Greenhouse effect, chemical contamination of water and microalgae

Á. Cid[1], M. Esperanza[1], M. González-Pleiter[2], C. Herrero[1], C. Rioboo[1] and M. Seoane[1]

[1] Laboratorio de Microbiología, Facultad de Ciencias, Universidade da Coruña, 15071 A Coruña, Spain
[2] Departamento de Biología, Facultad de Ciencias, Universidad Autónoma de Madrid, 28049 Madrid, Spain
E-mail: angeles.cid@udc.es

Human activities have strengthened the greenhouse effect and caused global warming. CO_2 is one of the major gases contributing to this greenhouse effect, but also is the source of carbon for the photosynthetic organisms. In a global climate change scenario with a dramatic increase in CO_2 levels, we need to know the behavior of carbon fixing organisms.

Microalgae are critical to global biogeochemistry since they produce the bulk of oxygen on Earth through photosynthesis, whereas transform atmospheric CO_2 into organic matter; however, chemical contamination of freshwater and marine environments provokes dramatic effects on microalgae, being the photosynthetic process one of the most altered.

Alterations provoked by a traditional aquatic pollutant (the herbicide atrazine, ATZ) and an emergent pollutant (the disinfectant triclosan, TCS) were studied in the model microalga *Chlamydomonas reinhardtii*.

Under near *in vivo* conditions, it has been observed that sublethal ATZ concentration provoked the decrease of cellular activity and chlorophyll *a* fluorescence, plasma membrane depolarization and hyperpolarization of mitochondrial membrane. These alterations, combined with the most significant changes in gene expression (amino acids catabolism and respiratory cellular process), suggest that photosynthesis inhibition leads cells to get energy through a heterotrophic metabolism to maintain their viability.

Furthermore, the same ATZ concentration provoked a premature senescence of microalgal cells, based on increase of caspase activity, number of cells with auto-phagosomes and alterations in the nuclei morphology. ROS-mediated DNA oxidation contributes to premature senescence in microalgal cells.

TCS also induced ROS overproduction which ultimately leads to oxidative stress with loss of membrane integrity, membrane depolarization, photosynthesis inhibition and mitochondrial membrane depolarization. An increase in caspase activity and altered expression of metacaspase genes, which are indicative of apoptosis, were also induced by TCS.

Stress responses to pollutants include changes in gene expression, alterations in photosynthesis, and a putative apoptotic response in *Chlamydomonas reinhardtii*. Despite these alterations, the cells were able to overcome stress and maintain cellular viability; however, aquatic pollution could lead to a dramatic decrease in CO_2 fixation at a global level, being the worst consequence in a global climate change scenario.

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