Plant Physiology and Biochemistry

Volume 43, Issue 7, July 2005, Pages 717-726

Original article

The application of micro-FTIR spectroscopy to analyze nutrient stress-related changes in biomass composition of phytoplankton algae

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https://doi.org/10.1016/j.plaphy.2005.07.001

Abstract

Micro-Fourier transform infrared (FTIR) spectroscopy was used to study changes in spectral features of three species of Cyanobacteria (*Microcystis aeruginosa, Croococcus minutus*, and *Nostoc* sp.) and two Bacillariophyceae (*Cyclotella meneghiniana*, and *Phaeodactylum tricornutum*) in response to nutrient stress. The change of physiological state of the cells was followed during a 4-week starvation period on the basis of physiological key parameters and by means of FTIR spectroscopy. Changes in the integrated FTIR bands of cell spectra assigned to proteins, lipids, carbohydrates and silicate were used to calculate relative biomass composition. The

results show that short-term acclimatization become visible at first in pigmentation and photosynthetic efficiency, whereas changes in biomass composition reflect long term modulation in the metabolism. Simultaneous monitoring of short term and long term stress acclimatization showed evidence that the metabolic strategies to cope with increasing nutrient limitation are highly species-specific. This species-specificity can only be resolved in natural phytoplankton samples by single cell techniques. The results show that the FTIR technique has the potential to become applicable for the determination of single cell biomass composition from natural phytoplankton communities.

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Keywords

Fourier transform infrared spectroscopy; Algae; Nutrient limitation

Abbreviations

Chl a, chlorophyll a; FTIR, Fourier transform infrared; LHC, light-harvesting-complex; NPQ, non-photochemical-quenching; PS II, photosystem II; RubisCo, ribulose-1,5-bisphosphatecarboxylaseoxygenase

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