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Microalgas

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Contenido

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Algal-Derived Synthesis of Silver Nanoparticles Using the Unicellular ulvophyte sp. MBIC10591: Optimisation, Characterisation, and Biological Activities

Autor: Reham Samir Hamida

Molecules. 2022 Dec 29;28(1):279. doi: 10.3390/molecules28010279.

ABSTRACT

Algal-mediated synthesis of nanoparticles (NPs) is an eco-friendly alternative for producing NPs with potent physicochemical and biological properties. Microalgae represent an ideal bio-nanofactory because they contain several biomolecules acting as passivation and stabilising agents during the biogenesis of NPs. Herein, a novel microalgae sp. was isolated, purified, and identified using light and electron microscopy and 18s rRNA sequencing. The chemical components of their watery extract were assessed using GC-MS. Their dried biomass was used to synthesise silver (Ag) NPs with different optimisation parameters. Ag-NPs were physiochemically characterised, and their anticancer and antibacterial effects were examined. The data showed that the isolated strain was 99% similar to the unicellular ulvophyte sp. MBIC10591; it was ellipsoidal to spherical and had a large cup-shaped spongiomorph chloroplast. The optimum parameters for synthesising Ag-NPs by unicellular ulvophyte sp. MBIC10591 (Uv@Ag-NPs) were as follows: mixture of 1 mM of AgNO3 with an equal volume of algal extract, 100 °C for 1 h, and pH of 7 under illumination for 24 h. TEM, HRTEM, and SEM revealed that Uv@Ag-NPs are cubic to spherical, with an average nanosize of 12.1 ± 1.2 nm. EDx and mapping analysis showed that the sample had 79% of Ag, while FTIR revealed the existence of several functional groups on the NP surface derivatives from the algal extract. The Uv@Ag-NPs had a hydrodynamic diameter of 178.1 nm and a potential charge of -26.7 mV and showed marked antiproliferative activity against PC3, MDA-MB-231, T47D, and MCF-7, with IC50 values of 27.4, 20.3, 23.8, and 40 µg/mL, respectively, and moderate toxicity against HFs (IC50 of 13.3 µg/mL). Uv@Ag-NPs also showed marked biocidal activity against Gram-negative bacteria. Escherichia coli was the most sensitive bacteria to the NPs with an inhibition zone of 18.9 ± 0.03 mm. The current study reports, for the first time, the morphological appearance of the novel unicellular ulvophyte sp., MBIC10591, and its chemical composition and potential to synthesise Uv@Ag-NPs with smaller sizes and high stability to act as anti-tumour and microbial agents.

Antibacterial, Antifungal and Algicidal Activity of Phlorotannins, as Principal Biologically Active Components of Ten Species of Brown Algae

Autor: Valeriya Lemesheva

Plants (Basel). 2023 Feb 12;12(4):821. doi: 10.3390/plants12040821.

ABSTRACT

Marine seaweeds synthesize a plethora of bioactive metabolites, of which phlorotannins of brown algae currently attract special attention due to their high antibiotic and cytotoxic capacities. Here we measured the minimum inhibitory concentrations (MICs) of several semi-purified phlorotannin preparations of different origins and molecular composition using a set of model unicellular organisms, such as Escherichia coli, Saccharomyces cerevisiae, Chlamydomonas reinhardtii, etc. For the first time, MIC values were evaluated for phlorotannin-enriched extracts of brown algae of the orders Ectocarpales and Desmarestiales. Phlorotannin extracts of Desmarestia aculeata, Fucus vesiculosus, and Ectocarpus siliculosus showed the lowest MIC values against most of the treated organisms (4-25 µg/mL for bacteria and yeast). Analysis of the survival curves of E. coli showed that massive loss of cells started after 3-4 h of exposure. Microalgae were less susceptible to activity of phlorotannin extracts, with the highest MIC values (≥200 µg/mL) measured for Chlorella vulgaris cells. D. aculeata, E. siliculosus, and three fucalean algae accumulate considerable amounts (4-16% of dry weight) of phlorotannins with MIC values similar to

those widely used antibiotics. As these species grow abundantly in polar and temperate seas and have considerable biomass, they may be regarded as promising sources of phlorotannins.

Application of microalgae Chlamydomonas applanata M9V and Chlorella vulgaris S3 for wheat growth promotion and as urea alternatives

Autor: Mekiso Yohannes Sido

Front Microbiol. 2022 Nov 29;13:1035791. doi: 10.3389/fmicb.2022.1035791. eCollection 2022.

ABSTRACT

Excessive use of chemical fertilizers to meet the global food demand has caused extensive environmental pollution. Microalgae can be used to enhance agricultural crop production as a potentially sustainable and eco-friendly alternative. In this study, Chlamydomonas applanata M9V and Chlorella vulgaris S3 were isolated from the soil and mass-cultured for use as microalgal fertilizers. The influence of microalgae M9V and S3 on the growth of wheat (Triticum aestivum L.) and soil properties was evaluated and compared with that of chemical urea fertilizer. A pot experiment was conducted with six treatments, i.e., living M9V (M9VL), dead M9V (M9VD), living S3 (S3L), dead S3 (S3D), urea fertilizer (urea), and control without fertilizer (control). M9VL was found to have the best effect on wheat growth promotion, followed by M9VD and S3D. In addition, M9VL resulted in the highest enhancement of shoot fresh weight (166.67 and 125.68%), root dry weight (188.89 and 77.35%), leaf length (26.88 and 14.56%), root length (46.04 and 43.93%), chlorophyll a (257.81 and 82.23%), and chlorophyll b contents (269.00 and 247.27%) comparing to the control and urea treatments, respectively. Moreover, all microalgal fertilizer treatments increased soil organic matter (SOM) by 1.77-23.10%, total carbon (TC) by 7.14-14.46%, and C:N ratio by 2.99-11.73% compared to the control and urea treatments. Overall, this study provided two microalgae strains, M9V and S3, that could promote wheat growth and improve soil properties, thus highlighting the use of microalgae as biofertilizers to reduce the use of chemical fertilizers and promoting sustainable agricultural production.

Asterarcys quadricellulare (Chlorophyceae) protects H9c2 cardiomyoblasts from H2O2-induced oxidative stress

Autor: Imen Saadaoui

Mol Cell Biochem. 2022 Dec 30. doi: 10.1007/s11010-022-04626-7. Online ahead of print.

ABSTRACT

Oxidative stress has recently been identified as an important mediator of cardiovascular diseases. The need to find efficient antioxidant molecules is essential in the disease's prevention. Therefore, the present study aimed to evaluate the potential of microalgae bioactive in protecting H9c2 cardiomyoblasts from H2O2-induced oxidative stress. Four microalgal species were investigated for their antioxidant capacity. A qualitative assessment of oxidative stress in H9c2 cardiomyoblasts stained with DCFH-DA, treated with the highly active microalgae extracts, was performed. The protein expression of total caspase-3 was also examined to investigate whether the extract protects H9c2 cardimyoblasts from H2O2-induced apoptosis. High antioxidant activity was observed for the hexanoic extracts after 10 days of cultivation. Asterarcys quadricellulare exhibited the highest antioxidant capacity of 110.59 ± 1.75 mg TE g-1 dry weight and was tested against H9c2 cardiomyoblasts, which were initially subjected to H2O2-induced oxidative stress. This hexanoic extract protected against H2O2 induced oxidative stress with a similar scavenging capacity as N-Acetylcysteine. Furthermore, total caspase-3 was increased following treatment with the hexanoic extract, suggesting that A. quadricellulare also had anti-apoptotic properties. The outcome of our study highlighted the possible use

of the local A. quadricellulare strain QUCCCM10 as a natural, safe, and efficient antioxidant to prevent cardiovascular diseases.

Biocoagulation of Dried Algae Chlorella sp. and Pellets of Aspergillus Niger in Decontamination Process of Wastewater, as a Presumed Source of Biofuel

Autor: Alžbeta Takáčová

J Fungi (Basel). 2022 Dec 7;8(12):1282. doi: 10.3390/jof8121282.

ABSTRACT

The removal of microalgae represents a problematic part of the water decontamination process, in which most techniques are expensive and non-ecological. In the paper, we focus on the synergistic relationship between microscopic filamentous fungi and algal culture. In the process of decontamination of a model sample containing ammonium ions, efficient biocoagulation, resp. co-pelletization of dried algae Chlorella sp. and Aspergillus niger sensu stricto are shown. The microscopic filamentous fungus species A. niger was added to a culture of an algal suspension of Chlorella sp., where the adhesion of the algal cells to the fungi subsequently occurred due to the electrostatic effect of the interaction, while the flocculation activity was approximately 70 to 80%. The algal cells adhered to the surface of the A. niger pellets, making them easily removable from the solution. The ability of filamentous fungi to capture organisms represents a great potential for the biological isolation of microalgae (biocoagulation) from production solutions because microalgae are considered to be a promising renewable source of oil and fermentables for bioenergy. This form of algae removal, or its harvesting, also represents a great low-cost method for collecting algae not only as a way of removing unnecessary material but also for the purpose of producing biofuels. Algae are a robust bioabsorbent for absorbing lipids from the environment, which after treatment can be used as a component of biodiesel. Chemical analyses also presented potential ecological innovation in the area of biofuel production. Energy-efficient and eco-friendly harvesting techniques are crucial to improving the economic viability of algal biofuel production.

CO2 gradient domestication improved high-concentration CO2 tolerance and photoautotrophic growth of Euglena gracilis

Autor: Kai Xin

Sci Total Environ. 2023 Apr 10;868:161629. doi: 10.1016/j.scitotenv.2023.161629. Epub 2023 Jan 16.

ABSTRACT

In order to improve CO2 biofixation efficiency of microalgae cultivated with coal-chemical flue gas, CO2 gradient domestication was employed to improve high-concentration CO2 tolerance and photoautotrophic growth of acid-tolerant Euglena gracilis. The dried biomass yield of photoautotrophic growth of E.gracilis increased from 1.09 g/L (wild-type strain) by 21 % to 1.32 g/L with CO2 gradient domestication to 15 % CO2. The RuBisCO activity and biomass production of E.gracilis strain domesticated to 99 % CO2 were 2.63 and 3.4 times higher, respectively, than those of wild-type strain. The chlorophyll a and b contents were 2.52 and 1.79 times higher, respectively, than those of wild-type strain. Superoxide dismutase and catalase activities of 99 % CO2-domesticated strain increased to 1.24 and 6 times, which reduced peroxide damage under high carbon stress and resulted in lower apoptotic and necrotic rates of domesticated strain. Thus, this work provides valuable guidance for CO2 fixation and adaptive evolution of E. gracilis in industrial flue gas.

CO_2 sequestration and biodiesel production from Volvox aureus a newly isolated green microalgal species from industrial wastewater

Autor: Fuad Ameen

Environ Res. 2023 Mar 15;221:115251. doi: 10.1016/j.envres.2023.115251. Epub 2023 Jan 16.

ABSTRACT

Recently, large-scale biofuel production is mainly dependent on third-generation feedstock, especially microalgae. Since most microalgae can sequester carbon dioxide and utilize it for the enhancement of their growth parameter. In the present study, CO_2 sequestration and Biodiesel production from Volvox aureus a newly isolated green microalgal species from industrial wastewater. Volvox aureus was isolated from the wastewater sample collected from the sewage treatment plant. The isolated V.aureus was grown in the BBM culture containing excess nutrients along with Artificial CO_2 supply to the bioreactor. The addition of an external carbon dioxide source enhanced the total lipid content by up to 27.95%. Further, the lipid was extracted using soxhlet extraction from the isolated microalgal biomass. The extracted lipid was converted into biodiesel using a base catalyst potassium hydroxide. The produced biodiesel was analyzed to test their fuel properties and compared with the diesel standard. This study approach investigated the potential of a future possible environmental pollution reduction and significant potential for a viable biofuel production from microalgae.

Cultivation of Arthrospira platensis and harvesting using edible fungi isolated from mould soybean cake

Autor: Aimi Alina Hussin

Bioresour Technol. 2023 Apr;373:128743. doi: 10.1016/j.biortech.2023.128743. Epub 2023 Feb 13.

ABSTRACT

In this study, the cultivation and harvesting of Arthrospira platensis biomass were proposed via simple, safe, and efficient techniques for direct consumption. Cultivation of microalgae in a covered macrobubble column under outdoor conditions resulted in significant differences ($p < 0.05$) with a maximum dry cell weight (Xm) of 0.959 ± 0.046 g/L. Notably, outdoor cultures resulted in approximately twofold biomass compared to indoor cultures. This outcome shows that the developed outdoor setup integrated with solar panels while utilising Malaysia's weather and atmospheric air as carbon sources is viable. Meanwhile, for harvesting, the screening showed that the fungus isolated from mould soybean cake (tempeh) starter indicated the highest harvesting efficiency, which was then further identified as Rhizopus microsporus, microscopically and molecularly. Overall, the economical and portable setup of outdoor cultivation coupled with safe harvesting via locally isolated fungus from tempeh as a bioflocculant would provide sustainability to produce A. platensis biomass.

Daphnia magna as biological harvesters for green microalgae grown on recirculated aquaculture system effluents

Autor: Stanley A Gorzelnik

Sci Total Environ. 2023 May 15;873:162247. doi: 10.1016/j.scitotenv.2023.162247. Epub 2023 Feb 14.

ABSTRACT

The sustainability of recycling aquaculture systems (RAS) is challenged by nutrient discharges, which cause water eutrophication. Efficient treatments for RAS effluents are needed to mitigate its environmental impacts. Microalgae assimilate nutrients and dissolved carbon into microbial biomass with value as feed or food ingredient. However, they are difficult to harvest efficiently. Daphnia magna is an efficient filter feeder that grazes on microalgae at high rates and serves as valuable fish feed. Combining nutrient removal by microalgae and biomass harvesting by D. magna could be a cost-effective solution for wastewater valorization. Nutrient removal from unsterilized aquaculture wastewater was evaluated using the microalgae species Chlorella vulgaris, Scenedesmus dimorphus, and Haematococcus pluvialis. The first two algae were subsequently harvested using D. magna as a grazer, while H. pluvialis failed to grow stably. All phosphorus was removed, while only 50-70 % nitrogen was recovered, indicating phosphorus limitation. Shortening the hydraulic retention time (HRT) or phosphorus dosing resulted in increased nitrogen removal. C. vulgaris cultivation was unstable at 3 days HRT or when supplied with extra phosphorus at 5 days HRT. D. magna grew on produced algae accumulating protein at 20-30 % of dry weight, with an amino acid profile favorable for use as high value fish feed. Thus, this study demonstrates the application of a two steps multitrophic process to assimilate residual nutrients into live feeds suitable for fish.

Development of serum-free and grain-derived-nutrient-free medium using microalga-derived nutrients and mammalian cell-secreted growth factors for sustainable cultured meat production

Autor: Kumiko Yamanaka

Sci Rep. 2023 Jan 10;13(1):498. doi: 10.1038/s41598-023-27629-w.

ABSTRACT

Considering the amount of global resources and energy consumed, and animal welfare issues associated with traditional meat production, cultured meat production has been proposed as a solution to these problems and is attracting worldwide attention. Cultured meat is produced by culturing/proliferating animal muscle cells in vitro. This process requires significant amounts of culture medium, which accounts to a major portion of the production cost. Furthermore, it is composed of nutrients derived from grains and heterotrophic microorganisms and fetal bovine serum (FBS), which will impact the sustainability of cultured meat in future. Here, we developed a novel medium containing nutrients extracted from microalga and cell-secreted growth factors. First, rat liver epithelial RL34 cells were cultured by adding Chlorella vulgaris extract (CVE) to inorganic salt solution. The supernatant, containing the RL34 cell-secreted growth factors, was used as the conditioned medium (CM). This CM, with CVE added as a nutrient source, was applied to primary bovine myoblast cultures. This serum-free and grain-derived-nutrient-free medium promoted the proliferation of bovine myoblasts, the main cell source for cultured beef. Our findings will allow us to take a major step toward reducing production costs and environmental impacts, leading to an expansion of the cultured meat market.

Effect of pretreated and anaerobically digested microalgae on the chemical and biochemical properties of soil and wheat grown on fluvisol

Autor: Ayten Namli

Environ Technol. 2023 Mar 22:1-14. doi: 10.1080/09593330.2023.2192364. Online ahead of print.

ABSTRACT

In this study, the effects of the potential application of digestate as an agricultural fertiliser obtained from anaerobically digested microalgae treated by three pretreatment methods, namely alkaline hydrogen peroxide (AHP), high temperature and pressure (HTP), and

hydrodynamic cavitation (HC) on some properties of soil, and wheat growth and yield were investigated. For this purpose, pretreated and anaerobically digested microalgae digestates alone or together with diammonium phosphate (DAP) as a chemical fertiliser were applied to soil for wheat growth. The highest dosage of AHP pretreated digestate combined with a half dose of DAP applied to soil was rich in nutrients as 0.25%N and 7.19 mg kg-1 compared to all groups. The properties of the soils were enhanced by applying the highest dosage (0.06 g kg-1) of microalgae digestate combined with a half dose of DAP. 0.02 g kg-1 dosage of HC pretreated digestate combined with a half dose of DAP also greatly improved nitrogen use efficiency indices by up to 104%. The soils' enzyme activities increased in wheat growth experiments by applying either raw or pretreated microalgae digestates. The soils' β-glycosidase, alkaline phosphatase, and urease enzyme activities increased to 1.38 mg pNP g-1 soil, 4.91 mg pNP g-1 soil, and 2.27 mg NH4-N 100 g-1 soil respectively by the application of highest dosage of HC pretreated digestate. The digestates did not have a toxic effect on wheat growth, it was determined that applied pretreatment processes did not cause significant changes in wheat plant height or wet and dry weight.

Effective fucoxanthin production in the flagellate alga Poterioochromonas malhamensis by coupling heterotrophic high-cell-density fermentation with illumination

Autor: Hu Jin

Front Bioeng Biotechnol. 2022 Dec 2;10:1074850. doi: 10.3389/fbioe.2022.1074850. eCollection 2022.

ABSTRACT

The unicellular flagellate algae Poterioochromonas malhamensis is a potential fucoxanthin-rich resource for sustainable and cost-effective fucoxanthin production. Light and nutrients are critical regulators for the accumulation of fucoxanthin in P. malhamensis. In this study, the maximum fucoxanthin yield of 50.5 mg L-1 and productivity of 6.31 mg L-1 d-1 were achieved by coupling high-cell-density fermentation with illumination. It was found that the combined use of organic and inorganic nitrogen (N) nutrition could improve the fucoxanthin yield as single inorganic or organic N had limitation to enhance cell growth and fucoxanthin accumulation. White light was the optimal light quality for fucoxanthin accumulation. Under white light and a moderate light intensity of 150 μmol m-2 s-1, the highest biomass concentration and fucoxanthin content reached 32.9 g L-1 and 1.56 mg g-1 of dry cell weight (DCW), respectively. This is the first study on effective fucoxanthin production in P. malhamensis by integrating illumination with high-cell-density fermentation, which paved the way for further development of P. malhamensis as a potential source for commercial fucoxanthin production.

Engineering microalgae for water phosphorus recovery to close the phosphorus cycle

Autor: Long Wang

Plant Biotechnol J. 2023 Mar 15. doi: 10.1111/pbi.14040. Online ahead of print.

ABSTRACT

As a finite and non-renewable resource, phosphorus (P) is essential to all life and crucial for crop growth and food production. The boosted agricultural use and associated loss of P to the aquatic environment are increasing environmental pollution, harming ecosystems, and threatening future global food security. Thus, recovering and reusing P from water bodies is urgently needed to close the P cycle. As a natural, eco-friendly, and sustainable reclamation strategy, microalgae-based biological P recovery is considered a promising solution. However, the low P-accumulation capacity and P-removal efficiency of algal

bioreactors restrict its application. Herein, it is demonstrated that manipulating genes involved in cellular P accumulation and signalling could triple the Chlamydomonas P-storage capacity to ~7% of dry biomass, which is the highest P concentration in plants to date. Furthermore, the engineered algae could recover P from wastewater almost three times faster than the unengineered one, which could be directly used as a P fertilizer. Thus, engineering genes involved in cellular P accumulation and signalling in microalgae could be a promising strategy to enhance P uptake and accumulation, which have the potential to accelerate the application of algae for P recovery from the water body and closing the P cycle.

Functional Properties of Dunaliella salina and Its Positive Effect on Probiotics

Autor: Ivana Hyrslova

Mar Drugs. 2022 Dec 15;20(12):781. doi: 10.3390/md20120781.

ABSTRACT

The unicellular green microalga Dunaliella is a potential source of a wide range of nutritionally important compounds applicable to the food industry. The aim of this study was to assess the effect of Dunaliella salina dried biomass on the growth and adherence of 10 strains of Lactobacillus, Lacticaseibacillus, and Bifidobacterium. The immunomodulatory, antioxidant, and cytotoxic effects of D. salina on human peripheral mononuclear cells and simulated intestinal epithelial cell lines Caco-2 and HT-29 were evaluated. Furthermore, the hypocholesterolemic effects of the microalgae on lipid metabolism in rats fed a high-fat diet were analyzed. The addition of D. salina biomass had a positive effect on the growth of nine out of 10 probiotics and promoted the adherence of three bifidobacteria strains to human cell lines. The antioxidant and immunomodulatory properties of D. salina were concentration-dependent. The inflammatory cytokines (TNF-α and IL-6) were significantly increased following Dunaliella stimulation at the lowest concentration (0.5% w/v). Eight week supplementation of D. salina to the diet of hypercholesteromic rats significantly decreased the serum concentrations of LDL-C, VLDL, IDL-B, and IDL-C. D. salina is not cytotoxic in intestinal cell models; it promotes adherence of selected bifidobacteria, it affords immunomodulatory and antioxidant effects, and its addition to diets may help decrease atherosclerosis risk factors.

Iron-dependent mutualism between Chlorella sorokiniana and Ralstonia pickettii forms the basis for a sustainable bioremediation system

Autor: Deepak Rawat

ISME Commun. 2022 Sep 15;2:83. doi: 10.1038/s43705-022-00161-0. eCollection 2022.

ABSTRACT

Phototrophic communities of autotrophic microalgae and heterotrophic bacteria perform complex tasks of nutrient acquisition and tackling environmental stress but remain underexplored as a basis for the bioremediation of emerging pollutants. In industrial monoculture designs, poor iron uptake by microalgae limits their productivity and biotechnological efficacy. Iron supplementation is expensive and ineffective because iron remains insoluble in an aqueous medium and is biologically unavailable. However, microalgae develop complex interkingdom associations with siderophore-producing bacteria that help solubilize iron and increase its bioavailability. Using dye degradation as a model, we combined environmental isolations and synthetic ecology as a workflow to design a simplified microbial community based on iron and carbon exchange. We established a mutualism between the previously non-associated alga Chlorella sorokiniana and siderophore-producing bacterium Ralstonia pickettii. Siderophore-mediated increase in iron bioavailability alleviated Fe stress for algae and increased the reductive iron uptake mechanism and bioremediation potential. In exchange, C. sorokiniana produced galactose, glucose, and mannose as major extracellular monosaccharides, supporting bacterial

growth. We propose that extracellular iron reduction by ferrireductase is crucial for azoreductase-mediated dye degradation in microalgae. These results demonstrate that iron bioavailability, often overlooked in cultivation, governs microalgal growth, enzymatic processes, and bioremediation potential. Our results suggest that phototrophic communities with an active association for iron and carbon exchange have the potential to overcome challenges associated with micronutrient availability, while scaling up bioremediation designs.

Microalgae Commercialization Using Renewable Lignocellulose Is Economically and Environmentally Viable

Autor: Xiaoxiong Wang

Environ Sci Technol. 2023 Jan 17;57(2):1144-1156. doi: 10.1021/acs.est.2c04607. Epub 2023 Jan 4.

ABSTRACT

Conventional phototrophic cultivation for microalgae production suffers from low and unstable biomass productivity due to limited and unreliable light transmission outdoors. Alternatively, the use of a renewable lignocellulose-derived carbon source, cellulosic hydrolysate, offers a cost-effective and sustainable pathway to cultivate microalgae heterotrophically with high algal growth rate and terminal density. In this study, we evaluate the feasibility of cellulosic hydrolysate-mediated heterotrophic cultivation (Cel-HC) for microalgae production by performing economic and environmental comparisons with phototrophic cultivation through techno-economic analysis and life cycle assessment. We estimate a minimum selling price (MSP) of 4722 USD/t for producing high-purity microalgae through Cel-HC considering annual biomass productivity of 300 t (dry weight), which is competitive with the conventional phototrophic raceway pond system. Revenues from the lignocellulose-derived co-products, xylose and fulvic acid fertilizer, could further reduce the MSP to 2976 USD/t, highlighting the advantages of simultaneously producing high-value products and biofuels in an integrated biorefinery scheme. Further, Cel-HC exhibits lower environmental impacts, such as cumulative energy demand and greenhouse gas emissions, than phototrophic systems, revealing its potential to reduce the carbon intensity of algae-derived commodities. Our results demonstrate the economic and environmental competitiveness of heterotrophic microalgae production based on renewable bio-feedstock of lignocellulose.

Oral Administration of Chaetoceros gracilis-A Marine Microalga-Alleviates Hepatic Lipid Accumulation in Rats Fed a High-Sucrose and Cholesterol-Containing Diet

Autor: Bungo Shirouchi

Metabolites. 2023 Mar 16;13(3):436. doi: 10.3390/metabo13030436.

ABSTRACT

Microalgae are attracting attention as a next-generation alternative source of protein and essential fatty acids that do not consume large amounts of water or land. Chaetoceros gracilis (C. gracilis)-a marine microalga-is rich in proteins, fucoxanthin, and eicosapentaenoic acid (EPA). Growing evidence indicates that dietary fucoxanthin and EPA have beneficial effects in humans. However, none of these studies have shown that dietary C. gracilis has beneficial effects in mammals. In this study, we investigated the effects of dietary C. gracilis on lipid abnormalities in Sprague-Dawley rats fed a high-sucrose cholesterol-containing diet. Dried C. gracilis was added to the control diet at a final dose of 2 or 5% (w/w). After four weeks, the soleus muscle weights were found to be dose-responsive to C. gracilis and showed a tendency to increase. The hepatic triglyceride and total cholesterol levels were significantly reduced by C. gracilis feeding compared to those

in the control group. The activities of FAS and G6PDH, which are related to fatty acid de novo synthesis, were found to be dose-responsive to C. gracilis and tended to decrease. The hepatic glycerol content was also significantly decreased by C. gracilis feeding, and the serum HDL cholesterol levels were significantly increased, whereas the serum levels of cholesterol absorption markers (i.e., campesterol and β-sitosterol) and the hepatic mRNA levels of Scarb1 were significantly decreased. Water-soluble metabolite analysis showed that the muscular contents of several amino acids, including leucine, were significantly increased by C. gracilis feeding. The tendency toward an increase in the weight of the soleus muscle as a result of C. gracilis feeding may be due to the enhancement of muscle protein synthesis centered on leucine. Collectively, these results show that the oral administration of C. gracilis alleviates hepatic lipid accumulation in rats fed a high-sucrose and cholesterol-containing diet, indicating the potential use of C. gracilis as a food resource.

Spray Drying Is a Viable Technology for the Preservation of Recombinant Proteins in Microalgae

Autor: Anaëlle Vilatte

Microorganisms. 2023 Feb 17;11(2):512. doi: 10.3390/microorganisms11020512.

ABSTRACT

Microalgae are promising host organisms for the production of encapsulated recombinant proteins such as vaccines. However, bottlenecks in bioprocess development, such as the drying stage, need to be addressed to ensure feasibility at scale. In this study, we investigated the potential of spray drying to produce a recombinant vaccine in microalgae. A transformant line of Chlamydomonas reinhardtii carrying a subunit vaccine against salmonid alphavirus was created via chloroplast engineering. The integrity of the recombinant protein after spray drying and its stability after 27 months storage at -80 °C, +4 °C and room temperature were assessed by immunoblotting. The protein withstood spray drying without significant losses. Long-term storage at +4 °C and room temperature resulted in 50% and 92% degradation, respectively. Optimizing spray drying and storage conditions should minimize degradation and favour short-term storage at positive temperatures. Using data on yield and productivity, the economics of spray drying- and freeze drying-based bioprocesses were compared. The drying stage corresponded to 41% of the total production cost. Process optimization, genetic engineering and new market strategies were identified as potential targets for cost reduction. Overall, this study successfully demonstrates the suitability of spray drying as a process option for recombinant protein production in microalgae at the industrial scale.

Thermal-tolerant potential of ordinary Chlorella pyrenoidosa and the promotion of cell harvesting by heterotrophic cultivation at high temperature

Autor: Yu-Ren Dai

Front Bioeng Biotechnol. 2022 Dec 1;10:1072942. doi: 10.3389/fbioe.2022.1072942. eCollection 2022.

ABSTRACT

During the heterotrophic cultivation of microalgae, a cooled process against temperature rise caused by the metabolism of exogenous organic carbon sources greatly increases cultivation cost. Furthermore, microalgae harvesting is also a cost-consuming process. Cell harvesting efficiency is closely related to the characteristics of the algal cells. It may be possible to change cell characteristics through controlling culture conditions to make harvesting easier. In this study, the mesophilic Chlorella pyrenoidosa was found to be a thermal-tolerant species in the heterotrophic mode. The cells could maintain their maximal specific growth rate at 40°C and reached 1.45 day-1, which is equivalent to that of cultures at 35°C but significantly higher than those cultured at lower temperatures.

Interestingly, the cells cultured at 40°C were much easier to be harvested than those at lower temperatures. The harvesting efficiency of the cells cultured at 40°C reached 96.83% after sedimentation for 240 min, while the cells cultured at lower temperatures were reluctant to settle. Likely, the same circumstance occurred when cells were harvested by centrifugation or flocculation. The promotion of cell harvesting for cells cultured at high temperatures was mainly attributed to increased cell size and decreased cell surface charge. To the best of our knowledge, this is the first report that cells cultured at high temperatures can promote microalgae harvesting. This study explores a new approach to simplify the cultivation and harvesting of microalgae, which effectively reduces the microalgae production cost.

Urea as a source of nitrogen and carbon leads to increased photosynthesis rates in Chlamydomonas reinhardtii under mixotrophy

Autor: Rinamara Martins Rosa

J Biotechnol. 2023 Mar 24;367:20-30. doi: 10.1016/j.jbiotec.2023.03.009. Online ahead of print.

ABSTRACT

Microalgae is a potential source of bioproducts, including feedstock to biofuels. Urea has been pointed as potential N source for microalgae growth. Considering that urea metabolism releases HCO3- to the medium, we tested the hypothesis that this carbon source could improve photosynthesis and consequently growth rates of Chlamydomonas reinhardtii. In this sense, the metabolic responses of C. reinhardtii grown with ammonium and urea as nitrogen sources under mixotrophic and autotrophic conditions were investigated. Overall, the mixotrophy led to increased cell growth as well as to a higher accumulation of lipids independent of N source, followed by a decrease in photosynthesis over the growth phases. In mixotrophy, urea stimulates growth in terms of cell number and dry weight. Furthermore, higher photosynthesis was verified in late logarithmic phase compared to ammonium. Under autotrophy conditions, although cell number and biomass were reduced, there was higher production of starch independent of N source. Nonetheless, urea-based autotrophic treatments stimulated biomass production compared to ammonium-based treatment. Under mixotrophy higher input of carbon into the cell from acetate and urea optimized photosynthesis and consequently promoted cell growth. Together, these results suggest urea as alternative source of carbon, improving photosynthesis and cell growth in C. reinhardtii.

Use of Refractance Window Drying as an Alternative Method for Processing the Microalga Spirulina platensis

Autor: Neiton C Silva

Molecules. 2023 Jan 11;28(2):720. doi: 10.3390/molecules28020720.

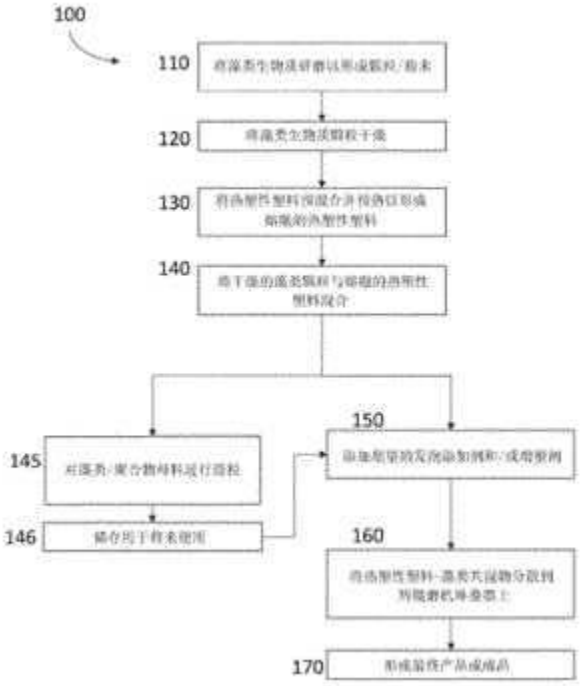
ABSTRACT

Microalgae such as Spirulina platensis have recently attracted the interest of the pharmaceutical, nutritional and food industries due to their high levels of proteins and bioactive compounds. In this study, we investigated the use of refractance window (RW) drying as an alternative technology for processing the microalga Spirulina biomass aiming at its dehydration. In addition, we also analyzed the effects of operating variables (i.e., time and temperature) on the quality of the final product, expressed by the content of bioactive compounds (i.e., total phenolics, total flavonoids, and phycocyanin). The results showed that RW drying can generate a dehydrated product with a moisture content lower than 10.0%, minimal visual changes, and reduced process time. The content of bioactive compounds after RW drying was found to be satisfactory, with some of them close to those observed in the fresh microalga. The best results for total phenolic (TPC) and total flavonoids (TFC) content were obtained at temperatures of around 70 °C and processing

times around 4.5 h. The phycocyanin content was negatively influenced by higher temperatures (higher than 80 °C) and high exposing drying times (higher than 4.5 h) due to its thermosensibility properties. The use of refractance window drying proved to be an interesting methodology for the processing and conservation of Spirulina platensis, as well as an important alternative to the industrial processing of this biomass.

ALGAE THERMOPLASTIC COMPOSITION AND PROCESS OF MAKING

Inventor(s):	ZELLER MARK ASHTON; HUNT RYAN
Applicant(s):	ALGISYS LLC



An algae-based thermoplastic foam is provided having a protein-rich algae biomass selected from either microalgae, macroalgae or combinations thereof. The protein content is greater than or equal to 15% by weight of the algae biomass and the algae biomass is dried to a moister content of less than or equal to 15% by weight having an average particle size of up to 200 microns. The composition includes a resin configured to exhibit rheological properties suitable for blending with algae including a melting temperature less than 250 degC and a melt flow rate in excess of 0.01 g/10 min. The foam includes a foaming ingredient selected from the group consisting of crosslinkers, compatibilizers, plasticizers, accelerants, catalysts, blowing agents, other ingredients, and combinations thereof.

Algae-based carbon quantum dot and preparation method thereof

Inventor(s):	GONG XUN; LIN LUQIU; WANG YUNYI; ZHANG CHUXUAN;

XU JINGYING; CHEN DONGLIANG; LI TAO

Applicant(s): UNIV HUAZHONG SCIENCE TECH

The invention provides an algae-based carbon quantum dot and a preparation method thereof. According to the preparation method of the algae-based carbon quantum dots, microalgae and an alcohol solvent are subjected to an alcohol thermal reaction to obtain a mixture, the mixture is subjected to centrifugal separation, and supernatant liquid is subjected to rotary evaporation to separate alcohol-phase and oil-phase carbon quantum dots. The microalgae are small in size and can have good dispersity without being broken, the reaction is more sufficient, the high nitrogen content of the microalgae is beneficial for improving the yield of the carbon quantum dots, and the generated algae-based carbon quantum dots have high two-photon fluorescence characteristics; compared with a hydrothermal method, the alcohol-thermal method has the advantages that the reaction is more sufficient in the same time, and the yield of the carbon quantum dots is higher; the generated dual-phase carbon quantum dots have different fluorescence excitation peaks and emission peaks, and show obvious blue light and red light under the irradiation of an ultraviolet lamp, so that the application channel of the product is widened; compared with a hydrothermal method, the alcohol-heat method does not need long-time dialysis and freeze-drying separation of products, so that the separation and purification steps are simplified, the process energy consumption is reduced, and the cost is saved.

Food-grade chlorella culture medium and culture method

Inventor(s): LAN BIAO; YANG SHI

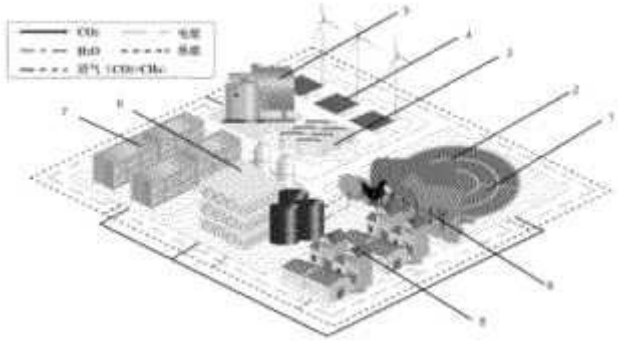
Applicant(s): ZHUHAI GUANGZAO LIFE SCIENCE CO LTD

The invention belongs to the technical field of microalgae biological culture, and discloses a food-grade chlorella culture medium and a culture method. According to the chlorella culture medium disclosed by the invention, a food-grade photoautotrophic culture medium is taken as a basis, waste yeast liquid and grain washing liquid recovered in a beer brewing process are fed into the photoautotrophic culture medium and are respectively used as an organic nitrogen source and a carbon source for culturing chlorella, and photoautotrophic and heterotrophic mixotrophic mode culture is carried out; the food-grade chlorella which is high in biomass, high in protein, safe and pollution-free can be obtained. The cyclic utilization of beer brewing waste yeast and saccharification and grain washing wastewater can be realized, and the environmental pollution is reduced.

Green agriculture zero-carbon energy supply system and intelligent configuration hierarchical optimization algorithm thereof

Inventor(s): YANG LIHUA; QIU JIE; QIU RUOHAN; CHEN XIANHAO; WU XIAO

Applicant(s): UNIV SOUTHEAST



The invention discloses a green agricultural zero-carbon energy supply system and an intelligent configuration hierarchical optimization method thereof under an energy system pattern with high renewable energy access in the future. A direct air carbon capture system is connected, complete absorption of CO2 emission of regional agricultural places is achieved, carbon-containing emission mainly including CO2 and CH4 in the regional agricultural production and living process is counteracted through methane-carbon dioxide dry reforming and microalgae carbon sequestration, and the greenhouse effect is better relieved. In order to ensure zero-carbon, economic and stable operation of the system, an intelligent system configuration hierarchical optimization algorithm is researched, and an upper layer comprehensively considers economic and zero-carbon indexes and determines the optimal structure of the system and the optimal capacity of each device; and the lower layer optimizes the optimal cooperative output of each device in the system by combining the renewable output and the load demand of the agricultural user, thereby supporting the stable, reliable, economical and zero-carbon operation of the system.

INTEGRATED MIXOTROPHIC INDUCTION BIOPROCESS FOR ASTAXANTHIN ACCUMULATION IN STRAINS OF THE GREEN MICROALGA HAEMATOCOCCUS LACUSTRIS

Inventor(s): AGURTO MUÑOZ CRISTIAN [CL]; LANDAHUR ESCALONA CHRIS [CL]; RODRIGUEZ JUAN [CL]; SAN MARTÍN PARRAGUEZ SERGIO [CL]; PINTO FIGUEROA CRISTINA [CL]; LATORRE CASTAÑEDA MÓNICA [CL]; HENRIQUEZ POBLETE ADOLFO [CL]; DONOSO YOULTON ANDREA [CL]; PAVON PEREZ JESSY [CL

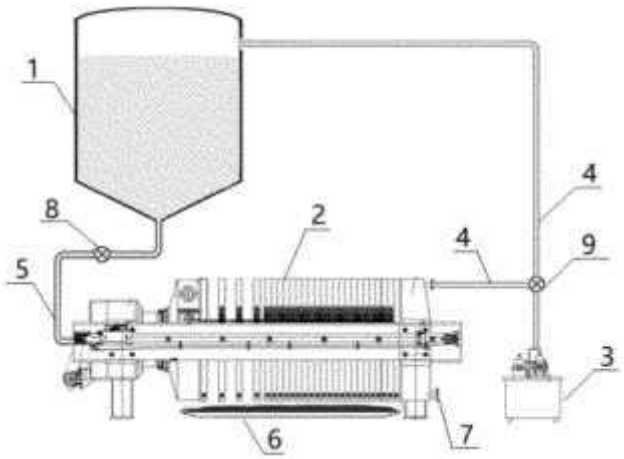
Applicant(s): UNIV CONCEPCION [CL]

The present invention relates to an integrated bioprocess for the mixotrophic induction of astaxanthin (ATX) accumulation in Haematococcus lacustris, comprising, at least, the following steps: autotrophic culture growth under standard conditions; mixotrophic induction of ATX accumulation in photobioreactor; biomass harvesting and drying under standard conditions; and ATX extraction under standard conditions. The use of this integrated bioprocess enables cultivation without sanitary, seasonal, climatic or geographical constraints.

Integrated microalgae heterotrophic fermentation and dehydration system and method

Inventor(s): LU YUE; QU YUJIAO; XIAO YIBO

Applicant(s): ZHUHAI YUANYU BIOTECHNOLOGY CO LTD



The invention relates to an integrated microalgae heterotrophic fermentation and dehydration system and method.The system comprises a fermentation device, an automatic dehydration device and a supercharging device, the fermentation device is arranged above the automatic dehydration device, and the supercharging device is arranged on the side away from a water inlet of the automatic dehydration device; compressed air pipelines are respectively connected between the supercharging device and the fermentation device and between the supercharging device and the automatic dehydration device, and compressed air is controlled to enter the fermentation device or the automatic dehydration device through a three-way valve. According to the invention, the gravity of the algae liquid in the fermentation device is fully utilized, the fermentation process is improved, the pressurization device is combined to assist filtration and dehydration, meanwhile, the pressurization device is utilized to perform reverse blowing drying, the microalgae biomass is produced by integrating fermentation, dehydration and drying, the device is simple, the energy consumption is low, the production cost is low, and the effect is good.

MICROALGAE CALCAREOUS COMPOSITIONS AND USES THEREOF

Inventor(s): TAKAHASHI TETSUYA [FR]

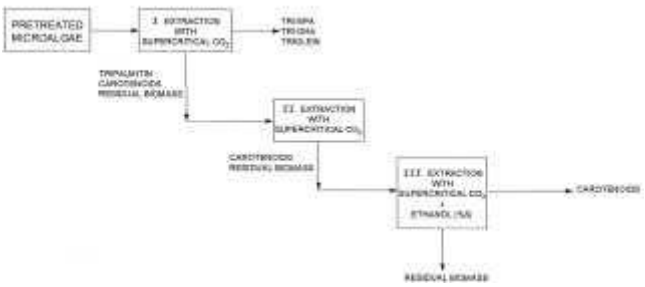
Applicant(s): MIYOSHI EUROPE [FR]

The present invention relates to a process for producing a cosmetic, a pharmaceutical or a nutraceutical composition, the process comprising cultivating Thoracosphaera heimii microalgae cells, recovering and drying the Thoracosphaera heimii calcispheres and mixing them with at least one cosmetically, pharmaceutically or nutraceutically acceptable ingredient. The invention further relates to the use of Thoracosphaera heimii microalgae as a cosmetically, pharmaceutically or nutraceutically acceptable ingredient. Lastly the invention relates to a cosmetic, pharmaceutical or nutraceutical composition comprising spherical Thoracosphaera heimii calcispheres of less than 15 µm average diameter and of sphere wall thickness of less than 1 µm, in association with at least one cosmetically, pharmaceutically or nutraceutically acceptable ingredient.

PROCESS FOR EXTRACTION OF NUTRACEUTICAL COMPOUNDS FROM MICROALGAE BY USING CO2 IN SUPERCRITICAL CONDITIONS

Inventor(s): CICCI AGNESE [IT]; IAQUANIELLO GAETANO [IT]; MAZZELLI ALESSIO [IT]

Applicant(s): NEXTCHEM S P A [IT]

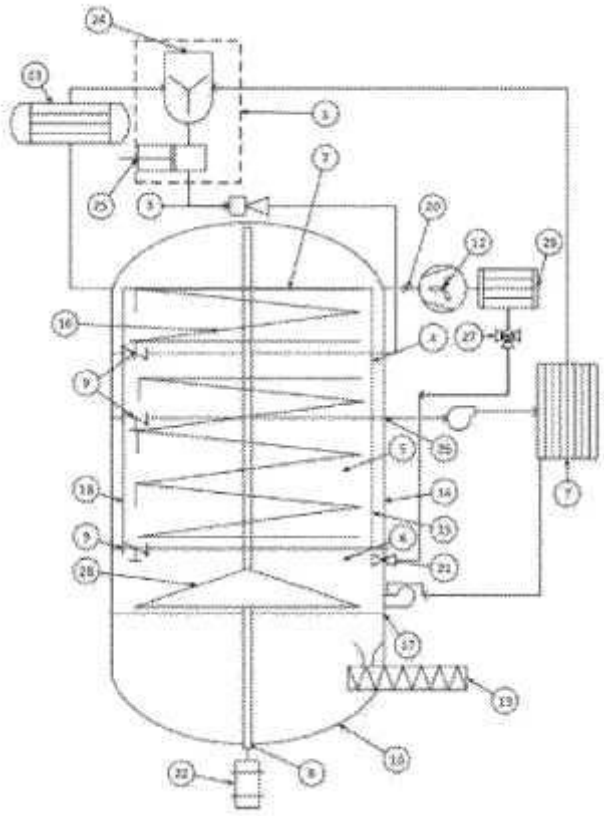


A process that allows the extraction of compounds of nutraceutical interest (specifically omega-3 and carotenoids) from microalgae and their separation through the use of CO2 in supercritical conditions (and when necessary a co-solvent), at the same time, wherein the removal of an unwanted component (tripalmitin) from the lipid extract, always by using supercritical CO2 in a fractional extraction, is advantageously carried out using its different extraction kinetics respect to the component present in the lipid phase.

Vertical continuous multiphase reactor for clean production of hydrocarbons and energy and thermochemical process carried out

Inventor(s): GUTIERREZ FONSECA JOSE EDUARDO

Applicant(s): SSS TECH INC



A reactor and method for the thermochemical degradation of wet biomass without the need for pre-drying, in particular a microalgae-rich substrate, is disclosed. A vertical continuous multiphase reactor (VCMR) is provided that uses indirect heating to simultaneously, stepwise, and continuously perform the steps of evaporation, pyrolysis, gasification, and combustion in separate chambers. The reactor operates at a subatmospheric pressure to increase thermal efficiency and production efficiency, using a portion of the same product as the fuel to achieve thermal self-sufficiency. A system for instantaneous evaporation at low temperatures by means of adiabatic expansion is used. The reactor has high efficiency and high yield, requires minimal space, and may be movable. The products obtained from the reactor are syngas, biochar and bio-oil for use in energy, agriculture, cosmetics, health and construction. The invention also provides a process for obtaining hydrocarbons and energy from high moisture biomass wherein the steps proceed continuously and do not require interruption of the process to add new wet biomass for conversion.

EVENTOS

Taller de tratamientos alternativos de efluentes industriales a base de cultivos microalgales

Lugar y fecha: miércoles 28 de junio de 2023 en U. Maimónides, Hidalgo 775, Cdad. de Buenos Aires, Argentina
Institución organizadora: RED IBEROAMERICANA PARA EL TRATAMIENTO DE EFLUENTES CON MICROALGAS (RENUWAL 320RT0005) - Programa Iberoamericano de Ciencia y Tecnología para el Desarrollo (CYTED).
marconi.patricialaura@maimonides.edu

CURSO DE EXPERTO EN PROCESOS SOSTENIBLES BASADOS EN MICROALGAS

Lugar y fecha: lunes 26 y martes 27 de junio de 2023 en U. Maimónides, Hidalgo 775, Cdad. de Buenos Aires, Argentina
Institución organizadora: RED IBEROAMERICANA PARA EL TRATAMIENTO DE EFLUENTES CON MICROALGAS (RENUWAL 320RT0005) - Programa Iberoamericano de Ciencia y Tecnología para el Desarrollo (CYTED).
marconi.patricialaura@maimonides.edu

2023 Algae Biomass Summit

Oct 9-11, 2023
Monona Terrace Convention Center
Madison, Wisconsin
https://algaebiomass.org/algae-biomass-summit/

Árbol de categorías

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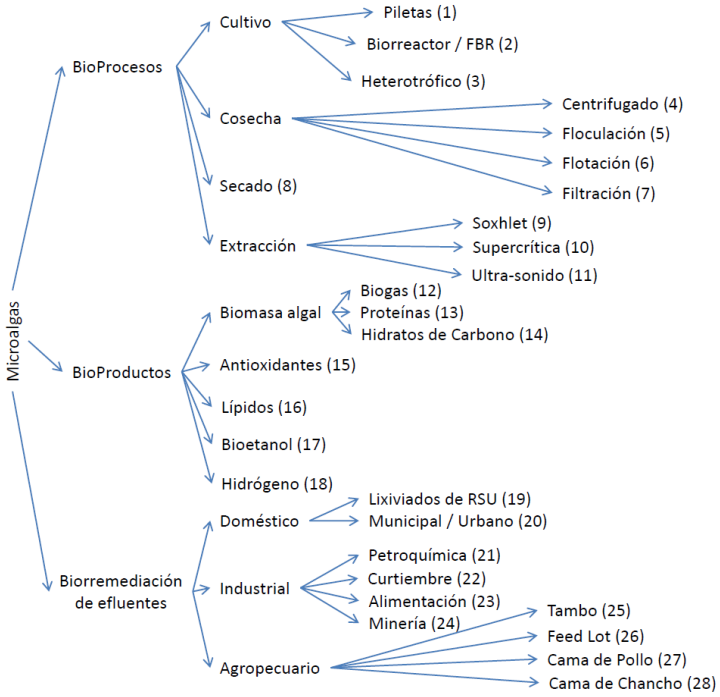

Inglés