Novel approach to controlling toxic cyanobacteria: effect of 365 nm UV-A LED irradiation on six *Microcystis aeruginosa* strains and their eleven associated microcystins

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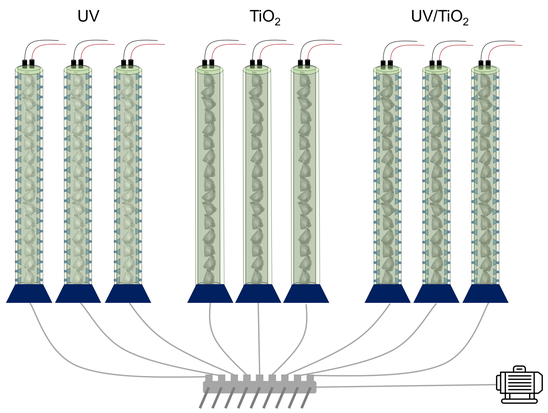
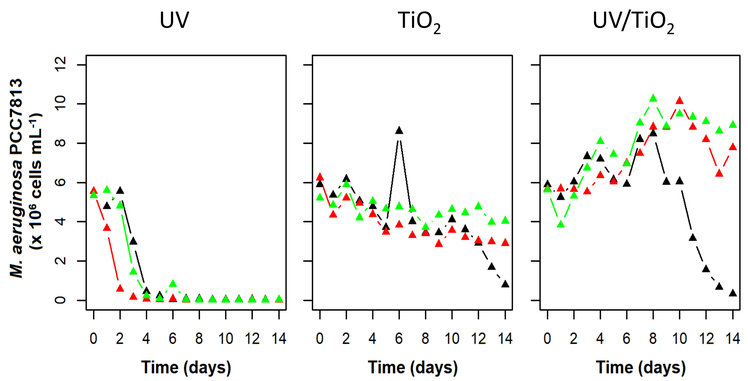
Introduction

The control of cyanobacteria and cyanotoxins *in-situ* is a challenge worldwide.
In a previous study, titanium dioxide (TiO_2) photocatalysis was expected to be effective for the removal of cyanobacterial cells and toxins, however, the results were inconclusive.
UV-A LED irradiation had dramatic effects on the cyanobacterium *M. aeruginosa*. Results showed an almost complete removal of cells in only 4 days of UV-A irradiation.

Pilot scale UV-A LED/TiO_2 photocatalytic reactor for *M. aeruginosa* cells and toxins removal



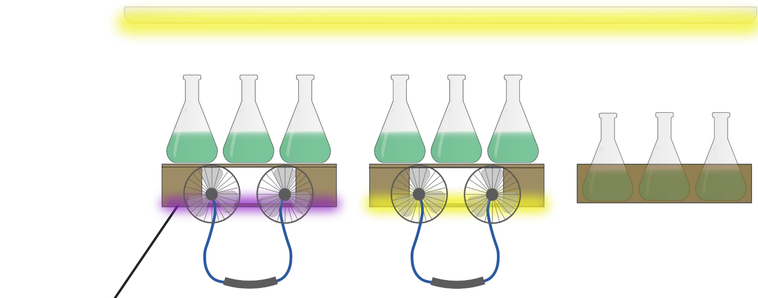
Scan here for more information

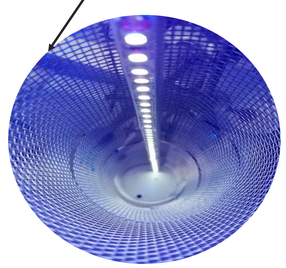


Methods

Microcystis aeruginosa	Microcystins (MCs)	Aerotopes	Locality	Culture collection
SCIENTO	MC-DmRR MC-RR MC-DmLR MC-LR MC-YR MC-WR MC-Htyr	Yes	England	Sciento Culture Collection
NIES 1099	MC-DmRR MC-RR MC-DmLR MC-LR MC-YR MC-WR	Yes	Japan	NIES collection Microbial Culture Collection
B2666	MC-LA MC-LR	Yes	South Africa	UTEX Algal Culture Collection
PCC 7820	MC-LR MC-LF MC-LY MC-LW	Yes	Scotland	Pasteur Culture Collection
PCC 7813	MC-LR MC-LF MC-LY MC-LW	No	Scotland	Pasteur Culture Collection
PCC 7806	MC-DmLR MC-LR	Yes	Netherlands	Pasteur Culture Collection

Reactors were prepared for UV-A LED irradiation (365 nm), visible light (Vis) LED irradiation (400 – 700 nm) and no LED irradiation on *M. aeruginosa* strains.





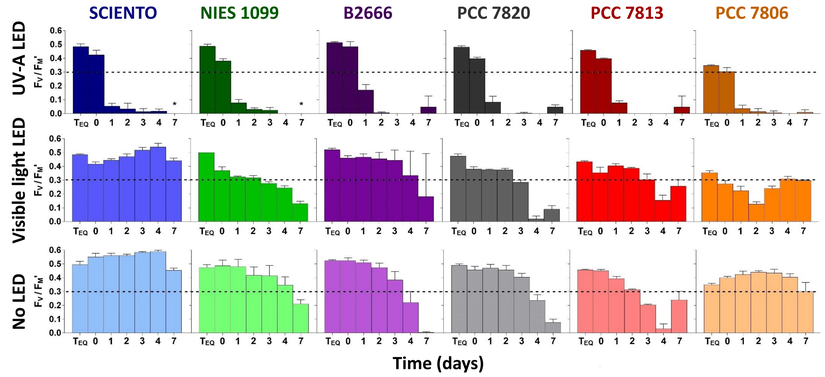
UV-A LED (365 nm)

Photosynthetic activity as a measure of cell viability was analyzed by Mini-PAM fluorometer and microcystins were determined by UPLC-MS/MS.
Initial cells were diluted to a concentration of 10 x 10^6 cells mL^{-1} (T_{EQ}). Then, cells acclimated to the conditions of the experimental set-up and samples were irradiated over 7 days.

Results

- All strains showed markedly reduced photosynthetic activity after 7 days of UV-A irradiation.
- Microcystin removal was analogue dependent. The removal percentage is consistent across different strains.
- Theory: occurrence of photoinduced oxidative radicals by UV-A irradiation on phycocyanin (specific to cyanobacteria).

M. aeruginosa photosynthetic activity



Microcystins irradiated by UV-A 365 nm LEDs

	DmRR	RR	DmLR	LR	YR	Htyr	WR	LA	LF	LY	LW
SCIENTO											
Removal (%)	*100*	*94*	*69*	*82*	*9*	*80*	*100*				
NIES 1099											
Removal (%)	84	90	76	71	10		100				
B2666											
Removal (%)				93				93			
PCC 7820											
Removal (%)				88					84	93	93
PCC 7813											
Removal (%)				95					95	95	97
PCC 7806											
Removal (%)			90	87							

Conclusion

UV-A 365 nm LED irradiation can be explored as a novel, long-lasting, environmentally safe, economical and targeted approach for the control of cyanobacteria and toxins at source.

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