Sargassum vulgare adaptation under natural acidified conditions

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Abstract

The influence of ocean acidification on marine organisms is an emerging global concern. However, there are uncertainties on its effect on fleshy macroalgae as most of the related studies have been performed in the laboratory conditions for short term. Volcanic CO_2 seeps are the ideal sites to improve our understanding on macroalgal acclimatization/adaptation to ocean acidification. In the present work, populations of brown alga *Sargassum vulgare* growing in the most acidified site of volcanic CO_2 vents (Castello Aragonese off Ischia Island, Italy) were compared with those growing in the control site (Lacco Ameno, another side of Ischia Island) in order to investigate their long term response and adaptation potential under acidification. A multidisciplinary approach was used combining physiological assessment (photosynthesis measurements), biochemical assays (oxidative/nitrosative stress markers and antioxidant status), and –omics tools (transcriptome, and proteome analysis).

The transcriptome analysis of long term acclimatized alga revealed alteration of several cellular and metabolic processes under acidification, in particular, genes related to carbon and energy metabolism, cellular signaling, transcription factors, and transposons. However, a few of the antioxidant and HSPs genes were differentially expressed with most of them being down-regulated, and expression of the genes encoding rubisco and carbonic anhydrase being unaffected. Direct differential protein expression by Mass Spectrometry supported the transcriptome results. These results indicate long term adaptive response of local population of *S. vulgare* to acidification. There was no signal of physiological and biochemical stress in alga at the acidified site, supporting the hypothesis of their acclimatization/adaptation. The transcriptome

wide polymorphism (SNPs) analysis confirmed strong genetic differentiation between the two compared populations. Further, *in situ* reciprocal transplantations performed to compare short and long term response of *S. vulgare* to lowered pH indicated sign of physiological stress in alga transplanted from acidified to control site. Overall, my PhD work suggests that fleshy macroalgae have potential to overcome the negative effects of ocean acidification and sustain themselves in the future acidified ocean, if acclimatized for longer periods.