Tailoring Quantum Efficiency of Cyanobacteria Photoresponse

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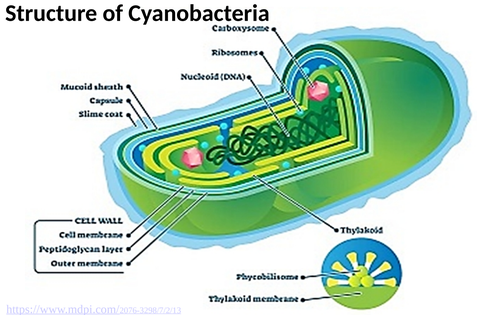
INTRODUCTION

Photosynthesis, especially by *Synechococcus elongatus* bacteria found in light- exposed freshwater, plays a crucial role in global carbon fixation and bioenergy production. They mainly absorb light in the blue and red regions but have a “green gap” in the spectrum. The auxiliary phycobilisome pigments (phycoerythrin 570nm, phycocyanin 620nm, allophycocyanin 650nm) absorb light at different wavelengths of the green region making efficient for photosynthesis. The distribution and dynamics of energy transfer components in cyanobacterial thylakoid membranes governs the regulation of electron transfer pathways in nature, this attracted attention for exact energy transfer mechanism. To improve our understanding of the mechanism, we developed new method of regulating photoresponse without any genetic modification. In this project we study binding of these pigments with nblA peptide which quenches photo response by changing quantum yield using the simple extraction, quantification with response to absorption and emission phenomenon to identify the pigment responsible for quenching of bacterial photoresponse.

Structure of Cyanobacteria



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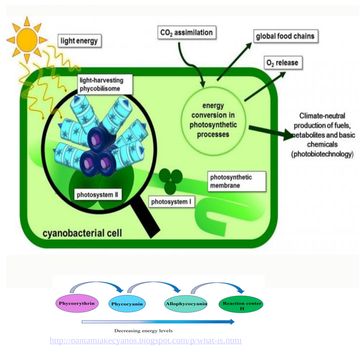
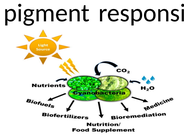
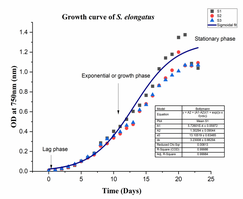


http://nantamaxecyanos.mogspot.com/p/what-is.html



https://www.eurekalert.org/news-releases/888167

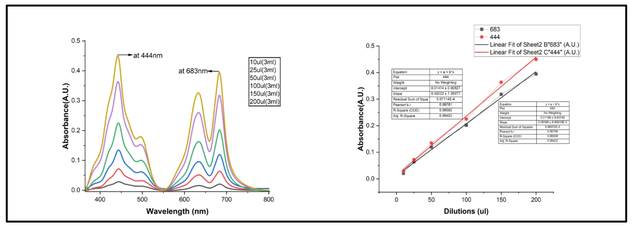
Results: Growth Curve

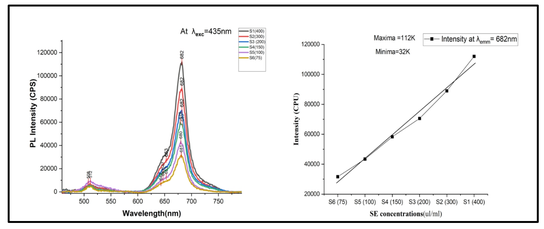


INITIAL CHARACTERIZATION AND MODIFICATION

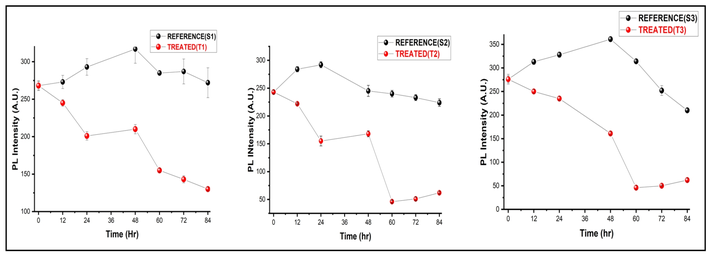
***S. elongatus* bacteria** spectrum shows visible absorption peaks related to triplet states of all pigments.

Results: UV-VIS Absorption Spectroscopy and Emission Spectroscopy for *S. elongatus* bacteria

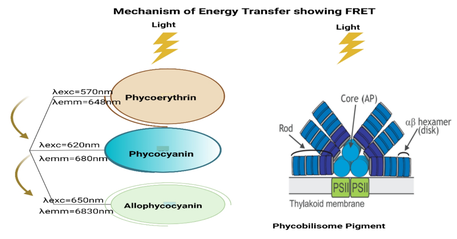




Trend in PL intensity change over time of *S. elongatus* (SE) bacteria at 570nm excitation wavelength for phycobilisome pigment



Possible mechanism of energy transfer through phycobilisome pigments
Forster Resonance Energy Transfer (FRET)



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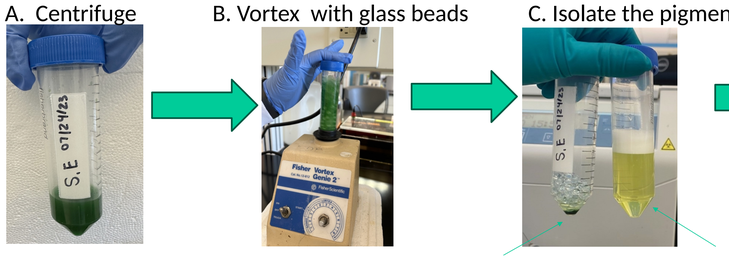
Reference: SE bacteria control sample
Treated : SE bacteria treated with nblA peptide hybrid (**nbla-GT15-SWCNT**) (n=3)

ssDNA(GT15)-SWCNT hybrid is able to electrostatically attach itself to nblA peptide thereby forming a nbla-GT15-SWCNT hybrid which is able to enter the thylakoid membrane of *S.elongatus* bacteria.

EXTRACTION QUANTIFICATION OF PIGMENTS

Our Procedure for Extraction of Phycobilisome pigments

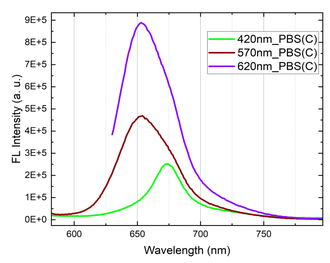
A. Centrifuge B. Vortex with glass beads C. Isolate the pigments

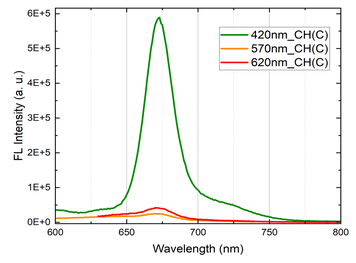


#	Time	Type	Area	Height	Width	Area%	Symmetry
1	0.913	BV	22.1	7.9	0.0448	6.269	0.954
2	1.072	VV	255.4	14	0.2373	72.328	0.372
3	1.439	VB	75.6	6.6	0.1474	21.403	0.147

Interesting note: Retention time value matches with the literature and indicating that in Phycobilisome complex the Phycocyanin pigment is present in more quantity than Phycoerytrin and Allophycocyanin pigments.

Comparison of fluorescence measurements of extracted Phycobilisome pigments (PBS) and chlorophyll a (CH) to corelate with HPLC results

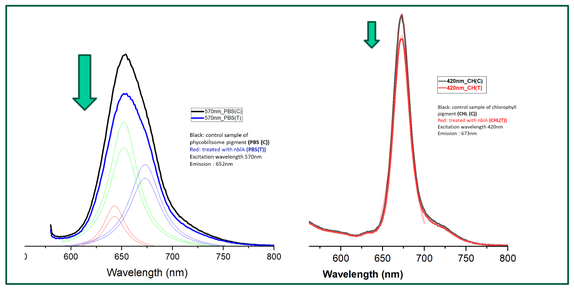


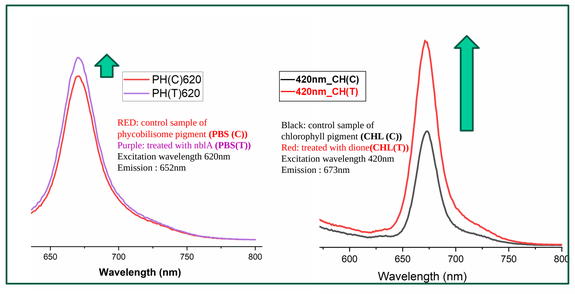


Results of extraction: HPLC quantification results are in good correlation with fluorescence of extracted pigments.

WHERE IS AN ATTACHMENT SITE?

Fluorescence intensity change in phycobilisome complex (PBS) and chlorophyll pigment(CH) after treatment with nblA peptide and pyrene- 4,5-dione dye





CONCLUSIONS: Upon introduction of nblA peptide the fluorescence intensity quenching is maximal at 620nm excitation wavelength, corresponding the phycocyanin resonance excitation. Upon introduction of pyrene derivative (dione dye) the fluorescence intensity of chlorophyll a (420nm of excitation) is enhanced, while phycobilisome pigment complex is does not show significant change.

Acknowledgements

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