

The polymorphic *psa* and *rbc* loci in populations of *Planktothrix agardhii* in Polish hypertrophic lakes

Karolina STEFANIAK^{1*}, Mikołaj KOKOCIŃSKI¹, Michał RUREK², Agata ROMANOWSKA², Halina AUGUSTYNIAK² & Lubomira BURCHARDT¹

¹Department of Hydrobiology, Institute of Environmental Biology, Adam Mickiewicz University, Umultowska 89, PL-61-614 Poznań, Poland; phone/fax: ++ 48 61 829 57 64, e-mail: hydro@amu.edu.pl

²Department of Plant Molecular Biology, Institute of Molecular Biology and Biotechnology, Adam Mickiewicz University, Miedzichodzka 5, PL-60-371 Poznań, Poland

Abstract: The *Planktothrix agardhii* isolates obtained from four lowland, shallow Polish hypertrophic lakes during water bloom events were investigated. In order to define what genetic type the investigated isolates belong to, the sequencing of the intergenic spacer (IGS) of the *psaAB* and the *rbcLX* genes was carried out. Additionally, the comparison of the investigated isolates with three strains from the NIVA Culture Collection was performed. Our results of genetic structure of *P. agardhii* populations in hypertrophic shallow lakes in Poland showed similarity to those obtained from the lakes of western and northern Europe. The analyses of 8 isolates of the *psa* loci and the analyses of 5 isolates of the *rbc* loci revealed sequence homogeneity among the investigated isolates. The new polymorphic sites in the IGS of the *psa* loci (substitution and deletion) may represent another type of *P. agardhii* strain, characteristic of nutrient-rich and shallow lakes.

Key words: Cyanobacteria, *Planktothrix agardhii*, *psaAB* loci, *rbcLX* loci, polymorphic sites.

Abbreviations: IGS, intergenic spacer.

Introduction

Planktothrix agardhii (Gom.) Anagn. et Kom. is a filamentous blue-green alga that can produce hepatotoxins and neurotoxins dangerous to animals and humans (LINDHOLM & MERILUOTO, 1991; LUUKKAINEN et al., 1993; KEIL et al., 2001). This cyanobacterium is characteristic of shallow, nutrient-rich lakes throughout the world (VAN LIERE & MUR, 1980; BERGER, 1984; RÜCKER et al., 1997). It is also frequently noted in the lakes of Poland due to advanced eutrophication process (GOLDYN et al., 1997; MESSYASZ, 1998; 1999; ZĘBEK, 1998; STEFANIAK et al., 2003). The taxonomic identifications of cyanobacteria from the genus *Planktothrix* were improved when molecular approaches developed by RUDI et al. (1998) as well as by HUMBERT & LE BERRE (2001) and HAYES et al. (2002) were applied in the analyses. Some studies have shown that populations of the genus *Planktothrix* found in lake during the water-bloom event can be clonal, however, to prove it, more gene regions have to be analysed. For that reason multilocus sequence typing, proposed by FEIL & SPRATT (2001), seems to be the appropriate approach.

Comparative studies concerning polymorphism in

the *psaAB* and the *rbcLX* loci of *Planktothrix agardhii* and *Planktothrix rubescens* strains, carried out by HUMBERT & LE BERRE (2001), revealed the presence of a few types of *Planktothrix* strains during blooms from the lakes in France, Switzerland, as well as in England, Norway, Sweden and Ireland. Sequences of the *rbc* genes, specific to photosynthetic prokaryotes, are often used in studies of polymorphism (RUDI et al., 1998; BEARD et al., 1999). The usefulness of the sequences of the *psa* genes, encoding proteins involved in structural organization of photosystem I (PSI), was demonstrated by HUMBERT & LE BERRE (2001). These sequences also play an important role in polymorphic analyses of chloroplasts genomes.

Based on the results of HUMBERT & LE BERRE (2001) we hypothesized that *P. agardhii* populations in Polish hypertrophic shallow lakes show the same genetic structure as strains in deep alpine lakes. However, probability of lateral gene transfer, that cause reassortment of alleles within populations, suggests, that genetic structure of cyanobacterial populations varies both in space and time (HAYES et al., 2002).

The aim of this study was to evaluate whether the isolates of *P. agardhii* obtained from several hy-

* Corresponding author