ABSTRACT

Environment in Polar Regions is characterized by many extremes. Low temperatures, lack of fluid water, irregular nutrient and light supply, fluctuations in daily and annual cycles could seem unfavourable for life. In spite of this, diatoms (Bacillariophyceae) are one of groups of microorganisms that apparently well adapted to such environment and dominate in a wide range of polar habitats. For many organisms, dormancy is a strategy to overcome unfriendly conditions, but morphologically distinct resting stages are observed rarely in diatoms. In this study, the tolerance of polar and temperate diatoms to freezing was experimentally tested and the difference in survivability of vegetative and resting cells was assessed.

Diatom strains for the experiments were isolated in 2014 using natural samples from the Maritime Antarctica (James Ross Island, Vega Island) and the Arctic (Spitsbergen). Further strains were acquired from culture collections of microorganisms (CCCryo and BCCM). Resting cells were induced by incubation under nitrogen and light limitation in lower temperature. The vegetative and resting cells of 26 strains were exposed to six different freezing treatments (including those simulating natural conditions) to –4 °C, –20 °C, –40 °C and –180 °C (liquid nitrogen). Treatments differed also in the rate of freezing and thawing (continuous versus abrupt).

The study concludes that diatoms are sensitive to freezing. The difference in survival between polar and temperate diatoms was not significant. All the strains survived the –4 °C treatment. Most of the strains survived –20 °C using continuous freezing followed by fast thawing. Abrupt freezing and slow thawing was not lethal only for two strains, suggesting that the rate of freezing and melting plays an important role in survival. Five strains withstood the –40 °C freezing experiment and four of these were also resistant to the –180 °C treatment followed by fast thawing. These were strains belonging to the *Pinnularia borealis* species complex. Cryopreservation treatment using cryoprotectant DMSO was not lethal only for two polar out of six tested strains. The importance of resting cells for the freezing survival was not confirmed.

Key words: diatoms, Bacillariophyceae, polar microorganisms, freezing survival, stress tolerance, dormancy, cryopreservation