Anaerobic membrane bioreactor for biogas production and ammonium recovery from spent microalgae.

Financiado por

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.

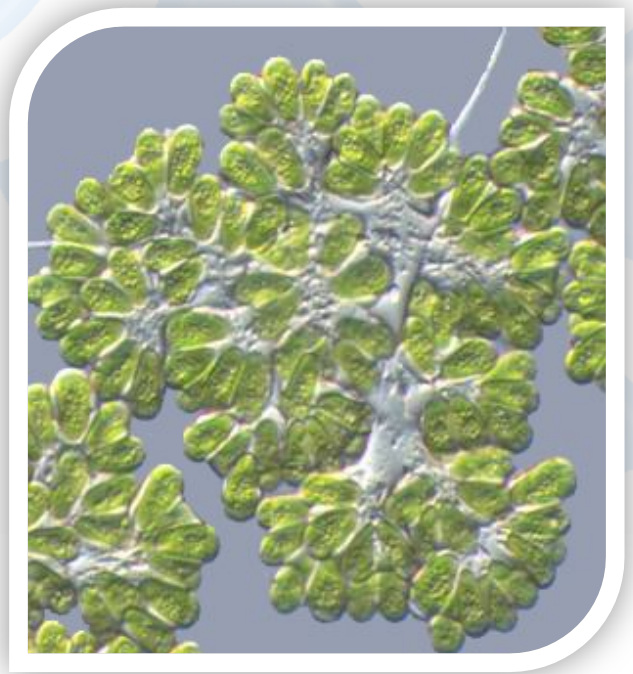
Why microalgae?

North of Chile presents ideal conditions for microalgae cultivation:

- Solar radiation
- Space availability
- No competition with food production (desertic area)

Microalgae for bioenergy production

- Efficient conversion of solar energy
- High biomass productivity
- High lipid accumulation



Microalgae for bioenergy production

- Biodiesel production from microalgae:
  - ➢ High nutrient requirements.
  - ➢ High energy demand due to biomass harvest and oil extraction
  - ➢ Low overall energy yield

Microalgae for bioenergy production

- Biogas production:
  - Energy recovery from oil extracted biomass
  - Tool for nutrient release and recovery/reuse
  - Cogeneration can produce electricity and heat valuables for biodiesel production (heat for solvent extraction)

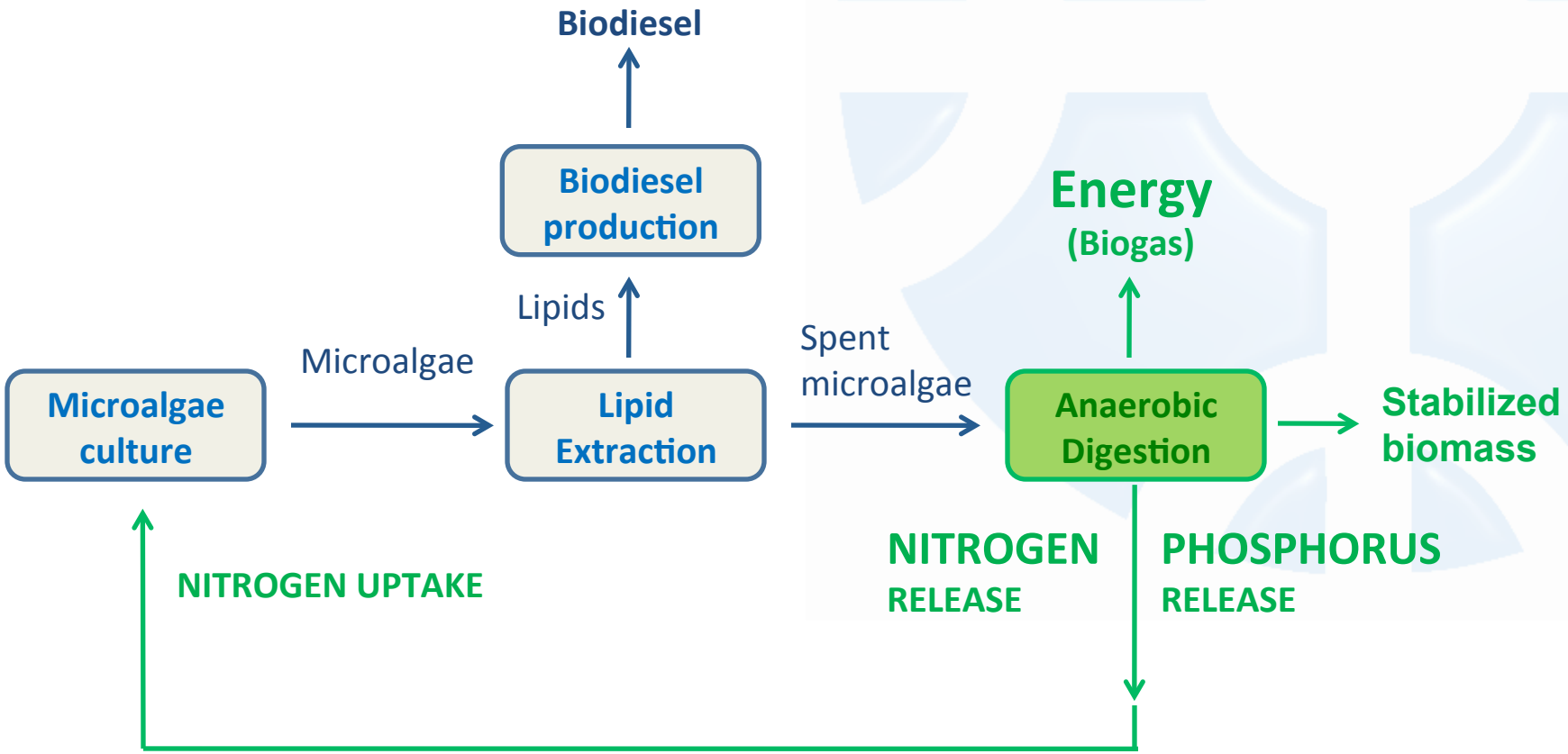
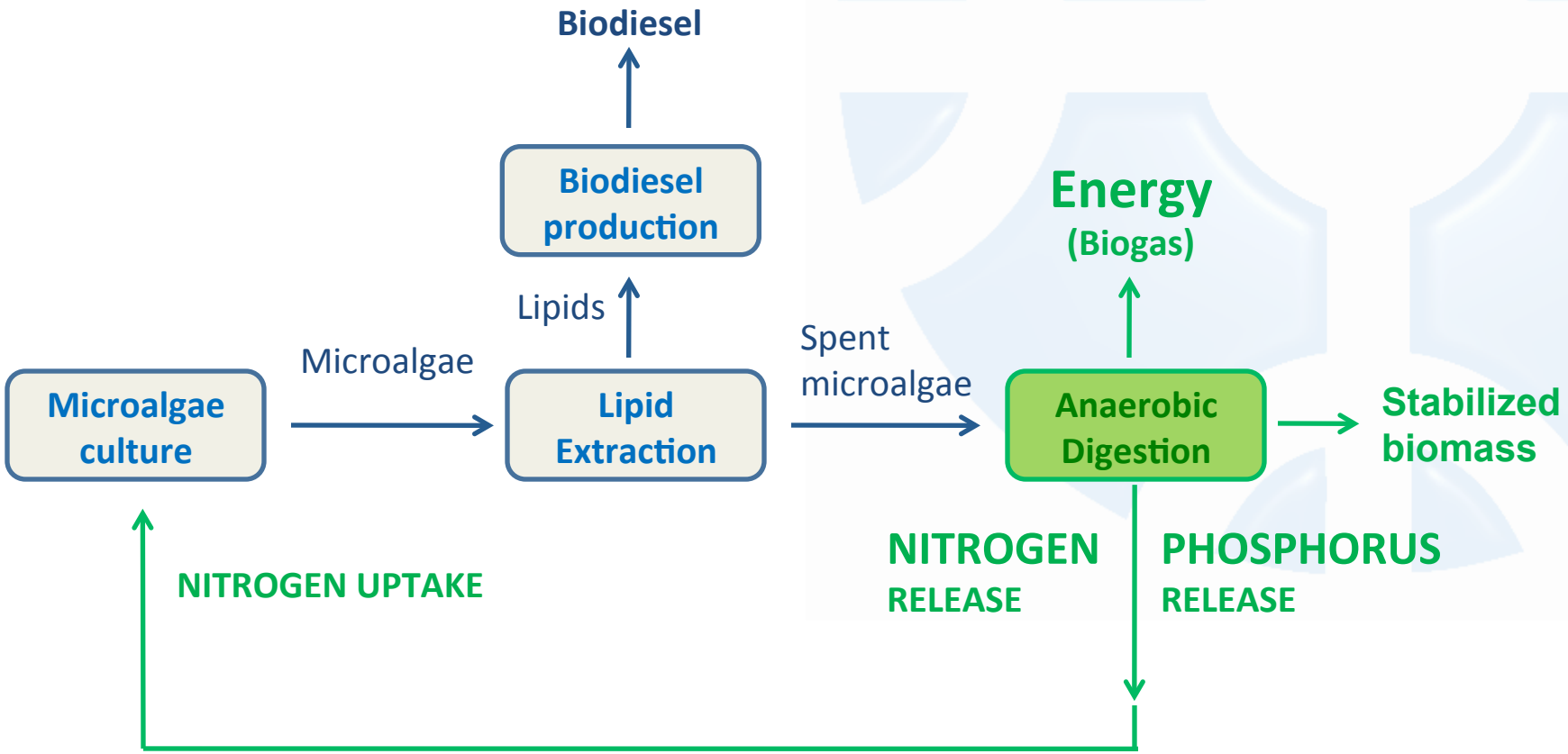


Figure 1. Scheme of nitrogen recovery from anaerobic digestion in microalgae biodiesel production.



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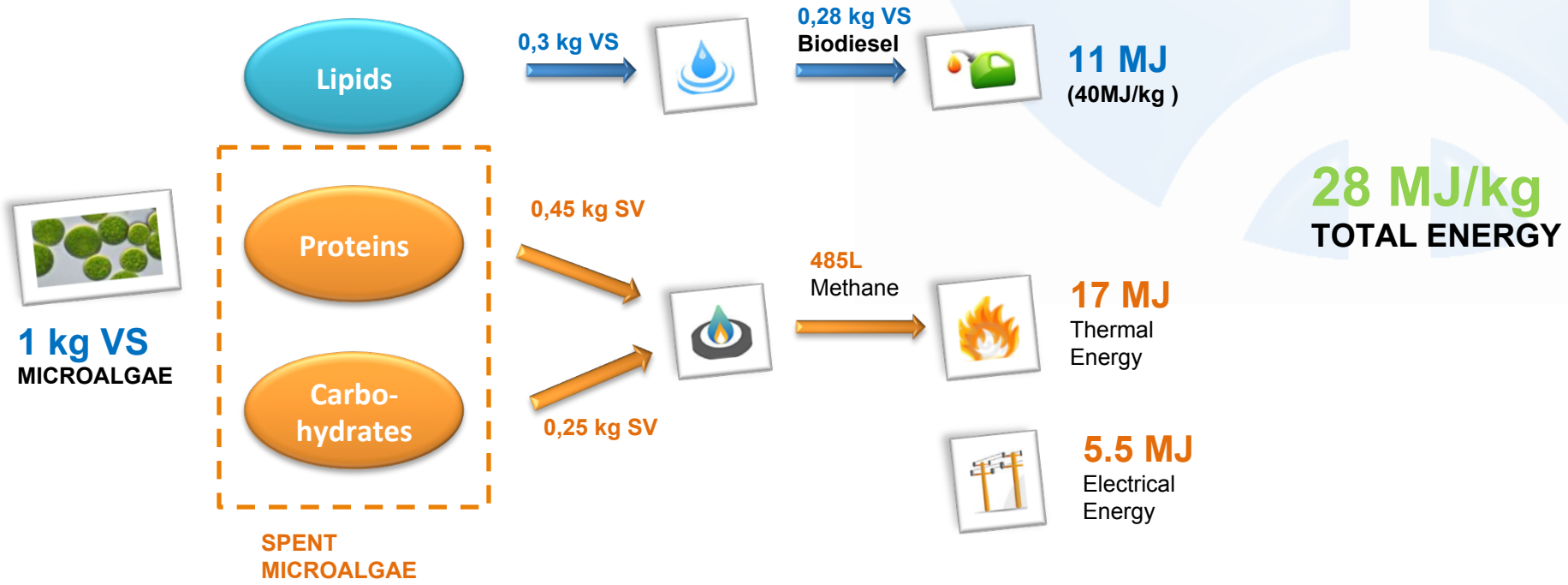
Energy

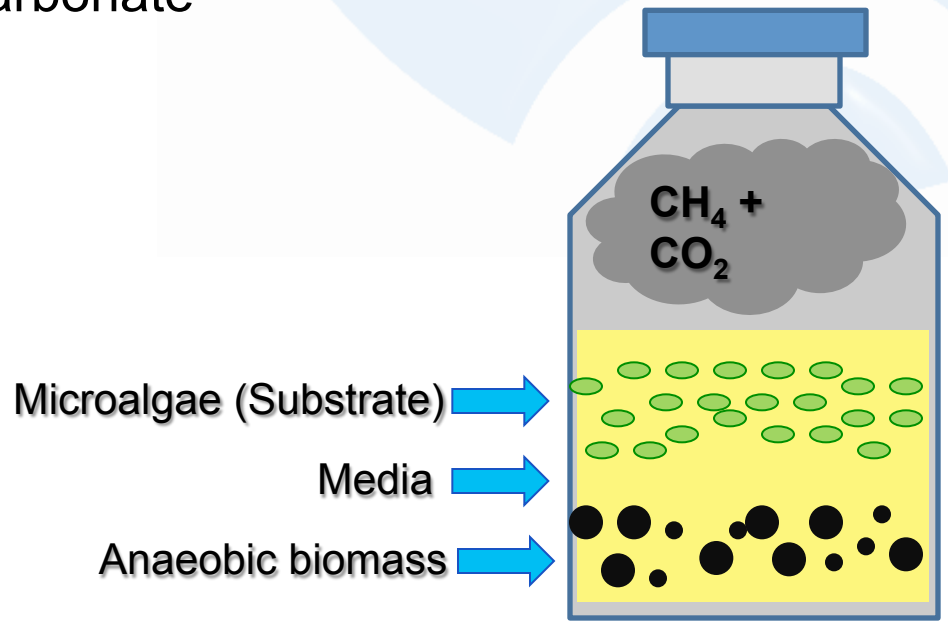
ENERGETIC POTENTIAL

biodiesel production (microalgae) + biogas production (spent microalgae)



BIO-METHANE POTENTIAL determination (BMP)

- **Inoculum=** Anaerobic consortia
- **T°**= 35° C
- **substrate/inoculum ratio**= 1:1 (g VS / gVS)
- **Buffer capacity=** sodium bicarbonate



Energy

Total and spent microalgae

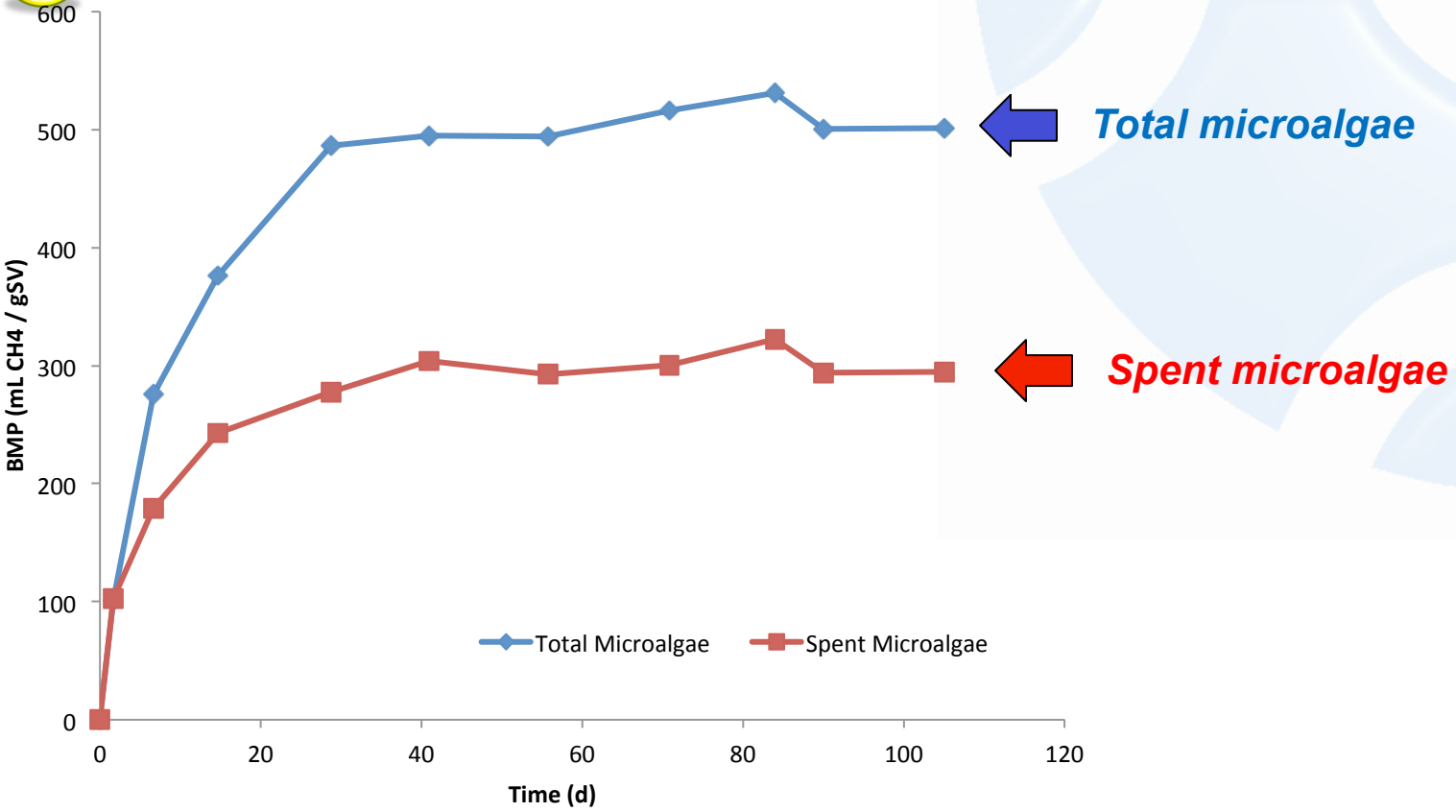


Figure 1. Bio-methane potential of total and spent microalgae *B.braunii.*

ENERGY

Lipid Extraction

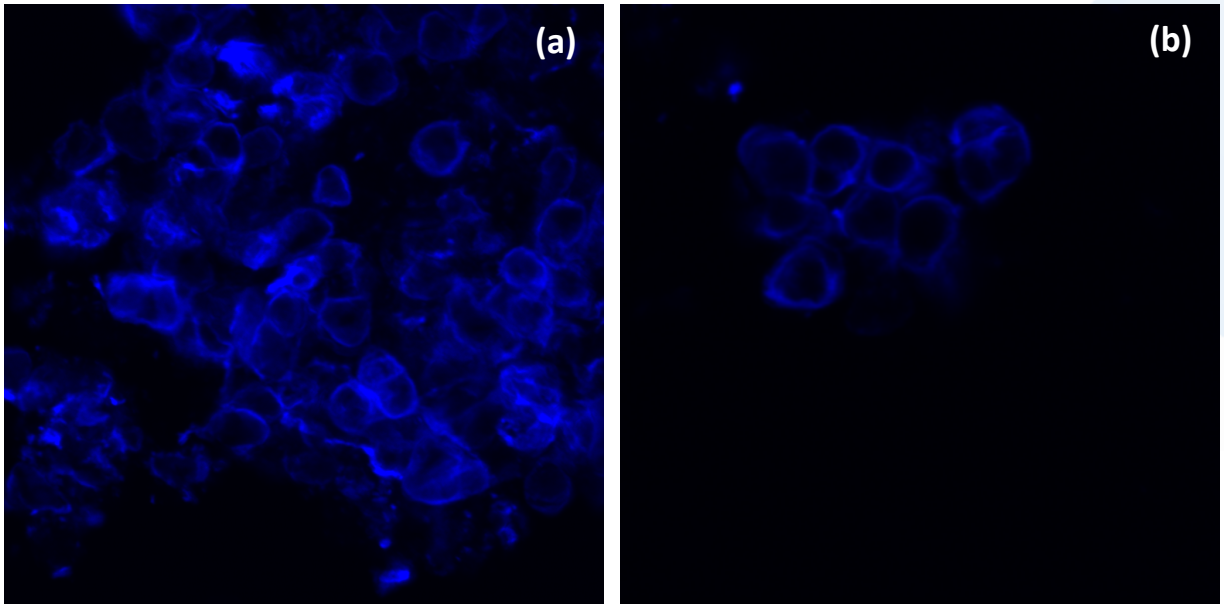


Figure 2. Confocal microscopy for total*(a)* and spent*(b)* microalgae *B.braunii* stained with calcofluor white.(non-specific cellulase staining)

Energy

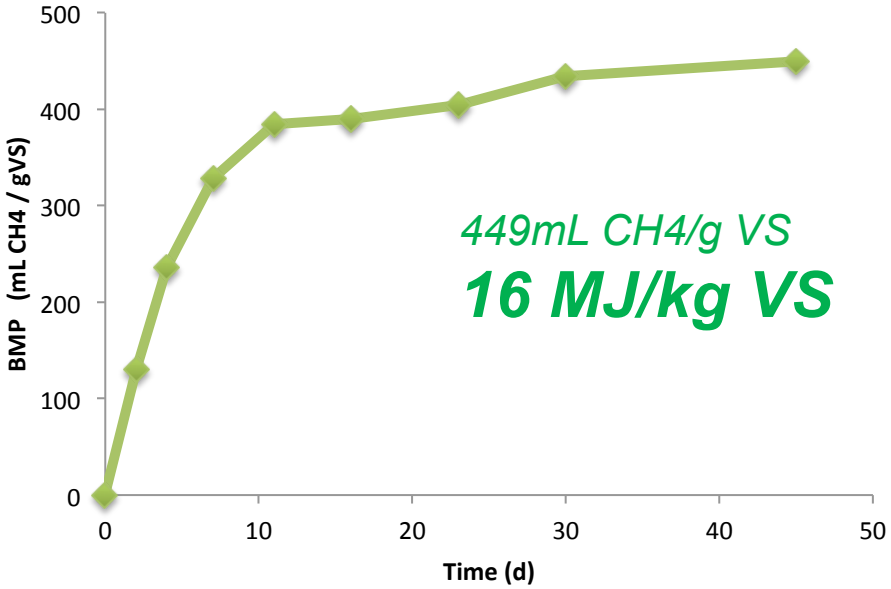
19 -26% of no degraded organic matter in this assay may be related to residues containing **resistant biopolymers.**

Oil extraction has **no effect as pretreatment.**

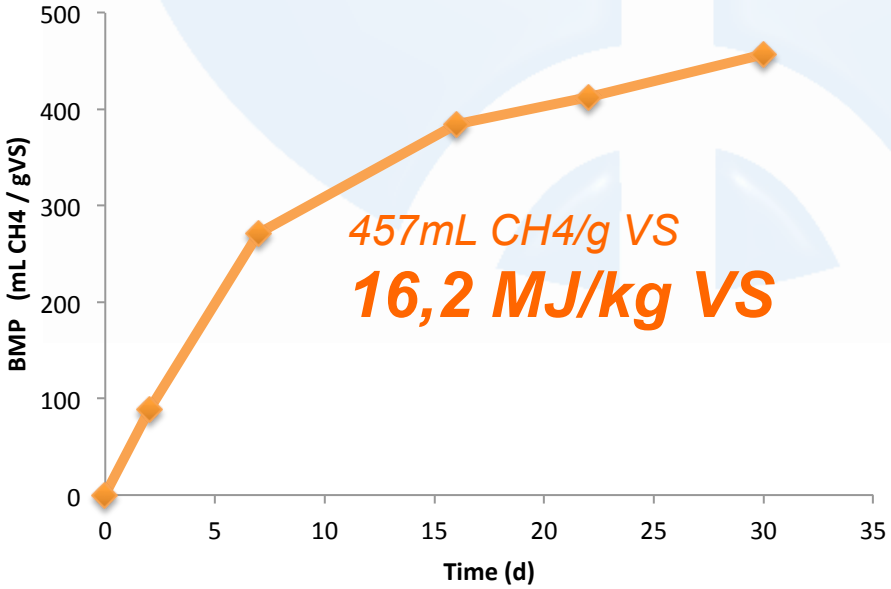
Energy

Total and spent microalgae

Botryococcus braunii



Nanochloropsis gaditana



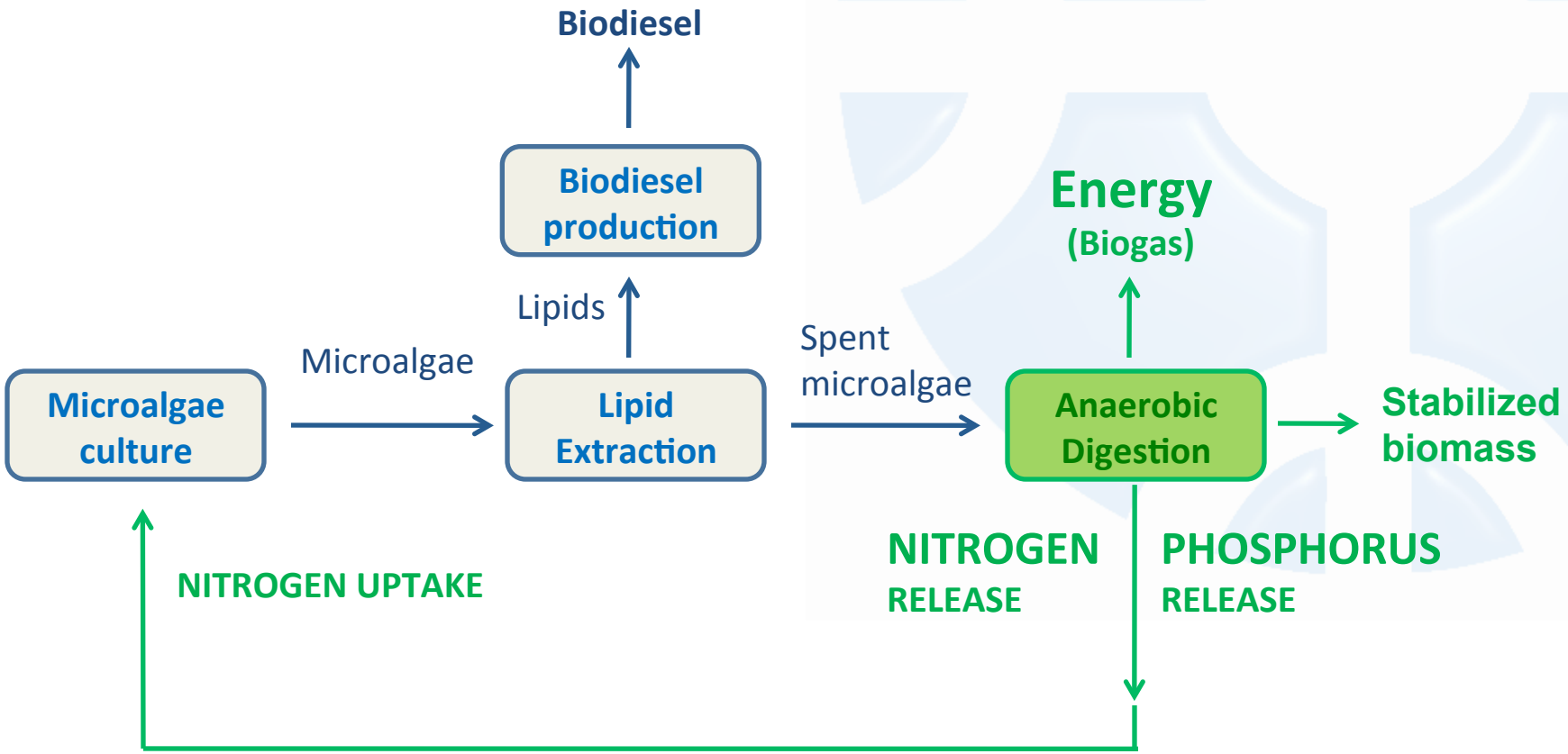
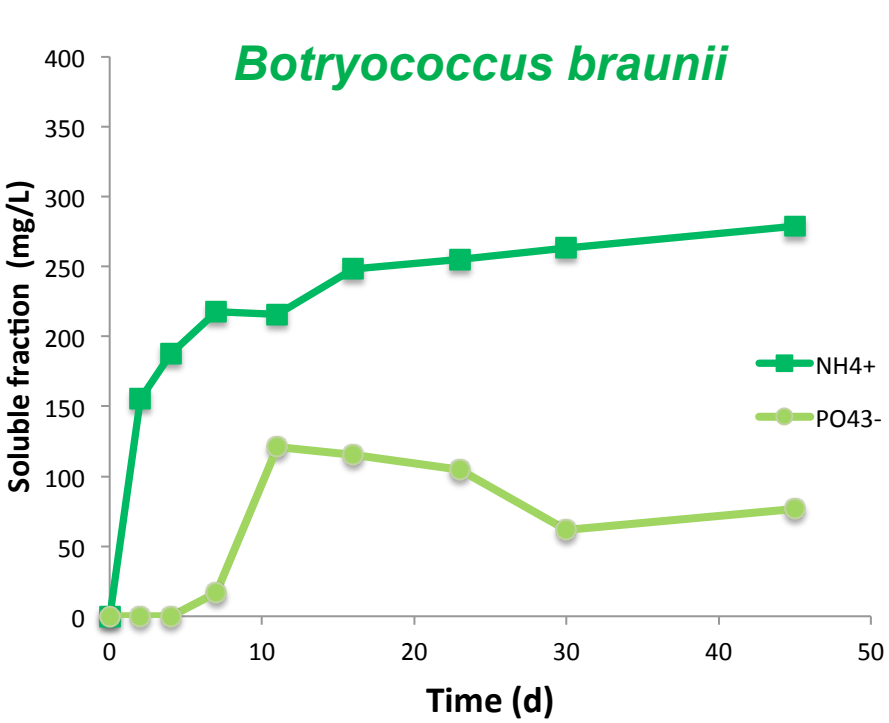


Figure 1. Scheme of nitrogen recovery from anaerobic digestion in microalgae biodiesel production.

Nutrients Release

Nitrogen release
68-72%



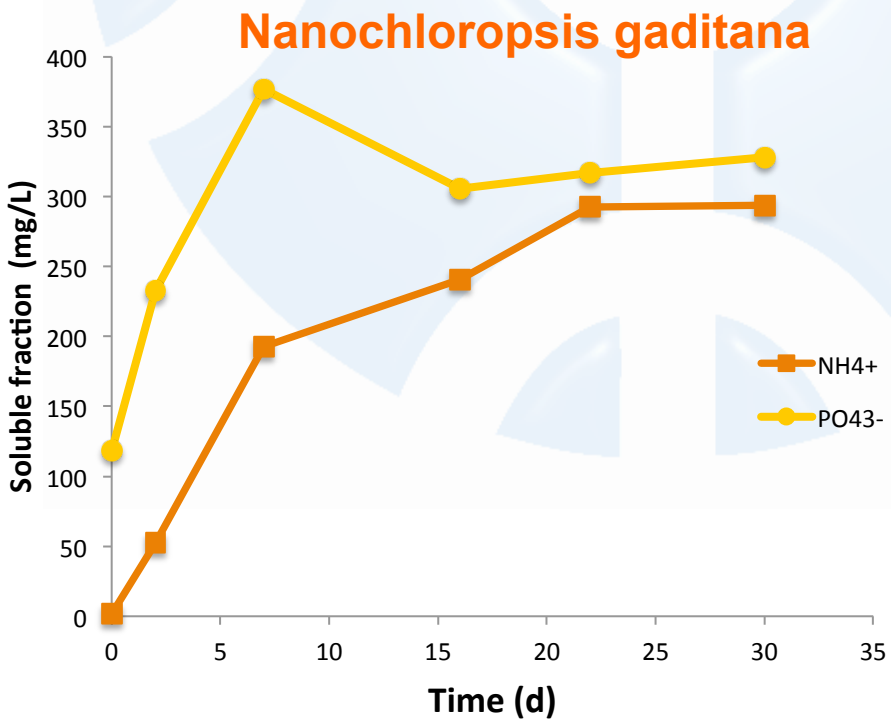


Figure 4. Ammonium and phosphate release assessment in anaerobic digestion assays. (a) *Botryococcus braunii*. (b) *Nannochloropsis gaditana*.

Nutrients → Nitrogen → Release capacity

4.2 Nitrogen release in AD

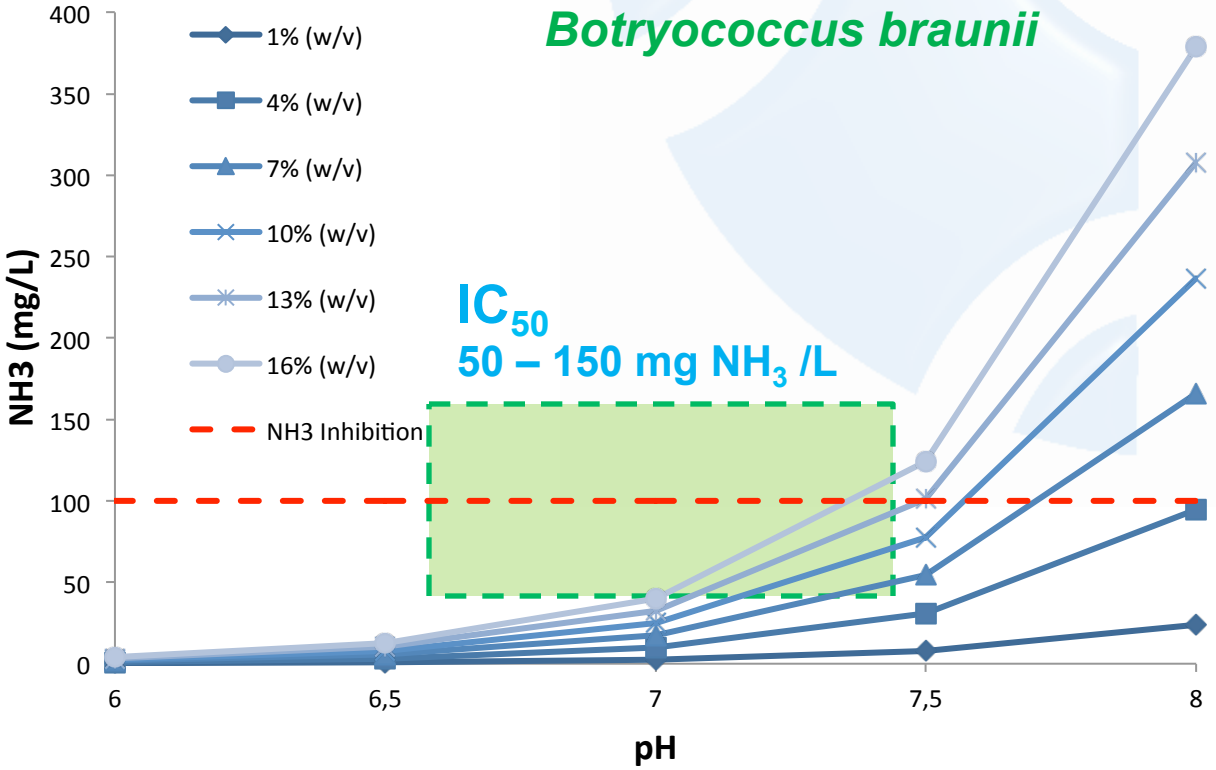
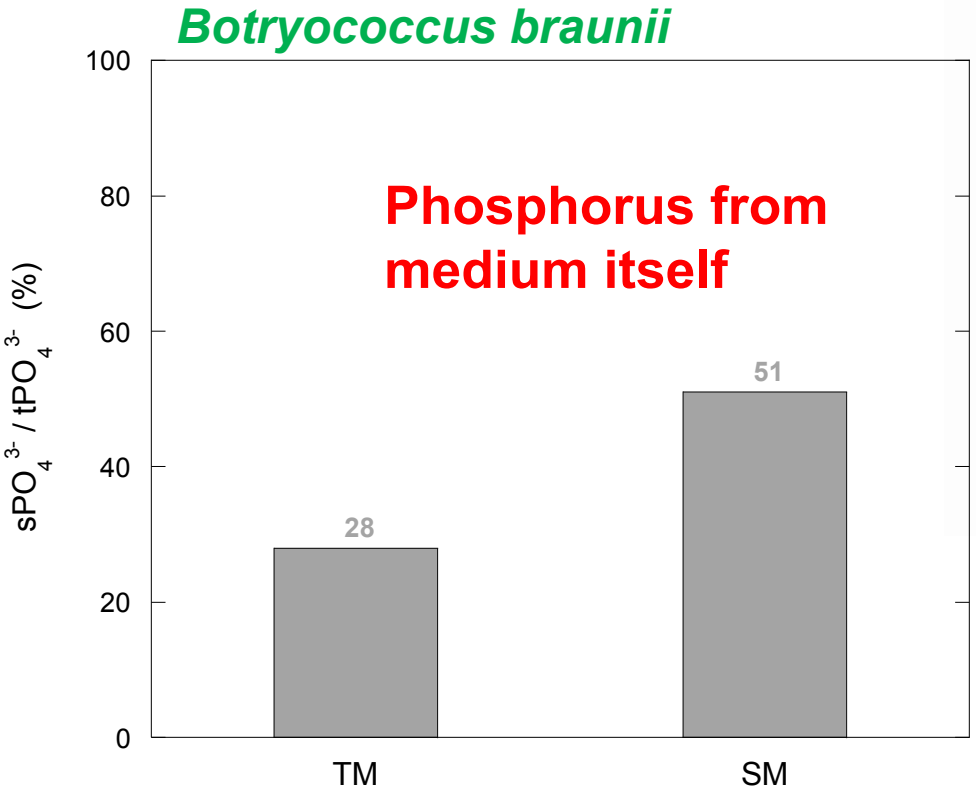


Figure 3. Estimation of un-ionized ammonia in hypothetical anaerobic digestion reactor considering effect of pH and substrate concentration.

Nutrients → Nitrogen → Release capacity

Phosphorus



50-70% phosphorus was present in original sample as soluble phosphate

Figure 5. Fraction of soluble phosphate presents in total and spent microalgae *Botryococcus braunii.*

1. INTRODUCTION

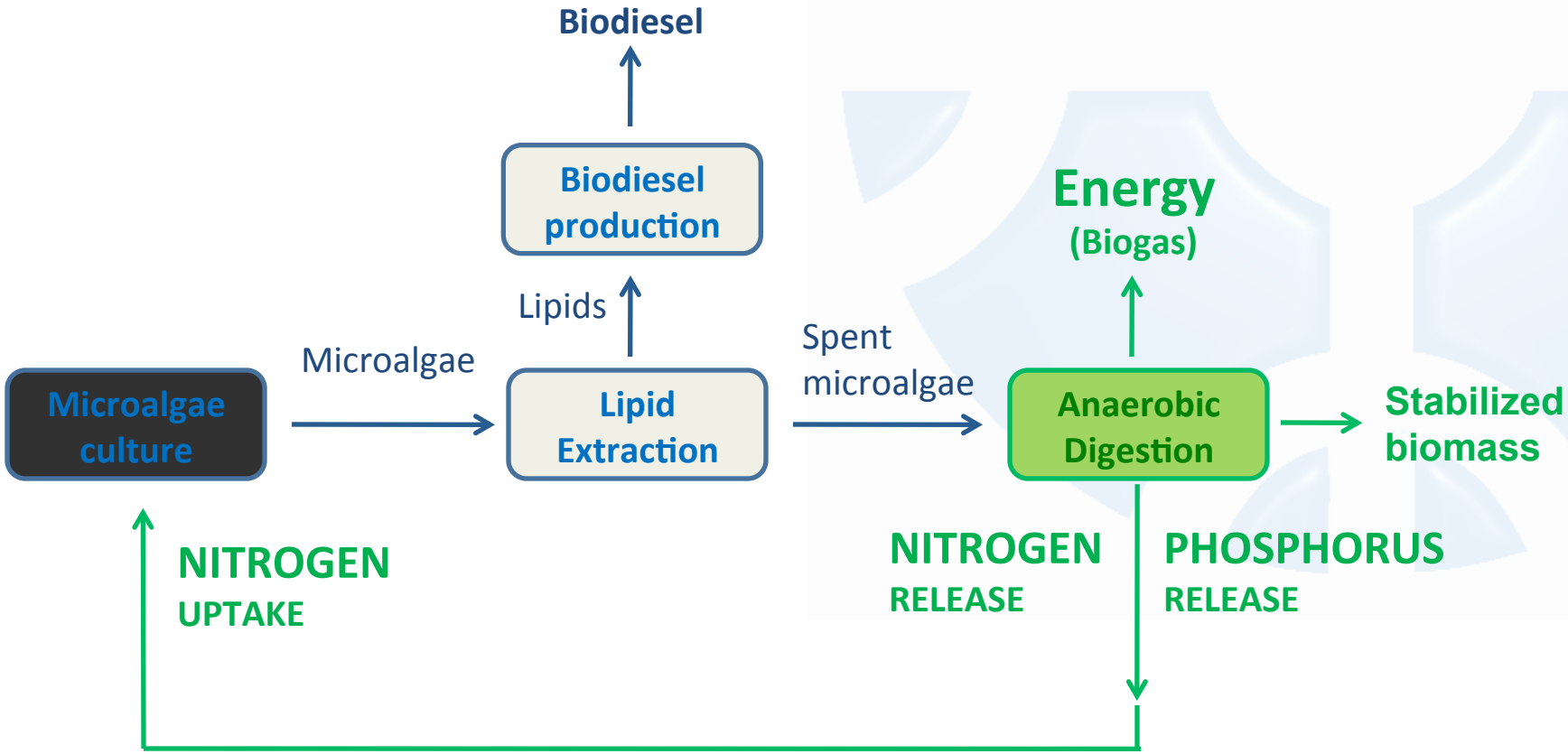
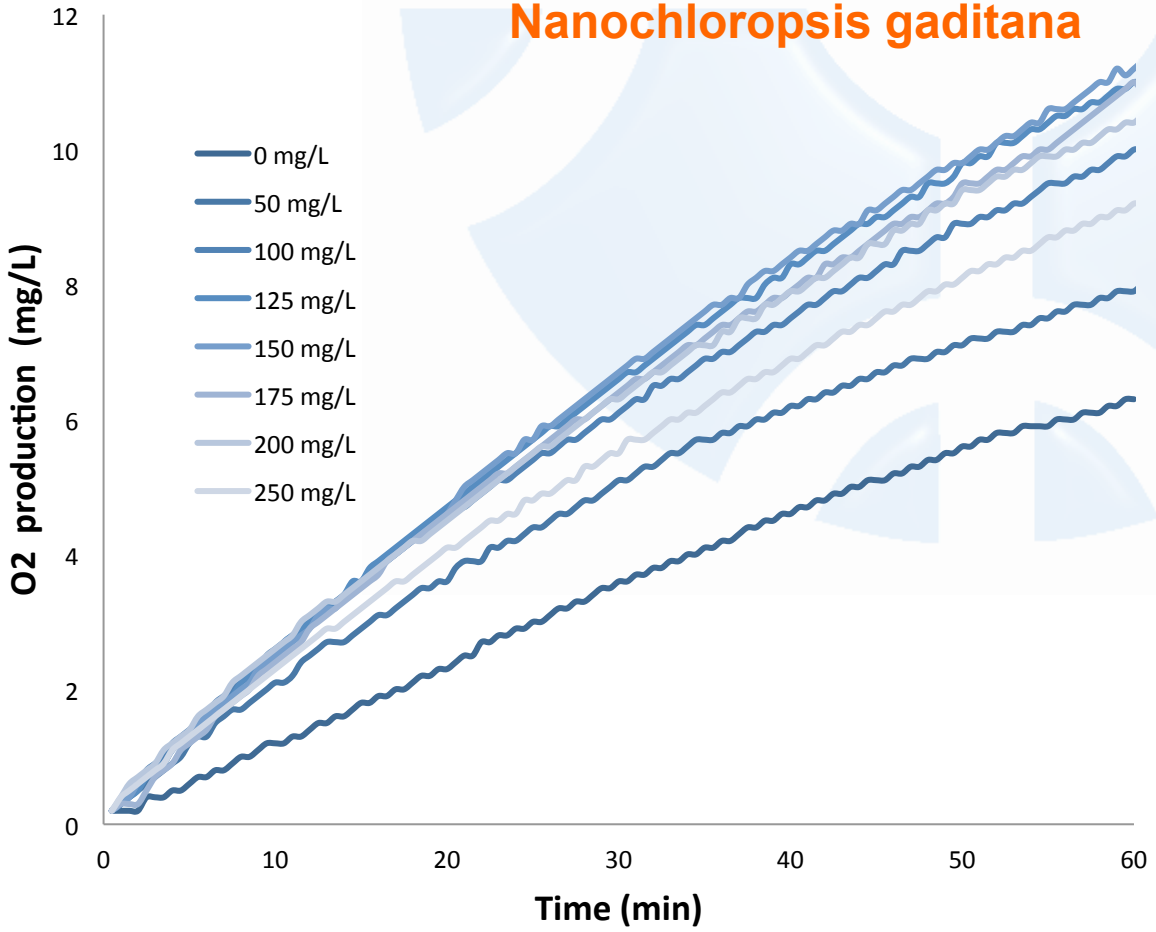


Figure 1. Scheme of nitrogen recovery from anaerobic digestion in microalgae biodiesel production.

Nutrients → Nitrogen → microalgae uptake

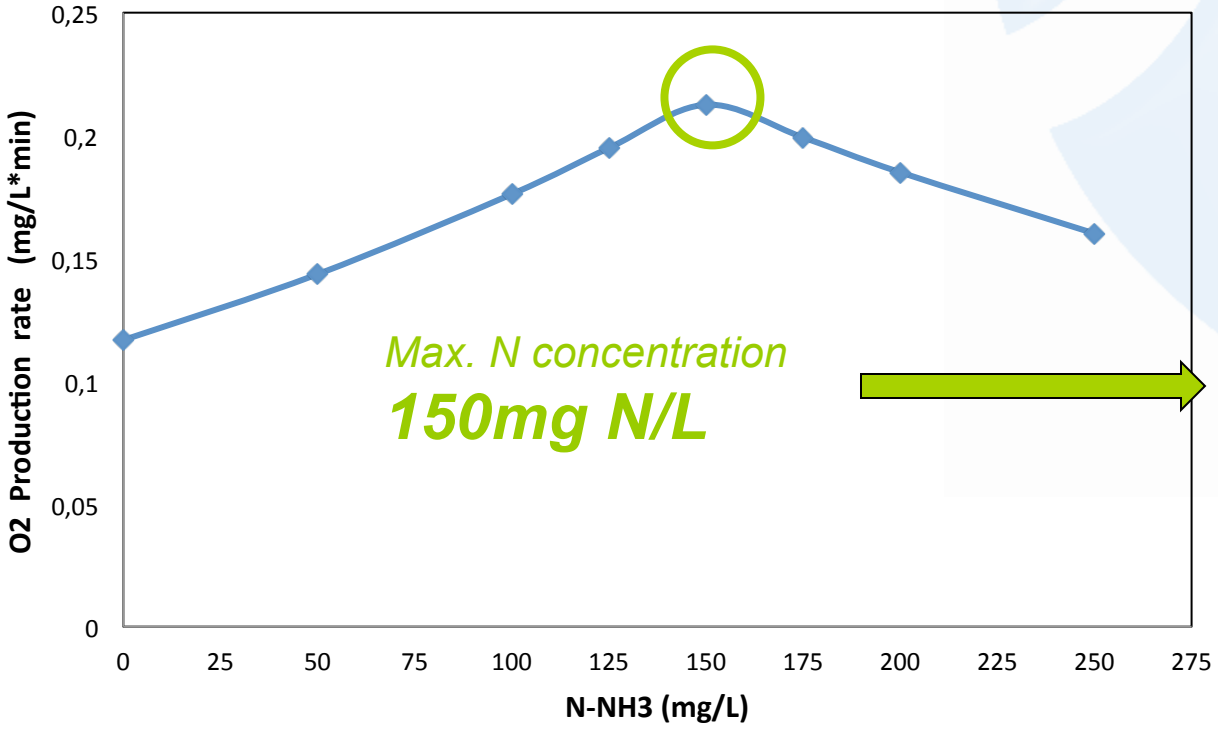
Effect of different NH4+ concentration

Oxygen production



Nutrients → Nitrogen → microalgae uptake

Nanochloropsis gaditana



Max. N concentration

150mg N/L

Culture conditions:

2 g/L TS

N added in culture:

135mg N/L

NO inhibition in microalgae culture

CONCLUSION

1. No total nitrogen release is observed in *B.* braunii (only 68% nitrogen release), which could be related to resistant biopolymers reported for this microalgae.

2. Anaerobic digestion of spent microalgae seems as a viable alternative in order to recover energy.

3. Phosphorus present in microalgae may be associated to phosphate from medium itself.

4. No inhibition is expected into microalgae culture for N.gaditana

Acknowledgements

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