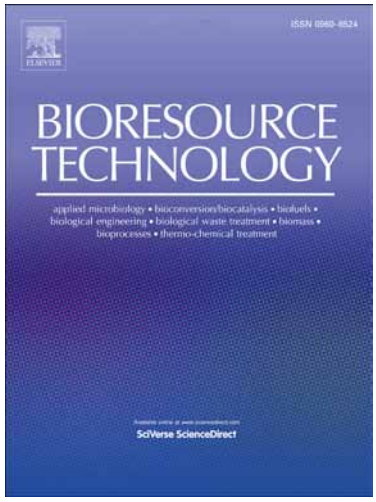

Exploration of upstream and downstream process for microwave assisted sustainable biodiesel production from microalgae *Chlorella vulgaris*

Amit Kumar Sharma, Pradeepta Kumar Sahoo, Shailey Singhal, Girdhar Joshi

PII: S0960-8524(16)30813-6
DOI: http://dx.doi.org/10.1016/j.biortech.2016.06.013
Reference: BITE 16635

To appear in: *Bioresource Technology*

Received Date: 31 March 2016
Revised Date: 2 June 2016
Accepted Date: 3 June 2016

Please cite this article as: Sharma, A.K., Sahoo, P.K., Singhal, S., Joshi, G., Exploration of upstream and downstream process for microwave assisted sustainable biodiesel production from microalgae *Chlorella vulgaris*, *Bioresource Technology* (2016), doi: http://dx.doi.org/10.1016/j.biortech.2016.06.013

Exploration of upstream and downstream process for microwave assisted sustainable biodiesel production from microalgae *Chlorella vulgaris*

Amit Kumar Sharma*[1], Pradeepta Kumar Sahoo[2], Shailey Singhal[3], Girdhar Joshi[4]

[1]Biofuel Research Laboratory, [3]Department of Chemistry, [4]Research and development Department, University of Petroleum and Energy Studies, Bidholi, Dehradun, India - 248007

[2]Department of Farm Machinery & Power, Orissa University of Agriculture & Technology (OUAT), Bhubaneswar, India- 751003

*Corresponding author, Email: amit.orgchemistry@gmail.com;

Contact No. +91-9634800400

Abstract: The present study explores the integrated approach for the sustainable production of biodiesel from *Chlorella vulgaris* microalgae. The microalgae were cultivated in 10 m^2 open raceway pond at semi-continuous mode with optimum volumetric and areal production of 28.105 kg/L/y and 71.51t/h/y, respectively. Alum was used as flocculent for harvesting the microalgae and optimized at different pH. Lipid was extracted using chloroform: methanol (2:1) and having 12.39% of FFA. Effect of various reaction conditions such as effect of catalyst, methanol:lipid ratio, reaction temperature and time on biodiesel yields were studied under microwave irradiation; and 84.01% of biodiesel yield was obtained under optimized reaction conditions. A comparison was also made between the biodiesel productions under conventional heating and microwave irradiation. The synthesized biodiesel was characterized by ^{1}H NMR, ^{13}C NMR, FTIR and GC; however, fuel properties of biodiesel were also studied using specified test methods as per ASTM and EN standards.

Key words: *Chlorella vulgaris*; Open raceway cultivation; microwave irradiation; biodiesel

Introduction:

Energy security, environmental concerns, increase in industrialization and living standards of the society across the world are the major reasons to be considered as driving force to look for the alternative energy sources. Fossil fuels are the only primary source of energy and have been continuously used globally for the last few decades. The exhaustive exploitation and consumption of fossil fuels has resulted in discharge of these resources (Karpagam et al., 2015, Tale et al., 2014). Thus alternative renewable energy sources like wind, solar, hydropower, geothermal, hydrogen, nuclear and biomass have attracted a remarkable