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**Excitation energy transfer of *Arthrospira platensis* cells grown in seawater medium
probed by time-resolved fluorescence spectroscopy**

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[Introduction] Large-scale cultivation of *Arthrospira (Spirulina) platensis* is now intensively researched worldwide due to its high potentials in pharmaceuticals, cosmetics, energy, and nutritious food source. Cultivation of *A. platensis* in seawater has been regarded as an attractive option, owing to the low cost of seawater and the limited freshwater available for large-scale farming. The excitation energy transfer between pigments in photosynthetic machinery largely governs the growth of oxygen-evolving organisms. However, changes in environmental conditions such as cultivation medium may induce changes in excitation energy transfer within the photosynthetic system, resulting in abnormal pigment production. In the present work, in vivo excitation energy transfer processes in *A. platensis* cells grown in both f/2 medium and SOT medium as a control were studied. The SOT medium is well known as one of the optimal media for *A. platensis*, while the use of f/2 medium was intended to imitate seawater.

[Experiment] The cyanobacterium *Arthrospira platensis* NIES-39 were grown under a fluorescent lamp of light intensity $50 \mu\text{mol photons m}^{-2} \text{s}^{-1}$ for 7-8 days in SOT medium or modified f/2 medium at 303 K ($\sim 30^\circ \text{C}$) with agitation at 100 rpm. Steady-state absorption and fluorescence spectra were measured with a spectrometer (JASCO V-650/ISV-722) and a

spectrofluorometer (JASCO FP-6600/PMU-183), respectively, at low temperature (77 K). Time-resolved fluorescence spectra were measured by a time-correlated single-photon counting system at 77 K, with excitation wavelength 400 nm. Fluorescence rise and decay curves were analyzed by global analysis to obtain fluorescence decay-associated spectra (FDAS). Photosynthetic oxygen evolution and dark respiration were determined with a Clark-type oxygen electrode controlled by a computerized oxygen monitoring system.

[Results and Discussion] Growth in f/2 medium induced changes in absorption and fluorescence spectra as well as in the energy transfer pathways. Relative amount of Photosystem (PS) I red chlorophylls and phycobilisome (PBS) markedly decreased (Fig. 1),

fraction of PBS not incorporated into energy transfer processes increased, and energy transfer between PC and APC was slowed in the f/2 medium. The energy transfer from PSII to PSI is highly inhibited in the f/2 medium, which might be result from the modification of proteins

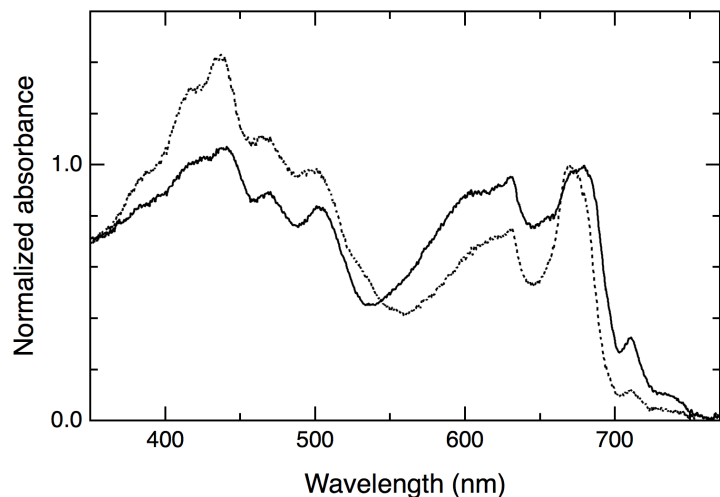


Fig. 1 Absorption spectra of *A. platensis* cells grown in SOT medium (solid line) and f/2 medium (dotted line).

under salt stress. The PBS-to-PSI in parallel to PBS-to-PSII energy transfer pathways were observed in the two medium, however excitation energy captured by PBS was transferred directly to PS I in f/2 medium, instead of being first transferred to an intermediate (PBS→PSII→PSI), as observed in SOT medium. It was also found in f/2 medium that respiration rate increased, photosynthetic rate reduced, and the delayed fluorescence (DF) lifetime was a half from that in SOT medium, which is probably result from inhibition of electron transfer in PSII and/or the decrease in antenna efficiency.