Research Project: Biophysics and Membrane Biotechnology

Staff:

Dr. K. Stamatakis, Research Director

Post Graduate Students:

Vayenos D., MSc, National Technical University of Athens, School of Civil Engineering, Department of Water Resources and Environmental Engineering, Thesis Topic “Study of the Cyanobacterial Photosynthesis: Energy Source friendly to the Environment”, 07 Dec. 2013.

Broussos P-I., Agricultural University of Athens, School of Plant Sciences, Department of Crop Science Diploma Thesis Topic “Study on cyanobacterial hydrogen production”, 04-Jul-2019

Giakoumidaki-Vogiatzi A. Agricultural University of Athens, School of Plant Sciences, Department of Crop Science Diploma Thesis Topic “Study on photosynthesis of cyanobacteria able to produce terpene”16-May-2019

Laboratory’s Scientific Subjects of Interest

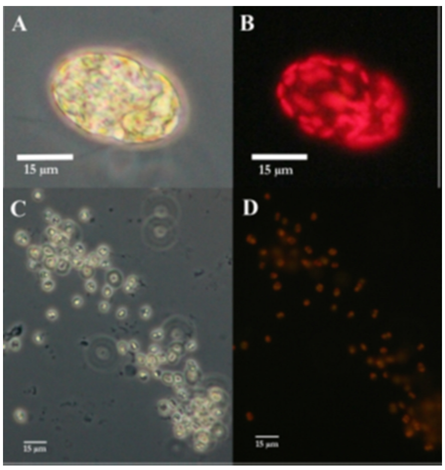
Photosynthetic cyanobacteria are preferable candidates for the sequestration of large quantities CO_2 from the atmosphere because they can grow in extreme or/and specified environmental conditions (temperature, pressure, salinity, pH, chemical composition) and are capable of binding CO_2 to produce high energy chemical compounds using sunlight. The rapidly growing cyanobacteria constitutes a very promising and CO_2 emission-free source for biofuels production which can substitute for other carbon-dependent natural sources of energy. The production and accumulation of sucrose in cyanobacteria is connected to their adaptation to extreme environmental conditions. Our research addresses the following themes:

(a) We investigate the production of hydrogen (H_2) production by cyanobacteria through the process of anaerobic "dark fermentation" of the sucrose they accumulated under salinity stress.

(b) Terpenes are the largest group of secondary metabolites and are used by industry (production of drugs, cosmetics, food technology). Study of the production of terpenes from genetically modified strains of the cyanobacterium Synechocystis sp PCC 6813 (S6813) capable of producing terpenes. They are synthesized from acetyl-coenzyme-A (acetyl-CoA) or from glycolysis intermediates

(c) We study, also, the time dependent changes of chlorophyll *a* fluorescence ($\mathbf{F_{Chla}}$), or fluorescence induction, in cyanobacteria, giving emphasis to the distribution of the electronic excitation to the reaction centers of photosystem I (PSI) and photosystem II (PSII), as an indicator of protective mechanism against the destructive effects of the reactive oxygen species (ROS) that are produced during photosynthesis.

(d) We study the photosynthetic apparatus of the haptophyte *Phaeocystis antarctica* and of a novel Ross Sea dinoflagellate (RSD) that hosts
P. Antarctica
chloroplasts as kleptoplasts. Both algae are dominant in the phytoplankton of Ross Sea in Antarctica. Our research led to the discovery of the kleptoplasty.



(A) Ross Sea Dinoflagellate(RSD) and (C) haptophyte Phaeocystis antarctica (B) Fluorescence microscopy image of RSD and (D) fluorescence microscopy images of Phaeocystis antarctica

(e) We have developed a new method for the evaluation and assessment of antibacterial properties of materials and surfaces by means of time-dependent changes of F_{Chla} (Patent No. OBI 20140100263/02.05.2014). Specifically, the method relates F_0, the initial value of F_{Chla} kinetic trace (OJIP), upon a transition from darkness to continuous light of cyanobacteria. Since cyanobacteria are gram negative, we can use them as a guide for antibacterial assay.

- **List of Publications (last 5 years)**

1. Heliopoulos, N.S., Galeou, A., Papageorgiou, S.K., Favvas, E.P., Katsaros, F.K., Stamatakis, K. (2016). Journal of Microbiological Methods, 121: 1-4
2. Stamatakis, K., Allakhverdiev, S.I., Garab, G., Govindjee (2016) Photosynthetica 54: 158-160
3. Stamatakis, K., Papageorgiou G. C., Govindjee (2016). Photosynthesis Research 130: 317-324
4. Allakhverdiev, S.I., Tomo, T., Stamatakis, K., Govindjee (2016) Photosynthesis Research 130: 1-10
5. Mavroidi, B., Sagnou, M., Stamatakis, K., Paravatou-Petsotas, M., Pelecanou, M., Methenitis C. (2016). Inorganica Chimica Acta 444: 63–75
6. Stamatakis, K., Vayenos, D., Kotakis, Ch., Gast, R.J., Papageorgiou, G.C. (2017). Biochim. Biophys. Acta (Bioenergetics) 1858: 189–195
7. Ellinas, K., Kefallinou, D., Stamatakis, K., Gogolides, E., Tserepi. A. (2017) ACS Applied Materials & Interfaces 9: 39781–39789
8. Stamatakis, K., Broussos P.-I., Panagiotopoulou, A., Gast, R. J., Pelecanou, M., Papageorgiou, G. C. (2019). Biochim. Biophys. Acta (Bioenergetics) 1860: 102–110
9. Kefallinou, D., Ellinas, K., Speliotis Th., Stamatakis, K., Gogolides, E., Tserepi. A. (2019) Coatings, 10, 25; doi:10.3390/coatings10010025Surfaces
10. Heliopoulos S. N., Kouzilos N. G., Papageorgiou S. K., Stamatakis K., Katsaros F. K. (2020) Fibers and Polymers 21: 1238-1250

11. Vayenos D., Romanos Em. G., Papageorgiou G. C., Stamatakis K. (2020). Photosynth. Research 146: 235-245
12. Heliopoulos S. N., Kythreoti G., Lyra K.M., Panagiotaki N.K., Papavasiliou A., Sakellis E., Papageorgiou S., Kouloumpis A, Gournis D., Katsaros K.F., Stamatakis K., Sideratou Z. (2020). Pharmaceuticals 2020, 13: 293
13. Samiotis, G., Stamatakis, K., Amanatidou, E (2021). Water Science and Technology 84: 1438-1451
14. Murata, N., Stamatakis K. (2022) Photosynthetica DOI 10.32615/ps.2021.056
15. Samiotis, G., Stamatakis, K., Amanatidou, E (2022). Chemical Engineering Journal doi: https://doi.org/10.1016/j.cej.2022.134895