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Qatar: A Valuable Resource for Autochthonous Microalgae with High Potential for Biofuel Production and Food Security

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Algae-derived products, in particular biodiesel, have received increased interest over recent years due to their advantages over fossil fuel derived products. The ability of algae to grow in different qualities of water, with high areal biomass productivities, and photoautotrophic capacity using sunlight and CO_2 as a source of energy, are just of few of their advantages. Due to the high biodiversity of microalgae and cyanobacteria, the selection of a suitable strain is paramount for successful development and commercial application of microalgae, be it for biodiesel production or, other applications such as products for the nutritional, pharmaceutical and chemical industries. This encouraged the scientific community to establish supporting culture collections of marine and fresh water microalgae and cyanobacteria from a range of diverse environments.

The isolation of autochthonous microalgae, with high lipid-contents and biomass productivities is a crucial aspect of the development of commercial production of microalgae-based biodiesel as well as food security in land-locked locales. This is especially important for deployments in climates such as are found in Qatar, a peninsula in the west Arabian Gulf, which is characterized by an extreme desert climate.

The present research work describes the establishment of the Qatar University Culture Collection of Cyanobacteria and Microalgae (QUCCCM). Indeed, different strains of cyanobacteria and microalgae were isolated from various local environments, ranging from freshwater bodies to marine environments, as well as from soil, sabkha and rocks. Strains were subjected to intensive purification and subculturing, and characterized at the morphological and molecular levels. Selected strains were characterized for growth rate, and secondary metabolite production in order to identify important strains with high potential for large-scale outdoor culture, specifically for biofuel production.

53 autochthonous strains of microalgae were isolated from various freshwater, marine and terrestrial environments in Qatar that led to the establishment of the Qatar University Culture Collection of Cyanobacteria and Microalgae

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(QUCCCM). Strains were identified via ribotyping and characterized in terms of growth rate and lipid production. 13 different known genera were identified, with the distribution analysis showing Chlorella as the most abundant fresh-water known genus (22.64%), followed by Chlorocystis (13.21%). Several microalgae strains belonging to the same classification showed significant genotypic diversity. Furthermore, several novel strains were identified (20.75%). Furthermore, several novel strains were identified. Growth rate analysis evidenced a thermo and halotolerant Nannochloris isolate QUCCCM31 able to tolerate 45°C and wide salinity range 35–100 ppt. Determination of lipid content and lipid profiling indicated the presence of promising strains for biodiesel production such as Nannochloris sp. (strain QUCCCM31) with a promising FAME profile for biodiesel production. This strain also produced nervonic acid, a C24:1 straight chain fatty acid of high pharmaceutical potential.

Our results show heterogeneity in the Qatar Culture Collection and highlight the presence of Nannochloris sp., strain QUCCCM31, very promising for biodiesel production. The presence of the nervonic acid in the FAME profile increase amply the importance of this strain and enlarge its application for pharmaceutical purposes.

Keywords

Microalgae, Biodiesel, Qatar Culture Collection of Cyanobacteria and Microalgae (QUCCCM), FAME, MUFA, Nervonic acid