2018年6月21日

学位論文の内容の要約

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学位の種類	博士（学術）
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学位論文題目	Development of green light-regulated gene expression in marine cyanobacteria, Synechococcus sp. NKBG 15041c for the future bioprocess design

【論文の内容の要約】

Photosynthetic marine cyanobacteria have high potential in serving as host in the biotechnological industry. They are fast growing, easily engineered, contribute in solving current environmental concern regarding reducing CO_2 emissions. Especially, they require sea water for their cultivation instead of limited and precious fresh drinking water. The aim of this thesis is to develop a marine cyanobacterial strain, *Synechococcus* sp. NKBG15041c (NKBG15041c) suitable for future bioprocesses. The mission of the study is to investigate its carbohydrate accumulation under nitrogen depleted conditions in order to understand the potential of this marine cyanobacterial strain to be used in the industrial applications, as well as studying the genetic regulation of glycogen synthesis which will provide future insights to further enhance glycogen production using genetic modification. Moreover, the development of a more robust and a cost effective gene regulatory system using green light as an inducer replacing currently developed chemically regulated ones in that can be used in regulating bioprocesses such as glycogen synthesis.

In this study, it was shown that NKBG15041c produced 404 μg/ml culture/OD_{730}, corresponding to 23% of cell dry weight after 288 h of cultivation when cultivated in marine $BG11_{\Delta N}$ medium supplemented with 3 mM $NaNO_3$ and this is considered the highest glycogen production achieved in marine cyanobacteria under the ambient conditions. Based on our observations, the high glycogen productivity of NKBG15041c can be explained as the contribution of both an increase in carbon flux towards glycogen synthesis, which is similar to PCC6803 and PCC7002, and an increase in the transcriptional level of genes responsible for glycogen synthesis, which is different from the conventionally reported phenomenon. Moreover, a two component regulation system to monitor green light, which was derived from *Synechocystis* sp. PCC 6803 was introduced into NKBG15041c. The results showed an enhanced gene expression upon green light illumination and repression under red light. Therefore, the novel gene regulatory expression system was constructed as a platform technology for regulating bioprocesses in marine cyanobacterial strains without the need to rely on hardly removed and expensive chemical inducers.

In conclusion, this study has successively demonstrated the establislument of marine cyanobacterial strain, NKBG15041c as a core technological platform for future bioprocess by evaluating its potential in producing glycogen, elucidating its genetic regulation and the development of green light regulated gene expression system. These achievements will offer tightly regulated bioprocesses with minimally consumed energy and with minimized waste.