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Biorefinery approach of microalgae feedstock for the production of ε-polylysine and biodiesel

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Environmental problems coupled with rapid depletion of fossil fuel and its resources prompted researchers to find alternative renewable resources and its commercialization. The biomass from microalgae with high oil content is a promising feedstock for the renewable resources. Compared with plants, microalgae can produce more oil per hectare with a shorter production cycle. The coupling of algae biofuels with high value compounds production widens the market opportunities which fits well with a recent trend of biorefinery concept. For biorefinery approach, it is essential to select the microalgae which contain high amounts of organic matters such as lipids and carbohydrates which can be used for biorefinery approaches. The present study focuses on the concomitant production of methyl ester and **ε**-polylysine from microalgae feedstock. The harvesting efficiency of *Botryococcus* sp. was increased up to 93% by treatment with a flocculant $FeCl_3$ at 100 mg/L for 30 min. The DMC (dimethyl carbonate) mediated enzyme catalyzed in-situ transesterification of *Botryococcus* sp. yielded the maximum methyl esters of 93% under optimized conditions. The spent biomass was further hydrolyzed using acid and the hydrolyzate obtained was used to produce value-added product e-polylysine using *Streptomomyces* sp. The key components of sugar and $MgSO_4$ involved in the ε-polylysine production were optimized whereby the maximum ε-polylysine production was achieved at 50 g/L sugars and 0.3 g/L $MgSO_4$. The ε-polylysine production was further improved by the supplementation of important acids (lysine and aspartate) and TCA cycle intermediates (citric acid and α-ketoglutaric acid). The maximum production of 2.31 g/L was found with 4 mM citric acid supplementation after 130h. The present study demonstrated the effective harvesting method of microalgae and integrated production of methyl ester and ε-polylysine as a biorefinery approach. The promising path of the biorefinery concept in the present study will help to develop the economy based sustainable fuels and value-added compounds production in the near future.

Recent Publications

1. Sivaramakrishnan R. and Aran I (2018) Enhancement of lipid production in *Synechocystis* sp. PCC 6803 overexpressing glycerol kinase under oxidative stress with glycerol supplementation. Bioresource Technology 267:532-540.
2. Sivaramakrishnan R and Aran I (2018) Utilization of microalgae feedstock for concomitant production of bioethanol and biodiesel. Fuel 217:458-466.
3. Sivaramakrishnan R and Aran I (2018) Microalgae as feedstock for biodiesel production under ultrasound treatment – A review. Bioresource Technology 250:877-887.
4. Sivaramakrishnan R. and Aran I (2017) Enhancement of total lipid yield by nitrogen, carbon, and iron supplementation in isolated microalgae. Journal of Phycology 53:855-868.
5. Sivaramakrishnan R and Aran I (2017) Enhancement of lipid production in Scenedesmus sp. by UV mutagenesis and hydrogen peroxide treatment. Bioresource Technology 235: 366-370.

Biography

Ramachandran Sivaramakrishnan is currently a Senior Post-Doctoral Research in the Cyanobacterial Biotechnology (Biochem dept.) Group Led by Dr. Aran Incharoensakdi at Chulalongkorn University, Bangkok, Thailand. His research interests include the production of biofuels, value-added products, understanding the mechanism of biofuel productions and exploring value-added products. Before joining Dr. Aran Incharoensakdi lab, he worked as a Junior research fellow in the Department of Chemical Engineering at Anna University, India.

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