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Algae-based multitrophic biomass biorefinery for the production of biofuels

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Statement of the Problem: Due to increased productivities and cultivation in marginal lands, microalgae have great potential as feedstock for biofuels alternative to plant crops. However, the current cost of producing biofuels from microalgae biomass is still high to envision massive and profitable commercialization in the near future. It is presumed that obtaining other higher-value byproducts in biorefineries would increase the profitability. Among other aspects, access to renewables as well as recycling of nutrients as substitutes for conventional fertilizers would be mandatory.

Methodology & Theoretical Orientation: We have been proposing alternative multispecies microbial cells-factories for the production of biofuels. Basically, the concept proposes the integration of operations that are exceptionally well performed by single microorganisms (whether naturally occurring or after genetic optimization) into multispecies systems than can execute more complex tasks and/or outperform any single species. We attempt to increase the use of N_2 from the air as a sole source of N-fertilizer for microalgae.

Findings: We used a N_2-fixing cyanobacterium that produces N-rich biomass that could be efficiently converted into biomass of a variety of microalgae. When using oleaginous strains, on-farm oil-production potential yields by ePBR simulations were up to 20-fold higher than those reported for soy oil. On the other hand, when we used microalgae accumulating carbohydrates (60-70% w/w), after a mild acid treatment for biomass hydrolysis and saccharification, bioethanol was produced at nearly 90% of its theoretical yield by fermentation with yeasts. The system also produced protein-rich biomass fractions as potential feed supplement and allowed some recycling of nutrients.

Conclusion & Significance: We have provided strong proof-of-principle suggesting potential for the economic and environmentally sustainable production of biofuels in multispecies biorefineries. Both on-farm demonstration and detailed modeling of environmental performance are required to take these ideas to a next step.

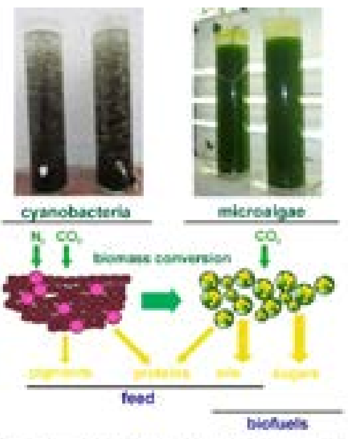

Figure 1: Biorefinery of multitrophic biomass of photosynthetic microorganisms. The process would allow co-production of biofuels (biodiesel, bioethanol, biomethane, others) and animal feed mostly form air and sun light.

Biography

Leonardo Curatti has received his graduate and PhD degree in Biology in the National University at Mar del Plata, Argentina. He has then joined Dr. Ludden's laboratory in the University of California at Berkeley as an Associate Postdoctoral Researcher to study biochemical and genetic aspects of N_2-fixation. In 2008, he started an independent line of research as an Investigator at the National Council for Scientific and Technical Research (CONICET) and as a Professor at the National University of Mar del Plata, Argentina. Presently his laboratory at the Institute of Biotechnology and Biodiversity Research (INBIOTEC-CONICET) is mainly engaged in R&D regarding the use of biological N_2-fixation as an alternative source of N-fertilizers for agriculture (including microalgae) and microalgae biorefineries for the production of biofuels and animal feed.

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