Abstract

Global warming due to greenhouse gases like, CO_2 is a major concern. Green algae may be used for CO_2 sequestration, bioenergy generation (e.g. biohydrogen) and production of many biomolecules (e.g. pigments). Suitable physico-chemical parameters were determined for the maximization of the growth of *C. sorokiniana.* Most suitable growth conditions like light intensity, temperature, pH and acetic acid concentration were 100 µmol m^{-2} s^{-1}, 30 ^oC, 7.5 and 34.8 mM respectively. Image analysis technique was used to determine the light distribution pattern inside the photobioreactor. Light was found mostly within 3 cm of the culture suspension irrespective of incident light intensity and cell concentration. Parameters such as CO_2 concentration, modification of medium to control pH, transport properties of different photobioreactors like volumetric mass transfer coefficient (K_La) and mixing time were determined for the comparative studies. Five percent CO_2 was found most suitable, resulting into CO_2 sequestration of 8.05 ± 0.09 g L^{-1} in a batch of 13 days in airlift reactor. Modelling and simulation of the growth profile was carried out using the logistic equation. In continuous mode of operation, maximum biomass productivity was 0.11 g L^{-1} h^{-1} at a dilution rate of 0.05 h^{-1}. Application of this microorganism for CO_2 sequestration was conducted using industrial flue gas rich in CO_2 and H_2S. Among different strategies used, serially connecting photobioreactors was found most promising for CO_2 sequestration. Algal biomass as substrate for a potent hydrogen producing bacteria, *E. cancerogenus (cloacae)* IIT-BT 08 was investigated. Pretreatment of algal biomass with 2% (v/v) HCl followed by heat was found suitable for hydrogen production. Hydrogen yield of 9 ± 0.2 mole H_2 (kg COD reduced)$^{-1}$ was obtained in double jacketed bioreactor. Hydrogen production profile followed the modified Gompertz equation. Proximate, elemental, pigment and fatty acids analysis of algal biomass were carried out. Algal biomass was found rich in Magnesium, Calcium and Iron. Stoichiometric analysis revealed that synthesis of 1 g of algal biomass consumes nearly 1.83 g of CO_2 from air. Both the length of the fatty acids and their degree of unsaturation in algae were increased in case of using flue gas.

Keywords: photobioreactor; growth kinetics; image analysis; flue gas; biomass analysis