Strategy development to optimize the production of a high added-value cyanotoxin

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Introduction

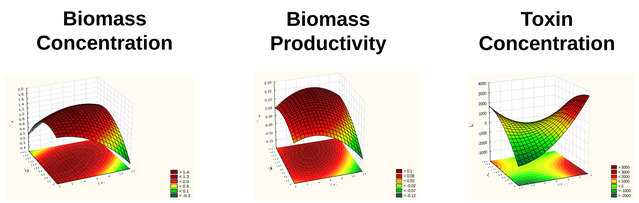
Microcystis aeruginosa is a well-known microcystin producer cyanobacterium that is commonly associated with water quality impairment and several animals/human intoxication occurrences. However, microcystin standards have applications in human and environmental risk assessment studies and recent research works highlight the huge potential of cyanotoxins to be applied as anticancer/antitumor drugs or antimicrobial agents. Nevertheless, the existing commercial microcystin solutions have prohibitive prices around 28000 €/mg due to high production costs. Envisaging the need to improve the cost-effectiveness of production process of microcystin, this work intended to address and optimize all the steps from up- to downstream processing of M. aeruginosa.

Process steps and results

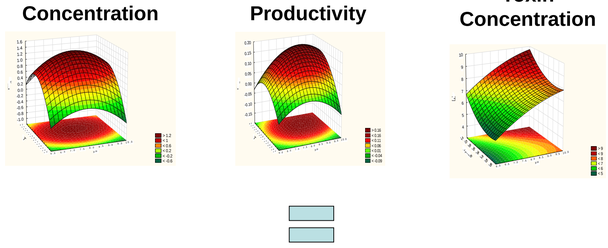
Cultivation

Abiotic factors

Light vs CO_2



Temperature vs pH



Property	Light ($\mu E.m^{-2}.s^{-1}$)	CO_2 (% v/v)	Temperature (˚C)	pH
Max. Biomass concentration	50-120	1-6	20-25	7-8
Max. Biomass productivity	110-190	4-9.5	29-39	8-9.4
Max. Toxin concentration	< 80	< 1	20-25	7-8

Photobioreactors

Flat-panel

Concentration
1.4 $g.L^{-1}$
Productivity
0.045 $g.L^{-1}.d^{-1}$

Airlift

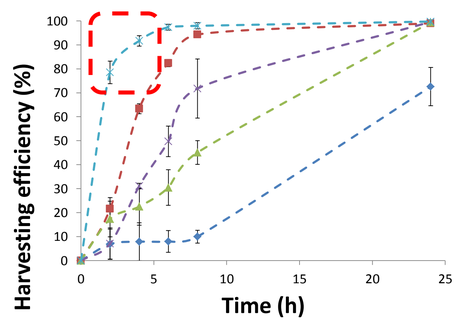
Concentration
0.7 $g.L^{-1}$
Productivity
0.010 $g.L^{-1}.d^{-1}$

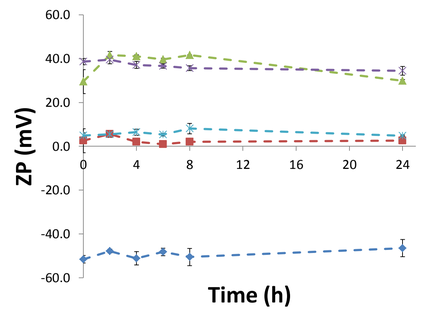
Bubble column

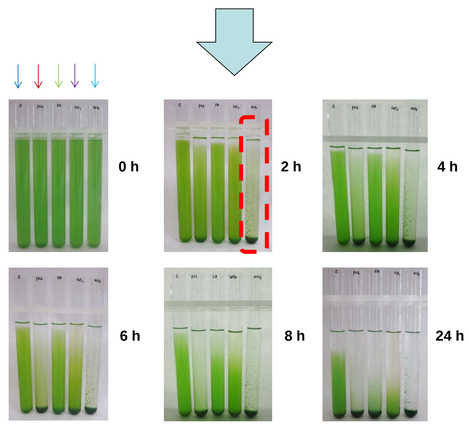
Concentration
1.0 $g.L^{-1}$
Productivity
0.020 $g.L^{-1}.d^{-1}$

Harvesting

Control | Autoflocculation (pH 2) | Chitosan | $FeCl_3$ | $AlCl_3$

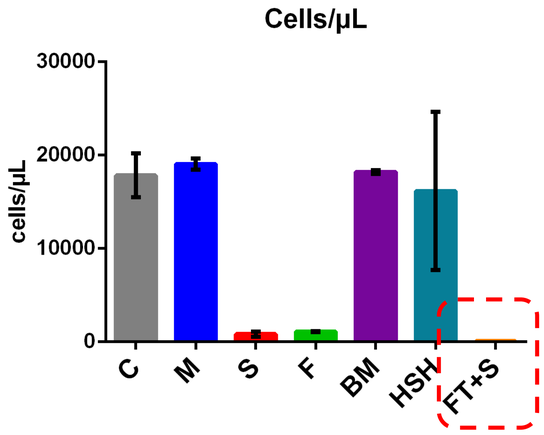


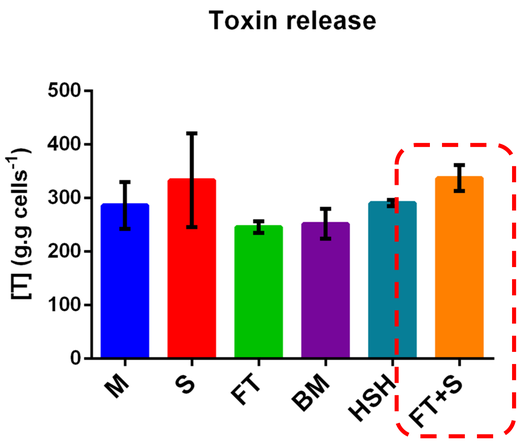




Disruption

Control | Microwave | Sonication | Freeze-thaw | Bead mill | High-speed homogenization | Freeze-thaw + Sonication





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