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Carbon dioxide supply in photobioreactors: a biological approach

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combining scientific excellence with commercial relevance

Introduction

Microalgal systems

Potential

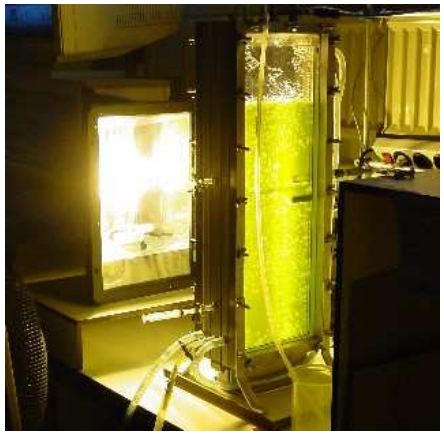
- *Alternative source for biofuels production*

Limitation in PBR´s

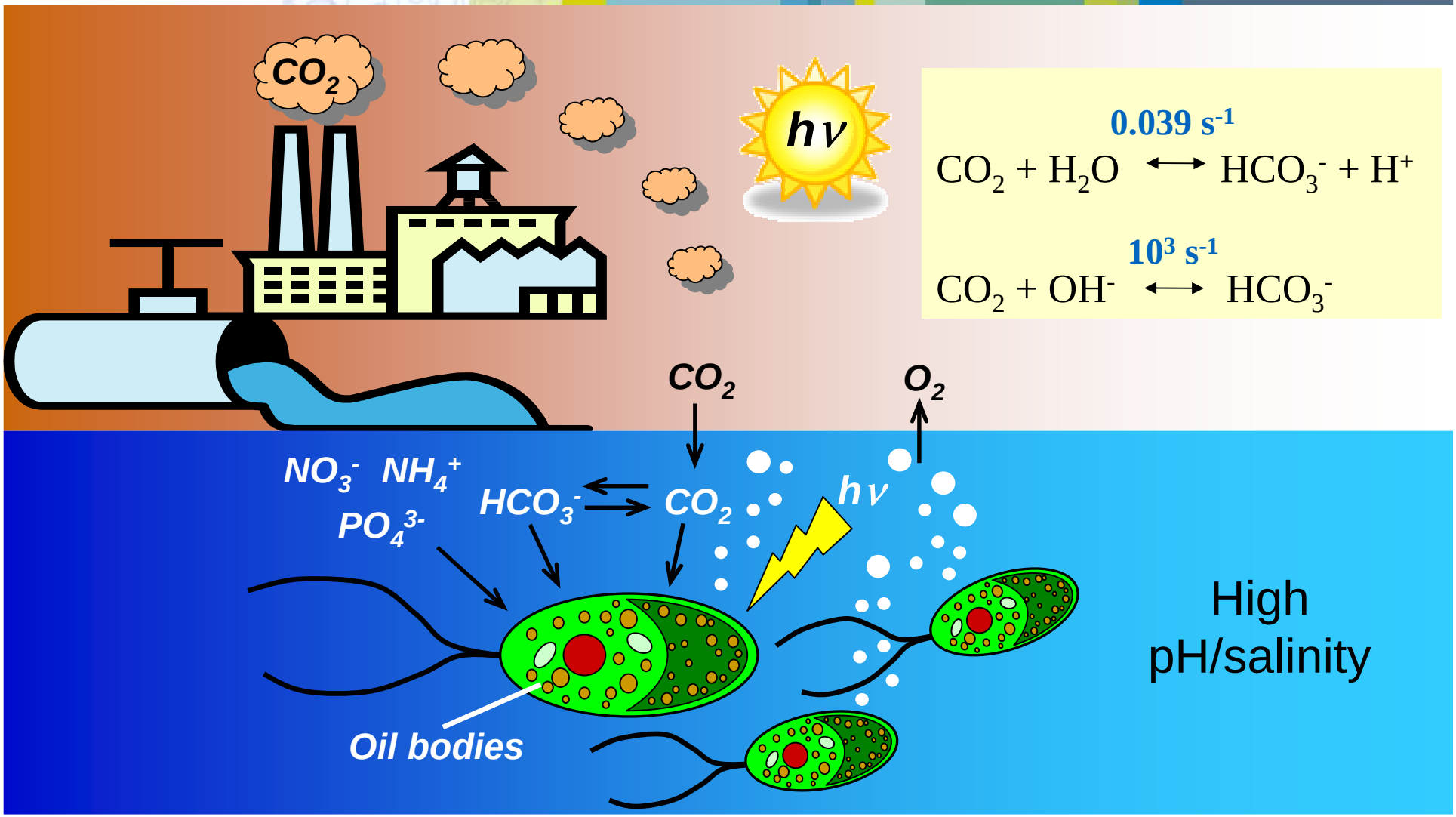
- *CO_2 transfer*

What's the goal?

Development of an energy efficient and economically feasible process for CO_2 transfer in the production of microalgae rich in lipids.



How to reach?

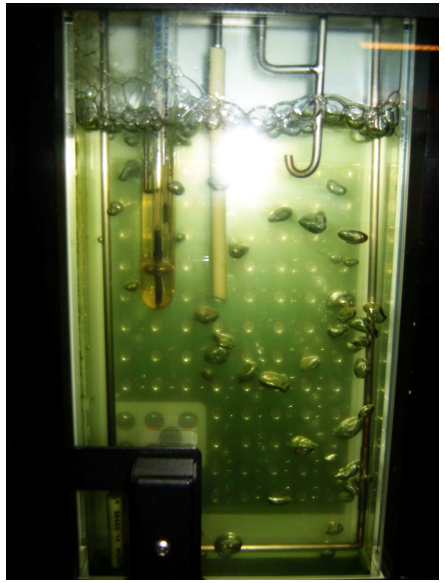

CO_2
hν
0.039 s-1
$CO_2 + H_2O \leftrightarrow HCO_3^- + H^+$
10^3 s-1
$CO_2 + OH^- \leftrightarrow HCO_3^-$
CO_2
O_2
NO_3^- NH_4^+
PO_4^{3-}
HCO_3^-
CO_2
hν
Oil bodies
High
pH/salinity

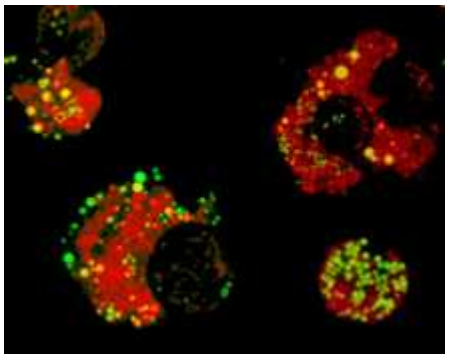
Biological approach

Growth of highly productive lipid accumulating strains under alkaline-saline conditions.

- *Biomass productivity*
- *Biomass yield on light energy*
- *TAG accumulation*

- ***CO_2 transfer***





Medium precipitation

Visual MINTEQ - Saturation indices for minerals

Simulation: pH 10.5

			***f/2* medium**
Mg^{2+}	48 mM		0.15 mM
Ca^{2+}	3.6 mM	→	0.01 mM
PO_4^{2-}	5 mM		0.32 mM
Hydroxyapatite	**High**		**3-folds decrease**

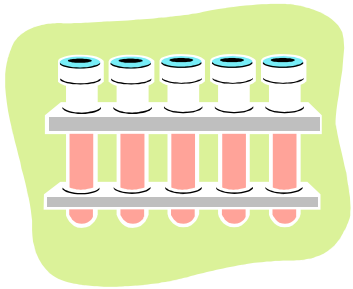
Medium design

Small scale

Parallelization

Automatization

Cost reduction

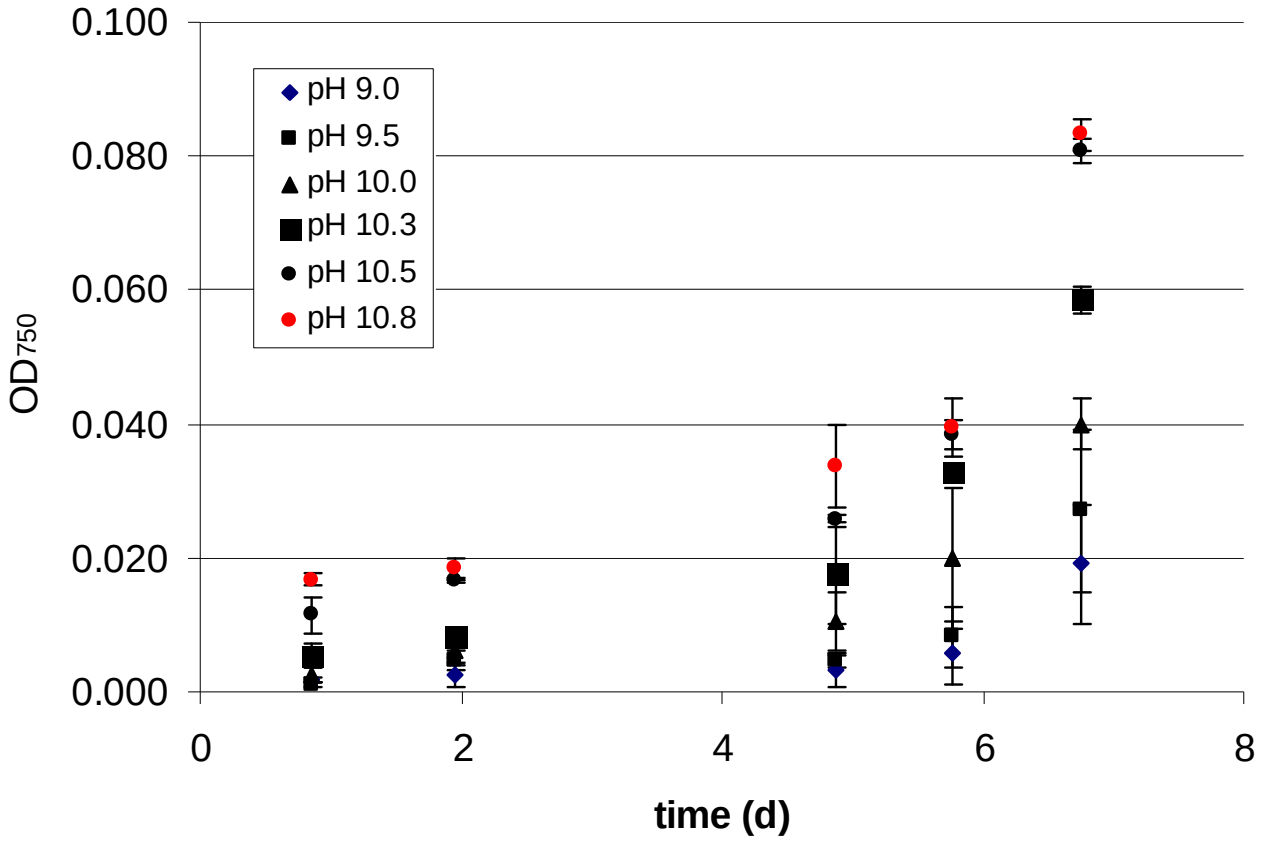


Changes

Lower nutrient concentrations (1 g L^{-1} biomass)

Super FK

Non-biological experiments



0.15 mM Mg^{2+}
0.01 mM Ca^{2+}
0.32 mM PO_4^{2-}

pH/salinity:

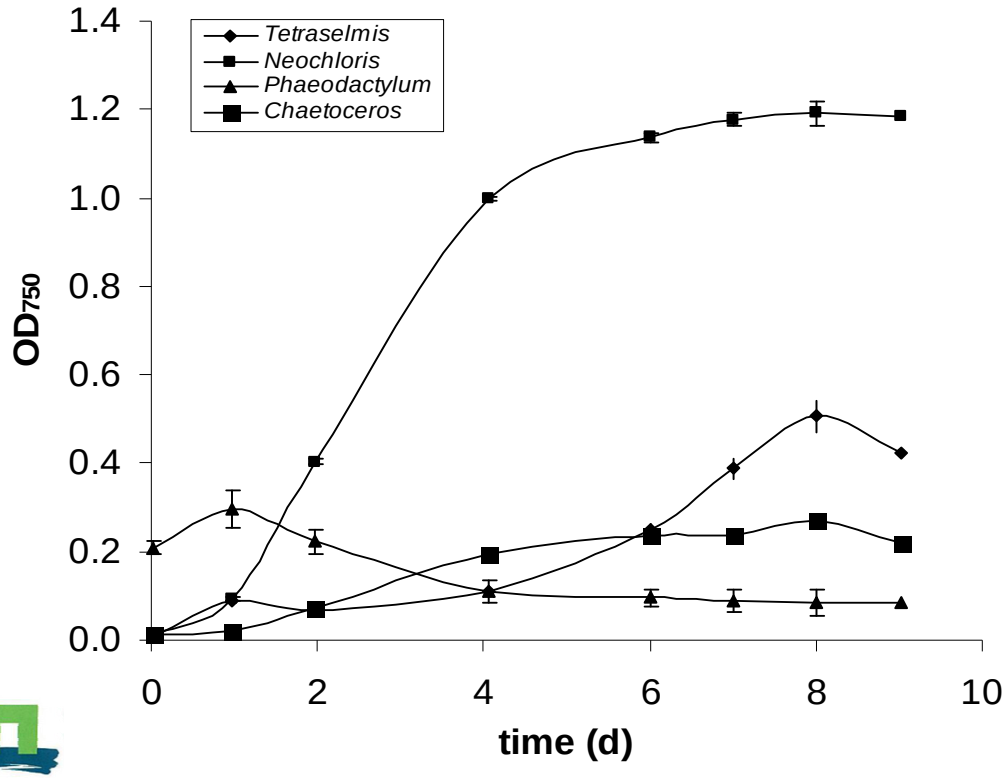
300 mM HCO_3^-/CO_3^{2-}

419 mM NaCl

Biological experiments

pH 7.5

Low $[Mg^{2+}]/[Ca^{2+}]$



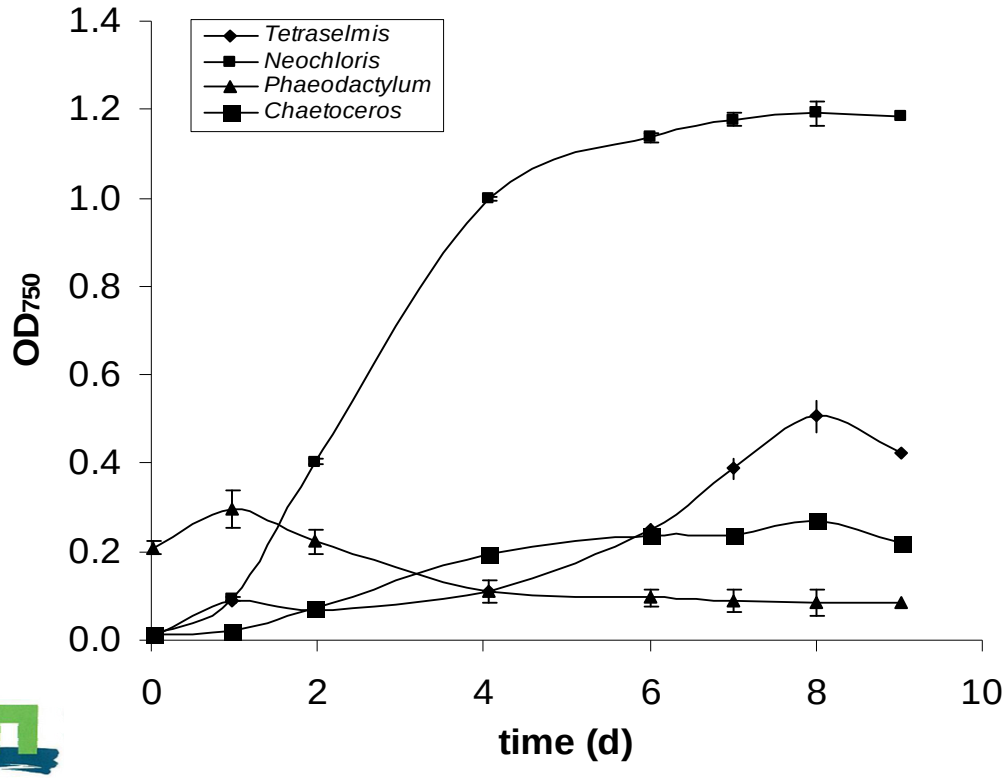
Biological experiments

pH 7.5

Low $[Mg^{2+}]/[Ca^{2+}]$

High pH

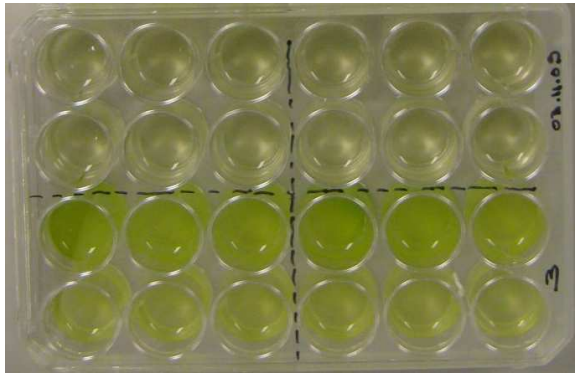
Low $[Mg^{2+}]/[Ca^{2+}]$



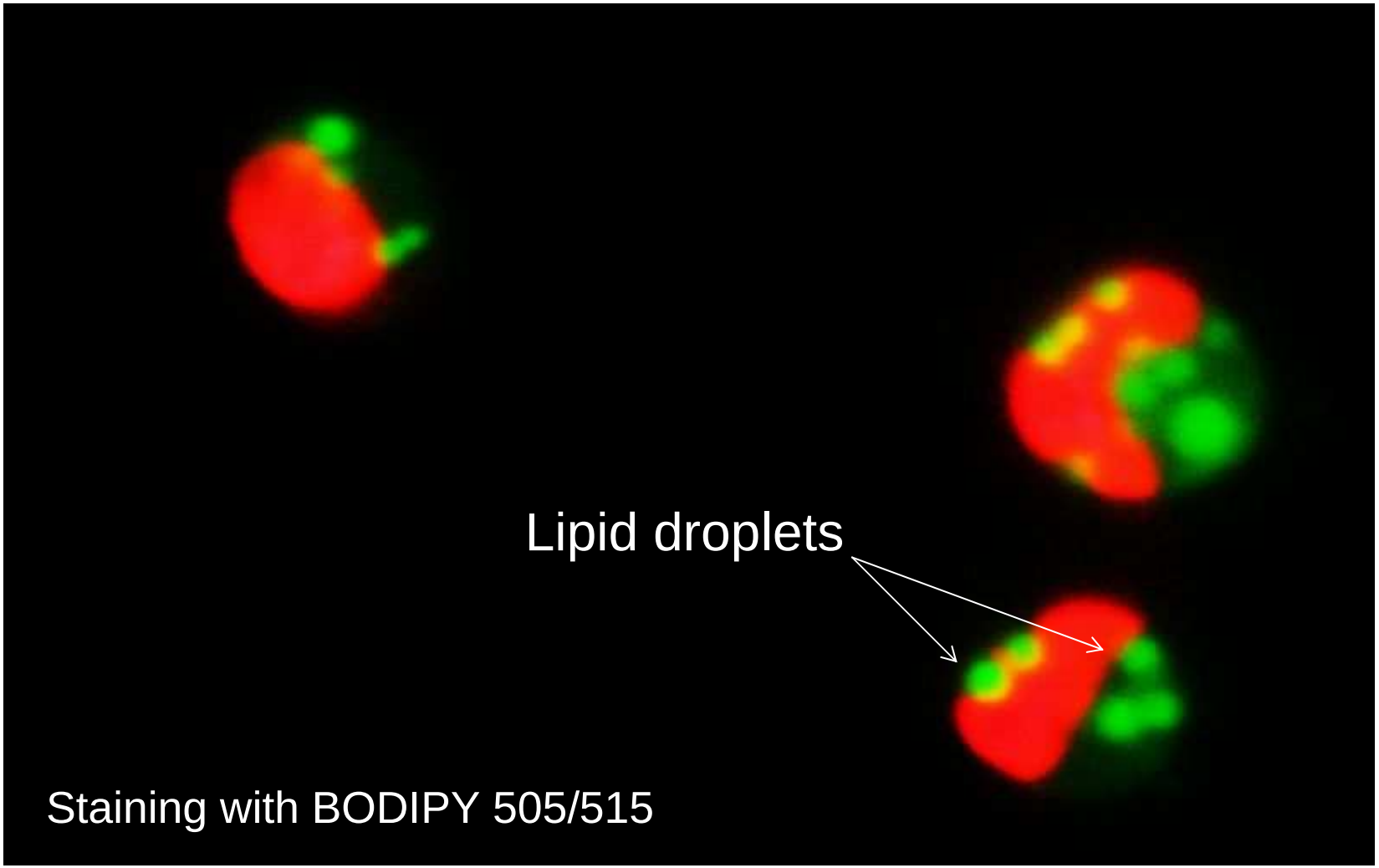
N. oleoabundans

OD_{750}=1

final pH~10



Lipid accumulation at high pH



Conclusions

Stable cultivation medium was identified at high pH and high salinity, with low concentrations of Mg^{2+}, Ca^{2+} and PO_4^{2-}.

N. oleoabundans showed promising results and its growth under alkaline-saline conditions is being studied in more detail.

Thank you for your attention!