MODIFICATION OF PHYCOBILISOMAL ANTENNAE OF *CYANIDIOSCHIZON MEROLAE* – AN ADAPTATION TO VARIABLE LIGHT-IRRADIATION CONDITIONS.

A RESEARCH PROJECT– FACULTY OF BIOLOGY, UNIVERSTY OF WARSAW

Organisms with the ability to thrive in the extreme environments such as high/low temperature, acidity or salinity, may well be generally classified as extremophiles. One such, particularly interesting example is *Cyanidioschizon merolae*, unicellular microalga of cell diameter just about 2 μm, thriving at acidity of pH between 0.4 to 2.5 and moderately high temperature of 42 to 52°C. These conditions can be found in Italian volcanic hot springs, naturally inhabited by *C. merolae*. This alga is an autotrophic organism, who derives biologically useful energy from conversion of solar irradiation to high energy products, by means of photosynthesis - a highly complex process of conversion of solar light into highly energetic bounds within organic molecules, simultaneously releasing oxygen into the air. This process is responsible for production of all the atmospheric oxygen on Earth. *C. merolae*'s cellular machinery, involved in photosynthesis, consists of particularly stable and active protein complexes, called 'photosystems' and associated antennae, responsible for efficient light harvesting. *C. merolae* possesses two kind of antennae: the photosystem I (PSI) associated Lhcr antennae and possibly, phycobilisomes (PBS). These are then associated with both photosystems (PSI and PSII). PBS are more primitive antennae, present in *Cyanobacteria* and red algae, whereas the Lhcr type antennae constitute a derived trait, characteristic to higher plants, thus *C. merolae* can be consider as an evolutionary mosaic of ancestral and derived traits. PBS are globular and soluble proteins, present in chloroplasts in great abundance (between 40 and 60% of all cellular proteins) and are capable of efficient light absorption in spectral range 600 - 650 nm. Phycobilisomes can coalesce atop of photosystems, amassing an enormous superstructure, protruding out of the membrane surface into the stromal space. Images obtained by electron microscopy (Fig. 1) present a typical PBS as a large semicircular protein assembly (visible in the panel A), build of the inner part or core, composed of allophycocyanin and the outer ring of phycocyanin[1]. Both of these components possesses several chromophores, covalently bound to the protein scaffold. Seen from above, PBS appear to be perfectly flat, 2-dimensional structure. The spectral properties of these chromophores depend on particular chemical character of the protein fragment in their immediate vicinity. Consequently the spectral properties can be modulated within the structure of the PBS and arrange by the gradually decreasing absorption energy and shortening life-times of excited states, forming a specific energy funnel, conveying the harvested solar energy to the photosystems and powering the light conversion process.

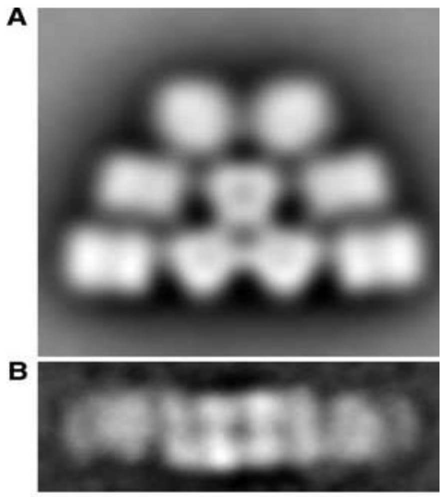

Fig. 1. Structure of phycobylisome. Picture obtained by electron microscopy (EM). A – Side view, B – Top view. Author: Zhi-Wei Yi, 2005

In this research project we aim at elucidating the mechanism of phycobilisomes elongation or degradation in response to light as the most important environmental stimulus. We will establish the influence of light intensity and the particular wavelength or color of light. We want to investigate the interactions of PBS with both photosystems, especially the elusive mechanism of attachment of PBS to PSI. We will produce a series of mutant varieties of *C. merolae* with disrupted genes of PBS, incapable of proper regulation of light-adaptation processes. This mutants will help to build a model of PBS assembly in this alga. Our research will provide us with knowledge about auxiliary antennae adaptation to light in red algae. This knowledge is important not only to understand one of the most elementary processes driving life on Earth, but also it can be used to maximize the photosynthetic efficiency for production of biofuels or recombinant proteins for medical and industrial purposes.

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[1] Yi ZW, Huang H, Kuang TY, Sui SF (2005) Three-dimensional architecture of phycobilisomes from *Nostoc flagelliforme* revealed by single particle electron microscopy. *FEBS Lett. Jul* 579: 3569-73.