Aquaculture Feeds May Be Produced from Micro-algal Biomass after Phycoremediation of Fresh Market Effluent

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Received: 02-May-2023, Manuscript No. FMBP-23-99669; **Editor assigned:** 04-May-2023, PreQC No. FMBP-23-99669 (PQ); **Reviewed:** 18-May-2023, QC No FMBP-23-99669; **Revised:** 23-May-2023, Manuscript No. FMBP-23-99669 (R); **Published:** 30-May-2023, DOI: 10.37532/2048-9145.2023.11(3).32-34

Abstract

The microalgal biomass created by the phycoremediation of wastewater is a significant source of lipids, natural antioxidants, and bioproducts as well as proteins. As a result, products for human nutrition and health as well as for animal and aquaculture feed use microalgal biomass and the chemicals obtained from it. For various bioproducts, numerous microalgal species have demonstrated great potential. However, considerable procedures are still needed to determine the ideal quality and quantity of microalgal biomass, particularly when it is utilised to replace aquaculture feed. The choice of microalgal species and their production are the constraints. The possibility for producing bioproducts from microalgal biomass that results from the phycoremediation of wet market wastewater is discussed in this paper. The consortium approach to wastewater treatment and a comparison of the availability of common aquaculture feeds and biomass output were studied.

Keywords: Aquaculture feeds • Microalgae • Phycoremediation • Wet market wastewater

Introduction

Microscopic algae, often known as microphytes, are not visible to the naked eye. They are phytoplankton that typically inhabits the water column and sediment in freshwater and marine settings. They are single-celled species that can be found alone, in chains, or in groups. Their diameters can range from a few micrometres (m) to a few hundred micrometres (m), depending on the species. Microalgae don't have roots, stems, or leaves like higher plants do. They have been specifically designed for a setting where viscous forces predominate.

Microalgae that can perform photosynthesis are crucial for life on earth because they produce around half of the oxygen in the atmosphere and use carbon dioxide as a greenhouse gas to develop photoautotrophically. Microalgae, which are also referred to as phytoplankton together with cyanobacteria, are the primary producers of marine photosynthetic organisms. Together with bacteria, microalgae form the foundation of the food chain and supply energy to all trophic levels above them. Chlorophyll a concentrations are frequently used to measure microalgae biomass, which might be a useful indicator of future output [1-5].

To replace petroleum-based fuels and chemicals, the use of renewable microalgal biomass as active feedstock for biofuels and bioproducts is being investigated. Due to a number of advantages connected with it, microalgae biomass has recently come to be recognised for its significance as a renewable feedstock. An effective and sustainable way to make value-added chemicals, food items, and biofuels is through the anaerobic digestion (AD) of microalgal biomass in biorefineries. Pretreatment of microalgal biomass is a crucial step in improving AD's ability to produce methane. Findings on the diversity and structure of the AD microbial community may have unexpected effects on the stability and appearance of the digester. This paper provides an important examination of the available data regarding the microbial community that produces

AD and AD production. In AD, co-digestion of microalgal biomass with various co-substrates was employed to increase biogas generation. The approach was both economically and biologically viable. The toxic cyanobacterial blooms that produce microcystins pose a serious threat to environmental health. The microcystins can be effectively broken down and converted into harmless compounds by anaerobic biodegradation. However, more highly developed research is still needed for the large-scale AD of microalgal biomass in order to convert it cost-effectively to energy and other positive outputs.

Discussion

For the production of high-value nutraceuticals, bioproducts, animal feed, and as a source of renewable fuels, bulk biomass from microalgae is of great interest. Higher output, utilisation of non-arable land, recovery of nutrients from wastewater, effective carbon capture, and quicker development of new domesticated strains are benefits of microalgal biomass production over plant biomass. Additionally, within this polyphyletic group, adaptability to a variety of environmental factors led to a high level of genetic diversity, making microalgae a rich source of intriguing and practical metabolites. Many worldwide demands could potentially be met by microalgae; but for this potential to be realised, production costs must be brought down. The most popular industrial strains' average productivity is much lower than maximal theoretical predictions, suggesting that domestication strategies aimed at making algal-derived bio-products profitable on an industrial scale must prioritise identifying factors limiting biomass yield and eliminating bottlenecks. A significant barrier to finally closing the productivity gap between theory and industry is the light-to-biomass conversion efficiency. Recent findings imply that significant yield improvement is possible in this regard. In order to maximise the efficiency with which solar energy is transformed into biomass and bioproducts, further developments in cultivation methods, together with genetic manipulation of both algal physiology and metabolic networks, are required to fully realise this potential. In this review, we outline the molecular processes that control the conversion of light into biomass during photosynthesis and explore how they might be targeted to increase productivity using genetic engineering, strain selection, or mutagenesis. We list noteworthy achievements and suggest techniques for making important future contributions to microalgae-based biotechnology.

Microalgae growth techniques, such as cultivation modes and bioreactors, have been improved based on microbial physiology to increase the utilisation of substrate and light. Such systems have (in part) succeeded in supplying microalgae with enough nutrients and photons—but not too many—to prolong their logarithmic growth phase. Due to its high energy content and carbon-free combustion characteristics, bio hydrogen is a viable alternative fuel for the current problems with global warming and the rapidly rising greenhouse gas emissions. Since hydrogen does not naturally exist, current methods of producing it (such as steam methane reforming and water splitting) are energy- and carbon-intensive. A green, sustainable, and emission-free method of manufacturing hydrogen is dark fermentative hydrogen generation by anaerobic hydrogen-producing bacteria. Microalgal biomass is regarded as the third generation of biofuel feedstock and is the subject of academic and commercial research because of its capacity to store carbon. The pretreatment techniques that can be used to microalga biomass for efficient bio hydrogen generation are covered in length in this paper. A critical analysis of the microalga cell wall structure and the related polymeric carbohydrates that provide some recalcitrance is provided, along with future research directions [6-10].

Conclusion

Microalgal polysaccharides are interesting substrates for dark fermentation-based biohydrogen generation. The primary objective of pretreatment is to liquefy and saccharify the algal carbohydrates while minimising costs, hazards, and the production of fermentation inhibitors. The majority of the literature discussed acid/alkali-based thermal pretreatment, in which heat energy causes the organic matter to liquefy while the chemical treatment promotes hydrolysis. The resulting fermentation inhibitors are far more anaerobic bacteria ferment microalgal carbohydrates to produce short chain volatile fatty acids and gaseous components for use in the manufacture of biohydrogen. Starting with high initial carbohydrate content could minimise considerable carbohydrate loss throughout pretreatment operations. High carbohydrate accumulating microalgal strains are the key to a successful biohydrogen production system.

Through process engineering and stress, reserve carbohydrate buildup in microalgae can be improved. In order to address the potential future shortage of petroleum supplies, microalgal biomass appears to be a promising renewable option. Large-scale processes using one or two microalgae products were demonstrated to be economically impractical using TEA and LCA. So, efforts were made to produce a number of useful byproducts. However, the procedure is neither economically or environmentally advantageous due to the current downstream methods.

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