

Sustainable production of fatty acid ethyl esters (FAEEs) and co-products from microalgae cultivated on dark fermentation effluents

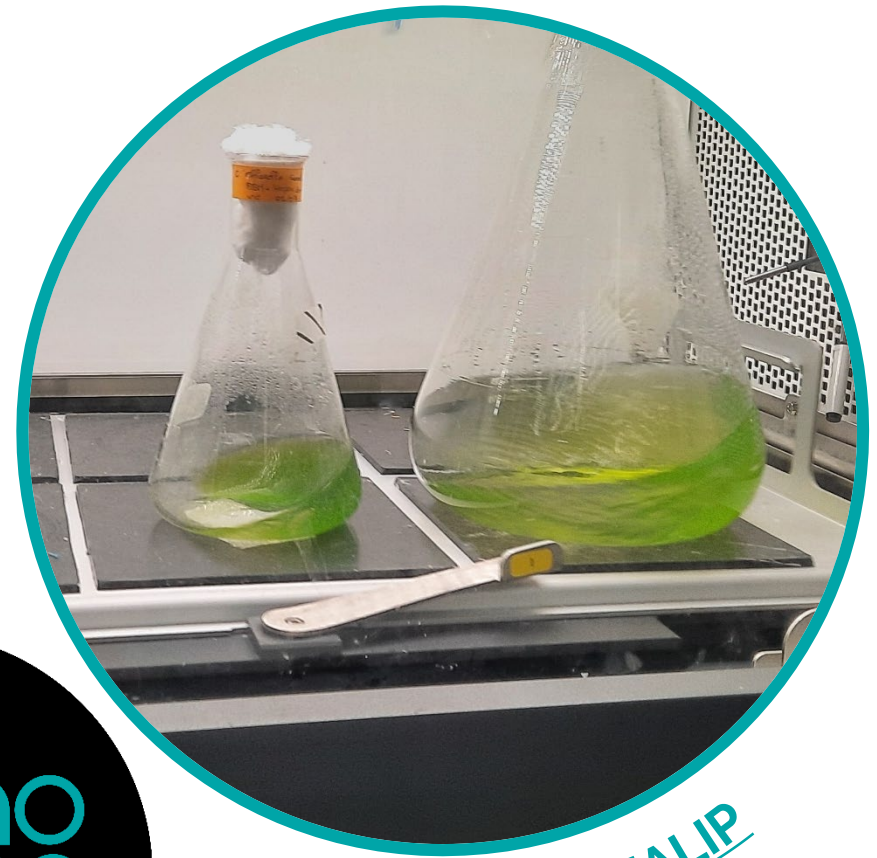
Patent application EP24306127.2

Process for producing fatty acid esters from microalgae

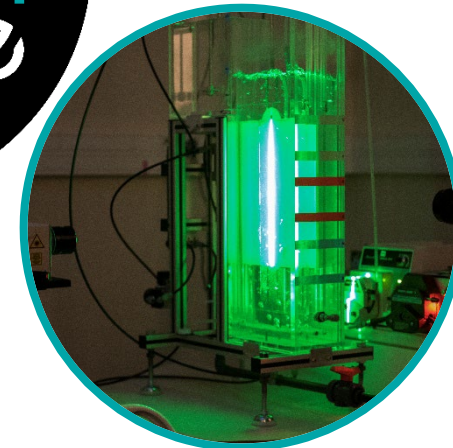
Lipids – Microalgae – Effluents – Fermentation



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FERMALIP





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Context

The energy transition and circular economy call for new, sustainable pathways to produce bio-based molecules. Today, fatty acid ethyl esters (FAEEs) – used as biofuels and oleochemical intermediates – are mostly derived from plant or animal fats, competing with food resources and relying on energy-intensive processes.

Description

The FermALip project introduces an integrated environmental biorefinery concept that converts food waste through dark fermentation, followed by microalgae cultivation and in situ enzymatic conversion of algal lipids into FAEEs. This process combines waste treatment, biomass production, direct transformation of lipids, and co-product valorization, significantly lowering both energy use and carbon footprint.

Results obtained

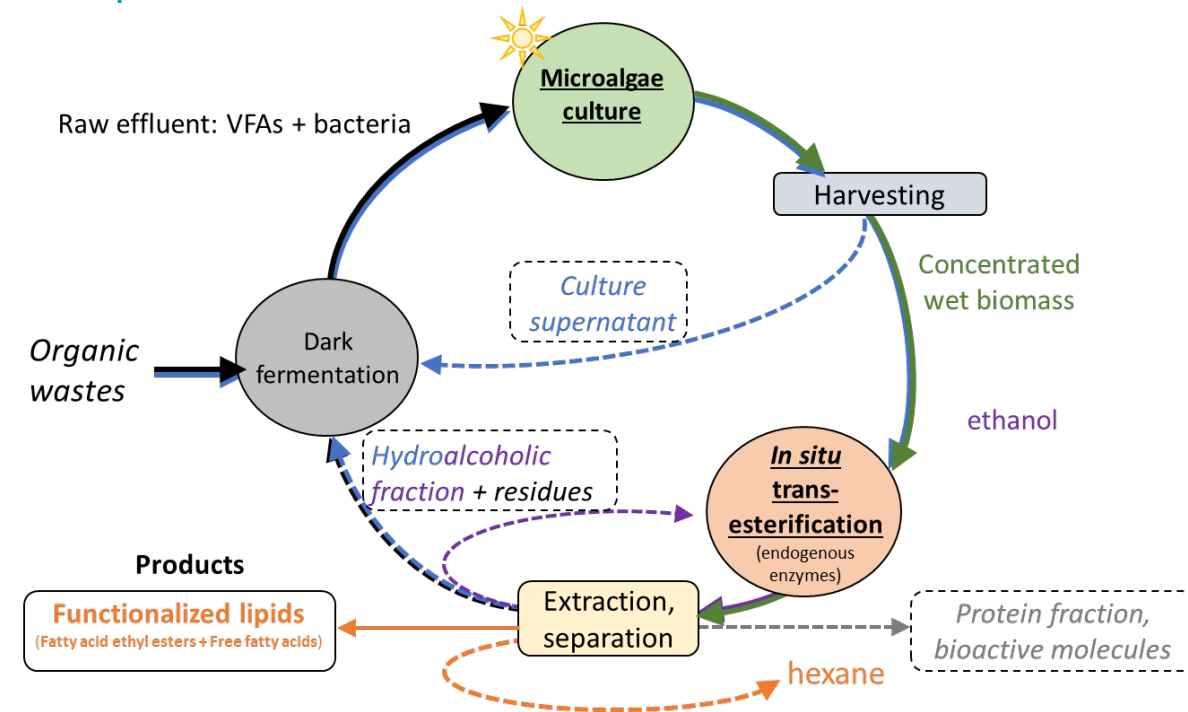
- Demonstrated the feasibility of cultivating microalgae directly on raw dark fermentation effluents.
- Highlighted the key role of phagotrophic microalgae, capable of consuming bacteria and organic compounds present in waste effluents.

CONTACT

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- Showed that lipids within the wet biomass can be converted directly into FAEEs through the natural enzymatic activity of the microalgae – in the presence of low-concentration ethanol and without external catalysts or drying steps.
- Confirmed the potential of an integrated process linking waste fermentation, algal growth, and lipid valorization in a single production chain.

Graphical abstract



Laboratories & Principal Investigators

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Advantages

- Uses organic waste as substrate – no competition with food production
- Simplified, low-energy process (fewer unit operations, no drying)
- Complete biomass valorization (lipids and co-products)
- Can be integrated into existing infrastructures (wastewater treatment plants, agro-industrial sites)
- Enables internal recycling of process fractions

Potential applications

- Bioenergy: biodiesel from FAEEs; biohydrogen from recycled carbohydrate fractions
- Oleochemistry: lubricants, surfactants, green solvents, biomaterials
- Agro-industry: fertilizers, biostimulants, animal feed
- Biotechnology: extraction of proteins, pigments, antioxidants, and bioactive compounds.

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Transfer opportunities

- Collaborative R&D contracts with industrial partners (waste management, bioenergy, biorefineries)
- Licensing opportunities for the patent under filing (non-exclusive or co-ownership agreements)
- Development of pilot-scale demonstrators with industrial actors

Development stage

1 2 3 4 5 6 7 8 9

TRL 3–4: proof of concept validated at laboratory scale

Next steps:

- Transition to semi-continuous cultures in photobioreactors (PBR)
- Optimization of FAEE yields
- Analysis and valorization of co-products
- Completion of mass and energy balances

Objective: pilot-scale validation (TRL 5–6) and upscaling toward industrial implementation



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