Unicellular green algae as a model for genotype resistance to oxidative stress

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Summary

Relevance of the problem: Mechanisms involved in the formation of genotypes' resistance to abiotic stress are of great importance for better understanding the processes involved in the formation of a genetic elite of populations and radio-chemo-therapy. The common strategy is to use resistant or sensitive mutant strains, lines, or GMO organisms. Recently, scientists have focused on extremophiles species and strains growing in extreme environmental conditions (high-low temperatures, salinity, acidic or alkaline pH of the environment, high pollution with heavy metals, etc.), speculating that these organisms could be used to clarify the adaptive mechanisms giving them the chance to survive in various extreme conditions.

Based on this here, a new approach was applied: two extremophilic strains of *Chlorella vulgaris* - *C.vulgaris* Antarctic, isolated from the soil of Livingstone Island, Antarctic, and *C.vulgaris* 8/1, isolated from hot spring in the Rupite region, and *C.kessleri* as a control mesophylic strain.

For more than 50 years unicellular green algae Chlorella is a robust model for different studies in the field of physiology, genetics, environmental mutagenesis, biophysics, and biochemistry because it is widespread photoautotrophic eukaryotes with typical plant cell structure, and genome organization so that the results could be extrapolated to higher plants; single-cell organisms so that

the response of a single cell is equivalent to the response of an individual organism; with a haploid genome so that the induced recessive mutations are revealed in the first generation, short life cycle and routine inexpensive laboratory cultivation techniques, very appropriate for molecular studies.

Hypothesis: The unicellular green algae of the genus Chlorella isolated from habitats with different extreme environmental conditions would have similar and/or more efficient cellular defense mechanisms compared to mesophilic strain and could be used in the future as a good model for studying the mechanisms involved in the formation of genotype's resistance to oxidative stress

Main results: Results presented here illustrate that taxons investigated by us differ in their cell survival, growth rate, photoreactivation, and dark repair, as well as in their DNA double-strand breaks repair capacity and constitutive and induced levels of HSP70B. Both extremophilic strains *Chlorella vulgaris* Antarctic and *Chlorella vulgaris* 8/1, isolated from habitats with very different environments (one of them isolated from the soil in Antarctic and strain 8/1 isolated from a hot spring) have developed very similar defense mechanisms. These strains possess high constitutive and induced levels of heat shock proteins (HSP70B), as well as they are photo- and dark repair proficient, with a good capacity to repair DSBs, induced in DNA after UV-B irradiation. The mesophilic *Chlorella kessleri* is probably with impaired dark repair and with a high level of DNA susceptibility to UV-B irradiation, measured as DSBs. On the other hand, using a complex of microbiological and molecular methods (survival, growth rate, levels of induced and repaired DNA damage, induction of HSP70B) some differences were found between responses of the both extremophilic strains: the extremophilic strain *Chlorella vulgaris* Antarctic has the highest capacity to overcome UV-B induced and temperature stress. Our finding could be explained by the fact that the strain 8/1 was cultivated in laboratory conditions for more than 50 years. Despite this, *C. vulgaris* 8/1 was found to possess better developed defense systems compared to the mesophilic *C. kessleri.*

Contribution: It was shown by us, that extremophilic organisms could be used for a better understanding of the molecular mechanisms involved in the formation of the cellular resistance to environmental stress; as models for investigating how biomolecules are stabilized when subjected to extreme conditions; the overproduction of HSP70B can be used as an early warning marker for the assessment of temperature-induced stress as well as for predicting an organism's responses to global climate change.