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Short Communication

Enhancement of lipid accumulation in *Scenedesmus obliquus* by Optimizing CO_2 and Fe^{3+} levels for biodiesel production

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HIGHLIGHTS

- *Scenedesmus obliquus* is cultivated in nutrient medium supplemented with different levels either CO_2 and iron is established.
- The maximum biomass and high total lipid are achieved at 12 % CO_2 and 20 mg/L iron.
- The fatty acid composition of algal lipid is suitable for biodiesel.
- Algal biodiesel is meet the specified of biodiesel standards.

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ABSTRACT

The effects of cultivation of *Scenedesmus obliquus* in nutrient medium supplemented with 0.03%, 3, 9% and 12% CO_2 or 2.5–20 mg L^{-1} of Fe^{3+} on dry weight of biomass (DW), total lipid accumulation (TL contents) and total lipid productivity (TLP) were evaluated under indoor conditions. The accumulation of TL and TLP showed an increasing trend with increasing of CO_2 or Fe^{3+} levels. In cultures with 12% CO_2 or 20 mg/L Fe^{3+}, maximum TL contents of 33.14% and 28.12%, respectively were obtained. These lipids displayed a fatty acid profile which is suitable for biodiesel production as the most abundant compounds were oleic (32.19–34.44%), palmitic (29.54–25.12%) and stearic (12.26–16.58% of total FAMEs) acids. The properties of biodiesel obtained from *S. obliquus*, were the same with those specification for biodiesel standards including ASTM D 6751 (American Society for Testing Material) and the European Standard En 14214. Thus, *S. obliquus* biomass could be used as suitable feedstock for biodiesel production.

1. Introduction

Photosynthetic microalgae are considered as one of the most important renewable feedstocks for the production of biofuels, foods additives and health-care products (Demirbas and Demirbas 2011; Abd El-Baky and EI-Baroty 2011). Among the microalgal, *Scenedesmus* and *Chlorella* species have the most desirable features for efficient and economic combination of CO_2 fixation, wastewater treatment and lipid synthesis toward biofuel production (Tang et al., 2011). However, the economic feasibility of algae mass culture for biofuel production greatly depends on a high biomass productivity and valuable lipid yield (Liu et al., 2010). Lipids in microalgae could be modified by growth conditions such as nutrient limitation and salt stress (Ho et al., 2010; Abd El Baky et al., 2006). Therefore, the aim of the study is to investigate the effect of utilizing CO_2 as a carbon source as well as iron at various levels on *Scenedesmus obliquus* endemic in Egypt growth for produce biomass containing a high quantity of lipids content characterized for biodiesel production, which has not yet been investigated.

2. Materials and Methods

2.1. Algae culture

S. obliquus was obtained from the Culture Collection of Algae at the University of Texas (Austin, TX, USA) from ten years ago. The cells were cultivated in 4 L Erlenmeyer flask with 3 L of N-9 medium (Borowitzka, 1988) at 25 ± 3.0 °C under a light intensity of approximately 200 $\mu E\, m^{-2} s^{-1}$ provided by ten fluorescent lamp (Toshiba FL 40T8D/36). The initial pH of cultures was 7.0. The cultures were aerated with different flow rates of CO_2 mixed with ambient air to prepare CO_2 levels of 0.3%, 3.0%, 9.0% and 12%, and supplemented with 2.5 Fe^{3+} mg/L as iron source. For the experiments on the effects of Fe ion concentrations, *S. obliquus* was cultivated in N-9 medium supplemented with Fe^{3+} at 0.0, 2.5, 5, 10 and

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