Impact of various microalgal-bacterial populations on municipal wastewater bioremediation and its energy feasibility for lipid-based biofuel production

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ABSTRACT

The microalgal-bacterial co-cultivation was adopted as an alternative in making microbial-based biofuel production to be more feasible in considering the economic and environmental prospects. Accordingly, the microalgal-bacterial symbiotic relationship was exploited to enhance the microbial biomass yield, while bioremediating the nitrogen-rich municipal wastewater. An optimized inoculation ratio of microalgae and activated sludge (AS:MA) was predetermined and further optimization was performed in terms of different increment ratios to enhance the bioremediation process. The nitrogen removal was found accelerating with the increase of the increment ratios of inoculated AS:MA, though all the increment ratios had recorded a near complete total nitrogen removal (94–95%). In light of treatment efficiency and lipid production, the increment ratio of 0.5 was hailed as the best microbial population size in accounting the total nitrogen removal efficiency of 94.45%, while not compromising the lipid production of 0.241 g/L. Moreover, the cultures in municipal wastewater had attained higher biomass and lipid productions of 1.42 g/L and 0.242 g/L, respectively, as compared with the synthetic wastewater which were only 1.12 g/L (biomass yield) and 0.175 g/L (lipid yield). This was possibly due to the presence of trace elements which had contributed to the increase of biomass yield; thus, higher lipid attainability from the microalgal-bacterial culture. This synergistic microalgal-bacterial approach had been proven to be effective in treating wastewater, while also producing useful biomass for eventual lipid production with comparable net energy ratio (NER) value of 0.27, obtained from the life-cycle analysis (LCA) studies.

Thereby, contributing towards long-term sustainability and possible commercialization of microbial-based biofuel production.

KEYWORDS
Microalgal-bacterial population size; Municipal wastewater; Nitrogen removal; Lipid; Energy demand; Life-cycle analysis

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