Unidad de Vigilancia

Microalgas

Boletín Septiembre 2015

Índice

Publicaciones

En esta sección del presente boletín se presentarán dos publicaciones de cada una de los 28 ejes principales del árbol. En futuros boletines serán seleccionados por una o dos ejes según mayoría de pedidos realizados.

Referente a la eje 1 BioProcesos-Cultivo-Piletones

Effect of temperature and light on the growth of algae species: A review

Fecha de Publicación: Octubre 2015
Fuente: Renewable and Sustainable Energy Reviews, Volume 50
Autor(es): S.P. Singh, Priyanka Singh
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS1364032115004839%26_version%3D1%26md5%3Da94ecf27b5682e56f846f31794fb3669

Abstract

Algae are fast growing biomass and can be converted to Biodiesel fuel. The demand of biodiesel is growing worldwide. Microalgae need a light:dark regime for productive photosynthesis. Light conditions and Temperature affect directly the growth rate of microalgae (duration and intensity).Literature review of some Green algae species Chlorella, Spirogyra, Chlamydomonas, Botryococcus, Scenedesmus, Neochloris, Haematococcus, Nannochloropsis, Ulva species and few species of brown algae, red algae, blue green algae were chosen to study the effect of temperature and light intensity on their growth. Optimum temperature range 20°C to30°C was observed for growth of different algae species. Light irradiance varies between 33µmolm−2 s−1 to 400µmolm−2 s−1. Maximum growth rate was found 1.73d−1 for Selenastrum minutum at 35°C and 420µmolm−2 s−1 irradiance. Minimum growth rate (0.10d−1) was reported for Botryococcus braunii KMITL 2 strain at temperature 25°C, photoperiod 24:0 and 200µmolm−2 s−1 irradiance.

Recent trends in the mass cultivation of algae in raceway ponds

Fecha de Publicación: 2015
Fuente: Renewable and Sustainable Energy Reviews 51 (2015) 875–885
Autor(es): Kumar, K. | Mishra, S.K. | Shrivastav, A. | Park, M.S. | Yang, J.-W.

Enlace:
http://syndic8.scopus.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.scopus.com%2Finward%2Frecord.url%3Feid%3D2-s2.0-84937433825%26rel%3DR4.0.0%26partnerID%3D35%26md5%3Dea8e89a7d61c5257ccd50cdeaa8163e3

Abstract

Algal technology has potential to combat the global energy crisis, malnutrition, and production of several value added products useful for the mankind. The cost effective cultivation system is the basis to realize this goal. Microalgal production in raceway ponds seems to be most promising, especially in the large scale. Several environmental (location of the cultivation system, rainfall, solar radiation, etc.), engineering (pond depth, CO2 delivery system, methods of mixing, power consumption, etc.), and biological (light, pH, oxygen accumulation, salinity, Algal predators etc.) parameters affect the biomass productivity in the open pond system. Vertical mixing is an important criteria influencing the algal growth compared to axial mixing as it determines the frequency by which cell will travel from bottom (dark zone) to surface (light zone) of the open pond. Therefore, different research works on the various designs of raceway ponds were mostly focused towards enhancing the vertical mixing (e.g. Design of bend and surface geometry, engineering flow field, etc.) and CO2 residence time (e.g. Closed, sump, airlift driven raceway ponds etc.). The present study summarizes the current state of knowledge for the biomass production in raceway ponds.

Referente a la eje 2 BioProcesos-Cultivo-Biorreactor/FBR

A mini review: photobioreactors for large scale algal cultivation

Fecha de Publicación: 2015
Fuente: World Journal of Microbiology and Biotechnology DOI 10.1007/s11274-015-1892-4
Autor(es): Gupta, P.L. | Lee, S.-M. | Choi, H.-J.
Enlace:
http://syndic8.scopus.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.scopus.com%2Finward%2Frecord.url%3Feid%3D2-s2.0-84931298814%26rel%3DR4.0.0%26partnerID%3D35%26md5%3D0c752054c0aef5c88e5321674d863f80

Abstract

Microalgae cultivation has gained much interest in terms of the production of foods, biofuels, and bioactive compounds and offers a great potential option for cleaning the environment through CO2 sequestration and wastewater treatment. Although open pond cultivation is most affordable option, there tends to be insufficient control on growth conditions and the risk of contamination. In contrast, while providing minimal risk of contamination, closed photobioreactors offer better control on culture conditions, such as: CO2 supply, water supply, optimal temperatures, efficient exposure to light, culture density, pH levels, and mixing rates. For a large scale production of

biomass, efficient photobioreactors are required. This review paper describes general design considerations pertaining to photobioreactor systems, in order to cultivate microalgae for biomass production. It also discusses the current challenges in designing of photobioreactors for the production of low-cost biomass.

CFD simulation for reduced energy costs in tubular photobioreactors using wall turbulence promoters

Fecha de Publicación: Noviembre 2015
Fuente: Algal Research, Volume 12
Autor(es): C.A. Gómez-Pérez, J. Espinosa, L.C. Montenegro Ruiz, A.J.B. van Boxtel
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS2211926415300217%26_version%3D1%26md5%3D6b3cc07c1c74f4a0488247cd73d8b999
Abstract

Tubular photobioreactors (PBR) have great potential for microalgae cultivation due to its high productivity compared with open ponds. However, the energy uptake for fluid circulation and mixing is significant, impacting the operation and production costs. In this work, we investigate by CFD simulation the effect of wall turbulence promoters, i.e. profiles at the inner tube wall, at low flow velocities (0.1–0.3m/s). The use of these wall turbulence promoters is compared to the mixing behaviour in standard tubular PBRs at flow velocity of 0.5m/s. It was found that the wall turbulence promoters have at flow velocities of 0.2–0.25m/s better mixing behaviour as in standard PBRs while the energy uptake is 60–80% lower.

Referente a la eje 3 BioProcesos-Cultivo-Heterotrófico

Optimizing energy yields from nutrient recycling using sequential hydrothermal liquefaction with Galdieria sulphuraria

Fecha de Publicación: Noviembre 2015
Fuente: Algal Research, Volume 12
Autor(es): T. Selvaratnam, H. Reddy, Tapaswy Muppaneni, F.O. Holguin, N. Nirmalakhandan, Peter J. Lammers, S. Deng
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS2211926415300175%26_version%3D1%26md5%3Dc217f0256376fd65ca099f874b33503c

Abstract

Hydrothermal liquefaction (HTL) provides a promising option for extracting bio-crude oil from wet algal biomass. One of the byproducts of HTL is an aqueous phase (AP) rich in organic carbon and nutrients. This study evaluated the hypothesis that recycling the AP to the cultivation step could enhance biomass productivity and net energy yield. Since the yields of bio-crude and nutrients post-HTL are functions of HTL reaction temperature, this study evaluated the impact of reaction temperature on net energy yield. Nutrient recycle experiments were conducted with a low-lipid, acidophilic strain, Galdieria sulphuraria, being developed for single-step removal of organic carbon, nitrogen and phosphorus from urban wastewater. G. sulphuraria was cultivated in different dilutions of the AP generated by HTL performed between 180 and 300°C. Biomass productivity recorded in this study with recycled AP was greater than that in the control by a factor as much as 1.94. Estimates of net energy yields indicate the optimum temperature for the second-stage HTL bio-crude oil extraction from G. sulphuraria to be 280 to 300°C.

Enhanced lipid accumulation and biodiesel production by oleaginous Chlorella protothecoides under a structured heterotrophic-iron (II) induction strategy

Fecha de Publicación: 2015
Fuente: World Journal of Microbiology and Biotechnology
Autor(es): Li, Y. | Mu, J. | Chen, D. | Xu, H. | Han, F.
Enlace:
http://syndic8.scopus.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.scopus.com%2Finward%2Frecord.url%3Feid%3D2-s2.0-84923797731%26rel%3DR4.0.0%26partnerID%3D35%26md5%3D8da6a5439dbfb36f99037fb26fa9b435

Abstract

A structured heterotrophic-iron (II) induction (HII) strategy was proposed to enhance lipid accumulation in oleaginous Chlorella protothecoides. C. protothecoides subjected to heterotrophic-iron (II) induction achieved a favorable lipid accumulation up to 62 % and a maximum lipid productivity of 820.17 mg/day, representing 2.78-fold and 3.64-fold increase respectively over heterotrophic cultivation alone. HII-induced cells produced significantly elevated levels of 16:0, 18:1D9, and 18:2D9, 12 fatty acids (over 90 %). The lipid contents and plant lipid-like fatty acid compositions exhibit the potential of HII-induced C. protothecoides as biodiesel feedstock. Furthermore, 31 altered proteins in HII-induced algal cells were successfully identified. These differentially expressed proteins were assigned into nine molecular function categories, including carbohydrate metabolism, lipid biosynthesis, Calvin cycle, cellular respiration, photosynthesis, energy and transport, protein biosynthesis, regulate and defense, and unclassified. Analysis using the Kyoto encyclopedia of genes and genomes and gene ontology annotation showed that malic enzyme, acyltransferase, and ACP were key metabolic checkpoints found to

modulate lipid accumulation in C. protothecoides. The results provided possible applications of HII cultivation strategy in other microalgal species and new possibilities in developing genetic and metabolic engineering microalgae for desirable lipid productivity.

Referente a la eje 4 BioProcesos-Cosecha-Centrifugado

Biological effects of chitosan and its derivatives10:46 06/06/2015, Bioprocesos, Cosecha, Centrifugado

Fecha de Publicación: Octubre 2015
Fuente: Food Hydrocolloids, Volume 51
Autor(es): Dai-Hung Ngo , Thanh-Sang Vo , Dai-Nghiep Ngo , Kyong-Hwa Kang , Jae-Young Je , Hoang Nguyen-Duc Pham , Hee-Guk Byun , Se-Kwon Kim
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http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0268005X15002246%26_version%3D1%26md5%3Dd27f0f8135063478e8b41fc4c351f403

Abstract

Chitosan is a natural nontoxic biopolymer produced by alkaline deacetylation of chitin. Chitin and chitosan are insoluble in water as well as most organic solvents. Chito-oligomers (COS), depolymerized products of chitosan, has received much attention in biomedical, food, pharmaceutical, agricultural and environmental industries due to their biocompatible, biodegradable, non-toxic and non-allergenic natures. Chitosan and its derivatives have been shown to possess diverse biological activities, including antioxidant, anti-hypertensive, anti-coagulant, anti-diabetic, anti-obesity, anti-allergic, anti-inflammatory, anti-microbial, anti-cancer, neuroprotective and matrix metalloproteinases inhibitory effects. Thus, this overview mainly focuses on biological effects of chitosan and its derivatives as well as presents their potential applications as ingredients in functional foods and nutraceuticals for the prevention or treatment of chronic diseases.

Life cycle analysis of β-carotene extraction techniques

Fecha de Publicación: Diciembre 2015
Fuente: Journal of Food Engineering, Volume 167, Part A
Autor(es): Konstantina Kyriakopoulou, Sofia Papadaki, Magdalini Krokida
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_ori

gin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0260877415000990%26_version%3D1%26md5%3Dd2348cec0973ae0eb833b2ff25ce08fc

Abstract

In this study, multifunctional extracts from Dunaliella salina microalga and Daucus carota carrots have been suggested as food additives since they are rich in B-carotene, a widely used coloring and antioxidant agent. A comparative analysis between conventional solvent extraction and innovative green extraction methods, using microwaves and ultrasounds, has been conducted. The isolation of b-carotene, as well as, the environmental impact of each method, were the criteria for the processes evaluation. In order to evaluate the selected extraction processes' sustainability, a comparative life cycle analysis was carried out from farm/cultivation to recovery process, using proper databases and software. The comparative analysis for both matrices revealed that the cultivation and harvesting of D. salina in open ponds exhibits an overall environmental impact greater than of the carrots farming. Nonetheless, D. salina 's high content in β-carotene leads to higher extraction yields and therefore to extraction processes with lower impact. UAE is the indicated extraction technique for the sustainable recovery of β-carotene from microalgae. This study is a laboratory-scale application with potential scale up practice for nutraceutical, cosmetic and food industries.

Referente a la eje 5 BioProcesos-Cosecha-Floculación

Evaluation of several flocculants for flocculating microalgae

Fecha de Publicación: Diciembre 2015
Fuente: Bioresource Technology, Volume 197
Autor(es): Jinheng Wu, Jiexia Liu, Lifang Lin, Chengwu Zhang, Aifen Li, Yi Zhu, Yuanming Zhang
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960852415012006%26_version%3D1%26md5%3Da0725aa3e3681106b34c87db6713f11c

Abstract

Flocculation of microalgae with chitosan, polyacrylamide, Al2(SO4)3, NaOH and HNO3 was evaluated. Their flocculation efficiencies and optimal dosages were discussed. The effects of the flocculants on cells viability were also investigated and the cells were found to be intact during the flocculation process. Moreover, the effects of flocculants on the extractions were evaluated. Lipid content after flocculants treatments showed no significant differences. Carbohydrate content was lower but protein content was higher after NaOH treatment than those after other treatments. Furthermore, the five flocculated media maintained approximate growth yields to that of the fresh medium in microalgal cultivation, indicating the five flocculated media could be recycled, thereby reducing the cost of biodiesel production from microalgae. Finally, economic comparison of the

flocculants was made and the cost of using HNO3, including flocculating cells and recycling medium, was found to be the lowest.

Reversible Flocculation of Microalgae using Magnesium Hydroxide

Fecha de Publicación: 2015
Fuente: Bioenergy Research DOI 10.1007/s12155-014-9554-1
Autor(es): Dries Vandamme & Annelies Beuckels & Giorgos Markou & Imogen Foubert & Koenraad Muylaert
Enlace:
http://syndic8.scopus.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.scopus.com%2Finward%2Frecord.url%3Feid%3D2-s2.0-84939796390%26rel%3DR4.0.0%26partnerID%3D35%26md5%3D3835b0a6327a1f7782958e1fbafda9a0

Abstract

Flocculation of microalgae is a promising low-cost strategy to harvest microalgae for bulk biomass production. However, residual flocculants can interfere in further downstream processes or influence biomass quality. In this study, a new concept is demonstrated based on reversible magnesium hydroxide flocculation, using Chlorella vulgaris and Phaeodactylum tricornutum as, respectively, a freshwater and a marine model species. We show that flocculation was induced by precipitation of magnesium hydroxide at high pH (10 to 10.5). This resulted in a magnesium content of the microalgal biomass of 5 % for Chlorella and 18 % for Phaeodactylum. After pre-concentration of the microalgal biomass by gravity sedimentation, 95 % of the precipitated magnesium hydroxide could be removed from the biomass by mild acidification (pH 7 to 8). The pH fluctuations experienced by the microalgae during flocculation/de-flocculation had no influence on biomass composition (FAME, total N and P, carbohydrates, proteins, mineral content) and on the viability of microalgal cells. Magnesium can thus be used as pH dependent reversible flocculant for harvesting microalgae in both marine and freshwater medium

Referente a la eje 6 BioProcesos-Cosecha-Flotación

Flotation of algae for water reuse and biomass production: Role of zeta potential and surfactant to separate algal particles

Fecha de Publicación: 2015
Fuente: Water Science and Technology Vol. 72 Issue 5, p762-769. 8p.
Autor(es): Kwak, D.-H.; Kim, M.-S.

Enlace:
http://syndic8.scopus.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=ou

tward&url=http%3A%2F%2Fwww.scopus.com%2Finward%2Frecord.url%3Feid%3D2-s2.0-84939864689%26rel%3DR4.0.0%26partnerID%3D35%26md5%3D0e5bdd5f83017bdb2200aa74d0bd2986

Abstract

The effect of chemical coagulation and biological auto-flocculation relative to zeta potential was examined to compare flotation and sedimentation separation processes for algae harvesting. Experiments revealed that microalgae separation is related to auto-flocculation of Anabaena spp. and requires chemical coagulation for the whole period of microalgae cultivation. In addition, microalgae separation characteristics which are associated with surfactants demonstrated optimal microalgae cultivation time and separation efficiency of dissolved CO2 flotation (DCF) as an alternative to dissolved air flotation (DAF). Microalgae were significantly separated in response to anionic surfactant rather than cationic surfactant as a function of bubble size and zeta potential. DAF and DCF both showed slightly efficient flotation; however, application of anionic surfactant was required when using DCF.

An innovative electrochemical process to alleviate the challenges for harvesting of small size microalgae by using non-sacrificial carbon electrodes

Fecha de Publicación: Disponible online 4 Septiembre 2015
Fuente: Algal Research
Autor(es): Abhishek Guldhe, Rohit Misra, Poonam Singh, Ismail Rawat, Faizal Bux
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS2211926415300424%26_version%3D1%26md5%3D3014a9990948e7db90314d9ac4fd7624

Abstract

Harvesting of microalgal biomass is still a bottleneck to its commercial scale application, due to small cell size, low culture densities, colloidal stability and thus unfavourable economics. Centrifugation is an efficient technique but the high energy consumption makes it unsuitable for low value microalgal products. Chemical flocculation and filtration are inefficient and time consuming methods for harvesting of small size microalgae. In this study, an electrochemical harvesting (ECH) process was assessed for the harvesting of a small size microalga Ankistrodesmus falcatus by using non-sacrificial carbon electrodes. Harvesting efficiency of ECH was compared to centrifugation and flocculation using alum and chitosan. The highest recovery efficiency was obtained by centrifugation (93% after 15min) followed by ECH process (91% after 30min), alum (86% after 60min) and chitosan (55% after 60min). However, the energy consumption of ECH process (1.76kWhkg−1) was much lower than the centrifugation process (65.34kWhkg−1). The biochemical composition of harvested biomass was also assessed, and it was found that the ECH process has no deteriorating effect on the quality of biomass. High recovery efficiency, low energy

consumption and the use of non-sacrificial electrodes make ECH a sustainable harvesting technique for small size microalgae.

Referente a la eje 7 BioProcesos-Cosecha-Filtración

Ultrafiltration of non-axenic microalgae cultures: Energetic requirements and filtration performance

Fecha de Publicación: 2015
Fuente: Algal Research
Autor(es): Pavez, J.; Cabrera, F.; Azócar, L.; Torres, A.; Jeison, D.
Enlace:
http://syndic8.scopus.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.scopus.com%2Finward%2Frecord.url%3Feid%3D2-s2.0-84937540156%26rel%3DR4.0.0%26partnerID%3D35%26md5%3D2567722ac11088f21cff35ed7e2f717e

Abstract

Microalgae represent a promising source of biomass for the production of bioproducts and biofuels. However, microalgae cultures are usually diluted. Harvesting processes need then to achieve high levels of volumetric reduction, which is normally energetically demanding. Membrane processes have been recently proposed as an alternative for microalgae concentration. During this research, membrane concentration of non-axenic cultures of saline microalga Nannochloropsis gaditana and freshwater Chlorella sorokiniana was evaluated by a series of batch filtration tests, using tubular ultrafiltration membranes. Theoretical energy demands were determined, based on filtration performance during lab-scale filtration tests. Surface response methodology was also used to determine the effect of cross-flow velocity and biomass concentration over critical flux. Results indicate that exposure of the microalgae culture to cross-flow conditions for long periods may affect suspension properties, decreasing particle size, affecting permeate flux. This would result in high-energy demands when high concentration factors are required, starting from diluted cultures. Moreover, presence of bacteria, resulting from non-sterile conditions, may also determine filtration performance. However, membrane filtration may be an interesting alternative as a postconcentration step for processes normally providing low concentration factors, such as flotation and settling. Short term experiments show that critical fluxes of 50–70 L/m2/h can be achieved, depending on the microalgae, at cross flow velocities in the range of 1.5–2 m/s, when working at 40–50 g/L of VS. Further research would be needed to evaluate if this fluxes can be sustained for long periods.

Investigation of the effects of microalgal cell concentration and electroporation, microwave and ultrasonication on lipid extraction efficiency

Fecha de Publicación: Febrero 2016
Fuente: Renewable Energy, Volume 86
Autor(es): Temesgen Garoma, Danielle Janda
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960148115302093%26_version%3D1%26md5%3D51892bed9dcd234d098deea34826b012

Abstract

This study investigated the effects of Chlorella vulgaris (C. vulgaris) concentrations and pretreatment methods, electroporation, ultrasonication, and microwave, on lipids extraction. The C. vulgaris concentrations were varied in the range of 8.4–28.8% for chloroform/methanol/water solvent system and in the range of 7.6–32.0% for n-hexane/methanol/water solvent system. A maximum total lipid yield of 0.248 g/g of dry C. vulgaris was achieved at biomass concentration of about 15% for the chloroform/methanol/water system. This is the highest yield reported for lipids extracted without pretreatment. On the other hand, a maximum lipids yield of 0.139 g/g of dry C. vulgaris was obtained at about 24% biomass concentration for the n-hexane/methanol/water system. When pretreated with electroporation, ultrasonication, and microwave, the yield for lipid extraction increased by 5.3, 26.4, and 28.9%, respectively. Although electroporation resulted in the least amount of yield, it was the most efficient in terms of energy gain per energy input.

Referente a la eje 8 BioProcesos-Secado

Pathways of processing of wet microalgae for liquid fuel production: A critical review

Fecha de Publicación: Diciembre 2015
Fuente: Renewable and Sustainable Energy Reviews, Volume 52
Autor(es): Sofia Chaudry, Parisa A. Bahri, Navid R. Moheimani
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS1364032115008473%26_version%3D1%26md5%3D9ddcdbebec76094fe403f0645df392c7

Abstract

Microalgae have tremendous potential for producing liquid renewable fuel. Many methods for converting microalgae to biofuel have been proposed; however, an economical and energetically feasible route for algal fuel production is yet to be found. This paper presents a review on the comparison of the most promising conversion pathways of microalgae to liquid fuel: hydrothermal liquefaction (HTL), wet extraction and non-destructive extraction. The comparison is based on important assessment parameters of product quality and yield, nutrient recovery, GHG emissions, energy and the cost associated with the production of fuel from microalgae, in order to better understand the pros and cons of each method. It was found that the HTL pathway produces more oil than the wet extraction pathway; however, higher concentrations of unwanted components are present in the HTL oil produced. Less nutrients (N and P) can be recovered in HTL compared to wet extraction. HTL consumes more fossil energy and generates higher GHG emissions than wet extraction, while the production cost of fuel from HTL pathway is lower than wet extraction pathway. There is considerable uncertainty in the comparison of the energy consumption and economics of the HTL pathway and the wet extraction pathway due to different scenarios analysed in the assessment studies. To be able to appropriately compare methodologies, the conversion methods should be analysed from growth to upgradation of oil utilising sufficiently similar assumptions and scenarios. Based on the data in available literature, wet oil extraction is the more appropriate system for biofuel production than HTL. However, the potential of alternative extraction/conversion technologies, such as, non-destructive extraction, need to be further assessed.

Biorenewable chemicals: Feedstocks, technologies and the conflict with food

Fecha de Publicación: Noviembre 2015
Fuente: Renewable and Sustainable Energy Reviews, Volume 51
Autor(es): Soubhik K. Bardhan , Shelaka Gupta , M.E. Gorman , M. Ali Haider
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS1364032115005833%26_version%3D1%26md5%3Dc24ef971dc4a8ad5f463ad1058aee021

Abstract

Volatile petroleum product prices along with depleting resources of oil and increasing environmental concerns had prompted several government agencies to promote and subsidize the production of biofuels from edible crops. The alarming rate at which edible crops were being deviated to produce biofuels caused the price of food crops like corn to shoot by a margin of over 100% in the initial three years (2005–2007). The twenty-first century has so far witnessed an enormous growth in production of biorenewable chemicals. The economically more lucrative business of biorenewable chemicals is currently projected to grow at a compounded annual growth rate of 22.4% and account for 45% of the chemicals produced in the US by 2025. This calls for a thoughtful regulation of the parameters, which should be considered for the production of

biorenewable chemicals, in order to avoid any direct conflict with food production. This study addresses the possible edible and non-edible feedstock sources, conversion technologies used, conflict with food production accessed in terms of market scenario, environmental concerns and availability of land area for the effective conversion of the individual generation of feedstocks to biorenewable chemicals.

Referente a la eje 9 BioProcesos-Extracción-Soxhlet

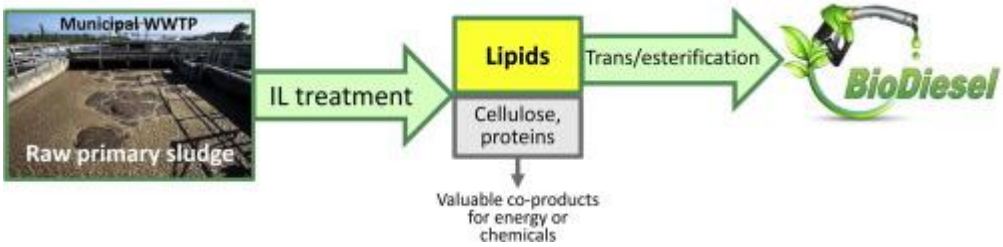
Efficient extraction of lipids from primary sewage sludge using ionic liquids for biodiesel production

Fecha de Publicación: 16 Octubre 2015
Fuente: Separation and Purification Technology, Volume 153
Autor(es): Magdalena Olkiewicz, Natalia V. Plechkova, Azael Fabregat, Frank Stüber, Agustí Fortuny, Josep Font, Christophe Bengoa
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS1383586615301738%26_version%3D1%26md5%3Dc835a24feddc9f6ea3c5f43082df7562

Abstract

This study proposes a novel method to extract lipids from wet primary sludge for biodiesel production using ionic liquids. Tetrakis(hydroxymethyl)phosphonium chloride and widely used 1-butyl-3-methylimidazolium methyl sulfate were evaluated to extract lipids from raw and dried sludge (96% and 2%, wt. water content, respectively) and compared to the conventional Soxhlet method using organic solvents. Both these ionic liquids showed suitability for lipid extraction from raw sludge, giving even better results than expected from dried sludge. The [C4mim][MeSO4] ionic liquid reached 18.5% and 26.9% of lipids, 14.1% and 18.4% of biodiesel from dried and raw sludge, respectively. The [P(CH2OH)4]Cl ionic liquid gained 23.4% and 27.6% of lipids, 17.0% and 19.8% of biodiesel from dried and raw sludge respectively, reaching comparable results to the conventional Soxhlet method (27.2% of lipids, 19.4% of biodiesel). Therefore, the proposed ionic liquid process is efficient in lipid extraction directly from wet primary sludge, eliminating the expensive step of sludge drying and the use of volatile organic solvents. Under the optimised extraction conditions using [P(CH2OH)4]Cl ionic liquid and raw sludge (1:5 sludge (g/TS):IL (cm3) ratio, 100°C and 3h), the obtained yield of lipids and biodiesel amounted to 25.7% and 21.1%, respectively. Additionally, lipid extraction using [P(CH2OH)4]Cl ionic liquid also precipitates cellulosic material, which allows for direct and easy cellulose-based co-product recovery, giving high additional value to the process. Consequently, the economic and environmental aspects of biodiesel production from sewage sludge could be improved.

Graphical abstract



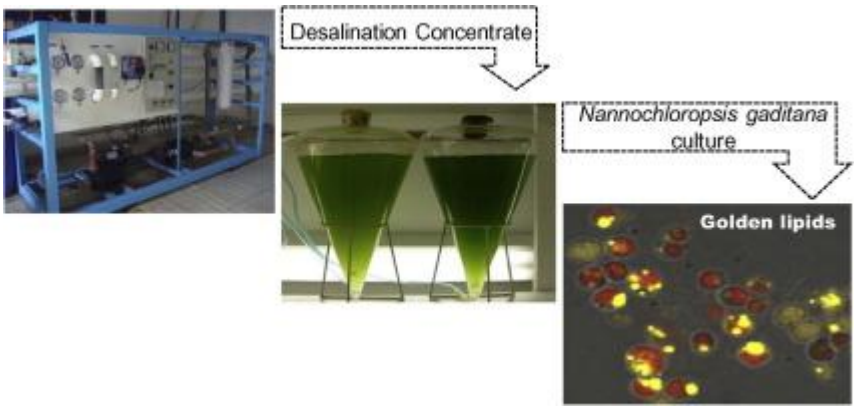
Biomass, lipid productivities and fatty acids composition of marine Nannochloropsis gaditana cultured in desalination concentrate

Fecha de Publicación: Diciembre 2015
Fuente: Bioresource Technology, Volume 197
Autor(es): Ângelo Paggi Matos, Rafael Feller, Elisa Helena Siegel Moecke, Ernani Sebastião Sant'Anna
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960852415011475%26_version%3D1%26md5%3Dead62689f7c9fa5161fd932b5c297cb7

Abstract

In this study the feasibility of growing marine Nannochloropsis gaditana in desalination concentrate (DC) was explored and the influence of the DC concentration on the biomass growth, lipid productivities and fatty acids composition was assessed. The reuse of the medium with the optimum DC concentration in successive algal cultivation cycles and the additional of a carbon source to the optimized medium were also evaluated. On varying the DC concentration, the maximum biomass concentration (0.96gL−1) and lipid content (12.6%) were obtained for N. gaditana in the medium with the optimum DC concentration (75%). Over the course of the reuse of the optimum DC medium, three cultivation cycles were performed, observing that the biomass productivity is directly correlated to lipid productivity. Palmitic acid was the major fatty acid found in N. gaditana cells. The saturated fatty acids content of the algae enhanced significantly on increasing the DC concentration.

Graphical abstract



Referente a la eje 10 BioProcesos-Extracción-Supercrítica

Cell-wall disruption and lipid/astaxanthin extraction from microalgae: Chlorella and Haematococcus

Fecha de Publicación: Disponible online 31 Agosto 2015
Fuente: Bioresource Technology
Autor(es): Dong-Yeon Kim, Durairaj Vijayan, Ejesamy Praveenkumar, Jong-In Han, Kyubock Lee, Ji-Yeon Park, Won-Seok Chang, Jin-Suk Lee, You-Kwan Oh
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960852415012134%26_version%3D1%26md5%3D3b11e255b3a69543ec31a7632ce2cc1f

Abstract

Recently, biofuels and nutraceuticals produced from microalgae have emerged as major interests, resulting in intensive research of the microalgal biorefinery process. In this paper, recent developments in cell-wall disruption and extraction methods are reviewed, focusing on lipid and astaxanthin production from the biotechnologically important microalgae Chlorella and Haematococcus, respectively. As a common, critical bottleneck for recovery of intracellular components such as lipid and astaxanthin from these microalgae, the composition and structure of rigid, thick cell-walls were analyzed. Various chemical, physical, physico-chemical, and biological methods applied for cell-wall breakage and lipid/astaxanthin extraction from Chlorella and Haematococcus are discussed in detail and compared based on efficiency, energy consumption, type and dosage of solvent, biomass concentration and status (wet/dried), toxicity, scalability, and synergistic combinations. This report could serve as a useful guide to the implementation of practical downstream processes for recovery of valuable products from microalgae including Chlorella and Haematococcus.

Biomass and carbon dioxide capture and storage: A review

Fecha de Publicación: Septiembre 2015
Fuente: International Journal of Greenhouse Gas Control, Volume 40
Autor(es): Jasmin Kemper
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS1750583615002650%26_version%3D1%26md5%3D85bd7d63455ac0562af42aae4585f97f

Abstract

This paper provides an overview of biomass with carbon capture and storage (Bio-CCS or BECCS) at the systems level. It summarises the relevant information from the recent 5th Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), describes the progress made since earlier reports and considers additional results recently published in literature. The focus is hereby not on the technical challenges but rather on the surrounding sustainability issues. Bio-CCS shows significant potential to achieve net CO2 removal from the atmosphere at a cost that is comparable to conventional CCS technologies. However, uncertainties remain due to the little experience with large-scale Bio-CCS demonstration plants, gaps in climate policies and accounting frameworks, missing financial instruments, unclear public acceptance and complex sustainability issues. A major conclusion is that the deployment of Bio-CCS cannot take place in isolation, thus will require an approach addressing the inextricable links within the food-water-energy-climate nexus.

Referente a la eje 11 BioProcesos-Extracción-Ultrasonido

Ultrasound-assisted green solvent extraction of high-added value compounds from microalgae Nannochloropsis spp

Fecha de Publicación: Disponible online 15 Septiembre 2015
Fuente: Bioresource Technology
Autor(es): O. Parniakov, E. Apicella, M. Koubaa, F.J. Barba, N. Grimi, N. Lebovka, G. Pataro, G. Ferrari, E. Vorobiev
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960852415012912%26_version%3D1%26md5%3Dd5806022b3711586b4cd3a88f960659e

Abstract

The aim of this work was to investigate ultrasound (US)–assisted green solvent extraction of valuable compounds from the microalgae Nannochloropsis spp. Individual green solvents (water, ethanol (EtOH), dimethyl sulfoxide (DMSO)) and binary mixture of solvents (water-DMSO and water-EtOH) were used for the extraction procedures. Maximum total phenolic compounds yield (Yp ≈0.33) was obtained after US pre-treatment (W=400 W, 15 min), being almost 5-folds higher compared to that found for the untreated samples and aqueous extraction (Yp ≈0.06). The highest yield of total chlorophylls (Yc ≈0.043) was obtained after US (W=400 W, 7.5 min), being more than 9-folds higher than those obtained for the untreated samples and aqueous extraction (Yc ≈0.004). The recovery efficiency decreased as DMSO>EtOH>H2O. The optimal conditions to recover phenolic compounds and chlorophylls from microalgae were obtained after US pre-treatment (400 W, 5 min), binary mixtures of solvents (water-DMSO and water-EtOH) at 25-30%, and microalgae concentration of 10%.

Ultrasound: A clean, green extraction technology

Fecha de Publicación: Septiembre 2015
Fuente: TrAC Trends in Analytical Chemistry, Volume 71
Autor(es): Brijesh K. Tiwari
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS016599361500148X%26_version%3D1%26md5%3D01f547b943a60b6ad1075817c98cf4cc

Abstract

The objective of this review is to discuss the ultrasound-assisted extraction (UAE) of various compounds using clean, green solvents. We also outline fundamental mechanisms and factors associated with the design and the development of clean, green UAE systems. Growing consumer demands for greener alternatives and natural ingredients that do not involve toxic chemicals and the environmental and health risk associated with the use of chemical solvents have attracted the interest of industries to sustainable, non-toxic routes of extraction. UAE can benefit the chemical industry in multiple ways: • enhancing extraction yield; • enhancing aqueous extraction processes without using solvents; • providing the opportunity to use alternative clean and/or green solvents by improving their extraction performance; and, • enhancing extraction of heat-sensitive components under conditions that would otherwise have low or unacceptable yields.

Referente a la eje 12 BioProductos-Biomasa Algal-Biogas

Accumulation of energy reserves in algae: From cell cycles to biotechnological applications

Fecha de Publicación: 1 Noviembre 2015
Fuente: Biotechnology Advances, Volume 33, Issue 6, Part 2

Autor(es): Milada Vitova, Katerina Bisova, Shigeyuki Kawano, Vilem Zachleder
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0734975015000919%26_version%3D1%26md5%3D34ea02a9f33ec15b6ac4328d47b3ea3d

Abstract

Starch and lipids are key components of algal cells and responsible for buffering variable supplies of energy and carbon that are vital for cell growth and reproduction, particularly DNA replication, nuclear and cellular division. The basic characteristics of energy reserves, their ultrastructure and localization inside the cell, regulation of their synthesis in relation to cell cycle phases, and their control by external factors, including light intensity, temperature, and carbon dioxide are described. Over the last two decades, research in this field has been boosted by possible biotechnological applications of algae for the production of biofuels from energy conserving compounds (bioethanol from starch and biodiesel from lipids). Recent findings on mechanisms that lead to an accumulation of exceptionally high levels of starch and lipids in algae will be summarized in this review. Macroelement (N, S, P) limitation, or depletion in mineral medium, as the most widely used approaches for enhancing both starch and lipid accumulation, are reviewed in detail. Potential biotechnological strategies for the economically viable overproduction of lipid and starch, such as a two-step procedure exploiting the effects of nutrient limitation and depletion, as well as the means and rationale for selecting appropriate strains, are discussed.

Quantification of methane losses from the acclimatisation of anaerobic digestion to marine salt concentrations

Fecha de Publicación: Febrero 2016
Fuente: Renewable Energy, Volume 86
Autor(es): Keiron P. Roberts, Sonia Heaven, Charles J. Banks
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960148115302469%26_version%3D1%26md5%3D28dc9262b06360db84b377d4674330b4

Abstract

The research assessed losses in methane production as a result of raising digester salt concentrations to marine values, and of increasing the feedstock sulphate concentration. Acclimatisation of inoculum from a municipal wastewater biosolids digester was begun by raising the concentration of chloride salts (Na, Mg, Ca and K) to 6–9 g L−1, as initial experiments showed higher concentrations caused severe inhibition. After stable operation for four retention times salt content in the reactors and the feed was increased by 1 g L−1 every 14 days, up to 31.1 g L−1. The digesters were fed daily in semi-continuous mode and monitored for performance and stability criteria including specific methane production (SMP). SMP was 6–7% less than in controls using

the same feedstock without saline addition. After steady-state conditions were achieved at high chloride salinity, magnesium chloride was partially replaced by magnesium sulphate to give a range of sulphate concentrations. Higher sulphate concentrations caused initial instability, indicated by volatile fatty acid accumulation. This subsequently reduced and stable operation was achieved at marine sulphate concentrations, but with a ~5% loss in SMP due to interspecies substrate competition. High sulphate also affected pH, leading to gaseous H2S production proportional to the applied sulphate load.

Referente a la eje 13 BioProductos-Biomasa Algal-Proteínas

An experimentally validated nitrate–ammonium–phytoplankton model including effects of starvation length and ammonium inhibition on nitrate uptake

Fecha de Publicación: 10 Deciembre 2015
Fuente: Ecological Modelling, Volume 317
Autor(es): Martino E. Malerba, Sean R. Connolly, Kirsten Heimann
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0304380015003877%26_version%3D1%26md5%3De8b6a3c15a3b7380ace8235d9452a339

Abstract

Nitrate and ammonium are the two most important ionic forms of inorganic nitrogen driving biomass production in marine and freshwater aquatic systems. The performance of plants and algae often changes when reared with either of these two forms of nitrogen individually, as well as when they are both present, or when cells have experienced previous periods of nitrogen starvation. Current functional responses quantifying how ambient nitrogen drives changes in population density are unable to capture interacting and transient effects of nitrate and ammonium. Hence, in this paper we formulate, calibrate, and test a new nitrate–ammonium quota model that accounts for nitrate and ammonium uptake, as well as the effects of nitrogen starvation length and ammonium-induced nitrate uptake inhibition. We fit the model with several time-series from the green alga Chlorella sp. reared in laboratory batch cultures under multiple initial conditions. We show that a single set of calibrated model parameters can capture time-series collected from experiments inoculated at 12 different initial concentrations of nitrate, ammonium, and biomass. The model also performed well when validated against time-series from two novel initial conditions withheld from model calibration. Our model therefore provides a framework for evaluating the potential broader ecological and environmental consequences of

ambient nitrate and ammonium regimes for phytoplankton communities in nature and aquaculture.

Evaluation of novel starch-deficient mutants of Chlorella sorokiniana for hyper-accumulation of lipids

Fecha de Publicación: Noviembre 2015
Fuente: Algal Research, Volume 12
Autor(es): Sofie Vonlanthen, David Dauvillée, Saul Purton
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS2211926415300369%26_version%3D1%26md5%3D8230eb345da0b31501cfd91c40fddddf

Abstract

When green algae are exposed to physiological stresses such as nutrient deprivation, growth is arrested and the cells channel fixed carbon instead into storage compounds, accumulating first starch granules and then lipid bodies containing triacylglycerides. In recent years there has been significant interest in the commercial exploitation of algal lipids as a sustainable source of biodiesel. Since starch and lipid biosynthesis involves the same C3 precursor pool, it has been proposed that mutations blocking starch accumulation should result in increased lipid yields, and indeed several studies have supported this. The fast-growing, thermotolerant alga Chlorella sorokiniana represents an attractive strain for industrial cultivation. We have therefore generated and characterized starch-deficient mutants of C. sorokiniana and determined whether lipid levels are increased in these strains under stress conditions. One mutant (ST68) is shown to lack isoamylase, whilst two others (ST3 and ST12) are defective in starch phosphorylase. However, we find no significant change in the accumulation or profile of fatty acids in these mutants compared to the wild-type, suggesting that a failure to accumulate starch per se is not sufficient for the hyper-accumulation of lipid, and that more subtle regulatory steps underlie the partitioning of carbon to the two storage products.

Referente a la eje 14 BioProductos-Biomasa Algal-Hidratos de Carbono

Optimal processing pathway selection for microalgae-based biorefinery under uncertainty

Fecha de Publicación: 2 de Noviembre 2015
Fuente: Computers & Chemical Engineering, Volume 82
Autor(es): Muhammad Rizwan, Muhammad Zaman, Jay H. Lee, Rafiqul Gani

Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS009813541500263X%26_version%3D1%26md5%3Dc163d51a9507efae2a5db5410ea9695e

Abstract

We propose a systematic framework for the selection of optimal processing pathways for a microalgae-based biorefinery under techno-economic uncertainty. The proposed framework promotes robust decision making by taking into account the uncertainties that arise due to inconsistencies among and shortage in the available technical information. A stochastic mixed integer nonlinear programming (sMINLP) problem is formulated for determining the optimal biorefinery configurations based on a superstructure model where parameter uncertainties are modeled and included as sampled scenarios. The solution to the sMINLP problem determines the processing technologies, material flows, and product portfolio that are optimal with respect to all the sampled scenarios. The developed framework is implemented and tested on a specific case study. The optimal processing pathways selected with and without the accounting of uncertainty are compared with respect to different objectives.

Integration of microalgae biomass in biomethanation systems23:08 29/08/2015, Bioproductos, Biomasa, HdC

Fecha de Publicación: Diciembre 2015
Fuente: Renewable and Sustainable Energy Reviews, Volume 52
Autor(es): Hamzat Tijani, Norhayati Abdullah, Ali Yuzir
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS1364032115008266%26_version%3D1%26md5%3D673a6899fbe2d8d1476f6cd9304afd13

Abstract

Concerted efforts in the field of bioenergy are driving dynamic studies for the production of microalgae-based biogas systems. Its ability to recycle residual nutrients and carbon dioxide (CO2) products of the anaerobic effluent reflected anaerobic digestion as the most sustainable means for renewable energy generation in microalgae. These measures will aid to lessen the effect of greenhouse gas emissions and increase the prospects for the application of microalgae biomass in the field of food and agricultural technology, medicine, and bioengineering, contributing to the sustainability of the industries. To begin with, the experimental limitations associated with the cultivation of microalgae biomass need to be resolved. In spite of the extensive studies conducted in the field of bioengineering, problems related to culture optimization, high building and operation costs remained persistent. This review highlighted vital points of microalgae-based bioprocesses that require several advancements in order to improve the prospects of anaerobic

digestion and discover novel renewable energy products. Coupled anaerobic digestion with microalgae cultivation systems requires intensive research as a distinct bioenergy generation process to uphold pilot-scale applications.

Referente a la eje 15 BioProductos-Antioxidantes

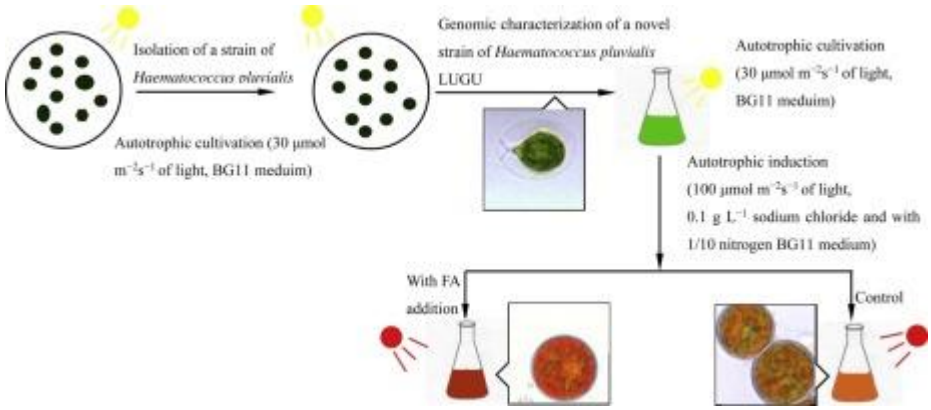
Enhanced astaxanthin production from a novel strain of Haematococcus pluvialis using fulvic acid

Fecha de Publicación: Disponible online 8 Septiembre 2015
Fuente: Process Biochemistry
Autor(es): Yongteng Zhao, Minmin Shang, Jun-Wei Xu, Peng Zhao, Tao Li, Xuya Yu
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS1359511315300714%26_version%3D1%26md5%3D5df298eae6dbeb1f43e6f4431f31bd9f

Abstract

Haematococcus pluvialis is one of the most promising natural sources of astaxanthin. Morphological and genomic characterization of a novel strain of H. pluvialis LUGU, which was isolated from Lugu Lake in Yunnan Plateau, was described in this study. The algae can accumulate astaxanthin under abiotic stress. Thus, the influences of fulvic acid (FA) on biomass and astaxanthin were investigated, and transcriptional levels of three astaxanthin biosynthetic genes in H. pluvialis, namely, phytoene desaturase gene (PDS), lycopene cyclase gene (LCY), and β-carotene hydroxylase gene (CHY), were measured. The astaxanthin content increased by 86.89% and 9.78% in 5 and 10mgL−1 FA-treated algal cells, respectively. The transcriptional levels of PDS and CHY genes were also enhanced under FA induction. Results suggested that high level of astaxanthin accumulation may correlate astaxanthin biosynthetic genes with FA induction. This research demonstrated a useful strategy to efficiently produce astaxanthin by using H. pluvialis.

Graphical abstract



Antioxidant responses of triangle sail mussel Hyriopsis cumingii exposed to harmful algae Microcystis aeruginosa and hypoxia

Fecha de Publicación: Noviembre 2015
Fuente: Chemosphere, Volume 139
Autor(es): Menghong Hu, Fangli Wu, Mingzhe Yuan, Qiongzhen Li, Yedan Gu, Youji Wang, Qigen Liu
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS004565351500795X%26_version%3D1%26md5%3D36f88317608ebe66d93032ef4e6511c8

Abstract

Bloom forming algae and hypoxia are considered to be two main co-occurred stressors associated with eutrophication. The aim of this study was to evaluate the interactive effects of harmful algae Microcystis aeruginosa and hypoxia on an ecologically important mussel species inhabiting lakes and reservoirs, the triangle sail mussel Hyriopsis cumingii, which is generally considered as a bio-management tool for eutrophication. A set of antioxidant enzymes involved in immune defence mechanisms and detoxification processes, i.e. glutathione-S-transferases (GST), glutathione (GSH), superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPX), lysozyme (LZM) in mussel haemolymph were analyzed during 14days exposure along with 7days depuration duration period. GST, GSH, SOD, GPX and LZM were elevated by toxic M. aeruginosa exposure, while CAT activities were inhibited by such exposure. Hypoxia influenced the immune mechanisms through the activation of GSH and GPX, and the inhibition of SOD, CAT, and LZM activities. Meanwhile, some interactive effects of M. aeruginosa, hypoxia and time were observed. Independently of the presence or absence of hypoxia, toxic algal exposure generally increased the five tested enzyme activities of haemolymph, except CAT. Although half of microcystin could be eliminated after 7days depuration, toxic M. aeruginosa or hypoxia exposure history showed some latent effects on most parameters. These results revealed that toxic algae play an important role on haemolymph

parameters alterations and its toxic effects could be affected by hypoxia. Although the microcystin depuration rate of H. cumingii is quick, toxic M. aeruginosa and/or hypoxia exposure history influenced its immunological mechanism recovery.

Referente a la eje 16 BioProductos-Lípidos

Microalgae and organic minerals enhance lipid retention efficiency and fillet quality in Atlantic salmon (Salmo salar L.)

Fecha de Publicación: 20 de Enero de 2016
Fuente: Aquaculture, Volume 451
Autor(es): K. Kousoulaki, T. Mørkøre, I. Nengas, R.K. Berge, J. Sweetman
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0044848615301460%26_version%3D1%26md5%3D60322f6cdbd4839e7d880dd3c933506e

Abstract

Pure spray dried DHA rich microalgae biomass (Schizochytrium sp.) was used to replace fish oil as a source of long chain n-3 polyunsaturated fatty acids (n-3 LC-PUFA) in medium (150gkg−1; MF) and low fish (100gkg−1; LF) meal diets for Atlantic salmon post smolt supplemented with either inorganic or organic minerals (OM: Zn, Cu, Mn, Fe and Se). The diets were balanced for total saturated fatty acids (SFA), sum DHA+EPA and n-3/n-6 ratio and had similar protein and energy digestibility and high pellet technical quality. Lipid digestibility was above 90% in all diets, nevertheless 2.3% lower in the diet containing 50gkg−1 microalgae, compared to the control, mainly due to the lower digestibility of SFA in the microalgae rich diets. The experimental fish grew from 0.4kg to 1.1kg with no significant differences in growth rate (TGC 3.7–3.8) or feed conversion ratio (FCR 0.7) among the dietary treatments. The retention efficiency of EPA+DHA in salmon body was significantly improved in the fish fed diets containing increasing levels of microalgae, and thus lower EPA/DHA ratios. Moreover, liver lipid levels were decreased and dress-out percentage increased by increasing microalgae dietary supplementation level. The fillet levels of SFA and DHA+EPA were similar for all treatments. Improved fillet quality in terms of lower gaping scores was observed with increasing dietary inclusion level of Schizochytrium sp. and even more pronounced for salmon fed organic minerals. No significant effects on fish blood plasma chemistry and whole body mineral content were observed. Statement of relevance Aquaculture is in urgent need of adequate volumes of new LCn-3PUFA sources, alternative to fish oil. The current work documents the feasibility of using practically relevant levels of heterotrophic microalgae as LCn-3PUFA source in the diet of Atlantic salmon in terms of extruded feed production feasibility, general fish performance, fish fillet product quality (nutritional and technical), nutrient retention efficiency and blood chemistry.

13C-metabolic flux analysis of lipid accumulation in the oleaginous fungus Mucor circinelloides

Fecha de Publicación: Diciembre 2015
Fuente: Bioresource Technology, Volume 197
Autor(es): Lina Zhao, Huaiyuan Zhang, Liping Wang, Haiqin Chen, Yong Q. Chen, Wei Chen, Yuanda Song
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960852415011396%26_version%3D1%26md5%3Dddde1f923583ee4a58553813e593fcb7

Abstract

The oleaginous fungus Mucor circinelloides is of industrial interest because it can produce high levels of polyunsaturated fatty acid γ-linolenic acid. M. circinelloides CBS 277.49 is able to accumulate less than 15% of cell dry weight as lipids, while M. circinelloides WJ11 can accumulate lipid up to 36%. In order to better understand the mechanisms behind the differential lipid accumulation in these two strains, tracer experiments with 13C-glucose were performed with the growth of M. circinelloides and subsequent gas chromatography–mass spectrometric detection of 13C-patterns in proteinogenic amino acids was carried out to identify the metabolic network topology and estimate intracellular fluxes. Our results showed that the high oleaginous strain WJ11 had higher flux of pentose phosphate pathway and malic enzyme, lower flux in tricarboxylic acid cycle, higher flux in glyoxylate cycle and ATP: citrate lyase, together, it might provide more NADPH and substrate acetyl-CoA for fatty acid synthesis.

Referente a la eje 17 BioProductos-Bioetanol

n-Butanol derived from biochemical and chemical routes: A review

Fecha de Publicación: Diciembre 2015
Fuente: Biotechnology Reports, Volume 8
Autor(es): B. Ndaba, I. Chiyanzu, S. Marx
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS2215017X15000430%26_version%3D1%26md5%3Df1191fee5147723e2f02f590d5130989

Abstract

Traditionally, bio-butanol is produced with the ABE (Acetone Butanol Ethanol) process using Clostridium species to ferment sugars from biomass. However, the route is associated with some

disadvantages such as low butanol yield and by-product formation (acetone and ethanol). On the other hand, butanol can be directly produced from ethanol through aldol condensation over metal oxides/ hydroxyapatite catalysts. This paper suggests that the chemical conversion route is more preferable than the ABE process, because the reaction proceeds more quickly compared to the fermentation route and fewer steps are required to get to the product.

Feasibility of bioethanol production from tubers of Dioscorea sansibarensis and Pyrenacantha kaurabassana

Fecha de Publicación: Noviembre 2015
Fuente: Bioresource Technology, Volume 196
Autor(es): Anselm P. Moshi, Jane P. Nyandele, Humphrey P. Ndossi, Sosovele M. Eva, Ken M. Hosea
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960852415011323%26_version%3D1%26md5%3D8542655e34068140268224b0b3f125a6

Abstract

Inedible tubers from Dioscorea sansibarensis (DS) and Pyrenacantha kaurabassana (PK) were found to be suitable feedstock for bioethanol production. Important composition parameters for bioethanol production for DS and PK are dry matter (% fresh tubers) ca. 20 and 6, total carbohydrates % dry weight base (db) ca. 68 and 47 and total protein (% db) ca. 16 and 10, respectively. DS and PK were found to contain inulin and galactomannan as principal polysaccharides (% of total carbohydrate) ca. 90 and 70, respectively. Diluted acid hydrolysis yielded ca. 100% of total reducing sugars. Ethanol yield ca. 56 and 35g/L was obtained at high efficiency through batch fermentation of acid hydrolysate (25% w/v) of DS and PK, respectively. A simple technique of recording and monitoring ethanol through CO2 generated during fermentation correlated strongly with HPLC measurement R 2 =0.99. Thus, tubers from these plants are potential feedstocks for bioethanol production with no competing uses.

Referente a la eje 18 BioProductos-Hidrógeno

Optimization of combined (acid + thermal) pretreatment for enhanced dark fermentative H2 production from Chlorella vulgaris using response surface methodology

Fecha de Publicación: Disponible online 2 de Septiembre de 2015
Fuente: International Biodeterioration & Biodegradation
Autor(es): Jae-Min Choi, Sun-Kee Han, Ji-Tae Kim, Chae-Young Lee

Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0964830515300330%26_version%3D1%26md5%3Da838827391b9dde294a7767ebaee4016

Abstract

This study was performed to optimize the combined (acid + thermal) pretreatment of Chlorella vulgaris for enhanced dark fermentative H2 production. Using response surface methodology, the maximum H2 yield of 47.7 mL H2/g dry cell weight (dcw) was predicted at the optimum conditions of HCl concentration (1.0%), heating temperature (92 °C), and reaction time (47 min). In a confirmation test, the similar result of 48.4 mL H2/g dcw was obtained at the optimum conditions. Meanwhile, only sucrose of 13 g/g dcw was detected from C. vulgaris without pretreatment, while glucose of 21 g/g dcw, fructose of 3 g/g dcw, and maltose of 16 g/g dcw were found from C. vulgaris with combined pretreatment. Fluorescence in situ hybridization (FISH) and polymerase chain reaction-denaturing gradient gel electrophoresis (PCR-DGGE) analyses revealed that Clostridium sp. cluster I such as Clostridium butyricum and C. perfringens accounted for 71.7% of total bacteria in a reactor with combined pretreatment.

Hydrogen and lipid production from starch wastewater by co-culture of anaerobic sludge and oleaginous microalgae with simultaneous COD, nitrogen and phosphorus removal

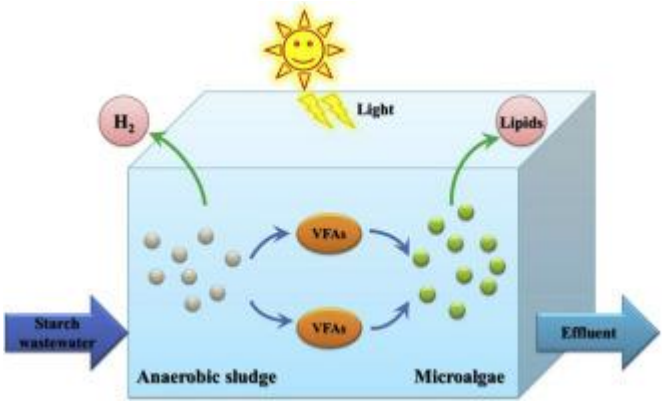
Fecha de Publicación: 15 Noviembre 2015
Fuente: Water Research, Volume 85
Autor(es): Hong-Yu Ren, Bing-Feng Liu, Fanying Kong, Lei Zhao, Nanqi Ren
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0043135415302086%26_version%3D1%26md5%3D899bf2649262f24789a7328c57408980

Abstract

Anaerobic sludge (AS) and microalgae were co-cultured to enhance the energy conversion and nutrients removal from starch wastewater. Mixed ratio, starch concentration and initial pH played critical roles on the hydrogen and lipid production of the co-culture system. The maximum hydrogen production of 1508.3 mL L−1 and total lipid concentration of 0.36 g L−1 were obtained under the optimized mixed ratio (algae:AS) of 30:1, starch concentration of 6 g L−1 and initial pH of 8. The main soluble metabolites in dark fermentation were acetate and butyrate, most of which can be consumed in co-cultivation. When sweet potato starch wastewater was used as the substrate, the highest COD, TN and TP removal and energy conversion efficiencies reached 80.5%, 88.7%, 80.1% and 34.2%, which were 176%, 178%, 200% and 119% higher than that of the control group (dark fermentation), respectively. This research provided a novel approach and achieved

efficient simultaneous energy recovery and nutrients removal from starch wastewater by the co-culture system.

Graphical abstract



Referente a la eje 19 Biorremediación de Efluentes-Doméstico-RSU

Effects of leachate recirculation on biogas production from landfill co-disposal of municipal solid waste, sewage sludge and marine sediment

Fecha de Publicación: Agosto 2002
Fuente: Environmental Pollution, Volume 118, Issue 3
Autor(es): G.Y.S. Chan , L.M. Chu , M.H. Wong
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS026974910100286X%26_version%3D1%26md5%3D99ff7a88678e9ba8bace26402f621a7b

Abstract

Leachate recirculation is an emerging technology associated with the management of landfill. The impact of leachate recirculation on the co-disposal of three major wastes (municipal solid waste, sewage sludge and sediment dredgings) was investigated using a laboratory column study. Chemical parameters (pH, COD, ammoniacal-N, total-P) and gas production (total gas volume, production rates and concentrations of CH4 and CO2) were monitored for 11 weeks. Leachate recirculation reduced waste-stabilization time and was effective in enhancing gas production and improving leachate quality, especially in terms of COD. The results also indicated that leachate recirculation could maximize the efficiency and waste volume reduction rate of landfill sites.

Co-digestion, pretreatment and digester design for enhanced methanogenesis

Fecha de Publicación: Febrero 2015
Fuente: Renewable and Sustainable Energy Reviews, Volume 42
Autor(es): Fayyaz Ali Shah, Qaisar Mahmood, Naim Rashid, Arshid Pervez, Iftikhar Ahmad Raja, Mohammad Maroof Shah
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS1364032114008788%26_version%3D1%26md5%3D2990dae287717b089ee228538c4671ae

Abstract

Co-digestion, pretreatment and digester design are the key techniques for enhanced biogas optimization. Co-digestion dilutes the inhibitory effects of substrates, balance the micro and macronutrients, increase the organic loading with consequent higher methane yields per unit of digester volume; lastly diversify and synergize the microbial communities which play pivotal role in the methanogenesis. Pretreatment facilitates in conversion of polymers to monomers and increased accessibility of the food to microbes. Proper and accessible feed have a crucial role in the biogas enhancement. The biodegradability of any particular biomass depends on its source from which it has been derived. The biodegradability of a biomass may be affected by various factors like crystalline structure the extent of cellulosic polymers; the surface properties of biomass, the amount of lignin content, the presence of hemicellulosic materials and the strength of fibers. The present review also discussed various types of the pretreatment to remove the obstacles before feeding for biogas digesters. Various biomasses being utilized for the anaerobic digestion of biogas optimization were discussed. The current review also discussed the digester design along various operation physical conditions and the nature of feed substrates employed for biogas optimization.

Referente a la eje 20 Biorremediación de Efluentes-Doméstico-Municipal

Pilot Scale Application of Anaerobic Baffled Reactor for Biologically Enhanced Primary Treatment of Raw Municipal Wastewater

Fecha de Publicación: Disponible online 14 Septiembre 2015
Fuente: Water Research
Autor(es): Martha J. Hahn, Linda A. Figueroa
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=o

utward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0043135415302402%26_version%3D1%26md5%3D190e5f7a2ef4de68acf0e70d05026e7e

Abstract

A four-cell anaerobic baffled reactor (ABR) was operated for two years treating raw municipal wastewater at ambient water and air temperatures of 12 to 23˚C and -10 to 35˚C, respectively. The 1000-liter pilot reactor operated at a 12-hour hydraulic residence time and was located in the Headworks building of the Plum Creek Water Reclamation Authority. The average influent was TSS = 510±400 mg/L, BOD5 = 320±80 mg/L and the average removal of TSS and BOD5 was 83±10% and 47±15%, respectively. The TSS and BOD removal exceeded that of conventional primary clarification, with no wasting of the settled solids over the two-years and stoichiometric production of methane. The estimated energy content of the biogas produced per unit volume of wastewater treated averaged 0.45 kWh/m3. The TSS and total COD removal in the first cell averaged 75±15% and 43±14%, respectively, but methane production was only 20% of the total observed for the full ABR. The performance of the ABR relative to the extent of solids hydrolysis and methane production can be varied by the number of cells and hydraulic residence time. The anaerobic baffled reactor is an energy-positive technology that can be used for biologically enhanced primary treatment of raw municipal wastewater in cold climates.

Graphical abstract

Continuous removal of zinc from wastewater and mine dump leachate by a microalgal biofilm PSBR

Fecha de Publicación: 30 Octubre 2015
Fuente: Journal of Hazardous Materials, Volume 297
Autor(es): Tong Li, Gengyi Lin, Björn Podola, Michael Melkonian
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_ori

gin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0304389415003787%26_version%3D1%26md5%3D4e0ab27b7dc204f7d474ff7c0cfa5439

Abstract

Bio-removal of heavy metals from wastewater by microalgae has been investigated for decades. However, technical and economical limitations of cultivation systems for microalgae still impair progress toward application. Recently, a novel type of bioreactor for (immobilized) biofilm cultivation, the Porous Substrate Bioreactor (PSBR), has been shown to optimize biomass feedstock production and harvest, offering novel possibilities for application in the treatment of wastewater. We used two types of laboratory-scale Twin-Layer PSBRs to remove zinc (2–3mgZnL−1) from synthetic wastewater and real mine dump leachate in a continuous and batch process. The selection and use of a biofilm of a Zn-resistant strain of the green alga Stichococcus bacillaris (EC50 of 28.9mgZnL−1 based on Pulse-amplitude modulated (PAM) chlorophyll fluorescence analysis) led to a high zinc absorption capacity of 15–19mgZng−1 algal dry matter. The removal capacity for zinc correlated positively with biomass production and was thus, light dependent. Bio-removal properties observed here combined with biomass productivities of PSBR systems compare favorably with other algal-based bio-sorption technologies.

Referente a la eje 22 Biorremediación de Efluentes-Industrial-Curtiembre

Ecotoxicological assessment of flocculant modified soil for lake restoration using an integrated biotic toxicity index

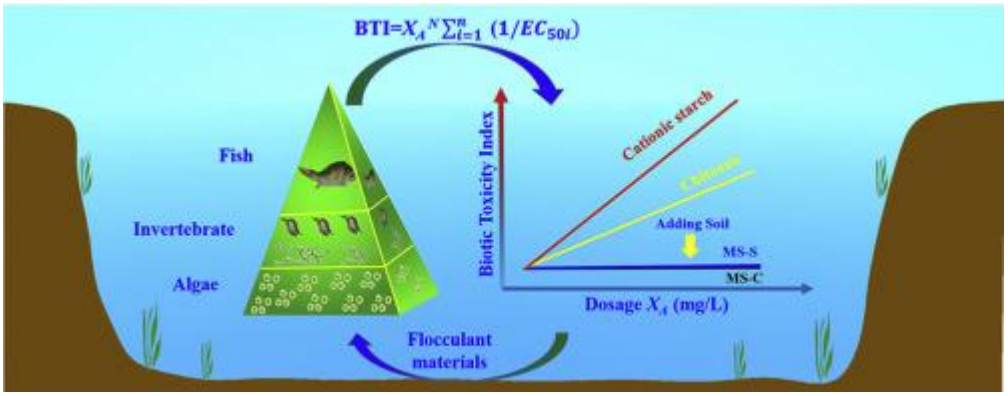
Fecha de Publicación: Disponible online 21 Agosto 2015
Fuente: Water Research
Autor(es): Zhibin Wang, Honggang Zhang, Gang Pan
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0043135415301846%26_version%3D1%26md5%3Dfacd3e5671710a40c1988d942a1e2e86

Abstract

Flocculant modified soils/clays are being increasingly studied as geo-engineering materials for lake restoration and harmful algal bloom control. However, the potential impacts of adding these materials in aquatic ecological systems remain unclear. This study investigated the potential effects of chitosan, cationic starch, chitosan modified soils (MS-C) and cationic starch modified soils (MS-S) on the aquatic organisms by using a bioassay battery. The toxicity potential of these four flocculants was quantitatively assessed using an integrated biotic toxicity index (BTI). The test system includes four aquatic species, namely Chlorella vulgaris, Daphnia magna, Cyprinus carpio and Limnodrilus hoffmeisteri, which represent four trophic levels in the freshwater ecosystem. Results showed that median effect concentrations (EC50) of the MS-C and MS-S were 31–124 times higher than chitosan and cationic starch, respectively. D. magna was the most sensitive

species to the four flocculants. Histological examination of C. carpio showed that significant pathological changes were found in gills. Different from chitosan and cationic starch, MS-C and MS-S significantly alleviated the acute toxicities of chitosan and cationic starch. The toxicity order of the four flocculants based on BTI were cationic starch > chitosan > MS-S > MS-C. The results suggested that BTI can be used as a quantitative and comparable indicator to assess biotic toxicity for aquatic geo-engineering materials. Chitosan or cationic starch modified soil/clay materials can be used at their optimal dosage without causing substantial adverse effects to the bioassay battery in aquatic ecosystem.

Graphical abstract



Biosorption of Cu2+ and Ni2+ by Arthrospira platensis with different biochemical compositions

Fecha de Publicación: 1 Enero 2015
Fuente: Chemical Engineering Journal, Volume 259
Autor(es): Giorgos Markou, Dimitris Mitrogiannis, Abuzer Çelekli, Hüseyin Bozkurt, Dimitris Georgakakis, Constantinos V. Chrysikopoulos
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS1385894714010912%26_version%3D1%26md5%3D73bd4f0c238eef4569eb686c337f2135

Abstract

This study is focused on copper and nickel biosorption onto Arthrospira platensis biomass of different biochemical compositions. Four types of A. platensis were employed, namely: (1) typical dry biomass (TDB), (2) carbohydrate-enriched dry biomass (CDB), (3) typical living biomass (TLB), and (4) carbohydrate-enriched living biomass (CLB). The CDB was produced using a cultivation mode where phosphorus was the limiting nutrient. The biosorption of both metals investigated was shown to be very fast. Most of the metal sorption capacity of the biomass was filled within 15–30min, and equilibrium was achieved within 30–60min. The cultivation conditions (nutrient

repletion or depletion) did not affect the pattern of copper and nickel biosorption kinetics. The capacity for copper ions biosorption was significantly positively affected by the accumulation of carbohydrates in the dry biomass, but was negatively affected by the accumulation of carbohydrates in the living biomass. For nickel ions, the alteration of biomass had a little but positive effect on the dry biomass, and a greater negative effect (about 30% lower biosorption capacity) on the living biomass. Living biomass exhibited a higher biosorption capacity than dry biomass, for both metals. The biosorption of copper and nickel onto A. platensis biomass occurred mainly due to the mechanisms of ion exchange and complexation, and less to physical adsorption.

Referente a la eje 23 Biorremediación de Efluentes-Industrial-Alimentación

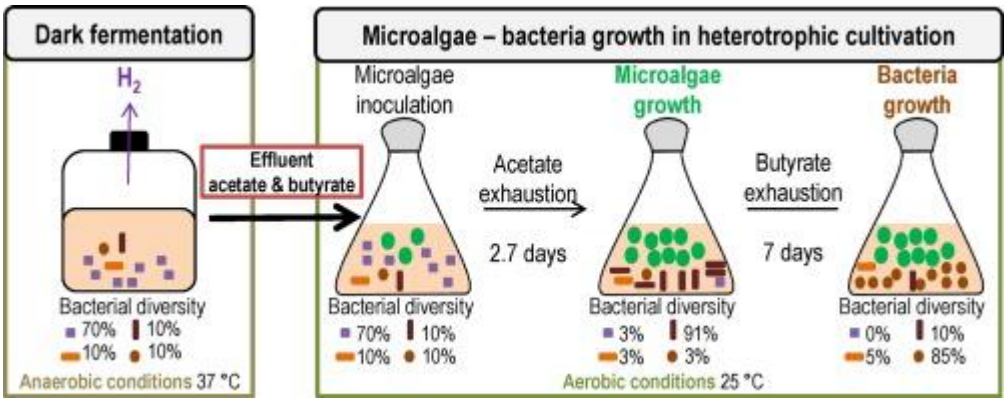
Raw dark fermentation effluent to support heterotrophic microalgae growth: microalgae successfully outcompete bacteria for acetate

Fecha de Publicación: Noviembre 2015
Fuente: Algal Research, Volume 12
Autor(es): V. Turon, E. Trably, A. Fayet, E. Fouilland, J.-P. Steyer
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS2211926415300394%26_version%3D1%26md5%3D51f84864fc23c3da02eaa5357ff3402b

Abstract

Coupling dark fermentation (DF), which produces hydrogen from diverse effluents or solid waste, and heterotrophic cultivation of microalgae, which produces lipids, carbohydrates and proteins, is a promising and innovative solution for developing sustainable biorefineries. The use of a raw DF effluent, containing acetate and butyrate, to support the heterotrophic growth of Chlorella sorokiniana was investigated. All the acetate in sterilized and unsterilized DF effluent was exhausted in less than three days of heterotrophic cultivation, whereas butyrate was not used by the microalgae. The microalgae biomass reached 0.33gL−1 with a carbon yield on acetate of 55%. The algal yield was higher than previously reported for synthetic DF effluent. It was concluded that compounds other than volatile fatty acids were present in the DF effluent and these could be consumed by the microalgae. After the acetate had been exhausted, butyrate was consumed by facultative and strict aerobic bacteria originating from the DF effluent. The concentration of the bacterial community increased during the experiment but did not have any significant impact on heterotrophic microalgae growth. A high microalgal biomass yield was achieved without requiring the DF effluent to be sterilized.

Graphical abstract



Anaerobic digestion of microalgal bacterial flocs from a raceway pond treating aquaculture wastewater: Need for a biorefinery

Fecha de Publicación: Noviembre 2015
Fuente: Bioresource Technology, Volume 196
Autor(es): Sofie Van Den Hende, Cedric Laurent, Marine Bégué
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960852415010202%26_version%3D1%26md5%3Deab22784ab0e38e19a130c3673ec6adb

Abstract

An outdoor raceway pond with microalgal bacterial flocs (MaB-flocs) is a novel sunlight-based system to treat pikeperch aquaculture wastewater while producing biomass. The harvested MaB-floc biomass (33tonTSha−1 y−1) needs further valorization. Therefore, the biochemical methane yield (BMY) of MaB-floc biomass was determined in batch experiments. The results show significant differences between the BMY of MaB-flocs amongst their harvest dates (128–226NLCH4 kg−1 VS), a low anaerobic digestion conversion efficiency (25.0–36.2%), a moderate chlorophyll a removal (51.5–86.9%) and a low biogas profit (<0.01€m−3 wastewater). None of the pretreatment methods screened (freezing, thermal, microwave, ultrasonic and chlorination, flue gas sparging, and acid) can be recommended due to a low BMY improvement and/or unfavorable energy balance. Therefore, anaerobic digestion of this MaB-floc biomass should only be granted a supporting role within a biorefinery concept.

Referente a la eje 24 Biorremediación de Efluentes-Industrial-Minería

Immobilization of heavy metal contaminated mine wastes using Canavalia ensiformis extract

Fecha de Publicación: Disponible online 31 Julio 2015
Fuente: CATENA
Autor(es): In-Hyun Nam, Seung-Bum Roh, Min-Jeong Park, Chul-Min Chon, Jae-Gon Kim, Sueng-Won Jeong, Hocheol Song, Min-Ho Yoon
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0341816215300734%26_version%3D1%26md5%3D1c475368a241d7624f291a32a840f60a

Abstract

This study examined the ability of crude extracts of Canavalia ensiformis to catalyze the precipitation of calcium carbonate (CaCO3) in columns packed with heavy metal contaminated mine waste collected from an abandoned mine site, and examined the effect of CaCO3 precipitates on the leaching of heavy metals out of such waste. X-ray diffraction and scanning electron microscopy were employed to confirm CaCO3 precipitation and to characterize the morphology of the resulting material. Urease in the C. ensiformis crude extracts catalyzed the hydrolysis of urea, leading to the formation of CaCO3 precipitates that formed bridges between the particles in the mine waste. In column experiments, the amounts of the heavy metals As, Mn, Zn, Pb, Cr, and Cu in leachates from the mine waste were reduced by 31.7%, 65.7%, 52.3%, 53.8%, 55.2%, and 49.0%, respectively, when the waste was treated with C. ensiformis crude extract. This reduction can be attributed to immobilization of heavy metals within the mine waste as a result of CaCO3 precipitation. Comparison of the microbial communities in mine waste columns that were untreated or incubated for 2weeks with C. ensiformis crude extract and purified urease, using PCR-DGGE of 16S rDNA, showed that a greater diversity of microorganisms was present in the columns treated with C. ensiformis crude extract and purified urease. These findings suggest that crude extracts of C. ensiformis may be used to stabilize and immobilize heavy metals in contaminated mine waste to prevent further dispersion to the surrounding environment.

Socio-economic impacts of algae-derived biodiesel industrial development in China: An input–output analysis

Fecha de Publicación: Mayo 2015
Fuente: Algal Research, Volume 9
Autor(es): Yanli Yang, Bo Zhang, Jing Cheng, Shengyan Pu
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS2211926415000363%26_version%3D1%26md5%3Dd7885552b41904fea71460d4bc961111

Abstract

The economic and employment impacts of algae-derived biodiesel industrial development in China are analyzed based on an input–output (I–O) model in this work. The results show that the algae-derived biodiesel industry has a significant impact on promoting regional economic and employment growth. In China, due to the development of algae-derived biodiesel with an annual production of 0.2milliont, the economic growth can reach from 5.08 billion to 17.87 billion CNY, while employment growth can be from 39,200 to 104,000 jobs. However, because of the differences in the regional industrial structure, product distribution and marginal consumption propensity, the regional economic and employment impacts vary significantly in China. For example, the biggest economic and employment impacts of the algae-derived biodiesel industry are seen in Yunnan followed by Guangxi, Hubei and Henan, with the smallest being in Hunan. A sensitivity analysis shows that certain social-economic parameters, including the post-factory price of biodiesel, marginal consumption propensity, production scale and production taxes, are more sensitive to economic impact than others. Furthermore, certain technical parameters, including biomass productivity, lipid content, running time, lipid extraction rate and lipid conversion rate, have a susceptible impact on employment than others. To achieve the maximum socio-economic benefit of algae-derived biodiesel development, areas should be chosen that have a large potential and a high socio-economic impact multiplier, taking full account of the conditions relating to the regional climate, marginal land, and socio-economic factors.

Referente a la eje 25 Biorremediación de Efluentes-Agropecuario-Tambo

Beyond land application: Emerging technologies for the treatment and reuse of anaerobically digested agricultural and food waste

Fecha de Publicación: Octubre 2015
Fuente: Waste Management, Volume 44
Autor(es): Johnathon P. Sheets, Liangcheng Yang, Xumeng Ge, Zhiwu Wang, Yebo Li
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0956053X15300532%26_version%3D1%26md5%3D417c9f8f9252186eeea6e986771ee106

Abstract

Effective treatment and reuse of the massive quantities of agricultural and food wastes generated daily has the potential to improve the sustainability of food production systems. Anaerobic digestion (AD) is used throughout the world as a waste treatment process to convert organic waste into two main products: biogas and nutrient-rich digestate, called AD effluent. Biogas can be used as a source of renewable energy or transportation fuels, while AD effluent is traditionally

applied to land as a soil amendment. However, there are economic and environmental concerns that limit widespread land application, which may lead to underutilization of AD for the treatment of agricultural and food wastes. To combat these constraints, existing and novel methods have emerged to treat or reuse AD effluent. The objective of this review is to analyze several emerging methods used for efficient treatment and reuse of AD effluent. Overall, the application of emerging technologies is limited by AD effluent composition, especially the total solid content. Some technologies, such as composting, use the solid fraction of AD effluent, while most other technologies, such as algae culture and struvite crystallization, use the liquid fraction. Therefore, dewatering of AD effluent, reuse of the liquid and solid fractions, and land application could all be combined to sustainably manage the large quantities of AD effluent produced. Issues such as pathogen regrowth and prevalence of emerging organic micro-pollutants are also discussed.

States and challenges for high-value biohythane production from waste biomass by dark fermentation technology

Fecha de Publicación: Mayo 2013
Fuente: Bioresource Technology, Volume 135
Autor(es): Zhidan Liu, Chong Zhang, Yuan Lu, Xiao Wu, Lang Wang, Linjun Wang, Bing Han, Xin-Hui Xing
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960852412015295%26_version%3D1%26md5%3D14e85c609488bab17543140d5957803e

Abstract

Hythane (H2 +CH4) has attracted growing attention due to its versatile advantages as, for instance vehicle fuel. Biohythane consisting of biohydrogen and biomethane via two-stage fermentation is a potential high-value solution for the valorization of waste biomass resources and probably an alternative to the fossil based hythane. However, the significance and application potential of biohythane have not yet been fully recognized. This review focuses on the progress of biohydrogen and subsequent biomethane fermentation in terms of substrate, microbial consortium, reactor configuration, as well as the H2/CH4 ratio from the perspective of the feasibility of biohythane production in the past ten years. The current paper also covers how controls of the microbial consortium and bioprocess, system integration influence the biohythane productivity. Challenges and perspectives on biohythane technology will finally be addressed. This review provides a state-of-the-art technological insight into biohythane production by two-stage dark fermentation from biomass.

Referente a la eje 26 Biorremediación de Efluentes-Agropecuario-FeedLot

Biorefinery as a promising approach to promote microalgae industry: An innovative framework

Fecha de Publicación: Enero 2015
Fuente: Renewable and Sustainable Energy Reviews, Volume 41
Autor(es): Liandong Zhu
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS1364032114008132%26_version%3D1%26md5%3D314e02ee41113d7c433cd15c83c32d2d

Abstract

In response to energy crisis, global warming and climate changes, microalgae have received a great deal of interest as a biofuel feedstock. However, the development of microalgal biofuels witnesses an obvious and serious dilemma. The reported literature shows that “fuel only” option is not economically viable due to the overwhelming investments in capital and operation. Hence, it is questionable whether it is too luxurious to produce microalgae only for biofuel application. In addition, there are some voiced concerns related to the impacts of microalgal biofuel production on the conventional applications, such as cosmetics, pharmaceuticals and nutritious feed. It is therefore questionable whether the microalgal biofuel production will affect the original functions. From a sustainability point of view, the author explores the current challenges in microalgal applications and proposes an innovative framework for microalgal biorefinery, which can realize the production of multiple products in the form of high values and biofuels such as biodiesel, bioethanol and biogas. With the aim at maximizing the value derived from different microalgal components, the innovative microalgal biorefinery concept includes four pathways: high-value products–biodiesel–bioethanol–biogas; high-value products–bioethanol–biogas; high-value products–biodiesel–biogas; and high-value products–biogas. Special attention has been paid to the production of high-value products through system integration and engineering, which is expected to promote the economics of microalgal biofuels. Net energy ratio assessment and cost-effectiveness assessment have been highlighted to testify the feasibility of microalgal biorefinery options, and some crucial actions have been suggested to help establish the process.

Using indigenous microalga species to reduce HCO3−, NH3N, NO3N, total P, Ca2+, SO42−, and Cl− from a high conductivity concentrate

Fecha de Publicación: 1 Octubre 2014
Fuente: Desalination, Volume 350
Autor(es): Maung Thein Myint
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0011916414003567%26_version%3D1%26md5%3Dc93f94d70bc1ef92ef19d5650f6a32c5

Abstract

Natural microalga species from desalination concentrate evaporation pond was used to reduce dissolved ions from a high level conductivity of desalination concentrate and leachate of anaerobic digested sludge (LADS) compost. The initial microalgae-to-conductivity ratio was in the range of 0.0008 to 0.0010g/(LμS/cm). LADS was supplied as nutrients. Carbon dioxide from the environment was dispersed into the growth medium. Mass conductivity reduction (Y) of 27.6–33.6% was achieved in 15days. Y is directly linear with mass microalgae-to-conductivity-ratio (X) as Y=30930X+8.9182 with R2 0.996: p<0.001 in three different studies with two different species. Reduction was on the order of HCO3 −, NH3N, NO3N, total P, Ca2+, SO4 2−, non-Ca2+ and multi-valent cations, and Cl− with mass reduction percentage 83.9–88.0, 69.0–77.6, 63.6–57.1, 59.1–70.7, 47.3–59.4, 12.6–19.0, 4.5–24.5, and 6.3–18.2, respectively. Reduction sequence follows C, N, P, Ca2+, SO4 2−, and Cl− as primary-, macro-, and micro-nutrients of microalga composition. Carbon species, H2CO3 □ was dominant in the growth medium.

Referente a la eje 27 Biorremediación de Efluentes-Agropecuario-Cama de Pollo

Fed-batch cultivation of Arthrospira and Chlorella in ammonia-rich wastewater: Optimization of nutrient removal and biomass production

Fecha de Publicación: Octubre 2015
Fuente: Bioresource Technology, Volume 193
Autor(es): Giorgos Markou
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960852415008627%26_version%3D1%26md5%3D75035781a953338f5cf12858ce21f16f

Abstract

In the present work the cyanobacterium Arthrospira platensis and the microalga Chlorella vulgaris were fed-batch cultivated in ammonia-rich wastewater derived from the anaerobic digestion of poultry litter. Aim of the study was to maximize the biomass production along with the nutrient removal aiming to wastewater treatment. Ammonia and phosphorus removals were very high (>95%) for all cultures investigated. Both microorganisms were able to remove volatile fatty acids to an extent of >90%, indicating that they were capable of mixotrophic growth. Chemical oxygen demand and proteins were also removed in various degrees. In contrast, in all cultures carbohydrate concentration was increased. The biochemical composition of the microorganisms varied greatly and was influenced by the indicate that the nutrient availability. A. platensis accumulated carbohydrates (≈40%), while C. vulgaris accumulated lipids (≈50%), rendering them interesting for biofuel production.

Growth optimisation of microalga mutant at high CO2 concentration to purify undiluted anaerobic digestion effluent of swine manure

Fecha de Publicación: Febrero 2015
Fuente: Bioresource Technology, Volume 177
Autor(es): Jun Cheng, Jiao Xu, Yun Huang, Yuyou Li, Junhu Zhou, Kefa Cen
Enlace:
http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960852414017131%26_version%3D1%26md5%3Dbe371f15141b21c29ba2eae4df188158

Abstract

Growth rate of the microalga Chlorella PY-ZU1 mutated by nuclear irradiation was optimised for use in the purification of undiluted anaerobic digestion effluent of swine manure (UADESM) with 3745mgL−1 chemical oxygen demand (COD) and 1135mgL−1 total nitrogen content. The problem of accessible carbon in UADESM was solved by continuous introduction of 15% (v/v) CO2. Adding phosphorus to UADESM and aeration of UADESM before inoculation both markedly reduced the lag phase of microalgal growth. In addition, the biomass yield and average growth rate of Chlorella PY-ZU1 increased significantly to 4.81gL−1 and 601.2mgL−1 d−1, respectively, while the removal efficiencies of total phosphorus, COD and ammonia nitrogen increased to 95%, 79% and 73%, respectively. Thus, the findings indicate that Chlorella PY-ZU1 can be used for effective purification of UADESM, while the biomass can be safely used as animal feed supplement.

Patentes

En esta sección del presente boletín se colocarán solamente las patentes en la que se encuentra involucrada la Argentina. En futuros boletines serán colocadas las patentes en referencia a las diferentes Ejes del Árbol, atendiendo a las solicitudes realizadas.

Methods and systems for producing lipids from microalgae using cultured multi-species microalgae

US9074191B2

Publication date
7 Jul 2015

Application
US98209610A (30 Dec 2010)

Abstract
The present invention provides a system and method for culturing a microalgae biofamily to produce lipids. The method includes growing a microalgae biofamily comprises multiple microalgae species in a liquid medium at a first stress level. A portion of the microalgae are exposed to a second stress level and harvested. Lipids are extracted from the harvested portion. Also disclosed is a system for culturing a microalgae biofamily that comprises an enclosed pond containing microalgae in growth medium and having a sloped bottom, at least one photobioreactor positioned above the pond, and a pump circulating the microalgae-containing growth medium between the pond and the at least one photobioreactor.

PatentInspiration Url
http://www.patentinspiration.com/redirect?url=/patent/US9074191B2

Métodos e sistemas para a produção de lipídios a partir de microalgas

BRPI1013474A2

Publication date
24 Feb 2015

Application
BRPI1013474A (28 Dec 2010)

Abstract
MÉTODO E SISTEMA PARA A PRODUÇÃO DE LIPÍDIOS A PARTIR DE MICROALGAS O objeto da invenção é um sistema e método para cultivar uma biofamília de microalgas para a produção de lipídios. O método inclui o cultivo de uma biofamília de microalgas compreende várias espécies de microalgas em meio liquido em um nível de estresse em primeiro lugar. Uma parte do microalgas

são expostos a um nível de estresse, segundo e colhida. Lipídios são extraídos da parte colhida. Também é descrito um sistema de cultura de uma biofamília de microalgas que compreende um tanque fechado contendo microalgas em meio de crescimento e ter um fundo inclinado, pelo menos um fotobioreator posicionado acima do lago, e uma bomba de circulação do meio de cultivo de microalgas, contendo entre a lagoa e o fotobioreator pelo menos um.

PatentInspiration Url
http://www.patentinspiration.com/redirect?url=/patent/BRPI1013474A2

Procedimento para obtenção de uma graxa e/ou óleo a partir de resìduos industriais para sua utilização como matéria prima de combustìveis

BRPI0903826A2

Publication date
7 Jun 2011

Application
BRPI0903826A (29 Sep 2009)

Abstract
PROCEDIMENTO PARA OBTENçãO DE UMA GRAXA E/OU óLEO A PARTIR DE RESìDUOS INDUSTRIAIS PARA SUA UTILIZAçãO COMO MATERIA PRIMA DE COMBUSTìVEIS, consiste num procedimento que compreende um 1 passo de acidificação; um 2> passo de centrifugação; um 3 passo de extração de graxa e ácidos graxos; um 4 passo de separação; um 5 passo de destilação; um 6 passo de tratamento num tanque grande de matéria orgânica não gordurosa com microalgas e um 7passo onde é realizada uma esterificação ou uma transesterificação conforme o grau de acidez.
PatentInspiration Url
http://www.patentinspiration.com/redirect?url=/patent/BRPI0903826A2

Process to obtain fat and/or oil from industrial waste to use them as raw materials for the production of fuels

EP2283734A1

Publication date
16 Feb 2011

Application
EP09010330A (11 Aug 2009)

Abstract

Process to obtain fat and/or oil from industrial waste to use them as raw materials for the production of fuels, which includes a prior stage consisting in the collection of industrial waste, and waste from effluent treatment industries; a first stage consisting in the acidification of industrial waste, a second stage where most organic matter is separated from fluids by way of centrifugation; a third stage consisting in the extraction of fat and fatty acids; a fourth stage, consisting in the separation fat, fatty acids and solvent from the remaining organic matter; a fifth stage, where the mixture -including fat, fatty acids and solvent- is heated; a sixth stage, where the nonfat organic matter and the fatty acids are put into a pool with microalgae; and a seventh stage, which consists in verifying the acidity of the mixture of fat and fatty acids.

PatentInspiration Url
http://www.patentinspiration.com/redirect?url=/patent/EP2283734A1

Sistema integral para el cultivo extensivo e intensivo de microalgas en invernaderos de diseno especial

AR070504A1

Publication date
14 Apr 2010

Application
ARP080102876A (3 Jul 2008)

Abstract
Invernadero hermético de estructura tubular, tipo carrusel, lo que facilita la circulacion del agua, generado por dos motores con paletas rotatorias, con perfiles alares ubicados de tal forma que posibiliten y faciliten la circulacion del agua a través a todo el invernadero, no dejando que se produzcan sedimentos en el mismo, con un sistema lumínico que complementa a la luz solar , o la suple en los casos en los que por la profundidad de las piletas la luz solar no llega a los microorganismos con la fuerza e intensidad necesaria, ayudado esto por la inyeccion de CO2. Posee un sistema de cosecha autolimpiante y continuo que favorece el reciclado del agua utilizada.

PatentInspiration Url
http://www.patentinspiration.com/redirect?url=/patent/AR070504A1

Eventos

November 2-6 Large-Scale Algal Cultivation, Harvesting and Downstream Processing.

AzCATI – Mesa, AZ

ATP3 Workshops are designed to enhance the knowledge of those who are already familiar with algae, and also provide an introduction to algae culture management for those with no prior experience.

atp3.org/education-and-training

November 6-8 Algal International Congress.

Qingdao, China

Topics include: omics and marine biotechnology, biology of marine organisms, marine enzymes and polysaccharides, marine natural products, aquatic disease models, bioactive compounds, algal biotechnology and phycology.

www.bitcongress.com/wcmb2015/

December 1-3 Algae Contractors' Conference, and International Algae Congress.

Lisbon, Portugal

…to benchmark the technological advances in view of deployment of algal biorefineries, commercializing algal biofuels and products, and looking ahead to the Horizon 2020 Programme.

algaecongress.com

December 8-9 World Alternative Transport Fuels Conference.

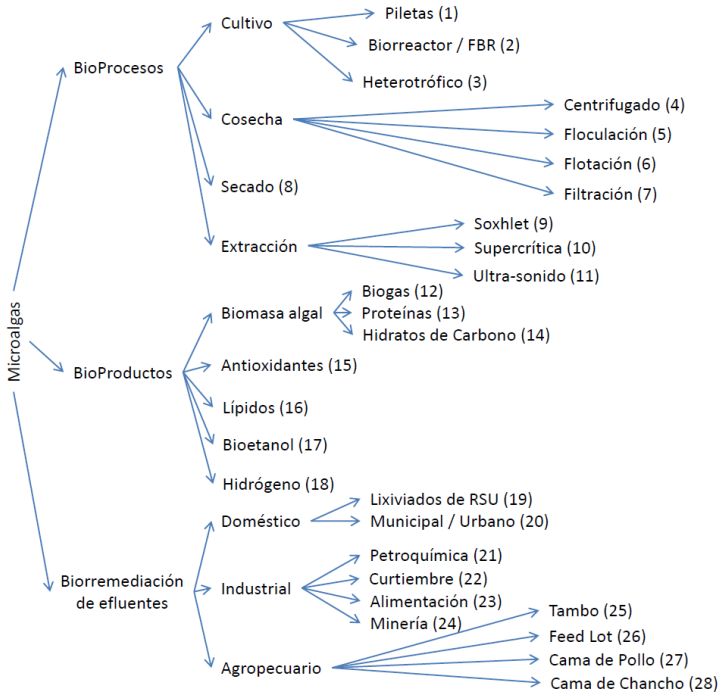
Dubai (UAE)

…designed to provide a crucial insight into the alternative fuel industry giving a brand new vision of the potential and challenges that the fuel industry faces in the constantly changing milieu.

www.af-conference.com

Árbol de categorías

Español



Inglés