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Biofuel recovery from microalgae biomass grown in dairy wastewater treated with activated sludge: The next step in sustainable production

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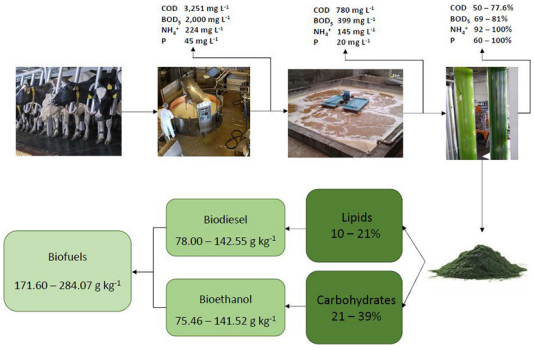
HIGHLIGHTS

- Microalgae were grown in synthetic dairy wastewater treated by activated sludge
- Bioremediation and CO_2 fixation rates were promising
- For production of 24,99 × 10^9 L bioethanol $year^{-1}$, an area of 2 ha would be needed
- It is possible to produce ~306 g of biofuels from 1 kg of *Scenedesmus obliquus*
- It is possible to produce 276 g of biofuels from 1 kg of *Chlorella vulgaris*

GRAPHICAL ABSTRACT



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ABSTRACT

Microalgae biofuel could be the next step in avoiding the excessive use of fossil fuels and reducing negative impacts on the environment. In the present study, two species of microalgae (*Scenedesmus obliquus and Chlorella vulgaris*) were used for biomass production, grown in dairy wastewater treated by activated sludge systems. The photobioreactors were operated in batch and in continuous mode. The dry biomass produced was in the range of 2.30 to 3.10 g L^{-1}. The highest volumetric yields for lipids and carbohydrates were 0.068 and 0.114 g L^{-1} day^{-1}. Maximum CO_2 biofixation (750 mg L^{-1} day^{-1}) was obtained in continuous mode. The maximum values for lipids (21%) and carbohydrates (39%) were recorded in the batch process with species *Scenedesmus obliquus*. In all of the experiments, the Linolenic acid concentration (C18:3) was greater than 12%, achieving satisfactory oxidative stability and good quality. Projected biofuel production could vary between 4,863,708 kg and 9,246,456 kg $year^{-1}$ if all the dairy wastewater produced in Brazil were used for this purpose. Two hectares would be needed to produce 24,99 × 10^9 L $year^{-1}$ of microalgae bioethanol, a far lower value than used in cultivating sugar cane. If all dairy wastewater generated annually in Brazil were used to produce microalgae biomass, it would be possible to obtain approximately 30,609 to 53,647 barrels of biodiesel per year. These data show that only by using dairy wastewater would biofuels be produced to replace 17% to 40% of the fossil fuels currently used in Brazil.

1. Introduction

Dairy products are widely consumed in most developed countries, and their consumption in developing countries is increasing quickly (Röös et al., 2016; Mendonça et al., 2017a, 2017b; Souza et al., 2021). Over the two last

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