Green algae biofixation and conversion to added-value compounds of fermentative carbon dioxide

Record number : OPR-384

Overview

RESEARCH DIRECTION

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INFORMATION

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ADMINISTRATIVE UNIT(S)

Faculté de génie
Département de génie chimique et de génie biotechnologique

LEVEL(S)

2e cycle
3e cycle
Stage postdoctoral

LOCATION(S)

Université de Sherbrooke
P3

Project Description

Following the COP21 conference in Paris, most of the global economies (including Canada) agreed to considerably cut-down their greenhouse-gas emissions. More specifically, these commitments are targeting a 37.5% reduction compared with 1990 levels by 2030 which represents (on transportation only) a very large number since Canada is presently using 40 billion liters of fuel each year. In recent years however, a mandate was set in place supporting the addition of a minimum of 5% ethanol to these volumes. This would amount for a total of 2 billion liters of ethanol at a national level and 450 million liters in Quebec alone. The industrial partner of the present proposal, GreenField Global, located in Varennes (QC), is the sole provider of industrial ethanol in the province, generating 185 ML of fuel-grade ethanol each year.

Considering that burning 1 L of gasoline produces approximately 2.3 kg of CO2, the addition of ethanol will reduce to some extent the release of this green-house gas. However, the fermentative production of each L of ethanol results in the cogeneration of approximately 0.9 kg of CO2. Considering the total required provincial targets of ethanol, a quantity of 400,000 t of CO2 will be cogenerated each year in Quebec alone. Thus, it is imperative to identify a suitable solution for the mitigation of this by-product. Microalgae are organisms that naturally consume and convert CO2 into various added-value compounds. For instance, microalgal strains such as Chlorella vulgaris were reported to proliferate at CO2 concentrations of up to 50%, accumulating 25-30% proteins, 6-10% carbohydrates, and 30-40% lipids of their dry weight. All these compounds can be recovered and further valorized locally at the plant by fermenting the sugars into ethanol and further refine the residual biomass to green gasoline, jet fuel and diesel. In addition, the liquid fermentation effluent obtained after the ethanol recovery could provide an optimal microalgal cultivation substrate, leading to the pretreatment of this waste through the microalgal consumption of fermentation metabolites.

Prof. Lavoie's group has made considerable advancements in this field by developing novel microalgal-based industrial effluent treatment approaches combined with biomass recovery and conversion to fermentable carbohydrates, proteins and fatty acids. Such an approach, using heavily-polluted industrial effluents, is currently under the commercialization process together with Transfertech Sherbrooke Inc. Thus, the main objective of this proposal is to identify the opportunity of using green microalgae to convert the CO2 generated through the ethanol fermentation process into valuable compounds which could be locally recovered and valorized. Moreover, by using the liquid fermentation streams as algae cultivation substrate, a complete effluent treatment solution could be developed and closely integrated into the plants current process workflow.

Discipline(s) by sector

Sciences naturelles et génie

Génie chimique

Funding offered

Yes

Partner(s)

GreenField Global Inc.

The last update was on 13 March 2024. The University reserves the right to modify its projects without notice.