog, pyoluteirn B (**2**), were purified from the strain Go58 by repetitive chromatography steps. Among these compounds,

pyoluteorin (**1**) was found to selectively inhibit microalgae cyanobacterial species, including *Microcystis aeruginosa* and *Anabaena cylindrica*. However, its analog, pyoluteirn B (**2**), was found to be less inhibitive or toxic on all tested organisms, including brine shrimp *Artemia salina*, small fish *Oryzias* species and water plant *Lemna minor* L. In addition, the co-culture experiment revealed that pyoluteorin (**1**) production was induced by the presence of *M. aeruginosa*.

In Chapter 5 and 6, the effect of pyoluteorin (**1**) and its producer strain Go58 against wild microalgae were analyzed, and the results revealed that pyoluteorin (**1**) and strain Go58 have algicidal effect on wild-caught *M. aeruginosa*, and improve the ratio of environmental Chlorophyta species, specifically the Chlorophyceae species. In terms of the Chlorophyta-promoting process, it was found that this strain Go58 was able to enhance the axenic Chlorophyta *Desmodesmus subspicatus*, by producing the indole 3-acetic indole and its isomer, 3-hydroxyacetyl indole.

In summary, this study shows that the water plant biofilm-originated algicidal strain Go58 has the potential to enhance the growth of the water plant *L. minor* L. The strain is likely able to coexist with water plants and regulate their growth because of its ability to produce the plant hormone indole 3-acetic acid and its isomer, 3-hydroxyacetyl indole. These two compounds produced by strain Go58 also showed a growth-promoting effect on Chlorophyta species, indicating that this algicidal strain is also beneficial for other eukaryotic plants and microalgae as an environmental probiotic. Additionally, its close relative, the *P. protegens* species, ubiquitously exists in the environment and is reported as a biopesticide for infectious diseases in the field of agriculture. Therefore, this strain Go58 is very promising for practical application as an environmentally friendly agent to solve cyanobacterial blooms in the future.