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Interactive Effects of Temperature and UV Radiation on Photosynthesis of *Chlorella* Strains from Polar, Temperate and Tropical Environments: Differential Impacts on Damage and Repair

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Abstract

Global warming and ozone depletion, and the resulting increase of ultraviolet radiation (UVR), have far-reaching impacts on biota, especially affecting the algae that form the basis of the food webs in aquatic ecosystems. The aim of the present study was to investigate the interactive effects of temperature and UVR by comparing the photosynthetic responses of similar taxa of *Chlorella* from Antarctic (*Chlorella* UMACC 237), temperate (*Chlorella vulgaris* UMACC 248) and tropical (*Chlorella vulgaris* UMACC 001) environments. The cultures were exposed to three different treatments: photosynthetically active radiation (PAR; 400–700 nm), PAR plus ultraviolet-A (320–400 nm) radiation (PAR + UV-A) and PAR plus UV-A and ultraviolet-B (280–320 nm) radiation (PAR + UV-A + UV-B) for one hour in incubators set at different temperatures. The Antarctic *Chlorella* was exposed to 4, 14 and 20°C. The temperate *Chlorella* was exposed to 11, 18 and 25°C while the tropical *Chlorella* was exposed to 24, 28 and 30°C. A pulse-amplitude modulated (PAM) fluorometer was used to assess the photosynthetic response of microalgae. Parameters such as the photoadaptive index (E_k) and light harvesting efficiency (α) were determined from rapid light curves. The damage (*k*) and repair (*r*) rates were calculated from the decrease in $\Phi PSII_{eff}$ over time during exposure response curves where cells were exposed to the various combinations of PAR and UVR, and fitting the data to the Kok model. The results showed that UV-A caused much lower inhibition than UV-B in photosynthesis in all *Chlorella* isolates. The three isolates of *Chlorella* from different regions showed different trends in their photosynthesis responses under the combined effects of UVR (PAR + UV-A + UV-B) and temperature. In accordance with the noted strain-specific characteristics, we can conclude that the repair (*r*)