Total Lipid Content and Fatty Acid Composition of Two Morphologically Distinct Chlorella spp. for Biodiesel Production

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Abstract

This study investigated the potential of two morphologically distinct Chlorella spp. to assess the total lipid content and fatty acid composition targeting biodiesel production. Due to their rapid growth, less space requirement, and zero-conflict with current food demand, green microalgae-led biodiesel production has gained a key attention as an alternative, sustainable and eco-friendly substitute for fossil fuels diminishing the increased demand for fossil fuels, fuel prices and excessive release of greenhouse gases to the atmosphere. The Chlorella spp. were isolated from Beire Lake, Colombo (Wet Zone) and Kiriibban Lake, Monaragala (Dry Zone) of Sri Lanka. They were named as BCS1 and RCS2, respectively. Semi-mass culturing of Chlorella spp. in BG-11 medium (pH=7.5-8.5) was carried out in a greenhouse providing aeration and a 12:12 light: dark photoperiod. After 4 weeks, Chlorella spp. were harvested using aluminium sulphate, employing flocculation method. Harvested biomass was oven-dried and made into a fine powder for analysis. The total lipid content (TLC) of Chlorella spp. was determined using n-hexane as the extraction solvent in a soxhlet extractor maintaining three replicates for each. Extracted lipids were dried in a rotary evaporator and TLC was calculated gravimetrically. The total lipid content of BCS1 and RCS2 was recorded as 15.67% and 18.33%, respectively. After quantification, lipids were resuspended and concentrated in 1 mL of n-hexane to convert into fatty acid methyl esters (FAMEs)/ biodiesel via a transesterification reaction. The trans-esterified lipids (FAMEs) were analysed via Gas Chromatography. The most dominant FAMEs of BCS1 were palmitic acid (C16:0), oleic acid [C18:1 cis (n9)], stearic acid (C18:0), lignoceric acid (C24:0), laurie acid (C12:0) and myristic acid (C14:0). The most dominant FAMEs of RCS2 were cis-10-pentadecenoic acid (C15:1), elaidic acid [C18:1 trans (n9)], linolelaic acid [C18:2 trans (n6)], cis-11-eicosenoic acid [C20:1 (n9)], lignoceric acid (C24:0) and oleic acid [C18:1 cis (n9)]. A well-balanced saturated and unsaturated FAME composition is essential for the optimal biodiesel quality, herein it was found in BCS1 with 41.62% of palmitic acid and 33.38% of oleic acid. Higher percentage of oleic acid exhibits a combination of oxidative stability and low temperature properties determining the suitability of BCS1 as a biodiesel feedstock compared to RCS2. In conclusion, even though RCS2 has a higher total lipid content, BCS1 exhibits more favourable characteristics in its FAME composition as a promising feedstock for biodiesel production.

Keywords: Green microalgae, Chlorella spp., Total lipid content, Lipid composition, Biodiesel