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Microalgas

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Contenido

A comprehensive study on the effect of light quality imparted by light-emitting diodes (LEDs) on the physiological and biochemical properties of the microalgal consortia of Chlorella variabilis and Scenedesmus obliquus cultivated in dairy wastewater

Autor: Bhalamurugan Gatamaneni Loganathan
Bioprocess Biosyst Eng. 2020 Aug;43(8):1445-1455. doi: 10.1007/s00449-020-02338-0. Epub 2020 Apr 8.
ABSTRACT
The effect of light wavelengths on the physiological, biochemical and lutein content of the microalgal consortia Chlorella variabilis and Scenedesmus obliquus was evaluated using different light sources. Among different light treatments, cool-white fluorescent light produced the highest biomass of 673 mg L-1 with a specific growth rate of 0.75 day-1 followed by blue (500 mg L-1; 0.73 day-1). The chlorophyll content was enhanced under blue light (10.7 mg L-1) followed by cool fluorescent light (9.3 mg L-1), whereas the lutein productivity was enhanced under cool fluorescent light (7.22 mg g-1). Protein content of the microalgal consortia was enhanced under all light treatments with the highest protein accumulation under cool-white fluorescent light (~56% of dry mass) closely followed by amber light (52% of dry mass), whereas the carbohydrate content was higher under amber light (~35% of dry mass). The results revealed that the consortia could grow well on diluted dairy wastewater thereby reducing the cost of algal production when compared with the use of inorganic media and a two-phase culture process utilizing cool fluorescent and amber light could be employed for maximizing algal biomass and nutrient composition with enhanced lutein production. The study also emphasizes on the economic efficiency of LED lights in terms of biomass produced based on the modest electricity consumed and the importance of using amber light for cultivating microalgae for its nutrient content which has seldom been studied.

Advanced Oxidation Processes and Biotechnological Alternatives for the Treatment of Tannery Wastewater

Autor: Néstor Andrés Urbina-Suarez
Molecules. 2021 May 27;26(11):3222. doi: 10.3390/molecules26113222.
ABSTRACT
The tannery industry is one of the economic sectors that contributes to the development of different countries. Globally, Europe and Asia are the main producers of this industry, although Latin America and Africa have been growing considerably in recent years. With this growth, the negative environmental impacts towards different ecosystem resources as a result of the discharges of recalcitrated pollutants, have led to different investigations to generate alternative solutions. Worldwide, different technologies have been studied to address this problem, biological and physicochemical processes have been widely studied, presenting drawbacks with some recalcitrant compounds. This review provides a context on the different existing technologies for the treatment of tannery wastewater, analyzing

the physicochemical composition of this liquid waste, the impact it generates on human health and ecosystems and the advances in the different existing technologies, focusing on advanced oxidation processes and the use of microalgae. The coupling of advanced oxidation processes with biological processes, mainly microalgae, is seen as a viable biotechnological strategy, not only for the removal of pollutants, but also to obtain value-added products with potential use in the biorefining of the biomass.

An eco-friendly strategy for dairy wastewater remediation with high lipid microalgae-bacterial biomass production

Autor: Tethi Biswas

J Environ Manage. 2021 May 15;286:112196. doi: 10.1016/j.jenvman.2021.112196. Epub 2021 Feb 25.

ABSTRACT

The present study attempts to integrate phyco-remediation and enhanced lipid productivity using microalgae-bacterial consortium enriched from wastewater fed aquaculture pond. Metagenomic analyses and microscopic images of the consortium revealed the presence of Chlorella variabilis, Parachlorella kessleri, Thermosynechococcus elongatus, Chlamydomonas, Phaeodactylum tricornutum, Oscillatoriales, Synechocystis sp., Microcystis aeruginosa, Nostocales, Naviculales, Stramenopiles, other members of Chlorophyceae, Trebouxiophyceae, and Chroococcales along with potential bacterial bioremediants. During a 30 days trial run (15 days stabilization and 14 days remediation studies) for phyco-remediation drastic reduction in the nutrient and COD content from the tested wastewater samples was seen. There was up to 93% and 87.2% reduction in chemical oxygen demand (COD) and ammonium concentration, respectively. Further, almost 100% removal of nitrates and phosphates from the dairy wastewater upon 48 h of treatment with polyculture under ambient temperature (25 ± 2 °C) with 6309 lux illumination and mild aeration, was observed for all the seven cycles. Interestingly, the nutrient and COD concentrations in the treated water were below the discharge standards as per Central Pollution Control Board (CPCB) norms. In additions, biomass (reported as dry cell weight) was enhanced by 67% upon treatment with ammonia-rich dairy wastewater exhibiting 42% lipid, 55% carbohydrate, and 18.6% protein content enhancement. The polyculture mainly grown as attached biofilm to the surface, offered an easy harvesting and separation of grown biomass from the treated wastewater. Overall, dairy wastewater was found to be a potential nutrient source for microalgae-bacteria cultivation thereby making the treatment process sustainable and eco-friendly.

An integrated approach for tannery effluent treatment with ozonation and phycoremediation: A feasibility study

Autor: D Saranya

Environ Res. 2020 Apr;183:109163. doi: 10.1016/j.envres.2020.109163. Epub 2020 Jan 21.

ABSTRACT

For the exploration of an effective and economical method to treat composite raw tannery effluent, the integrated approach of Ozonation and phycoremediation was followed. In a

lab-scale Ozone reactor, the highest performance index was attained, when it was operated at a low O3 flowrate (2 g/h) condition. The tannery effluent partially treated by Ozonation (≈60% COD removed in 90 min) with the ozone consumption of 1.5 g of O3/g of COD, at pH 7.6, coupled with phycoremediation had improved the tannery effluent characteristics to a considerable extent. Overall, the maximum reduction in pollutant concentration attained with the combined treatment was 84% for COD, 60% for colour, 100% for odour, 90% for inorganic carbon, 82% for NH4+- N, 100% for PO4-P, 97% for chromium and 10% for TDS. In phycoremediation, microalgae Nannochloropsis oculata had shown an enhanced growth (μ = 0.255 day-1) with a maximum cell density of 5.2 × 107 cells/mL, dry biomass of 0.86 g L-1 and cell division rate of 0.369 day-1. Elemental analysis of biomass validated the chromium remediation along with other elements such as calcium, magnesium, sodium, potassium, zinc, and iron from the tannery effluent. Therefore, the phycoremediation integrated ozone process can be considered as a feasible treatment method for tannery effluent along with value-added biomass production.

Assessment upon heterotrophic microalgae screened from wastewater microbiota for concurrent pollutants removal and biofuel production

Autor: Liang Shen

Bioresour Technol. 2017 Dec;245(Pt A):386-393. doi: 10.1016/j.biortech.2017.07.177. Epub 2017 Aug 3.

ABSTRACT

Heterotrophic microalgae, capable of converting organic carbons to biofuel, as well as assimilating nutrients, have a great prospective in wastewater treatment. Meanwhile, the knowledge about heterotrophic microalgae is still far less than the autotrophic conterpart. Hence, in this study, 20 heterotrophic microalgal strains were isolated from a domestic wastewater treatment plant, and identified according to morphology and partial 18S and 23S rRNA gene sequences. Further, their biological traits were assessed in terms of N, P, TOC removal efficiencies, growth parameters, self-settleability and lipids production, expressed through a comprehensive selection index. By such, the optimal strains were chosen and applied back to treat the real wastewater, with or without pretreatment of sterilization. An organic-adaptable strain, i.e., Botryococcus sp. NJD-1, was ultimately recommended to achieve the concurrent biofuel production (up to 61.7% lipid content) and pollutants removal (up to 64.5%, 89.8% and 67.9% for N, P and TOC) in pristine wastewater.

Biodiesel production through algal cultivation in urban wastewater using algal floway

Autor: Thomas Kiran Marella

Bioresour Technol. 2019 May;280:222-228. doi: 10.1016/j.biortech.2019.02.031. Epub 2019 Feb 6.

ABSTRACT

The aim of this work was to study algal floway (AFW) to treat urban wastewater and to evaluate biomass productivity, lipid contents and biodiesel production. The results indicated the seasonal average algae productivity of 34.83 g dry weight m2 d-1 with a

nutrient removal rate of 2.52 g m2 d-1N and 1.25 g m2 d-1P while the lipid content ranged between 14 and 22% of dry cell weight with the highest lipid productivity of 9.29 g m-2 d-1 during summer. Biodiesel quality was superior during summer with high centane number and cold filter plugging point values. High eicosapentaenoic acid content was found during winter growth cycles. AFW algae community was dominated by pennate diatoms during all growing seasons. This study is one of its kinds in Indian wastewaters and it provides fundamental information for further optimization and use of AFW to treat domestic wastewater and to produce algae biofuel feedstock.

Biofuel recovery from microalgae biomass grown in dairy wastewater treated with activated sludge: The next step in sustainable production

Autor: Henrique Vieira de Mendonça

Sci Total Environ. 2022 Feb 14:153838. doi: 10.1016/j.scitotenv.2022.153838. Online ahead of print.

ABSTRACT

Microalgae biofuel could be the next step in avoiding the excessive use of fossil fuels and reducing negative impacts on the environment. In the present study, two species of microalgae (Scenedesmus obliquus and Chlorella vulgaris) were used for biomass production, grown in dairy wastewater treated by activated sludge systems. The photobioreactors were operated in batch and in continuous mode. The dry biomass produced was in the range of 2.30 to 3.10 g L-1. The highest volumetric yields for lipids and carbohydrates were 0.068 and 0.114 g L-1 day-1. Maximum CO2 biofixation (750 mg L-1 day-1) was obtained in continuous mode. The maximum values for lipids (21%) and carbohydrates (39%) were recorded in the batch process with species Scenedesmus obliquus. In all of the experiments, the Linolenic acid concentration (C18:3) was greater than 12%, achieving satisfactory oxidative stability and good quality. Projected biofuel production could vary between 4,863,708 kg and 9,246,456 kg year-1 if all the dairy wastewater produced in Brazil were used for this purpose. Two hectares would be needed to produce 24,99 × 109 L year-1 of microalgae bioethanol, a far lower value than used in cultivating sugar cane. If all dairy wastewater generated annually in Brazil were used to produce microalgae biomass, it would be possible to obtain approximately 30,609 to 53,647 barrels of biodiesel per year. These data show that only by using dairy wastewater would biofuels be produced to replace 17% to 40% of the fossil fuels currently used in Brazil.

Dairy Manure Wastewater Remediation Using Non-airtight Digestion Pretreatment Followed by Microalgae Cultivation

Autor: Liang Wang

Appl Biochem Biotechnol. 2020 Nov;192(3):1093-1105. doi: 10.1007/s12010-020-03363-1. Epub 2020 Jul 17.

ABSTRACT

The non-airtight digestion technology is emerging to be applied in the acidogenic phase for two-stage methane production. However, in this study, it was used to pretreat screened dairy manure (SDM) in order to provide microalgae cultivation with a substrate that might

be more suitable for nutrient reduction, especially phosphorus. SDM was firstly underwent non-airtight digestion applying different dilution folds, i.e., blank (no dilution), 5-fold, 10-fold, and 15-fold. Total solids (TS), total dissolved solids (TDS), and chemical oxygen demand (COD) of the SDM were mostly reduced when there was no dilution applied. Five-fold dilution is the most beneficial one for ammonia reduction. Total phosphorus (TP) was reduced the most efficiently in the blank SDM. After the non-airtight digestion, 5-fold diluted original SDM, 5-fold diluted digested original SDM, and digested 5-fold diluted SDM were used to grow microalgae for 8 days. Microalgae grown in 5-fold diluted digested original SDM and digested 5-fold diluted SDM had better removal efficiencies in COD and NH4-N. From the monitoring of pH and TP during the 8-day culture period, it is found that pHs were peaked on the 4th day for microalgae grown in 5-fold diluted digested original SDM and digested 5-fold diluted SDM, corresponding to the maximal TP removal. Non-airtight digestion of SDM could help achieve better nutrient removal by microalgal cultivation in a shorter time span.

Effect of light intensity and wavelength on nitrogen and phosphate removal from municipal wastewater by microalgae under semi-batch cultivation

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Environ Technol. 2020 Oct 13:1-7. doi: 10.1080/09593330.2020.1829087. Online ahead of print.

ABSTRACT

Domestic, agricultural and industrial water activities lead to organic and inorganic pollution of the environment. Biotreatment of municipal wastewater with the potential production of biomass is a valuable feature of microalgae. In this study we evaluated the effects of wavelength and light intensity on phosphate and ammonium removal on the one hand, and biomass and protein production on the other hand by Spirulina platensis in municipal wastewater treatment under semi batch cultivation. S. platensis was inoculated at 40% in artificial wastewater open pond system. Red, blue and purple light with 3800, 4800 and 5800 lux light intensity under 12 h light and 12 h darkness were investigated. Cultivation was conducted in semi-batch conditions; after four days cultivation, one third of the culture was replaced with fresh medium. The highest biomass and protein concentrations were observed under blue light at 5800 lux light intensity, 5.45 and 3 g/l respectively cumulatively; while the highest amount of phosphate and ammonium removal were about 145 and 218 mg/l under purple light at 5800 lux intensity, respectively. The amounts of biomass and protein produced, as well as phosphate and ammonium removed, are therefore impacted by wavelength, light intensity, results show that light intensity and wavelength can be customized to reach on the one hand the highest biomass and protein production, and on the other hand to maximize the removal of phosphorous and ammonium.

Formulation of New Media from Dairy and Brewery Wastes for a Sustainable Production of DHA-Rich Oil by Aurantiochytrium mangrovei

Autor: Giovanni L Russo

Mar Drugs. 2021 Dec 29;20(1):39. doi: 10.3390/md20010039.
ABSTRACT
Mozzarella stretching water (MSW) is a dairy effluent generated from mozzarella cheese production that does not have a real use and is destined to disposal, causing environmental problems and representing a high disposal cost for dairy producers. Spent brewery yeast (SBY) is another promising food waste produced after brewery manufacturing that could be recycled in new biotechnological processes. Aurantiochytrium mangrovei is an aquatic protist known as producer of bioactive lipids such as omega 3 long chain polyunsaturated fatty acids (ω3 LC-PUFA), in particular docosahexaenoic acid (DHA). In this work MSW and SBY have been used to formulate new sustainable growth media for A. mangrovei cultivation and production of DHA in an attempt to valorize these effluents. MSW required an enzymatic hydrolysis to enhance the biomass production. The new media obtained from hydrolysed MSW was also optimized using response surface methodologies, obtaining 10.14 g L-1 of biomass in optimized medium, with a DHA content of 1.21 g L-1.

High-rate algal pond for removal of pharmaceutical compounds from urban domestic wastewater under tropical conditions. Case study: Santiago de Cali, Colombia

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Water Sci Technol. 2020 Sep;82(6):1031-1043. doi: 10.2166/wst.2020.362.
ABSTRACT
This study evaluated the capacity of a pilot-scale high-rate algal pond (HRAP) to remove pharmaceutical compounds (PCs) from domestic wastewater in the city of Santiago de Cali, Colombia. The compounds analyzed included antiepileptics, hypolipidemic drugs, tranquilizers and analgesics, and anti-inflammatory drugs. The HRAP operated under a continuous water flow of 0.2 m3d-1 and a 3-day hydraulic retention time (HRT). Removal efficiencies were high (>70%) for fenofibric acid, ibuprofen, and paracetamol; medium (30-70%) for gabapentin, lamotrigine, fenofibrate, gemfibrozil, diclofenac, ketoprofen, naproxen, and pentoxifylline; and low (<30%) for carbamazepine and its metabolite 10,11-Dihidro-10,11-dihidroxicarbamazepine (CBZ-Diol). The findings herein are similar to other studies, but were obtained with a shorter HRT. These results show that tropical environmental conditions favor photodegradation and contribute to the development of microalgae and the biodegradation process. Twenty microalgae species were identified, with the phylum Chlorophyta as the most abundant, particularly due to its natural introduction. The removal of the PCs also reflected a percentage reduction (>50%) in the ecological hazard posed by most of the compounds, although it is important to note that the hazard from gemfibrozil and ibuprofen remained high even after treatment, indicating the need for complementary treatment.

Improving reverse osmosis concentrate treatment and nutrients conversion to Chlorella vulgaris bioenergy assisted with granular activated carbon

Autor: Rui Hu

Sci Total Environ. 2022 Apr 1;815:152663. doi: 10.1016/j.scitotenv.2021.152663. Epub 2021 Dec 28.

ABSTRACT

Landfill leachate (LL), especially the reverse osmosis concentrate (ROC), is a societal burden due to high toxicity but may have intrinsic values attributing to copious nutrients and organics. ROC bioremediation by microalgae has attracted much attentions benefiting from its extra advantage of bioenergy production. However, efficient microalgae cultivation with ROC is still a challenging task attributing to notorious ROC characteristics, like high chromaticity and toxicity. To alleviate these negative influences, a technique integrating granular activated carbon (GAC) pretreatment and microalgae bioremediation was proposed, with which nitrogen and phosphorus removal efficiencies achieved 100% along with an optimized microalgal biomass concentration of 1.44 g/L and lipid yield of 482.4 mg/L. Furthermore, a total volumetric energy yield of 33.6 kJ/L was acquired, which was conducive to realize energy valorization. The visualization evidence of three-dimensional fluorescence spectroscopy revealed chromaticity degradation mechanism of ROC as humic acids reduction and transfer to family of soluble microbial by-products. Meanwhile, contributions of GAC adsorption and microalgae assimilation on nutrients removal were analyzed. Together, this work provides a promising method and valuable information for ROC bioremediation with microalgae.

Influence of the hydraulic retention time on the removal of emerging contaminants in an anoxic-aerobic algal-bacterial photobioreactor coupled with anaerobic digestion

Autor: Graziele Ruas

Sci Total Environ. 2022 Mar 8;827:154262. doi: 10.1016/j.scitotenv.2022.154262. Online ahead of print.

ABSTRACT

This work evaluated, for the first time, the performance of an integral microalgae-based domestic wastewater treatment system composed of an anoxic reactor and an aerobic photobioreactor, coupled with an anaerobic digester for converting the produced algal-bacterial biomass into biogas, with regards to the removal of 16 contaminants of emerging concern (CECs): penicillin G, tetracycline, enrofloxacin, ciprofloxacin, sulfamethoxazole, tylosin, trimethoprim, dexamethasone, ibuprofen, naproxen, acetaminophen, diclofenac, progesterone, carbamazepine, triclosan and propylparaben. The influence of the hydraulic retention time (HRT) in the anoxic-aerobic bioreactors (4 and 2.5 days) and in the anaerobic digester (30 and 10 days) on the fate of these CECs was investigated. The most biodegradable contaminants (removal efficiency >80% regardless of HRT) were tetracycline, ciprofloxacin, sulfamethoxazole, tylosin, trimethoprim, dexamethasone, ibuprofen, naproxen, acetaminophen and propylparaben (degraded predominantly in the anoxic-aerobic bioreactors), and tetracycline, sulfamethoxazole, tylosin, trimethoprim and naproxen (degraded predominantly in the anaerobic reactor). The anoxic-aerobic bioreactors provided removal of at least 48% for all CECs tested. The most recalcitrant contaminants in the anaerobic reactor, which were not removed at any of the HRT tested, were enrofloxacin, ciprofloxacin, progesterone and propylparaben.

Influence of three microalgal-based cultivation technologies on different domestic wastewater and biogas purification in photobioreactor

Autor: Shiqing Sun
Water Environ Res. 2019 Aug;91(8):679-688. doi: 10.1002/wer.1097. Epub 2019 Apr 1.
ABSTRACT
To investigate the effects of different microalgae and culture methods on the purification of domestic wastewater and biogas, Chlorella vulgaris and Scenedesmus obliquus were selected. Three different culture methods (monoculture, microalgal-fungi cocultivation, and microalgal-activated sludge cocultivation) were used to remove nutrients from four different domestic wastewaters and remove CO2 from raw biogas in a photobioreactor. The results show that the effluent from the centrate of pretreated urban wastewater (WW4) achieved the highest nutrient and CO2 removal efficiency. Cocultivation of C. vulgaris and activated sludge achieved the highest COD, TP, and CO2 removal efficiencies of 79.27%, 81.25%, and 60.39% with WW4, respectively. Cocultivation of C. vulgaris and fungi achieved the highest TN removal efficiency of 78.46% with WW4. The contents of C, N, and P in the microalgal-activated sludge symbiont after treatment exceeded 50%, 8%, and 0.8%, respectively. Highly economically efficient energy consumption was achieved with WW4 for both C. vulgaris and S. obliquus. Microalgal-activated sludge cocultivation was identified as the optimal option for the simultaneous purification of wastewater and biogas based on its high pollution and CO2 removal efficiency. This provides a reference for the microalgal-based purification of actual domestic wastewater and raw biogas. PRACTITIONER POINTS: Nutrient and CO2 were efficiently removed by C. vulgaris with activated sludge. CO2 was removed up to 60.4% and was economically viable. Cocultivation of C. vulgaris and fungi could achieve the highest TN removal with WW4.

Insights into upstream processing of microalgae: A review

Autor: Ehsan Daneshvar
Bioresour Technol. 2021 Jun;329:124870. doi: 10.1016/j.biortech.2021.124870. Epub 2021 Feb 18.
ABSTRACT
The aim of this review is to provide insights into the upstream processing of microalgae, and to highlight the advantages of each step. This review discusses the most important steps of the upstream processing in microalgae research such as cultivation modes, photobioreactors design, preparation of culture medium, control of environmental factors, supply of microalgae seeds and monitoring of microalgal growth. An extensive list of bioreactors and their working volumes used, elemental composition of some well-known formulated cultivation media, different types of wastewater used for microalgal cultivation and environmental variables studied in microalgae research has been compiled in this review from the vast literature. This review also highlights existing challenges and knowledge gaps in upstream processing of microalgae and future research needs are suggested.

Long-term semi-continuous production of carbohydrate-enriched microalgae biomass cultivated in low-loaded domestic wastewater

Autor: Cesar E Solís-Salinas

Sci Total Environ. 2021 Dec 1;798:149227. doi: 10.1016/j.scitotenv.2021.149227. Epub 2021 Jul 22.

ABSTRACT

The production of carbohydrate-enriched biomass from waste streams as a sustainable biofuel precursor is a noteworthy endeavor. This study investigates the long-term microalgae cultivated under low domestic wastewater loads and different hydraulic retention times (HRT) in a semi-continuous photobioreactor. The influence of operational conditions, the microalgae interaction with carbon, nutrients availability, and microbial population in terms of carbohydrate content were elucidated. The results revealed that the operation at similar low nutrients and carbon loads maintained at three different hydraulic retention times (HRT) of 10, 8, and 6 days caused different patterns in nutrients uptake and biomass composition. Particularly, the carbohydrate accumulation was greatly influenced by the unbalance in the N:P ratios than complete depletion of the nutrients. Hence, during the period operated at HRT of 10 d, high nutrients removal efficiencies were observed while gradually increasing carbohydrate content up to 57% in dry cell weight (DCW). Afterward, the decrease to 8 and 6 d of HRT showed lower nutrient consumption with depleted alkalinity, reaching an appreciably high carbohydrate accumulation of up to 46%, and 56%, respectively. The biomass concentration decreased in the order of HRT of 10, 8, and 6 days. This study demonstrated that microalgae adapted to low carbon and nutrient loads could still accumulate high carbohydrate at shorter HRT using domestic wastewater as substrate.

Microalgae Cultivation Using Screened Liquid Dairy Manure Applying Different Folds of Dilution: Nutrient Reduction Analysis with Emphasis on Phosphorus Removal

Autor: Liang Wang

Appl Biochem Biotechnol. 2020 Oct;192(2):381-391. doi: 10.1007/s12010-020-03316-8. Epub 2020 May 8.

ABSTRACT

A number of dairies in southern Idaho employed stationary inclined screens to separate large solid particles out of liquid dairy manure. In this way, the total solid content of the liquid dairy manure can drop about 20%. Solids in dairy wastewater cause high turbidities, which could block the incident light, a key factor in the microalgae cultivation process using wastewaters as culture media. In this study, screened liquid dairy manure was used as the microalgae Chlorella vulgaris culture media. The aim was to optimize the dilution folds for the best growth of Chlorella vulgaris and nutrients' reduction with a special focus on phosphorus removal and recovery. Four folds of dilution, designated as 5*, 10*, 15*, 20*, were applied to the liquid dairy manure to alleviate hindrance of the high turbidity together with the high ammonium. Microalgal cultivation removed a significant amount of turbidity and major nutrients. For differently diluted liquid dairy manures, although the initial turbidities varied a lot, the final removal rates were not significantly different, falling in the range of 88.11-91.73%. Chemical oxygen demand (COD) in the 5-fold diluted liquid

dairy manure dropped from 6700 to 1200 mg/L, corresponding to a removal rate of 79.81%. For the 10-fold, 15-fold, and 20-fold diluted manures, Chlorella removed around 67-69% of the initial CODs. Total Kjeldahl nitrogen (TKN) was removed at rates ranging from 70.84 to 73.99% from the four differently diluted liquid dairy manures without significant differences. NH4-N was removed most efficiently by 88.92% from the 20-fold diluted liquid dairy manure, and the least at 68.65% from the 5-fold diluted one. Although the original total phosphorus (TP) concentrations were distinctive for each group, the TP removal rates stayed in the range of 52.16 to 65.22%. Scanning electron microscopy (SEM) and energy-dispersive spectrometry (EDS) analysis of the precipitates harvested from the microalgal cultivation suggested possible phosphate precipitate forms. The chelation of Ca or Mg cations by dissolved organic matter (DOM) under alkaline conditions caused by microalgae cultivation could explain the unsatisfactory phosphorus removals observed in this study.

Microalgae cultivation in wastewater from agricultural industries to benefit next generation of bioremediation: a bibliometric analysis

Autor: Jessica Muniz Melo

Environ Sci Pollut Res Int. 2022 Mar;29(15):22708-22720. doi: 10.1007/s11356-021-17427-0. Epub 2021 Nov 19.

ABSTRACT

The aim of this study was to provide a bibliometric analysis and mapping of existing scientific papers, focusing on microalgae cultivation coupled with biomass production and bioremediation of wastewater from agricultural industries, including cassava, dairy, and coffee. Using the Web of Science (WoS) database for the period 1996-2021, a search was performed using a keyword strategy, aiming at segregating the papers in groups. For the first search step, the keywords "wastewater treatment", AND "microalgae", AND "cassava" OR "dairy" OR "coffee" were used, resulting in 59 papers. For the second step, the keywords "wastewater treatment" AND "biomass productivity" AND "microalgae" AND "economic viability" OR "environmental impacts" were used, which resulted in 34 articles. In these papers, keywords such as "carbon dioxide biofixation" and "removal of nutrients by the production of biomass by microalgae" followed by "environmental and economic impacts" were highlighted. Some of these papers presented an analysis of the economic feasibility of the process, which reveal the state-of-the-art setup required to make the cultivation of microalgae economically viable. Researches focusing on the efficiency of microalgae biomass harvesting are needed to improve the integration of microalgae production in industrial eco-parks using wastewater to achieve the global goal of bioremediation and clean alternatives for renewable energy generation.

Microalgae-bacteria consortia in high-rate ponds for treating urban wastewater: Elucidating the key state indicators under dynamic conditions

Autor: Ángel Robles

J Environ Manage. 2020 May 1;261:110244. doi: 10.1016/j.jenvman.2020.110244. Epub 2020 Mar 2.

ABSTRACT

On-line performance indicators of a microalgae-bacteria consortium were screened out from different variables based on pH and dissolved oxygen on-line measurements via multivariate projection analysis, aiming at finding on-line key state indicators to easily monitor the process. To fulfil this objective, a pilot-scale high-rate pond for urban wastewater treatment was evaluated under highly variable conditions, i.e. during the start-up period. The system was started-up without seed of either bacterial or microalgal biomass. It took around 19 days to fully develop a microalgal community assimilating nutrients significantly. Slight increases in the biomass productivities in days 26-30 suggest that the minimum time for establishing a performant bacteria-microalgae consortium could be of around one month for non-inoculated systems. At this point, the process was fully functional, meeting the European discharge limits for protected areas. The results of the statistical analyses show that both the pH and the dissolved oxygen concentration represent accurately the biochemical processes taking place under the start-up of the process. Both pH and dissolved oxygen represented accurately also the performance of the high-rate algal pond, being affordable, easily-implemented, options for monitoring, control and optimization of industrial-scale processes.

Microalgal Biorefinery Concepts' Developments for Biofuel and Bioproducts: Current Perspective and Bottlenecks

Autor: Ramachandran Sivaramakrishnan

Int J Mol Sci. 2022 Feb 27;23(5):2623. doi: 10.3390/ijms23052623.

ABSTRACT

Microalgae have received much interest as a biofuel feedstock. However, the economic feasibility of biofuel production from microalgae does not satisfy capital investors. Apart from the biofuels, it is necessary to produce high-value co-products from microalgae fraction to satisfy the economic aspects of microalgae biorefinery. In addition, microalgae-based wastewater treatment is considered as an alternative for the conventional wastewater treatment in terms of energy consumption, which is suitable for microalgae biorefinery approaches. The energy consumption of a microalgae wastewater treatment system (0.2 kW/h/m3) was reduced 10 times when compared to the conventional wastewater treatment system (to 2 kW/h/m3). Microalgae are rich in various biomolecules such as carbohydrates, proteins, lipids, pigments, vitamins, and antioxidants; all these valuable products can be utilized by nutritional, pharmaceutical, and cosmetic industries. There are several bottlenecks associated with microalgae biorefinery. Hence, it is essential to promote the sustainability of microalgal biorefinery with innovative ideas to produce biofuel with high-value products. This review attempted to bring out the trends and promising solutions to realize microalgal production of multiple products at an industrial scale. New perspectives and current challenges are discussed for the development of algal biorefinery concepts.

Phycoremediation and valorization of synthetic dairy wastewater using microalgal consortia of Chlorella variabilis and Scenedesmus obliquus

Autor: Bhalamurugan Gatamaneni Loganathan

Environ Technol. 2021 Aug;42(20):3231-3244. doi: 10.1080/09593330.2020.1725143. Epub 2020 Feb 11.

ABSTRACT
Microalgae are known to grow on wastewater utilizing their available nutrients. The residual algal biomass thus obtained could be used for producing value-added products thereby making it an economically viable and sustainable option for the dairy industry. The present study evaluates the ability of the microalgal consortia composed of Chlorella variabilis and Scenedesmus obliquus to treat and valorize diluted synthetic dairy wastewater under controlled laboratory conditions. The effect of time, inoculum concentration and light intensity on five responses, namely phosphate removal, ammoniacal nitrogen removal, COD removal, biomass productivity and lutein content, are studied by response surface methodology utilizing central composite design. The quadratic models are found to be suitable for phosphate removal, ammoniacal nitrogen removal, COD removal and biomass productivity. At optimized experimental conditions, the microalgal consortia exhibited phosphate removal of 70.19%, ammoniacal nitrogen removal of 86.22%, COD removal of 54.72%, biomass productivity of 29.13 mg/L/day and lutein content of 12.59 mg/g respectively. This study is of high importance as the lutein content exhibited by the microalgal consortia is higher when compared to other microalgal species and could be considered in the future as a commercial source of lutein.

Potential Applications of Arthrospira platensis Lipid-Free Biomass in Bioremediation of Organic Dye from Industrial Textile Effluents and Its Influence on Marine Rotifer (Brachionus plicatilis)

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Materials (Basel). 2021 Aug 8;14(16):4446. doi: 10.3390/ma14164446.
ABSTRACT
Arthrospira platensis is one of the most important cultured microalgal species in the world. Arthrospira complete dry biomass (ACDB) has been reported as an interesting feedstock for many industries, including biodiesel production. The A. platensis by-product of biodiesel production (lipid-free biomass; LFB) is a source of proteins, functional molecules, and carbohydrates, and can also be reused in several applications. The current study investigated the efficiency of ACDB and LFB in bioremediation of dye (Ismate violet 2R, IV2R) from textile effluents. In addition, the potential of ACDB and LFB loaded by IV2R as a feed for Rotifer, Brachionus plicatilis, was examined. The surface of the adsorbents was characterized by SEM, FTIR, and Raman analysis to understand the adsorption mechanism. The batch sorption method was examined as a function of adsorbent dose (0.02-0.01 g L-1), solution initial concentration (10-100 mg L-1), pH (2-10), and contact time (15-180 min). The kinetic studies and adsorption isotherm models (Freundlich, Langmuir, Tempkin, and Halsey) were used to describe the interaction between dye and adsorbents. The results concluded that the adsorption process increased with increasing ACDB and LFB dose, contact time (120 min), initial IV2R concentration (10 mg L-1), and acidity pH (2 and 6, respectively). For the elimination of industrial textile wastewater, the ACDB and LFB sorbents have good elimination ability of a dye solution by 75.7% and 61.11%, respectively. The kinetic interaction between dye and adsorbents fitted well to Langmuir, Freundlish, and Halsey models for LFB, and Langmuir for ACDB at optimum conditions with R2 > 0.9. In addition, based on the bioassay study, the ACDB and LFB loaded by IV2R up to 0.02 g L-1 may be used as feed for the marine Rotifer B. plicatilis.

Production of microalgae with high lipid content and their potential as sources of nutraceuticals

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Phytochem Rev. 2022 Jan 23:1-28. doi: 10.1007/s11101-021-09784-y. Online ahead of print.

ABSTRACT

In the current global scenario, the world is under a serious dilemma due to the increasing human population, industrialization, and urbanization. The ever-increasing need for fuels and increasing nutritional problems have made a serious concern on the demand for nutrients and renewable and eco-friendly fuel sources. Currently, the use of fossil fuels is creating ecological and economic problems. Microalgae have been considered as a promising candidate for high-value metabolites and alternative renewable energy sources. Microalgae offer several advantages such as rapid growth rate, efficient land utilization, carbon dioxide sequestration, ability to cultivate in wastewater, and most importantly, they do not participate in the food crop versus energy crop dilemma or debate. An efficient microalgal biorefinery system for the production of lipids and subsequent byproduct for nutraceutical applications could well satisfy the need. But, the current microalgal cultivation systems for the production of lipids and nutraceuticals do not offer techno-economic feasibility together with energy and environmental sustainability. This review article has its main focus on the production of lipids and nutraceuticals from microalgae, covering the current strategies used for lipid production and the major high-value metabolites from microalgae and their nutraceutical importance. This review also provides insights on the future strategies for enhanced microalgal lipid production and subsequent utilization of microalgal biomass.

Reduction and liquid-solid partitioning of SARS-CoV-2 and adenovirus throughout the different stages of a pilot-scale wastewater treatment plant

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Water Res. 2022 Apr 1;212:118069. doi: 10.1016/j.watres.2022.118069. Epub 2022 Jan 14.

ABSTRACT

Investigating waterborne viruses is of great importance to minimizing risks to public health. Viruses tend to adsorb to sludge particles from wastewater processes by electrostatic and hydrophobic interactions between virus, aquatic matrix, and particle surface. Sludge is often re-used in agriculture; therefore, its evaluation is also of great interest to public health. In the present study, a pilot scale system treating real domestic wastewater from a large city in Brazil was used to evaluate the removal, the overall reduction, and liquid-solid partitioning of human adenovirus (HAdV), the novel coronavirus (SARS-CoV-2) and fecal indicators (F-specific coliphages and E. coli). The system consists of a high-rate algal pond (HRAP) post-treating the effluent of an upflow anaerobic sludge blanket (UASB) reactor. Samples were collected from the influent and effluent of each unit, as well as from the sludge of the UASB and from the microalgae biomass in the HRAP. Pathogens and indicators were quantified by quantitative polymerase chain reaction (qPCR) (for HAdV), qPCR with reverse transcription (RTqPCR) (for SARS-CoV-2), the

double agar plaque assay (for coliphages), and the most probable number (MPN) method (for E. coli). The removal and overall reduction of HAdV and SARS-CoV-2 was greater than 1-log10. Almost 60% of remaining SARS-CoV-2 RNA and more than 70% of remaining HAdV DNA left the system in the sludge, demonstrating that both viruses may have affinity for solids. Coliphages showed a much lower affinity to solids, with only 3.7% leaving the system in the sludge. The system performed well in terms of the removal of organic matter and ammoniacal nitrogen, however tertiary treatment would be necessary to provide further pathogen reduction, if the effluent is to be reused in agriculture. To our knowledge, this is the first study that evaluated the reduction and partitioning of SARS-CoV-2 and HAdV through the complete cycle of a wastewater treatment system consisting of a UASB reactor followed by HRAPs.

Removal of nutrients from domestic wastewater by microalgae coupled to lipid augmentation for biodiesel production and influence of deoiled algal biomass as biofertilizer for Solanum lycopersicum cultivation

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Chemosphere. 2021 Apr;268:129323. doi: 10.1016/j.chemosphere.2020.129323. Epub 2020 Dec 15.

ABSTRACT

In this study, Chlorella sp., Scenedesmus sp., and their consortium were used for the biorefinery approach. The algal consortium (Chlorella sp. + Scenedesmus sp.) grown well in 75% diluted wastewater, and obtained the highest biomass (1.78 g L-1), chlorophyll (27.03 μg mL-1), protein (175 μg mL-1) and lipid content (34.83% dry cell weight). Algal consortium showed mainly 51.75% of palmitic acid and 35.45% of oleic acid in the lipids. The removal of nitrate, ammonium, phosphate, chemical oxygen demand, total organic carbon and total nitrogen in 75% diluted wastewater by algal consortium were 96%, 98%, 95%, 83%, 86% and 94%, respectively. Moreover, deoiled algal biomass (DAB) waste used as a biofertilizer combined with inorganic fertilizer resulted in the grater improvement of Solanum lycopersicum shoot length (44%), root length (89%), fresh weight (95%), dry weight (53%), macro and micro-nutrients (N 61%, P 179%, K 71%, Ca 38%, Mg 26% and Fe 11%), and tomato yield (174%) as compared to control treatment. Our results indicate that the use of consortium is not only a potential bioresource for wastewater treatment and biodiesel production but also the DAB waste is an effective biofertilizer for sustainable agriculture production.

Spatiotemporal variations in the composition of algal mats in wastewater treatment ponds of tannery industry

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Environ Monit Assess. 2021 May 26;193(6):359. doi: 10.1007/s10661-021-09144-5.

ABSTRACT

Wastewater Treatment Pond (WTP) is an effective remediation technology for economically developing nations. Although it's excessive organic and nutrient loads with higher water logging time triggers mixed and unprofitable microalgal mats. This may serve as a seeding source for Cyanobacterial bloom in receiving waterbodies. Since, to maintain the growth of

desirable algal species in WTPs, understanding towards environmental regulation and algal mat composition is important, especially for tropical countries, like India. In this study, biological treatment pond (BTP) and outlet pond (OP), of a tannery effluent treatment plant in eastern coast of India, were chosen for surveying the algal community composition concerning ecological parameters. Nearly, both the ponds were polluted, but the diversity was lower in BTP due to its elevated nutrient content (Ammonia 173 mg L-1) and higher persistent organic matters (COD 301.7 mg L-1) than OP. Using canonical correspondence analysis, seasonal variations showed higher species abundance during early summer compared to other seasons. A total of 37 taxa forming thick algal mats were recorded. The matrix of mats was mainly composed of Cyanobacterial members such as Phormidium, Leptolyngbya, Spirulina, and Pseudanabaena, followed by diatoms, especially Amphora and Nitzschia. Diatoms commonly occurred as embedded component in the entangled matrix of blue-green algal filaments. Hierarchical cluster analysis was employed to group all these taxa based on their seasonal appearance and abundance. This year-long intensive study revealing seasonal algal mat composition patterns in these WTPs will ultimately safeguard the livelihood and security of adjoining localities through proper site-specific pollution control.

Strategy for Managing Industrial Anaerobic Sludge through the Heterotrophic Cultivation of Chlorella sorokiniana: Effect of Iron Addition on Biomass and Lipid Production

Autor: Esteban Charria-Girón

Bioengineering (Basel). 2021 Jun 10;8(6):82. doi: 10.3390/bioengineering8060082.

ABSTRACT

Microalgae provides an alternative for the valorization of industrial by-products, in which the nutritional content varies substantially and directly affects microalgae system performance. Herein, the heterotrophic cultivation of Chlorella sorokiniana was systematically studied, allowing us to detect a nutritional deficiency other than the carbon source through assessing the oxygen transfer rate for glucose or acetate fermentation. Consequently, a mathematical model of the iron co-limiting effect on heterotrophic microalgae was developed by exploring its ability to regulate the specific growth rate and yield. For instance, higher values of the specific growth rate (0.17 h-1) compared with those reported for the heterotrophic culture of Chlorella were obtained due to iron supplementation. Therefore, anaerobic sludge from an industrial wastewater treatment plant (a baker's yeast company) was pretreated to obtain an extract as a media supplement for C. sorokiniana. According to the proposed model, the sludge extract allowed us to supplement iron values close to the growth activation concentration (KFe ~12 mg L-1). Therefore, a fed-batch strategy was evaluated on nitrogen-deprived cultures supplemented with the sludge extract to promote biomass formation and fatty acid synthesis. Our findings reveal that nitrogen and iron in sludge extract can supplement heterotrophic cultures of Chlorella and provide an alternative for the valorization of industrial anaerobic sludge.

Sustainable livestock wastewater treatment via phytoremediation: Current status and future perspectives

Autor: Hao Hu

Bioresour Technol. 2020 Nov;315:123809. doi: 10.1016/j.biortech.2020.123809. Epub 2020 Jul 10.

ABSTRACT

Phytoremediation, the application of vegetation and microorganisms for recovery of nutrients and decontamination of the environment, has emerged as a low-cost, eco-friendly, and sustainable approach compared to traditional biological and physico-chemical processes. Livestock wastewater is one of the most severe pollution sources to the environment and water resources. When properly handled, livestock wastewater could be an important alternative water resource in water-scarce regions. This review discussed the characteristics and hazards of different types of livestock wastewater and available methods for the treatment. Meanwhile, the current status of investigations on phytoremediation of livestock wastewater via different hydrophyte systems such as microalgae, duckweed, water hyacinth, constructed wetlands, and other hydrophytes is reviewed, and the utilization of hydrophytes after management is also discussed. Furthermore, advantages and limitations on livestock wastewater management via phytotechnologies are emphasized. At last, future research needs are also proposed.

Sustainable treatment of domestic wastewater through microalgae

Autor: Nandini Moondra

Int J Phytoremediation. 2020;22(14):1480-1486. doi: 10.1080/15226514.2020.1782829. Epub 2020 Jun 30.

ABSTRACT

The present work evaluated the optimum concentration of microalgal cells for domestic wastewater treatment in terms of removal in nutrients and physicochemical parameters. In the study, three different concentrations (20, 30, and 40%) of microalgae was considered at 8 hours and 24 hours of Hydraulic Retention time (HRT). Among the different microalgal concentrations studied 30% microalgae concentration gave maximum removal at both the HRTs. The maximum removal efficiency of phosphate, ammonia and COD for the non-filtered sample was 87.67, 96.88, and 80.39%, respectively, for filtered sample it was about 91.32, 100, and 83.64%, respectively at 8 hours HRT. However, at 24 hours HRT maximum removal efficiency observed was 97.92, 92.22, and 93.47% for ammonia, COD and phosphate respectively in case of non-filtered sample whereas in filtered samples maximum removal efficiency was 100, 94.44, and 95.51% for ammonia, COD and phosphate respectively. From the study, it was found that microalgae can effectively remove nutrients and organic contents to desirable limits even at a low HRT of 8 hours. At the urban sector, if microalgae are incorporated in a conventional wastewater treatment system will enhance the cost-effective efficiency by lowering the HRT and increasing the removal efficiency with footprints of sustainable treatment.

Upgrading of microalgal consortia with CO(2) from fermentation of wheat straw for the phycoremediation of domestic wastewater

Autor: Jyoti Sharma

Bioresour Technol. 2020 Feb 21;305:123063. doi: 10.1016/j.biortech.2020.123063. Online ahead of print.

ABSTRACT

Algae have been considered as a best feedstock for combating CO2. In the present study, two mixed microalgal cultures i.e. MAC1 and MAC2 were evaluated in batch mode with an extraneous supply of CO2 from the fermentation of wheat straw. Both the mixed cultures displayed promising CO2 sequestration potentials of 287 and 263 mg L-1d-1, respectively. The removal efficiencies in terms of ammonium, phosphate, chemical oxygen demand, and nitrate were found to be 87%, 78%, 68% and 65%, respectively. Enriching the tolerance of the microalgal consortia to CO2 supply and wastewater as the nutrient source significantly enhanced the lipid production for both the microalgae consortia. Lipid contents of MAC1 and MAC2 were observed to be 12.29 & 11.37%, respectively while the biomass yield from both the consortia was 0.36 g L-1. Total chlorophyll and protein contents of MAC1 and MAC2 were 14.27 & 12.28 μgmL-1 and 0.13 & 0.15 mgmL-1, respectively. Both the consortia found to have significant potential for CO2 sequestration, wastewater remediation and biofuel production.

Utilization of domestic wastewater as a water source of Tetradesmusobliquus PF3 for the biological removal of nitric oxide

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Environ Pollut. 2020 Jul;262:114243. doi: 10.1016/j.envpol.2020.114243. Epub 2020 Feb 21.

ABSTRACT

The reduction of nitrogen oxide (DeNOx) from flue gas by microalgae is a promising technology that has attracted increasing attention. Because the water source is a major limitation of microalgae application in the DeNOx from flue gas, we investigated the feasibility of using domestic wastewater (WW) as a water source. As a result, a biomass accumulation rate of 0.27 ± 0.01 mg L-1 d-1 was achieved by Tetradesmusobliquus PF3 cultivated in WW for 8 d, and 30 mg L-1 of nitrate nitrogen was added to the WW to fulfill the nutrient requirements of the microalgae cells. The ammonium (NH4+) nitrogen present in WW exerted inhibitory effects on the removal of nitric oxide (NO), thereby leading to 8% decrease removal efficiency in comparison with that using clean water and nutrients (BG11 medium). However, these inhibitory effects disappeared following the exhaustion of NH4+ by T. obliquus PF3 after 1 d. To overcome the inhibition of NH4+ and to achieve a high NO removal efficiency, a strategy of connecting two reactors in series was presented. The removal efficiency of NO by the two series reactors reached up to 71.2 ± 2.9%, which was significantly higher than that obtained by a single reactor (43.1 ± 3.6%). In addition, 70.9 ± 4.8% of the supplied NO was fixed into microalgae cells in the two reactors, which was 1.75 times higher than that in the single reactor (40.6 ± 5.1%), thereby suggesting that connecting two reactors in series rendered effective recovery of NO from flue gas using WW as a water source. In this study, we provided an economically viable water source for the application of microalgae in the biological DeNOx from flue gases.

Valorization of poultry litter using Acutodesmus obliquus and its integrated application for lipids and fertilizer production

Autor: Pfano Musetsho

Sci Total Environ. 2021 Nov 20;796:149018. doi: 10.1016/j.scitotenv.2021.149018. Epub 2021 Jul 13.

ABSTRACT

Microalgae are recognized as potential candidates for resource recovery from wastewater and projected for biorefinery models. This study was undertaken to evaluate the potential of poultry litter and municipal wastewater as nutrient and water sources, for the cultivation of Acutodesmus obliquus for lipids production for biodiesel application. The efficacy of lipid extracted biomass (LEA) as fertilizer for mung bean crops was also assessed in microcosm. A. obliquus cultivation in acid pre-treated poultry litter extract (PPLE) showed maximum biomass production of 1.90 g L-1, which was 74.67% and 12.61% higher than the raw poultry litter extract (RPPE) and BG11 respectively. Higher NO3-N, NH3-N, and PO4-P removal of 79.51%, 81.82%, and 80.52% respectively were observed in PPLE as compared to RPLE treatment. The highest biomass (140.36 mg L-1 d-1), lipids (38.49 mg L-1 d-1), and carbohydrates (49.55 mg L-1 d-1) productivities were observed in the PPLE medium. The application of LEA as a fertilizer for mung bean crops showed improvement in plant growth and soil microbial activity. A maximum increase in organic carbon (59.5%) and dehydrogenase activity (130.8%) was observed in LEA amended soil which was significantly higher than chemical fertilizer (CF) control in 30 days. Whilst plant fresh weight and leaf chlorophyll in the LEA amended soil was comparable to whole algal biomass (WA) and CF control. The strategy developed could be a basis for sustainable biorefinery for the valorization of wastewater for the production of microalgae-derived biofuel and byproducts for agricultural application.

Wastewater based microalgal biorefinery for bioenergy production: Progress and challenges

Autor: Shashi Kant Bhatia

Sci Total Environ. 2021 Jan 10;751:141599. doi: 10.1016/j.scitotenv.2020.141599. Epub 2020 Aug 10.

ABSTRACT

Treatment of industrial and domestic wastewater is very important to protect downstream users from health risks and meet the freshwater demand of the ever-increasing world population. Different types of wastewater (textile, dairy, pharmaceutical, swine, municipal, etc.) vary in composition and require different treatment strategies. Wastewater management and treatment is an expensive process; hence, it is important to integrate relevant technology into this process to make it more feasible and cost-effective. Wastewater treatment using microalgae-based technology could be a global solution for resource recovery from wastewater and to provide affordable feedstock for bioenergy (biodiesel, biohydrogen, bio-alcohol, methane, and bioelectricity) production. Various microalgal cultivation systems (open or closed photobioreactors), turf scrubber, and hybrid systems have been developed. Although many algal biomass harvesting methods (physical, chemical, biological, and electromagnetic) have been reported, it is still an expensive process. In this review article, resource recovery from wastewater using algal cultivation, biomass harvesting, and various technologies applied in converting algal

biomass into bioenergy, along with the various challenges that are encountered are discussed in brief.

Wastewater treatment by microalgal membrane bioreactor: Evaluating the effect of organic loading rate and hydraulic residence time

J Environ Manage. 2021 Jan 15;278(Pt 1):111548. doi: 10.1016/j.jenvman.2020.111548. Epub 2020 Oct 27.

ABSTRACT

Current microalgal based photobioreactors focus on the secondary treated effluent while limited researches attempted for treating the raw domestic wastewater. This study aimed to assess the microalgal biomass production, removal performance, and fouling characteristics of microalgal membrane bioreactors (MMBRs) for treating synthetic wastewater under different conditions of organic loading rate (OLR) and hydraulic residence time (HRT). The 12h/12 h dark/light cycle continuous experiments were performed for four MMBRs at different OLRs and three MMBRs at different HRTs. Results showed that microalgal biomass production rate (as TSS and chlorophyll-a) decreased with increasing OLR and increased with decreasing of HRT. Regardless of the OLR and HRT conditions, MMBRs can achieve up to 94% organic removal by bacterial oxidation without external aeration. Total nitrogen (TN) and total phosphorus (TP) removals were significantly decreased with increasing OLR. Highest TN removal (68.4%) achieved at the OLR of 0.014 kg/(m3 d) which was reduced to 58.1% at 0.028 kg/(m3 d). Removals of total phosphorous significantly decreased from 48.2% to 37.7% with an increase in OLR from 0.011 to 0.014 kg/(m3 d). TN removal was reduced at shorten HRT (2 d), while, the effect of HRT was found insignificant at higher HRT. An effective removal of P can only be achieved at higher HRTs, i.e., 7 days. OLR up to 0.014 kg/(m3 d) and 2 days HRT was found suitable for maintaining the fouling frequency at an optimal level of 0.016/d. Overall the OLR and HRT need to be carefully selected to achieve optimal efficiency of MMBR. The results of this study provide guidelines for designing the microalgal-based membrane bioreactors for the treatment of domestic wastewater.

Method for processing soy sauce wastewater through microalgae

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Applicant(s): UNIV NANCHANG +

A method for processing soy sauce wastewater through microalgae specifically includes the steps of obtaining salt-resistant and stain-resistant microalgae through screening, adding the microalgae to aculture medium for high-density culturing, inoculating harvested microalgae cells into the soy sauce wastewater, and conducting oscillation culturing under the illumination conditions. Since a largeamount of organic matter, nitrogen, phospho-rus and other substances in the wastewater can be consumed in the microalgae growth and metabolism process, the concentration of pollutants in the wastewateris reduced, and the aim of purifying the wastewater is real-ized. The method is simple in operation and small in device input, greatly reduces the wastewater processing cost, meets the microalgae industrial wastewater processing application requirements, and has the advantages of being high in efficiency, environmentally friendly, high in comprehensive utilization rate and the like. The microalgaeefficiently absorb the organic matter, nitrogen, phosphorus and other nutrient substances in the soy sauce wastewater and convert the organic matter, nitrogen, phosphorus and other nutrient substances into high-additional-value biomass, the harvested microalgae cells can be used for subsequent biological energy pre-paring, feed and bait applying and the like, economic benefits are improved, and resource recycling is sufficiently realized.

Urban ecological environment self-healing system

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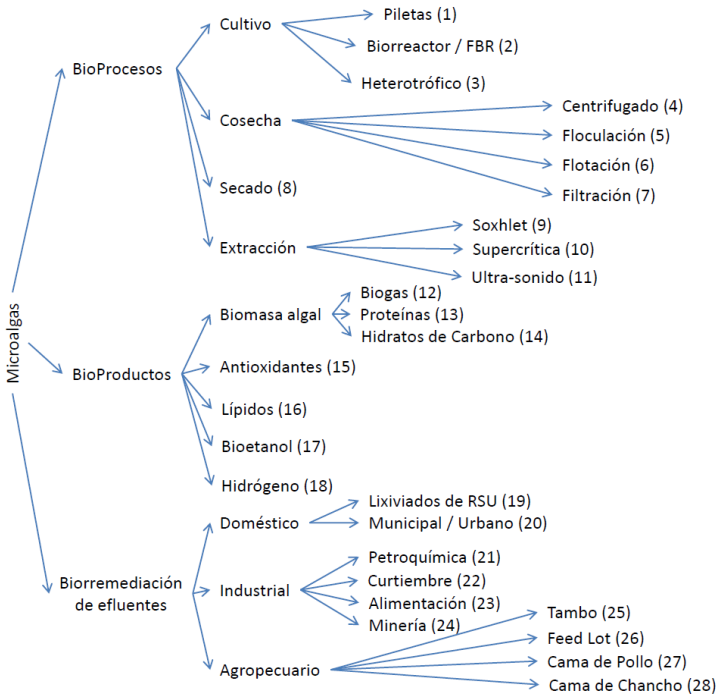
The invention discloses an urban ecological environment self-healing system. The urban ecological environment self-healing system comprises a domestic garbage magnetic thermal cracking module, an integrated sewage treatment module, an industrialized microalgae industry module, a soil remedi-ation agent preparation module and a microalgae concentration module; the domestic garbage mag-netic thermal cracking module carries out thermal cracking treatment on garbage for 24 hours by using a thermal cracking furnace; the garbage is reduced to 1/200-300 ashes to be discharged; the ashes are mixed withalgae water in the following to be used for soil remediation; flue gas is cooled to 45 degrees centigrade by using water heat exchanging equipment; the cooled flue gas enters flue gas treatment equipment; after being treated, the flue gas enters the industrialized microalgae indus-try module to be utilized; and heat generated by thermal cracking passes through a water heat ex-changing system. The urban ecological environment self-healing system disclosed by the invention has the advantages of rapidness, no harm, no residue, high applicability, small floor area, reclama-tion, good microalgae concentration production market prospect, advanced equipment, energy cyclic

utilization, good economic benefit and so on; and a problem that the domestic garbage operation and treatment cost is high because domestic garbage separation, recycling and utilization project is de-veloped from the source is solved.

Árbol de categorías

Español



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