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Lipid Yields and Fatty Acid Composition if Indigenous Microalgae, Isolated from the Beira, and Diyawanna Urban Lakes, for Sustainable Biofuel Production in Sri Lanka

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Abstract

Biofuels are carbon-neutral combustibles produced from renewable biomass. Third generation biofuels, derived from microalgal biomass, are distinctly superior to their preceding generations, due to higher productivity and resource use efficiency of microalgae compared to conventional energy crops. It is a viable source of sustainable energy for our country due to the availability of water, ambient temperatures and year-round sunlight needed for microalgae cultivation, and most importantly, the abundance of diverse microalgae species. However, these native microalgae are relatively unexplored for their productivities and thereby, greatly underutilized. This research was aimed to investigate the lipid yields and fatty acid compositions of local freshwater microalgae, and to identify their potential for biodiesel production. This was carried out by (1) microalgae isolation and morphological identification (2) microalgae cultivation (3) biomass harvesting, lipid extraction, gravimetric measurement of extracted lipids and (4) acid-catalysed transesterification, followed by GCMS analysis of the biodiesel product. *Chlorella* sp., *Chlorococcum* sp. and *Chlamydomonas* sp. were isolated from Beira/ Diyawanna Lakes using streak plate technique in solid standard BBM media. They were next cultivated under axenic conditions in liquid standard BBM media under 16: 8 (light: dark), at 25°C for 20 days in duplicates. The biomass was then harvested using alum, dried to reach a constant weight and the Bligh and Dyer lipid extraction was done in triplicate. The extracted lipids were trans-esterified with methanol, using sulfuric acid catalyst at 90° C for 60 minutes. The separated product was analysed by GCMS. *Chlorella* sp., *Chlorococcum* sp. and *Chlamydomonas* sp. cultivated under standard conditions gave average lipid yields of 11.34±1.01%, 15.00±1.40% and 2.10±0.50% respectively. Average lipid yield of *Chlamydomonas* sp. was significantly lower than the other two species at 95% confidence level (Two-sample T test on SPSS Version 21). GCMS analysis of the biodiesel product from *Chlorella* sp. indicated significant levels of saturated fatty acids including palmitic and stearic acids, monounsaturated fatty acids like cis-11-eicosenoic acid and polyunsaturated fatty acids including linoleic and linolenic acids. The fatty acid ratios were used to calculate the saturation value, cetane number, density, iodine value and pour point of the produced biodiesel. These quality parameters were in accordance with the ASTM D6751- 20a standards. Therefore, with a substantial yield and fatty acid composition of intracellular lipids, this local species of *Chlorella* can be a prospective candidate for sustainable bioenergy production in Sri Lanka.

Keywords: *Chlorella, Chlorococcum, Chlamydomonas,* Microalgal lipids, Biodiesel