FACTORIAL OPTIMISATION OF THE PRODUCTION OF ***CYANOBIUM* SP.** AS SOURCE OF **PIGMENTS** AND **ANTIOXIDANT COMPOUNDS**

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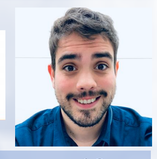
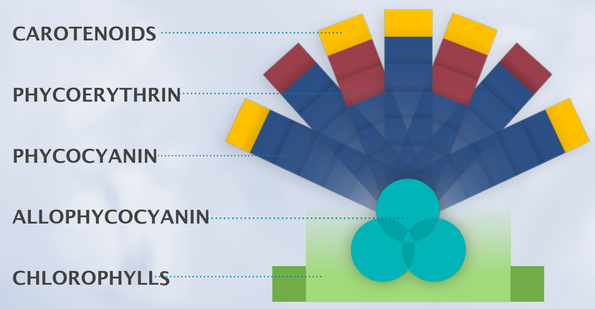


Fernando Pagels[1,2], D Salvaterra[1,2], HM Amaro[1], G Lopes[1,2], I Sousa-Pinto[1,2], V Vasconcelos[1,2], AC Guedes[1]

[1]CIIMAR – Interdisciplinary Centre of Marine and Environmental Research, University of Porto, Portugal
[2]Department of Biology, Faculty of Sciences of the University of Porto (FCUP), Portugal

INTRODUCTION

The interest for **cyanobacteria** have increased in the last few years due to the capacity of those microorganisms to produce **high-valued bioactive compounds**, in special pigments, such as **phycobiliproteins** and **carotenoids**.



However, two of the great constrains about cyanobacteria-based bioprocesses are the **lack of knowledge** on cyanobacteria basic biology and the **limited number of species used by industry**.

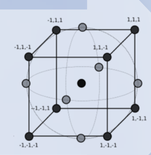
The cyanobacterium *Cyanobium* sp. appears as a **potential source** of high-valued compounds and its **unicellular morphology** can be an advantage for industrial application.

In terms of cyanobacteria production, **abiotic factors** have a great impact in the growth and biochemical composition. **Temperature**, **pH** and **salinity** are mainly responsible for the maintenance of the photosynthetic apparatus and consequentially the **accumulation of pigments**.

MATERIAL AND METHODS

Experimental design

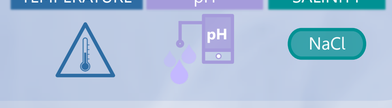
***Cyanobium* sp. LEGE 06113**



Box-Behnken design

Run	T (°C)	pH	[NaCl] (g.L^{-1})
1	20	6.0	20
2	20	7.5	10
3	20	7.5	30
4	20	9.0	20
5	25	6.0	10
6	25	6.0	30
7	25	7.5	20
8	25	9.0	10
9	25	9.0	30
10	30	6.0	20
11	30	7.5	10
12	30	7.5	30
13	30	9.0	20

TEMPERATURE | pH | SALINITY



Evaluated parameters

Biomass quantification (Dry Weight)

ACETONIC EXTRACTION

Antioxidant capacity (A) (ABTS$^{\bullet+}$)

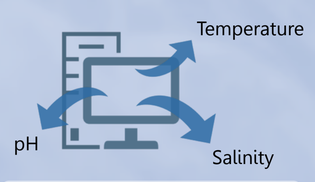
Carotenoids quantification (HPLC)

WATER EXTRACTION

Antioxidant capacity (W) (ABTS$^{\bullet+}$)

Phycobiliproteins quantification (Spectrophotometry)

Modulation



Optimal condition

Model validation

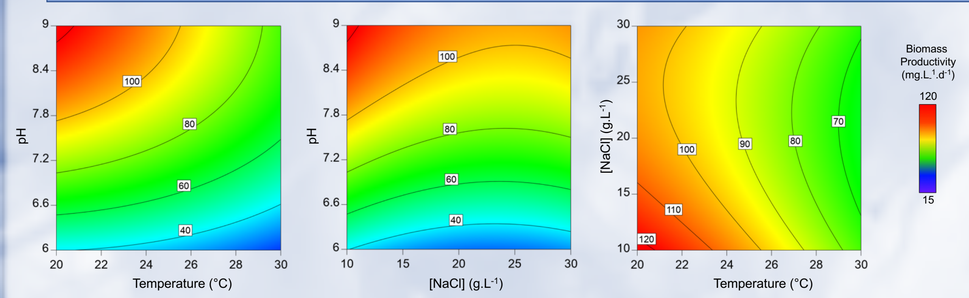
Statistics

DESIGN-EXPERT version 11

Significance levels for each evaluated parameter were obtained by the analysis of variance (ANOVA). Also, a lack-of-fit test was applied to compare the residues of the model and the observed results. The model is validated whenever the statistical significance was higher than 0.05 in the lack-of-fit test.

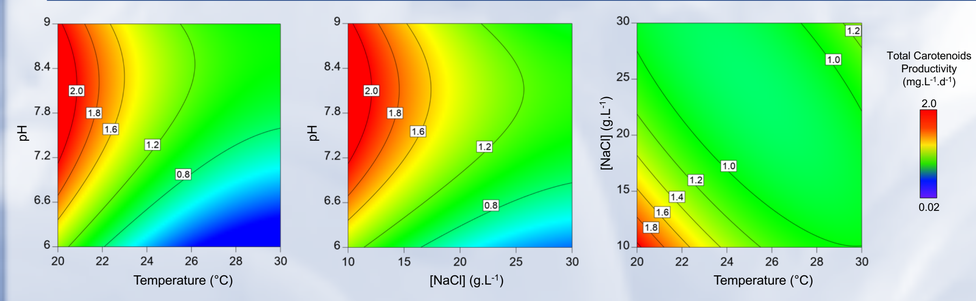
RESULTS

Biomass



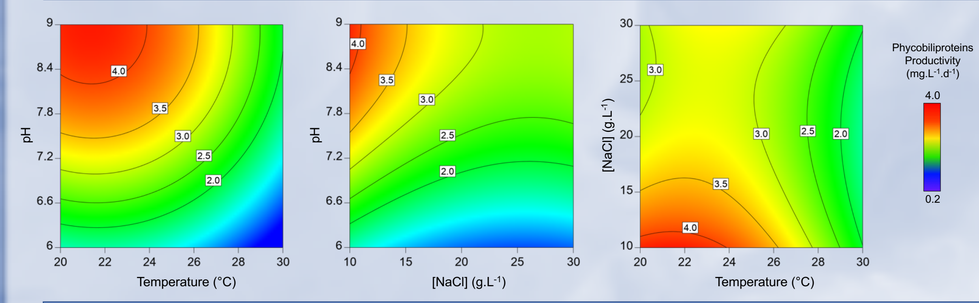
Optimal condition
T = 20 °C
pH = 9.0
NaCl = 10 g.L^{-1}

Carotenoids



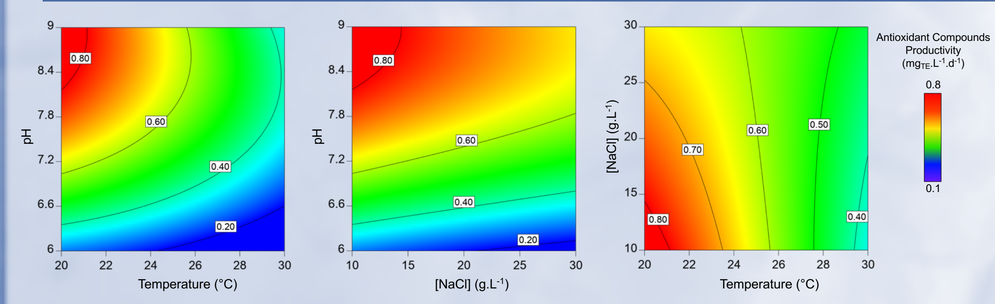
Optimal condition
T = 20 °C
pH = 9.0
NaCl = 10 g.L^{-1}

Phycobiliproteins



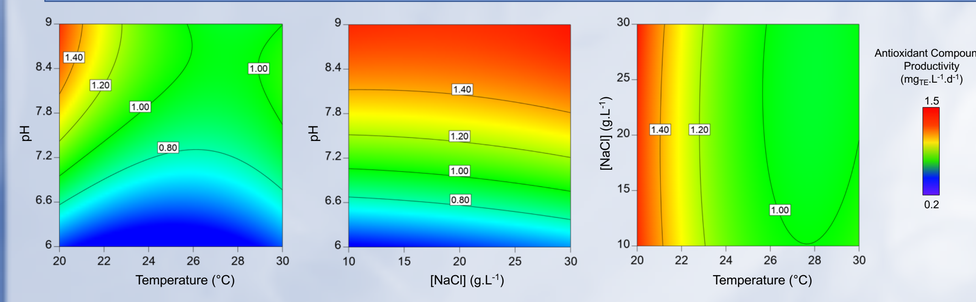
Optimal condition
T = 20 °C
pH = 9.0
NaCl = 10 g.L^{-1}

Antioxidant Capacity (W)



Optimal condition
T = 20 °C
pH = 9.0
NaCl = 10 g.L^{-1}

Antioxidant Capacity (A)



Optimal condition
T = 20 °C
pH = 9.0
NaCl = 10 g.L^{-1}

MODEL VALIDATION

Parameter	Predicted value	Observed value	p value
P_X (mg.L^{-1}.d^{-1})	122.67 ± 17.71	127.12 ± 1.30	0.676
Antioxidant capacity – A (mg$_{TE}$.L^{-1}.d^{-1})	1.55 ± 0.19	0.92 ± 0.06	0.001
Antioxidant capacity – W (mg$_{TE}$.L^{-1}.d^{-1})	0.84 ± 0.11	0.97 ± 0.07	0.122
Total Carotenoids (mg.L^{-1}.d^{-1})	2.04 ± 0.51	2.09 ± 0.25	0.986
Lutein	0.05 ± 0.02	0.06 ± 0.00	0.929
Zeaxanthin	0.25 ± 0.07	0.28 ± 0.01	0.789
Echinenone	0.15 ± 0.05	0.12 ± 0.01	0.537
β-carotene	0.72 ± 0.17	1.00 ± 0.13	0.101
Total Phycobiliproteins (mg.L^{-1}.d^{-1})	4.14 ± 0.71	3.98 ± 0.07	0.708
Phycocyanin	2.94 ± 0.50	2.79 ± 0.03	0.841
Allophycocyanin	1.20 ± 0.22	1.18 ± 0.05	0.978

T = 20 °C
pH = 9.0
NaCl = 10 g.L^{-1}

CONCLUSIONS

Factorial designs, such as **Box-Behnken** are fundamental for the **optimization** of cyanobacterial production, since the **synergetic effects** between **processing parameters** must been take in consideration.

For ***Cyanobium* sp.** the **optimal condition** for simultaneous production of **biomass**, **carotenoids**, **phycobiliproteins** and total **antioxidant compounds** is found in a T = 20 °C, pH = 9.0 and [NaCl] = 10 g.L^{-1}. The model and optimal condition were **validated** by biological experimental data.

Under optimal condition, *Cyanobium* sp. **harvested biomass** is composed by ca. **10 % of pigments** and an **antioxidant capacity** of ca. 14 mg$_{TE}$.g$_{DW}^{-1}$. Providing a potential source of **bioactive compounds** for future applications (e.g. cosmetical industry).

Acknowledgements

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