ABSTRACT OF PH.D. THESIS

DIMORPHISM AND PUTATIVE SEXUAL REPRODUCTION OF CRYPTOPHYTES (CRYPTOPHYCEAE)

Magdalena Solarska

Doctoral thesis done at the Institute of Botany of the Polish Academy of Sciences in Kraków under the supervision of PD Dr Kerstin Hoef-Emden.

Cryptophytes (Cryptophyceae) are a relatively small, but ecologically and evolutionarily important group of microscopical algae occurring in different types of water habitat. They are mostly photosynthetic, with chlorophylls a and c_2 and highly modified biliproteins – phycoerythrin and phycocyanin. Another characteristic common to all cryptophytes, is a cell invagination (either furrow or gullet or furrow/gullet system) with explosive organelles called ejectosomes. They also have a periplast, that is a cell surrounding consisting of proteinaceous inner and surface components with the plasmamembrane in between. Taxonomic studies of this group are difficult because cryptophytes have a very large phenotypic variability and taxonomically important features are often invisible or impossible to identify by light or microscope observations. Thus the determination to species level must be supported with molecular data. Among cryptophyte species there are taxa that proved to be dimorphic during their life cycle, with crypto- and campylomorphs. Cryptomorphs are the forms with inner periplast component made of plates, while campylomorphs have a sheet-like component. So far the frequency of both morphotypes occurrence for particular species and the function of the phenomenon have not been explained. Therefore this study aimed to explain the functional meaning of the dimorphism and to investigate the occurrence of species morphotypes during a year in three water bodies in Kraków.

The studies on the function of dimorphism were conducted during experiments with dimorphic *Cryptomonas curvata* strain, which morphotypes are easily distinguishable under the light microscope (among others, campylomorphs are twice as big as cryptomorphs). For the first time a fusion of two cryptomorph cells and a transformation into a campylomorph was observed, providing an evidence that the dimorphism in cryptophytes is related to sexual reproduction in cryptophytes. It means that cryptophytes have a unique life history where both, haploid and diploid forms, are motile cells capable of vegetative reproduction.

The analyses of relative DNA content in dimorphic strains of *C. curvata* (from Culture Collection of Algae at the University of Cologne) and *C. obovoidea* (strain from own research). The ploidy level of morphotypes in both cultures was analyzed with the use of propidium iodide, that binds with DNA and measured with the flow cytometer. The occurrence of haploid and diploid cells in culture of *C. obovoidea* was confirmed (in *C. curvata* the number of campylomorphs was too low to show the difference), therefore it was proved that cryptophyte morphotypes are related to sexual reproduction.

A cryptophyte culture collection of 113 strains was established during the study, from the samples collected during a year period from three waterbodies in Kraków area. The analysis

of the sequenced partial nuclear LSU rDNA revealed the affinity of isolated strains to the species previously described and revised in the literature, as well as some newly found lineages. Among 45 sequenced strains, 37 strains belonged to known species and 8 strains represented new lineages. The examined strains were belonging to *C. curvata*, *C. gyropyrenoidosa*, *C. obovoidea C. phaseolus*, *Cryptomonas* sp. 1-3 and *Rhodomonas* sp. Only *C. curvata* and *C. phaseolus* were previously reported from Poland, but their identification then was with the use of light microscopy only.

The examination of cell covering was performed with the use of scanning and transmission electron microscopes. The results had shown that *C. curvata* strains were predominantly cryptopmorphs, but two strains might be dimorphic, as cells resembling campylomorphs were observed. All *C. phaseolus* strains were cryptomorphs, while *C. gyropyrenoidosa* and *Cryptomonas* sp. 1-3 were all campylomorphs. *C. obovoidea* strains were either crypto- or campylomorps and one dimorphic strain was identified for the first time for this species (hence the number of species with direct evidence for dimorphism was increased in this study). Strains determined as *Rhodomonas* sp. based on molecular analyses had a sheet like periplasts (taxa with that type of periplast in Pyrenomonadaceae family were assigned to *Storeatula* genus). Thus far, molecular studies of this group had shown that *Rhodomonas* genus is paraphyletic and *Storeatula* genus comprising taxa with sheet-like periplasts is an alternating morphotype of the genera *Rhinomonas* and *Rhodomonas*, that have plates as an IPC.