Bioresource Technology 129 (2013) 7–11

Contents lists available at SciVerse ScienceDirect

Bioresource Technology

journal homepage: www.elsevier.com/locate/biortech

The influence of light intensity and photoperiod on the growth and lipid content of microalgae *Nannochloropsis* sp.

Suzana Wahidin [a], Ani Idris [b,*], Sitti Raehanah Muhamad Shaleh [c]

[a] Universiti Kuala Lumpur, Malaysian Institute of Chemical and Bioengineering Technology, 78000 Alor Gajah, Melaka, Malaysia
[b] Department of Bioprocess Engineering, Faculty of Chemical Engineering, c/o Institute of Bioproduct Development (IBD), Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia
[c] Borneo Marine Research Institute, Universiti Malaysa Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia

HIGHLIGHTS

- Light intensity and photoperiod cycle influences the growth *Nannochloropsis* sp.
- Light intensities at three photoperiod cycles are 50, 100 and 200 mol m^{-2} s^{-1}.
- Maximum cell growth was obtained at 100 mol m^{-2} s^{-1} and 18 h light: 6 h dark cycle.
- Improved specific growth rate is accompanied by improved lipid yields.

ARTICLE INFO

Article history:
Received 5 September 2012
Received in revised form 4 November 2012
Accepted 5 November 2012
Available online 16 November 2012

Keywords:
Microalgae
Nannochloropsis sp.
Light intensity
Photoperiod
Lipid

ABSTRACT

Illumination factors such as length of photoperiod and intensity can affect growth of microalgae and lipid content. In order to optimize microalgal growth in mass culture system and lipid content, the effects of light intensity and photoperiod cycle on the growth of the marine microalgae, *Nannochloropsis* sp. were studied in batch culture. *Nannochloropsis* sp. was grown aseptically for 9 days at three different light intensities (50, 100 and 200 μmol m^{-2} s^{-1}) and three different photoperiod cycles (24:0, 18:06 and 12:12 h light:dark) at 23 °C cultivation temperature. Under the light intensity of 100 μmol m^{-2} s^{-1} and photoperiod of 18 h light: 6 h dark cycle, *Nannochloropsis* sp. was found to grow favorably with a maximum cell concentration of 6.5×10^7 cells mL^{-1}, which corresponds to the growth rate of 0.339 d^{-1} after 8 day cultivation and the lipid content was found to be 31.3%.

1. Introduction

Microalgae are the current renewable feedstock for biodiesel production due to higher photosynthesis efficiency, fast generation of biomass and rapid growth potential compared to other energy crops (Minowa et al., 1995; Milne et al., 1990; Dote et al., 1994). According to Chisti (2007) rapid growth rate or higher biomass productivity of microalgae commonly depend on their potential to double their biomass during exponential phase within 24 h or in a short period (210 min). The mass of oil yield per unit volume of the microalgal broth per day is defined as oil productivity and it is dependent on the growth rate of algal and also its biomass contents.

Microalgae such as green algae have been found to contain proportionally high level of lipids. Different kinds of microalgae have different capability in producing lipid yields for lipid productivity, depending on types of microalgae species. Among the locally marine microalgae, *Nannochloropsis* sp. displayed the best potential micro-biodiesel production because they have both high biomass productivity and high lipid content (Thi et al., 2011). Similar findings were reported by Rodolfi et al. (2009), Moazami et al. (2011), Chiu et al. (2008) and Gouveia and Oliveira (2009). Recently, Moazami et al. (2012). Have produced *Nannochloropsis* sp. in a large scale open pond system with illumination provided by daily sunlight (150 μmol m^{-2} s^{-1}). *Nannochloropsis* sp. is a photoautotrophic microalgae belonging to the *Eustigmatophyceae* classis. Marine microalgae *Nannochloropsis* sp. contains high levels of lipids from 31% to 68% dry weight (Chisti, 2007). Damiani et al. (2008) and Pyle et al. (2008) reported that lipid extraction for *Nannochloropsis* sp. has the following composition: triglycerides: 37.74%; other nonpolar hydrocarbons, isoprenoids: 8.72% and polars, glycolipids, phospholipids: 3.54%. The modification of culture conditions, specifically the variations of salinity and the concentration of carbon

* Corresponding author. Tel.: +60 7 5535603; fax: +60 7 5588166.
E-mail address: ani@cheme.utm.my (A. Idris).

0960-8524/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biortech.2012.11.032