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Macro-organization and structural flexibility of the light-harvesting system of diatoms (Bacillariophyceae) and their significance in the photosynthetic light energy utilisation

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Among the phytoplankton species of marine and freshwater communities, diatoms play a dominant role in the biogeochemical cycles of carbon, nitrogen, phosphorus and silicon with a strong impact on the global climate. Since diatoms experience randomly fluctuating light intensities and large scale temperature changes, they have developed various mechanisms of photoprotection.

In higher plants, it has been established that the photosystems (PSs) with their peripheral chlorophyll *a/b* light-harvesting antenna complexes (LHCs) form supercomplexes. The PSII-LHCII and PSI-LHCI supercomplexes are laterally segregated in the granal and stromal thylakoid membranes, respectively (cf. e.g. Mustárdy and Garab 2003). It has also been shown that LHCII and PSII-LHCII are assembled into macrodomains with long-range chiral order, which possess remarkable structural flexibility and by this means the structural flexibility of the macroassemblies plays an important role in the regulation of the light energy conversion (Garab 1996).

Diatoms contain specialized peripheral light-harvesting antennas, the fucoxanthin-chlorophyll *a/c* proteins (FCPs), instead of LHCs. FCPs are also intrinsic light-harvesting complexes but their carotenoid is the fucoxanthin and contains chlorophyll *c* as accessory pigment. Compared to higher plants, our knowledge concerning the arrangement and the supramolecular organization of the antenna complexes in the thylakoid membranes is quite rudimentary, and much less is known about their possible role in different regulatory processes.

The major aim of our studies was to characterize the (macro-)organization of the complexes in *Phaeodactylum tricornutum* and *Cyclotella meneghiniana* cells, as well as on isolated thylakoid membranes and FCPs. By using circular dichroism (CD) spectroscopy, we found that the spectra of the whole cells were dominated by an intense band at (+)698 nm, with typical psi-type features (psi, polymerization or salt-induced). This band, which appeared to be associated with the multilamellar membrane architecture, was sensitive to the light intensity during growth, to the osmotic pressure of the medium and to heat. We also found that it was capable of undergoing reversible changes upon illumination with actinic light. In isolated thylakoid membranes, the psi-type CD band, which was lost during the isolation procedure, could be partially restored by addition of Mg^{2+} ions; the same treatment was also important for optimizing the quantum yield of PSII and the non-photochemical quenching of chlorophyll *a* (Szabó et al. 2008). With a refined isolation method, we were able to isolate the oligomeric form of FCP, which represented the native form of the antenna system in thylakoid membranes of diatoms (Lepetit et al. 2007). We also gained information on the orientation and local environment of a special fucoxanthin pigment molecule of the FCP, which exhibited an extremely strong electrochromic response and intense linear dichroism (LD) signal at around 550 nm, most probably given rise by strong fucoxanthin/chlorophyll *c* interaction.

In summary, our data have shown the presence of highly flexible macroassemblies of the light-harvesting system in diatoms, which also appears to participate in different regulatory processes of the photosynthetic light energy conversion.

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Characterization of beta-glucosidase enzymes and their coding genes from the fungal class Zygomycetes

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The genus *Rhizomucor* (Zygomycetes, Mucorales) comprises two well-established thermophilic species, *R. pusillus* and *R. miehei* (Vágvölgyi et al. 1999). Both of them are well known from biotechnological applications in consequence of their effective extracellular enzymes, e.g. proteases and lipases (Rao et al. 1998). Beta-glucosidases play important roles in biology, including the degradation of cellulose biomass by fungi and bacteria, degradation of glycolipids in mammalian lysosomes, and the cleavage of glycosylated flavonoids in plants (Bhatia et al. 2002).

Filamentous fungi are known to be good producers of beta-glucosidases and several fungal glucosidases have been isolated and analyzed. Unfortunately, Zygomycetes are poorly characterized from this aspect. In the frame of a recent study, beta-glucosidase activity of