Optimisation and acclimatisation of *Chlorella vulgaris* grown on cow manure based digestate

SEMPRE-BIO

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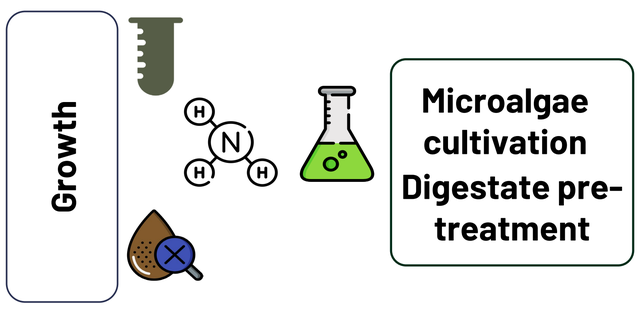
SEMPRE-BIO Project

SEMPRE-BIO aims to demonstrate **innovative, cost-effective biomethane solutions** to help meet EU climate targets for 2030 and net-zero emissions by 2050, while boosting biomethane technology adoption.

Introduction

SEMPRE-BIO uses anaerobic digestion to produce biogas, with digestate as a by-product. This study explores growing *Chlorella vulgaris* on digestate for sustainable protein production, focusing on overcoming growth challenges caused by high ammonia and dark colour through pre-treatments like acclimatisation, stripping and clarification.

Methodology



→Aim to gradually reach a **15% digestate concentration** for microalgae cultivation in *Chlorella vulgaris*

→ **Acclimatisation**

✓Evaluate the effect of:

- ✓**Nutrient** deficiency
- ✓**Ammonia (NH_3)** removal on algal growth.

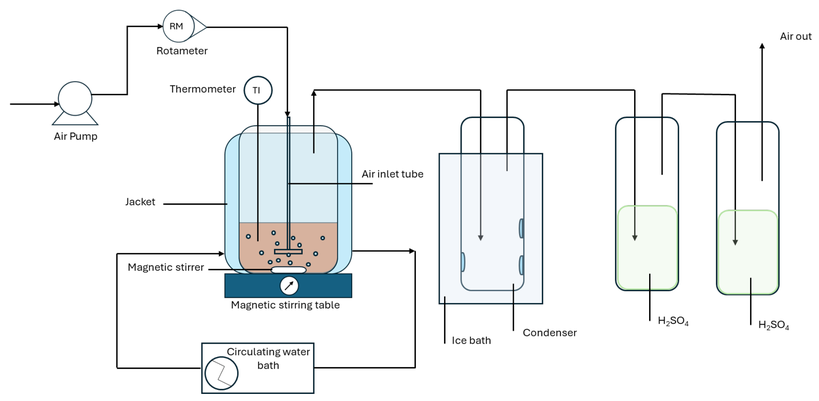


Fig 1. Experimental setup of ammonia stripping and scrubbing.

Results

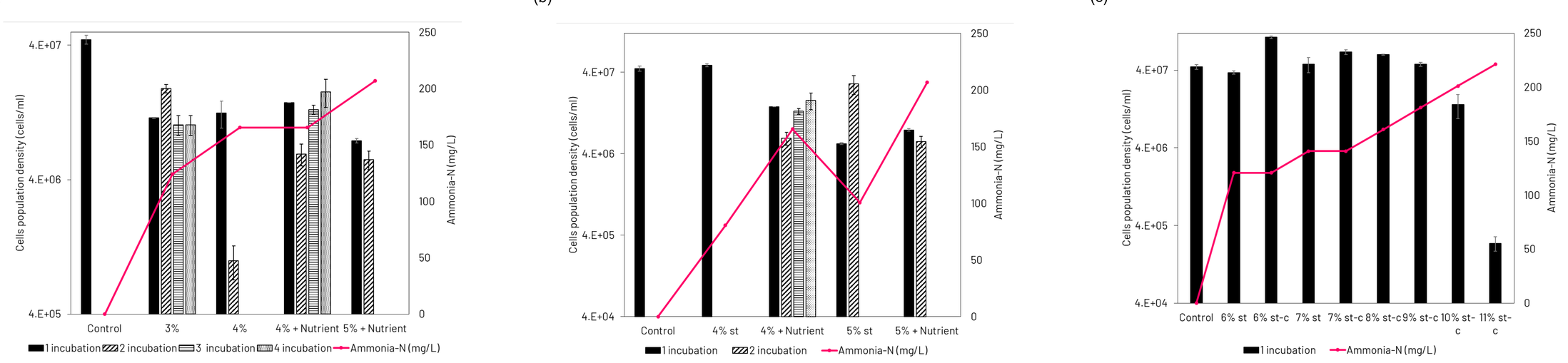


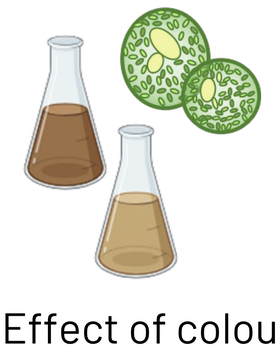
Fig 2. Growth performance of *C. vulgaris* across successive incubation cycles in increasing CMD concentrations. (a)(3–5% v/v) and the effect of nutrient supplementation with BBM/2 without N; (b) 4% and 5% stripped digestate, with comparison to nutrient-supplemented digestate and control; (c) stripped (st) and stripped-centrifuged (st-c) cow manure digestate at increasing concentrations (6%-11% v/v).

Tab 1. Turbidity measurement of digestate, stripped digestate and stripped-centrifuged digestate.

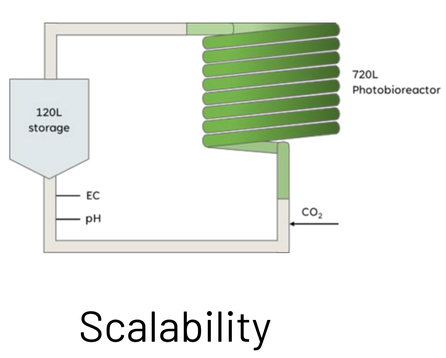
Control	1.2%	1.2% St	1.2% st-c	Unit
0.34±0.04	543±2.65	142.67±4.62	78.7±3.62	NTU

- **Nutrient addition not sufficient**: Supplementation improved biomass but did not achieve full acclimatisation.
- **Ammonia identified as primary limiting factor**: Growth inhibition increased above ~100–110 mg/L NH_4^+-N.
- **Ammonia stripping improved growth**: ~55% NH_4^+ removal enabled successful acclimatisation at 4–5% CMD.
- **Turbidity limited light availability**: Stripped digestate remained visually dense → reduced light penetration and smaller cells.
- **Centrifugation significantly enhanced performance**: Clarified digestate enabled growth above control levels at 6-10% CMD. Stripping + clarification overcame both chemical (NH_3) and physical (light) limitations.

Future Perspective



Effect of colour removal



Scalability

* Control: Bold's basal medium; CV: Chlorella Vulgaris; %: % v/v Digestate; Nutr: 50% Nutrient substitution; st: stripped digestate; st-c: stripped and centrifuged digestate; dig: Digestate; AC: Acclimatised; NAC: Non-Acclimatised; H_2O_2: Hydrogen Peroxide

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