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Impact of medium-term exposure to elevated pCO_2 levels on the physiological energetics of the mussel *Mytilus chilensis*

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HIGHLIGHTS

- New results about ocean acidification in the southern region of South America.
- First study of the effects of acidification on the physiology of a chilean bivalve.
- Effects of ocean acidification on the mussel farming.

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ABSTRACT

This study evaluated the impact of medium-term exposure to elevated pCO_2 levels (750–1200 ppm) on the physiological processes of juvenile *Mytilus chilensis* mussels over a period of 70 d in a mesocosm system. Three equilibration tanks filled with filtered seawater were adjusted to three pCO_2 levels: ~380 (control), ~750 and ~1200 ppm by bubbling air or an air–CO_2 mixture through the water. For the control, atmospheric air (with aprox. 380 ppm CO_2) was bubbled into the tank; for the 750 and 1200 ppm treatments, dry air and pure CO_2 were blended to each target concentration using mass flow controllers for air and CO_2. No impact on feeding activity was observed at the beginning of the experiment, but a significant reduction in clearance rate was observed after 35 d of exposure to highly acidified seawater. Absorption rate and absorption efficiency were reduced at high pCO_2 levels. In addition, oxygen uptake fell significantly under these conditions, indicating a metabolic depression. These physiological responses of the mussels resulted in a significant reduction of energy available for growth (scope for growth) with important consequences for the aquaculture of this species during medium-term exposure to acid conditions. The results of this study clearly indicate that high pCO_2 levels in the seawater have a negative effect on the health of *M. chilensis*. Therefore, the predicted acidification of seawater associated with global climate change could be harmful to this ecologically and commercially important mussel.

1. Introduction

Atmospheric CO_2 diffuses passively into the ocean surface water and causes an increase in the partial pressure of CO_2, this reaction involves the formation of carbonic acid which lowers the pH of the ocean (ocean acidification; OA). According to the current tendency of global climate change, it is expected that by the end of this century the atmospheric CO_2 concentration could reach 750 ppm which would reduce the pH of the surface water by 0.2 units (Wolf-Gladrow et al., 1999; Meehl et al., 2007) and will exceed 1500 ppm between the years 2100–2200, with a corresponding decrease in the seawater pH by 0.5 units (Wigley et al., 1996; Caldeira and Wickett, 2003; Pörtner et al., 2004). The increase in atmospheric pCO_2 to 800 ppm, will reduce the availability of carbonate ions by 60%, creating a serious environmental problem that marine organisms must face (Feely et al., 2004). A drop in pH and a decrease in the carbonate availability are known to negatively affect the calcification processes of many marine organisms (Riebesell et al., 2000; Orr et al., 2005; Miles et al., 2007).

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