Life Cycle Assessment of *Euglena gracilis* Cultivation under Purple LED Strips Lights

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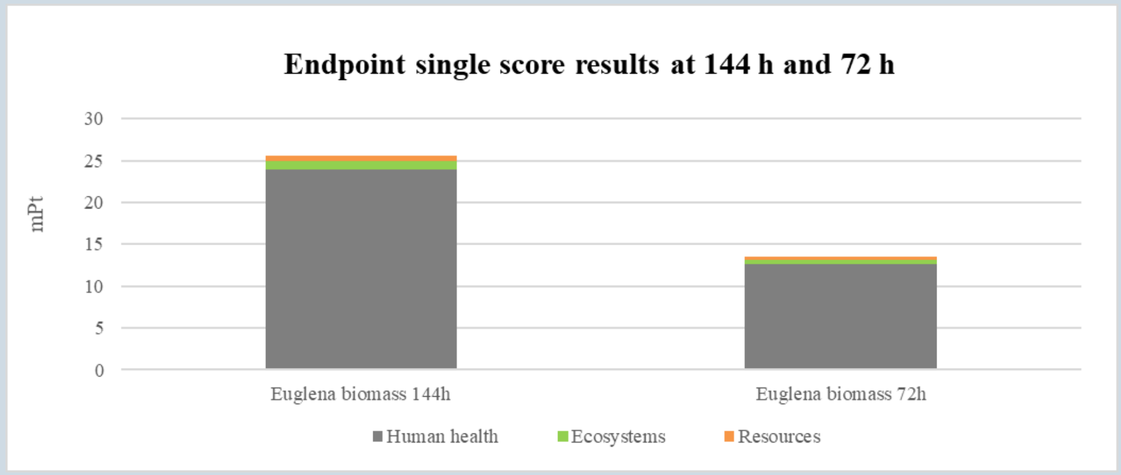
The growth stage of *Euglena gracilis* represents the main environmental hotspot, while shortening the cultivation time can reduces total damage by 47%

- The cultivation stage of *Euglena gracilis* accounts for approximately 93% of total impacts in both midpoint and endpoint assessments



- Decreasing the growth period from 144 h to 72 h, while maintaining the approximate biomass production and higher paramylon accumulation during this period

- A reduction in total environmental impact from 25.55 to 13.51 mPt

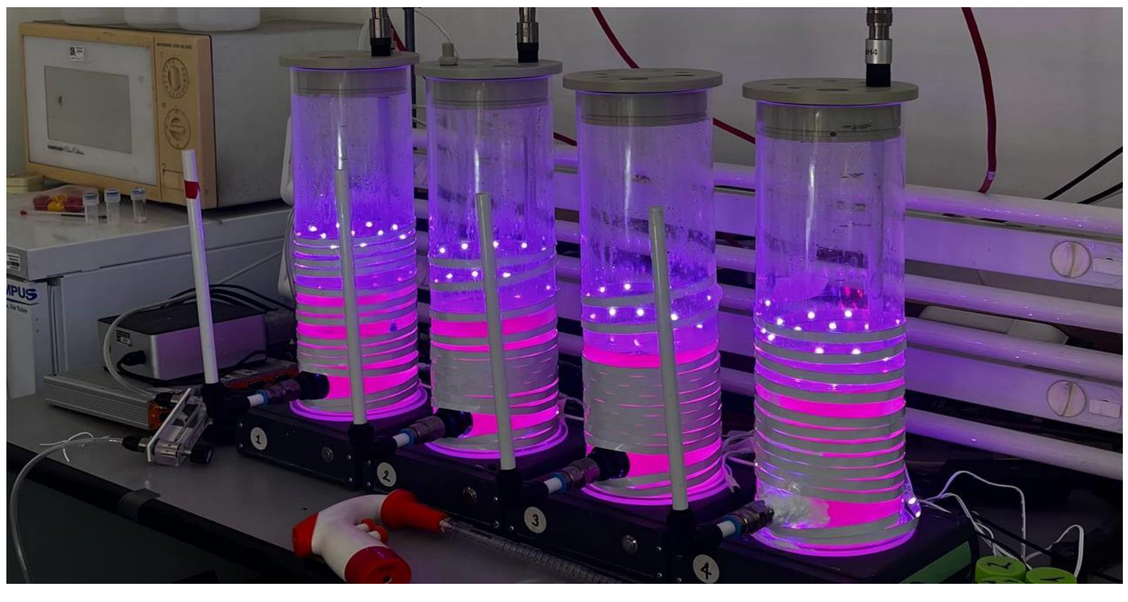
Introduction

Euglena gracilis

- ***Why:*** *N*utritionally rich microalga as promising alternative for aquaculture, containing more than 40% protein and up to 80% carbohydrates in the form of β-1,3-glucan.
- ***Evidence:*** research shows that including *Euglena sp*. in fish and shrimp diets can significantly increase growth rates and reduce metabolic stress.
- ***Gaps***: cultivation can be energy-intensive, particularly due to continuous lighting and mixing, which significantly affect environmental performance, highlighting the need for more cost and resource efficient approaches.

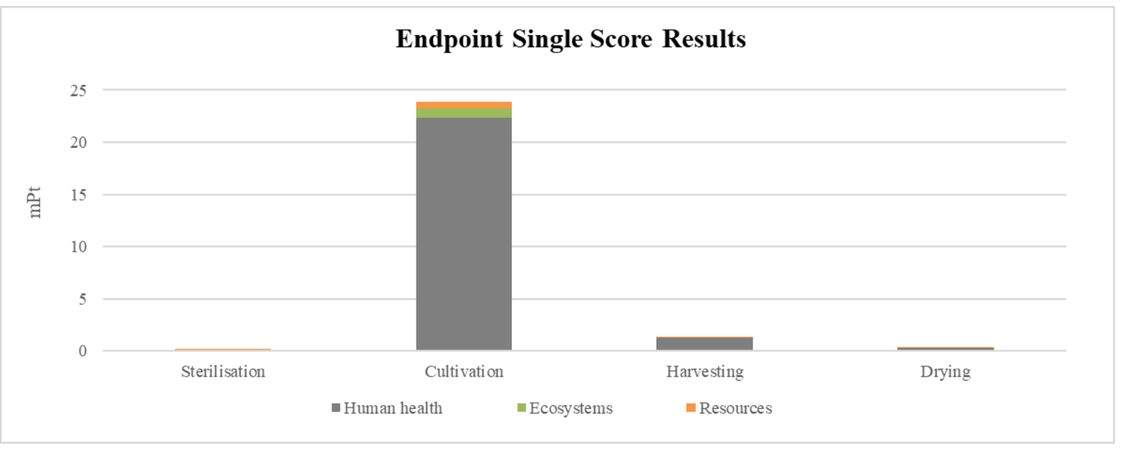
Methodology & Experimental setup

LCA	SimaPro 9.6 • Ecoinvent 3.10 • ReCiPe 2016 (H) **FU**: 1 g of dry biomass • Gate-to-Gate
Experiment	**Medium:** *Euglena gracilis* • digestate • vinasse **Light:** Purple LEDs (120 diodes, 5 m, 12 W, 110 µmol m^{-2} s^{-1}) • 12 h light / 12 h night photoperiod **PBR:** 1.5 L working volume • 4 L total volume • pH 5 • Mixing: 300 rpm

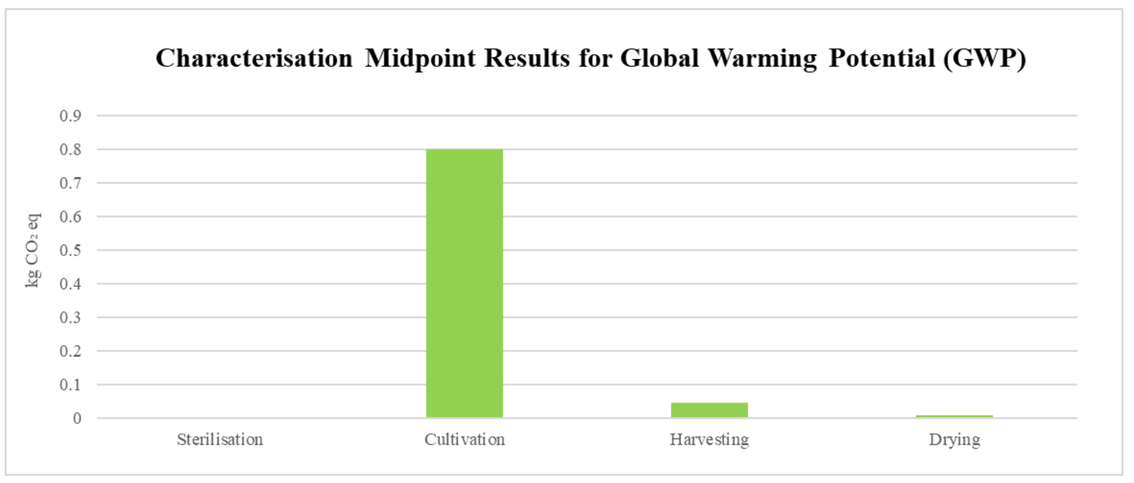


(PBR) system used for laboratory-scale cultivation of *Euglena gracilis*

Results



- Impacts associated with the sterilisation, harvesting and drying stages were negligible for most categories, accounting for less than 6%.



- The cultivation stage contributes 0.8005 kg CO_2 eq. out of a total of 0.8551 kg CO_2 eq. (GWP)

Conclusions

1. Energy demand is the principal driver of environmental impacts in laboratory-scale microalgae production systems.

2. Cultivation stage was identified as the main ecological hotspot; mitigation strategies should primarily focus on reducing energy demand during the growth phase.

3. Reduction of cultivation duration is a promising strategy to lower the environmental footprint of microalgae production.