Characterization of a Newly Isolated Oleaginous Microalgae for Enhancement of Biomass Production

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1. INTRODUCTION AND OBJECTIVE

In the context of depletion and price destabilization of petroleum, global warming, termination of nuclear power plant, etc, research and development of renewable energy is extremely important. Microalgae-based biofuel becomes more and more attractive due to its advantages in high productivity per unit area, hardly being affected by season or location compared with those plant-based biofuel. However, it's indispensable to reduce the cost of practical microalgae-based biofuel production to a great extent. Recent years, differ from the conventional suspended cultivation, a next generation cultivation method called attached cultivation has got a wide range of expectations profiting from its extremely high productivity. The selection and evaluation of microalgal strain is deeply vital for this culture method. Therefore, the objective of this study which aims at cost cutting by enhancing the biomass productivity is characterization of an oleaginous microalgae M6-20 which is newly isolated by growth rate on agar medium and evaluation of its biomass productivity under optimal condition in attached cultivation.

2. MATERIALS AND METHODS

Chlorella sorokiniana M6-20 newly isolated from Miyakojima was utilized in this study. Optimal growth temperature, nitrogen source, pH, light intensity in suspended cultivation was determined by the calculation of μ_{max} under differ culture condition which was based on turbidimetric assay. In addition, intracellular lipid accumulation was confirmed by Nile-Red staining and NMR measurement. Light saturation point of attached cultivation was determined by calculation and comparison of μ_{max} under differ light intensity which was based on the variety of fluorescence intensity of chloroplast *a* on agar medium. These growth features was taken as a quota of optimal condition of attached cultivation. In attached cultivation, agar medium and filter paper was taken as a carrier, based on the variety of dry weight of cells, biomass productivity was calculated and evaluated.

3. RESULTS AND DISCUSSION

According to the characterization in suspended cultivation, M6-20 is able to grow in the range of 15~35℃ (optimal 25~35℃), pH 4~11 (optimal pH 5 and pH 9~10), 40~250 μmol photons$\cdot m^{-2}\cdot s^{-1}$ (optimal 150 μmol photons$\cdot m^{-2}\cdot s^{-1}$ approximately), and utilize NO_3^-, NH_4^+, Urea as nitrogen source. In addition, the cells of M6-20 is able to accumulate lipid up to 60% by dry weight under nitrogen starvation. Based on these features, M6-20 has the capacity of growing in low-cost culture medium and achieving high biomass productivity under high temperature especially in summer. The maximum surface biomass productivity of 4.38 $g\cdot m^{-2}\cdot day^{-1}$ and 6.12 $g\cdot m^{-2}\cdot day^{-1}$ in attached cultivation was achieved by utilizing agar medium and filter paper as a carrier. Assume that the outside solar irradiation intensity was 2,000 μmol photons$\cdot m^{-2}\cdot s^{-1}$, it's worth expecting that footprint biomass productivity could be enhanced to 100~120 $g\cdot m^{-2}\cdot day^{-1}$, if the design of culture system was ameliorated. This value approaches the theoretical biomass productivity under natural condition, thus it's worth expecting that reduce the cost of biomass production (raw material of biofuel) by development of attached cultivation utilizing M6-20.