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"Gheorghe Asachi" Technical University of Iasi, Romania

P69

ON THE POTENTIAL UTILIZATION OF NANNOCHLORIS EUCARYOTUM AS FEEDSTOCK FOR CO_2 CAPTURE AND BIOFUELS PRODUCTION

G.A. Lutzu[1], A. Concas[*2], A.M. Locci[3], G. Cao[*1,2,3,4]

[1]Centro Interdipartimentale di Ingegneria e Scienze Ambientali (CINSA), Via San Giorgio 12, 09123 Cagliari, Italy
[2]Centro di ricerca Sviluppo e Studi Superiori in Sardegna(CRS4), Parco Scientifico e Tecnologico POLARIS,Edificio 1, 09010 PULA (CA-Italy); [3]Dipartimento di Ingegneria Chimica e Materiali dell'Università di Cagliari; [4]Piazza d'Armi, 09123 Cagliari, Italy; [4]Laboratorio del Consorzio Interuniversitario Nazionale "La Chimica per l'Ambiente" (INCA), Via San Giorgio 12, 09123 Cagliari, Italy

Abstract

The production of biofuels from renewable resources is critical to accomplish a sustainable economy and to face global climate changes. In recent years, the potential use of microalgae as renewable feedstock for the massive production of liquid biofuels has received a rising interest mostly driven by the global concerns related to the depletion of fossil fuels supplies and the increase of CO_2 levels in the atmosphere. On the other hand the current microalgae-based technology is still not widespread since it is affected by technical and economic constraints that hinder its full scale-up. In particular, the main barriers are related to the extensive land's areas needs as well as to the high costs of the operating phases of microalgae cultivation, harvesting and lipid extraction.

Thus, the main target of scientific community is to identify, and/or to create, new microalgae strains which are intrinsically characterized by high biomass productivity and high lipid content as well as by the capability of capturing CO_2 from flue gases. A further goal is to suitably exploit process engineering techniques to identify the operating conditions of photobioreactors (i.e. light supply, mass transfer, culture media etc.) that maximize lipid productivity and CO_2 fixation. Moreover, the exploitation of costless feedstocks such as seawater, wastewater and flue gas as sources of macronutrients (C, N, P), might greatly improve the economic feasibility of the microalgae-based technology while simultaneously producing a positive impact on important environmental concerns such as water and air pollution. In this work the growth kinetics of Nannochloris Eucaryotum (a relatively unknown marine strain) in batch and semi-batch photobioreactors is investigated. In particular, the maximum growth rate and the half saturation constants, for nitrate and bi-phosphate, are evaluated for the first time with the aim of developing suitable mathematical models for process engineering and its optimization. In addition to the study of growth kinetics, the possibility of exploiting wastewater as source of macronutrients for N. Eucaryotum is verified. Finally, the potential use of 100%v/v CO_2 gas as carbon source is evaluated for the first time in the literature. It is shown that the use of pure CO_2 led to the increase of growth rate and lipid content of N. Eucaryotum, thus improving its biomass and lipid productivity. In addition, the oil extracted from N. Eucaryotum grown under 100%v/v CO_2 bubbling shows good quality in view of its exploitation as feedstock for the production of biofuels. In fact, once the trans-esterification process is performed for analytical purposes, the resulting fatty acid composition is in compliance with the European Regulation for biodiesel.