Production of biofuels from microalgae, challenges and opportunities

Luis Fernández-Linares; Unidad Profesional Interdisciplinaria de Biotecnología - Instituto Politécnico Nacional (UPIBI-IPN). Departamento de Bioprocesos. México, D.F.
e-mail: lfernand36t@gmail.com

Key words: Biofuels, microalgae, biorefineries .

The accelerated global demand of energy is expected to continuously increase; nevertheless, some of the conventional methods of generating energy are no longer sustainable. Renewable energies are needed for petroleum replacement, because fossil energetics contributes to global warming and are of limited availability. In recent years, technologies for renewable energy have been developed and implemented, such as wind, solar, hydropower, geothermal or biomass. The power sector can be supplied with these renewable sources, nevertheless, the transportation sector, which represents 28% of global energy consumption, strongly depends on renewable liquid and gaseous biofuels. Biodiesel and bioethanol are the two potential renewable fuels that have been considered as fossil fuels substitutes. Presently, biofuels are produced from common sugar and starch crops (bioethanol) and vegetable oils or animal fats (biodiesel). This feedstock production in large quantities is not sustainable. Microalgae represent a remarkable alternative to produce biofuels.

The algal cultures have several advantages over plants, they grow extremely rapid and many of them show high oil yields and productivities, algae does not compete with food or feed crops or farmland; they do not have high requirements for nutrients or water, algal cultures benefit small scale farmers and energy security, and contribute to mitigate climate change. Currently there are several challenges for biofuel production from algae: algal biomass production and oils at low cost, biomass drying, lipid extraction and transesterifcation, among others. Several approaches have been studied, including biorefineries and industrial ecology, which can make economically feasible the production of biofuels from microalgae.

Research and development in biomass production followed by integration into biorefineries, are the main areas to achieve the feasibility of using microalgae. With regard to biomass, it may have different approaches: search for new strains, media optimization, genetic transformation, design and innovation of photobioreactors and open systems, illumination and agitation mechanisms for reactor, problem solving of dioxide carbon and oxygen diffusion in culture media, among others. In regard to biorefineries, it can be said that is the valorization of all biomass, getting different types of biofuels such as biodiesel, ethanol, hydrogen, methane or syngas, likewise, obtaining biojetfuel, which is a biofuel with greater value added. Plus, other high value products such as pigments, proteins and active principles can be produced.

The integration of biomass production process to an industrial ecology system can be an important contribution, using wastes from other companies as inputs, in addition to, the reuse of their own waste or as inputs to other processes. In this aspect, there is considerable interest of using wastewater for microalgae production.

In our group we are working on an integrated platform, including the production of biomass growth systems, biomass separation, biomass drying, oil extraction and transesterification. Specifically in the culture system, it is being carried out the search of new strains, optimization of culture media, open and closed culture systems, culture regime type, use of wastewater, among others. Currently, we have several strains of freshwater, brackish and saltwater, also strains able to grow in wastewater. Nitrogen limitation and CO_2 supply tests, in both open and closed photobioreactors have been developed; as well flocculation of biomass with organic compounds; biomass drying by different methods and in particular solar drying.

It is important to note that in Mexico the development of biofuel technologies requires well-established policies; investment in research and development, as well as institutional and interdisciplinary collaboration in order to become competitive and ensure that Mexico become a country with energetic autonomy.