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Qatar Culture Collection of Microalgae: A Sustainable Source for Biodiesel Production and Omega Fatty Acid Compounds

Touria Bounnit[1], Gomza Al Ghazal[2], Mariam Al Mureikhi[2], Imen Saadaoui[2], Hareb Al Jabri[2]

[1]Algal Technology Program, Center for Sustainable Development, Qatar University, QA
[2]Algal Technology Program, QA

Email: Touria.bounnit@qu.edu.qa

Microalgae are photosynthetic microorganisms that can grow in different environments (sea water, fresh water, waste water soil, rocks…) and under various conditions (Light, pH, temperature, salinity…). During their phases of growth, they produce a variety of metabolites such as lipids, proteins and carbohydrates in large amounts over a short period of time. These metabolites can be processed into both biofuels and other useful bioproducts. Microalgal lipids can be converted to biodiesel via process called transesterification. The use of biodiesel will decrease the emission of harmful gases, which can help in reducing the greenhouse effects and global warming. It is nontoxic, biodegradable and has the potential to replace the conventional diesel fuel. The microalgal lipids extract can also constitute a natural source of active compounds offering a variety of nutraceutical and pharmaceutical applications.

In the Algae Technologies Program at Qatar University, a Culture Collection of Cyanobacteria and Microalgae (QUCCCM) has been built and maintained in the liquid nitrogen. This culture collection contains more than 200 strains isolated during different periods of the year and from various places in Qatar. In this work we present the results of 8 marine green algae belonging to 3 different microalgal major groups: Chlorocystis sp., Nannochloris sp and Tetraselmis sp.

The strains collected from different Qatar coastal places were screened for their growth rate, amount of total lipids as well as their Fatty Acid Methyl Ester (FAMEs) profiling. Culture was done in liquid F/2 medium at 300 C for a period of 15 days, after which algae were harvested for the determination of total lipids. A one step transesterification process was used to derivitize the intrinsic lipid into fatty acid methyl esters and the individual components were identified against known standards. The fatty acid profiling was obtained using a GC-FID.

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The comparative analysis of the QUCCCM isolates growth rate showed that Nannochloris sp. is the fastest growing isolate with a maximum value of 1.013 day-1. In terms of lipid contents, the results indicate a variety of the amounts. Nannochloris sp. showed the highest amount of total lipid (28.5%) followed by Chlorocystis sp. isolates with a total lipid amount of (19.5–21.5%) and later comes the Tetraselmis sp. strains with a total lipid content of (17.8–20.3%). The GC analysis showed a diverse range of FAMEs produced. All the strains screened contains the important FAMEs suitable for biodiesel production (C14, C16 and C18). The good growth rate of these strains along with their lipid content and profile make them competitive for a viable algal biofuel technology comparing to the terrestrial oil crops which need longer time to grow and present lower amount of lipids (Weyer et al., 2010). In addition, we observed the presence of the omega-3 and 9 long-chain polyunsaturated fatty acids (LC-PUFAs), such as eicosapentaenoic (EPA, 20:5 n-3), docosahexaenoic (DHA, 22:6 n-3) and Nervonic Acid (C24:1 n-9) acids, which have a high commercial value and are known for their beneficial effects on human health.

Keywords

Microalgae, Lipid, Fatty Acid Methyl Ester, Biodiesel, LC-PUFAs.