Facing climate change: Effects of temperature and salinity on fatty acid content in Antarctic plankton

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Marine planktonic communities in Antarctica are increasingly exposed to higher surface temperatures from global ocean warming and to reduced salinities from enhanced glacial melting. We performed a 7-day microcosm experiment on the shores of Potter Bay in King George Island, in which we assessed the effects of an increase (4 ºC) in temperature (T) and a decrease (4 units) in salinity (S) on plankton composition, carbon content, fatty acid (content and composition) and Thiobarbituric Acid Reactive Substances (TBARS) content as a measure of lipid damage from oxidative stress. Triplicate microcosms were exposed to four treatments: ambient T&S (control), ambient T-lower S, higher T-ambient S, and higher T-lower S. Phytoplankton assemblages showed an increase in the relative abundance of diatoms >20 µm in size in the manipulation treatments compared to the control, an increase in smaller diatoms (10-20 µm) only at higher T-ambient S, and a decrease in prasinophytes at higher T-lower S. Carbon content increased significantly in the higher T-ambient S and higher T-lower S treatments, with maximum values after 5 days. A significant increase in the relative abundance of unsaturated fatty acids EPA, C18:4ω3 and C16:1ω7, was measured in all treatments, compared to the control, after only 24 h. However, after 48 h, the increase in abundance of unsaturated fatty acid was only sustained at ambient T-lower S and at higher T-ambient S. The fatty acid composition changes measured under both ambient T-lower S and higher T-ambient S treatments, resulted in an increase in TBARS content by 48 h. However, at higher T-lower S, the increase in the proportion of unsaturated fatty acids was not different than that in the control. This may indicate that at low salinity, elevated temperatures increase enzymatic activity, which decreases the fluidity of cell's membranes, and therefore helps to avoid osmotic stress and the production of reactive oxygen species. Interestingly, although fatty acid composition showed variations for at least 48 h, there was no change in phytoplankton assemblages during this period in any of the manipulation treatments compared to the control. Physiological changes on plankton carbon fixation and fatty acid levels due to these stressors can have serious implications for food-web energy flow and the overall functioning of Antarctic coastal ecosystems.