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Transcriptome sequencing of an Antarctic microalga, *Chlorella* sp. (Trebouxiophyceae, Chlorophyta) subjected to short-term ultraviolet radiation stress

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Abstract Stratospheric ozone depletion has led to increasing levels of ultraviolet radiation (UVR) reaching the Earth's surface. Elevated UVR, particularly in the high latitudes, potentially causes shifts in species composition and diversity in various ecosystems, consequently altering the biogeochemical cycles. Microalgae are not only ecologically important as primary producers, generating atmospheric oxygen and sequestering carbon dioxide; they are also economically important as sources of health supplement, pigments, biofuel and others. Changes to the size and composition of algal communities can lead to profound impacts to the fisheries productivity. There have been studies on the effects of UVR on the growth, photosynthesis and biochemical composition of microalgae, but limited information on the underlying molecular mechanisms involved in the response and adaptation of microalgae to UVR is available. We employed RNA-seq to quantitatively evaluate and compare the transcriptomes of an Antarctic freshwater *Chlorella* sp. grown at ambient versus elevated UVR conditions. Differentially expressed genes, relating to the fatty acid degradation, amino acid metabolism, starch and sucrose metabolism and peroxisome pathways, suggest conservation and remobilisation of energy resources, maintenance of newly synthesised protein and inhibition of protein degradation, ensuring membrane lipid homeostasis and regulating antioxidative mechanisms, as the acclimation strategies in response to UVR. These findings expand current knowledge of gene expression in polar *Chlorella* sp. in response to short-term UVR. Studies on stress tolerance mechanisms are important to understand and predict future impacts of climate change. Genes, proteins and pathways identified from these adaptable polar algae have potentially far-reaching biotechnological applications.

Keywords Fatty acid degradation · Peroxisome · RNA-seq · Starch and sucrose metabolism

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Introduction

The depletion of atmospheric ozone, particularly (but not exclusively) at high latitudes by atmospheric pollutants, has led to an increase in the levels of ultraviolet radiation (UVR) reaching the Earth's surface. Despite reductions in ozone-depleting emissions of chlorofluorocarbons (CFCs), the stratospheric ozone holes over the polar regions (more prominently over Antarctica) and elevated UVR at high- and mid-latitudes are expected to persist until at least 2050 or beyond (Madronich et al. 1998; Salawitch 1998). Although the total ozone column is steadily registering a return to its pre-depletion levels, it still varies in periods of varying chemical

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