

論文 / 著書情報
Article / Book Information

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種別(和文)	論文要旨
Type(English)	Summary

論文要旨

THESIS SUMMARY

専攻 : Department of	International Development Engineering	専攻	申請学位 (専攻分 博士 野) : Academic Degree Requested	Doctor of (Philosophy)
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要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

Red seaweeds have emerged to be promising biomass for the production of bioethanol, because carbohydrate that form the major component of red seaweeds, glucan and galactan, can be hydrolyze into fermentable sugars. However, because red seaweeds contain low content of glucan, the conversion of only the glucan from seaweeds is not sufficient to produce high concentration of bioethanol. Therefore, it is also necessary to produce bioethanol from galactan component of red seaweeds. In spite of many researches on saccharification and fermentation (SSF) of glucan, there are no report for agarose (galactan) saccharification and fermentation by engineered microbial cells for the production of bioethanol yet.

An α -agarase gene, *agaNash* gene, was identified from the genome of *Cellvibrio* sp. OA-2007. Firstly, an α -neogaroooligosaccharide hydrolase, AgaNash, was purified from strain OA-2007. The N-terminal amino acid sequence of AgaNash was determined. The *agaNash* gene, which encodes AgaNash, was obtained by comparing the N-terminal amino acid sequence of AgaNash with that deduced from the nucleotide sequence of the full-length OA-2007 genome. The *agaNash* gene combined with the *Saccharomyces cerevisiae* signal peptide α -mating factor was transformed into the YPH499 strain of *S. cerevisiae* to generate YPH499/pTEF-MF-agaNash, and the recombinant yeast was confirmed to produce AgaNash, though it was mainly retained within the recombinant cell. To enhance AgaNash secretion from the cell, the signal peptide was replaced with a combination of the signal peptide and a threonine- and serine-rich tract (T-S region) of the *S. diastaticus* *STA1* gene. The new recombinant yeast, YPH499/pTEF-STA1SP-agaNash, successfully secrete AgaNash and hydrolyze neogaroobiose thereby producing galactose, which is a fermentable sugar for the yeast, and ethanol, directly from neogaroobiose.

Then, an expression system for endo-type β -agarase was constructed for its extracellular secretion in *Brevibacillus*. *agaA* gene, which encodes agarase AgaA, derived from strain OA-2007 was cloned in pNY326 vector with secretion signal peptide upstream of the gene to construct pNY326-agaA. The resultant plasmid was transformed into *Brevibacillus choshinensis* SP3 to generate *B. choshinensis* SP3/pNY326-agaA. The recombinant *B. choshinensis* SP3/pNY326-agaA was confirmed to secrete agarase AgaA extracellularly and hydrolyzed agarose to produce neogaroooligosaccharides. Simultaneous saccharification and fermentation (SSF) of agarose was carried out by co-culture of *B. choshinensis* SP3/pNY326-agaA and YPH499/pTEF-STA1-agaNash. An Efficient production of bioethanol was observed by conducting SSF.

Lastly, a novel β -agarase gene, *agaMY* gene, with exo-acting hydrolysis mode was identified from strain OA-2007. The *agaMY* gene consisted 2364 bp nucleotide sequence, was cloned in pUC19 vector. The recombinant plasmid, pUC19-*agaMY* was transformed into *Escherichia coli* DH α , to generate *E. coli* DH α /pUC19-*agaMY*. The recombinant agarase AgaMY was confirmed to have the ability to hydrolyze neoagarotetraose and neoagarohexaose to release neoagarobiose. The complete bioconversion of agarose to produce bioethanol was conducted by employing the engineered microbial cells that was constructed in this study. Hydrolysis of agarose by *B. choshinensis* SP3/pNY326-*agaA* resulted to the production of neoagarooligosaccharides. By addition of crude enzyme of recombinant AgaMY into neoagarooligosaccharides solution, the concentration of neoagarobiose doubled, resulted from neoagarohexaose and neoagarotetraose decomposed to neoagarobiose. By introducing YPH499/pTEF-STA1-*agaNash*, bioethanol was produced from neoagarobiose with higher concentration.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

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