Integrated System for Microalgae Culture

Vennila M[1]*, Subashini V[2], Manikandavelu[1] and Rajeshwari C[1]

[1]Dr.MGR Fisheries College and Research Institute-TNJFU,Ponneri.
[2]Central Institute of Fisheries Education -ICAR, Mumbai.

Corresponding Author
Vennila M
Email: mpkvennila97@gmail.com

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ABSTRACT

Microalgae, a renewable source for lipid extraction, has mostly focused on biofuel production. There has been an inadequate study on food oils from microalgae. Microalgae grow in seawater, freshwater and wastewater. Comparable to terrestrial plants, microalgae use less land and water source and produce biomass ten times more than terrestrial plants. However, due to significant energy consumption, the economic viability of industrial-scale manufacturing is yet to be reached. The integrated system for microalgae oil production was developed to reduce energyconsumption, be eco-friendly and produce value-added products.

INTRODUCTION

MICROALGAE

Microalgae are photosynthetic unicellular organisms. Microalgae comprise a heterogeneous group of species that includes prokaryotic and eukaryotic microorganisms with the common feature of transforming light and carbon dioxide into biomass through photosynthesis. Half of the atmospheric oxygen was produced by the microalgae. The main component of the microalgal cell are the proteins, carbohydrates and lipids .microalgae can be manipulated to induce the production of vitamin A minerals, pigments and other bio compounds and their biomass can be used as a dietary supplement for humans and animals, including aquaculture. Microalgae cells typically contain 30-80 % of lipids mainly including functional lipid /polyunsaturated fatty acids.

MICROALGAE CULTURE

Production of microalgae is generally the least expensive than growing crops. The main essential elements for microalgae growth was nitrogen, phosphorous, carbon dioxide, iron and in some case silica. The success of algae cultivation depends on many factors. Thus variations in bioprocessing factors i.e., temperature, pH, light, carbon source salinity and nutrient etc. have been used to improve both biomass and productivity of bioproducts. Microalgae are cultured in two systems: open and closed systems. In the open system, culture is done in the raceway pond under direct sunlight. The main problem in the open system is that the temperature and contaminants cannot be controlled. More care is needed to maintain the culture in the open system.

In the closed system, photobioreactors are widely used and more advantageous than open system. We can adjust the optimal conditions for biomass production such as temperature, nutrient content, and light for lipid production. Photobioreactors can also avoid the effects of fluctuating weather conditions and microbial contamination. The integrated system was developed for culturing the microalgae and utilizing every outcome and debris.

INTEGRATED SYSTEM

The integrated system for microalgae oil production is shown in fig.1.The system contains Microalgae cultivation, harvesting, and extraction of lipids. After the lipid extraction, all remaining residues are converted to value-added products.

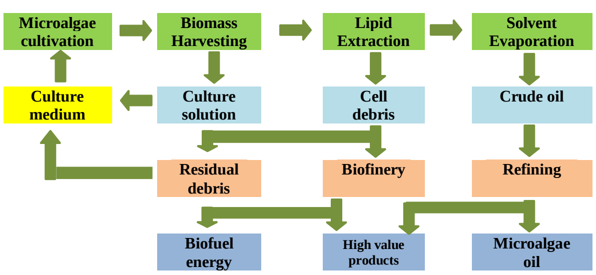

Fig.1. Flow chart for the Integrated system for microalgae culture

After the cultivation, the microalgae are harvested. Microalgal biomass is extracted from the medium and dewatered by flocculation, sedimentation, centrifugation and filtration. The separated water and culture media are stored in the cultured tank to reuse the media for another successive culture. Extracted biomass is used for lipid extraction. The wet biomass was freeze-dried and the microalgae cell was disturbed with the solvent to extract the oil directly. After the oil extraction the Crude oils are separated by centrifugation and processed for the production of edible oil. The enduring microalgae cell debris is stored and used for the production of value-added products. The cell debris contains sugars, cellulose, starch, and other carbohydrates. The leftover biomass is used to produce the high value-added products to increase the economic feasibility of the microalgal process. From this, the production of value-added products from microalgae is the one viable strategy for lowering oil costs.

Oil refineries can separate a variety of high-value by-products. Degumming techniques may separate phospholipids from oils, which can then be added to chocolate as an additive to reduce bloom development and crystallization. They can also be used as bread-making additives, affecting the quality of wheat dough. Due to their advantageous biological activities, separated pigments (carotenoids, chlorophylls, and phycobiliproteins) have significant potential for use in food and medicines. Additionally, the remaining debris can be further processed to grow microalgae as a source of carbon and nitrogen. Chlorophyll from microalgae is used as a natural colorant in food. Carotenoids have strong antioxidant qualities and can be employed in healthy foods to prevent lipid peroxidation and cell damage by scavenging free radicals and interacting with reactive oxygen species. In clinical or research immunology laboratories, phycobiliproteins can be used as fluorescent dyes. Thus, commercially valuable pigments improve the interest in microalgae as alternative sources of bioactive compounds

CONCLUSION

Microalgae demand is increased in the next generation due to their properties and uses. As a result, future researchers should focus on maximizing the usage of microalgae and minimizing energy consumption. The integrated system of microalgae culture is energy consumption and gave more value-added products foremost to reduce the culture cost Expanding commercial production of microalgal oils may require the development of adequate cultivation techniques.

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