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Molecular response of *Sargassum vulgare* to acidification at volcanic CO_2 vents: insights from de novo transcriptomic analysis

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Abstract

Ocean acidification is an emerging problem that is expected to impact ocean species to varying degrees. Currently, little is known about its effect on molecular mechanisms induced in fleshy macroalgae. To elucidate genome wide responses to acidification, a transcriptome analysis was carried out on *Sargassum vulgare* populations growing under acidified conditions at volcanic CO_2 vents and compared with populations in a control site. Several transcripts involved in a wide range of cellular and metabolic processes were differentially expressed. No drastic changes were observed in the carbon acquisition processes and RuBisCO level. Moreover, relatively few stress genes, including those for antioxidant enzymes and heat-shock proteins, were affected. Instead, increased expression of transcripts involved in energy metabolism, photosynthetic processes and ion homeostasis suggested that algae increased energy production to maintain ion homeostasis and other cellular processes. Also, an increased allocation of carbon to cell wall and carbon storage was observed. A number of genes encoding proteins involved in cellular signalling, information storage and processing and transposition were differentially expressed between the two conditions. The transcriptional changes of key enzymes were largely confirmed by enzymatic activity measurements. Altogether, the changes induced by acidification indicate an adaptation of growth and development of *S. vulgare* at the volcanic CO_2 vents, suggesting that this fleshy alga exhibits a high plasticity to low pH and can adopt molecular strategies to grow also in future more acidified waters.

Keywords: brown algae, climate change, CO_2 vents, fleshy macroalgae, molecular response, mRNA-Seq, ocean acidification

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Introduction

The anthropogenic emission of carbon dioxide (CO_2) in the atmosphere has increased in the postindustrialization era and it is still accelerating. Over the last 200 years, oceans have absorbed a major portion of these emissions, acting as an efficient sink for CO_2 (Sabine *et al.* 2004). However, current CO_2 emission rates exceed the buffering capacity of the oceans and cause a shift of marine carbonate chemistry and a decrease of pH. Consequently, oceanic pH, which has already decreased 0.1 units since last century, might face a drop of extra 0.3–0.5 units by the end of this century, a phenomenon known as ocean acidification (OA; Caldeira & Wickett 2005).

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