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Ettlia sp. YC001 showing high growth rate and lipid content under high CO_2

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HIGHLIGHTS

- *Ettlia* sp. YC001 showing high biomass productivity even under a high CO_2 of 5–10%.
- A high lipid content of 42% (dry cell weight) and accumulation of certain carotenoids.
- *Ettlia* sp. YC001 can be a candidate for producing biodiesel and high-value products.

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ABSTRACT

Over 100 green-colored colonies were isolated from environmental samples when cultivating on a BG11 agar medium, and 4 strains showing different morphologies were selected based on light microscopic observation. Among these strains, the microalgal species with the highest growth rate under 10% CO_2 was identified as *Ettlia* sp. YC001 using an 18S rDNA-based phylogenetic analysis and morphological comparison. The highest cell density of 3.10 g/L (based on dry cell weight) and biomass productivity of 0.19 g/L/d were obtained under 5% CO_2 after 16 days. The lipid content and productivity were also up to 42% of the dry cell weight and 80.0 mg/L/d, respectively. The color of the *Ettlia* sp. YC001 culture changed from green to red after a month due to the accumulation of certain carotenoids. Therefore, it would seem that *Ettlia* sp. YC001 is appropriate for mitigating CO_2 due to its high biomass productivity, and a suitable candidate for producing biodiesel and high-value products.

1. Introduction

The world is currently confronted by global warming and energy depletion that has led to unexpected climate changes and a serious energy crisis worldwide. This situation is due to the emission of huge amounts of CO_2 into the atmosphere from the usage of fossil fuels, such as petroleum, coal, and natural gas (Brennan and Owende, 2010; Chi et al., 2011). The representative emitter of anthropogenic CO_2 is coal-fired thermoelectric plants that account for over 7% of global CO_2 emissions (De Morais and Costa, 2007). This emission of CO_2 can be reduced using various strategies, such as physicochemical absorbents, injection into deep oceans and geological formations, and enhanced biological fixation (Kumar et al., 2010). Microalgae have already been receiving much attention as a promising feedstock to mitigate CO_2 and to produce biodiesel. The advantage of microalgae is their potential to fix CO_2 from the atmosphere or combustion flue gas ranging from 5% to 30% CO_2 (Zeng et al., 2011). Microalgae not only have a high CO_2 fixation ability, but also can produce 15–300 times more biodiesel than conventional feedstocks, such as palm oil, corn, and other food crops (Chisti, 2007). Plus, the biodiesel derived from a microalgal biomass is a high-density fuel that is an ideal substitute for petroleum without competing with food crops (Rittmann, 2008).

Some microalgae have high content of lipid which can be used as substrate for biodiesel production and have been studied since the 1970s, however it has not been commercialized due to the relatively high production cost (Lv et al., 2010). The production of biodiesel from microalgae consists of selecting the algal strain, mass cultivation, harvesting, lipid extraction, and conversion to biodiesel (Khoo et al., 2011; Scott et al., 2010). However, the choice of a suitable algal strain is generally considered the key factor for the successful biological sequestration of CO_2 and production of biodiesel (Pulz and Gross, 2004; Scott et al., 2010). While the estimated number of microalgal species is more than 50,000, only around 3000 have been studied and analyzed (Mata et al., 2010).

The desirable microalgal characteristics for mass cultivation are as follows: rapid growth rate, high product content, growth in extreme environments, large cell size, wide tolerance of environmental conditions, CO_2 tolerance and uptake, and tolerance of

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