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Exploring the uptake pathways of calcium and some trace elements in the marine bivalve, Mytilus edulis using isolated gill tissues

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Marine organisms take up elements from the surrounding water and ingested food. Most elements enter organisms through the soft tissues before being incorporated into the hard tissues or skeletons. Some elements may be used as proxies of environmental conditions (temperature, salinity, pH). Therefore, shells of marine bivalves are potential records of past climatic changes. Understanding the fundamental mechanisms of how elements are taken up from the environment by organisms is critical in making the extrapolation of recorded proxies in the shells to environmental conditions. We investigated the pathways by which different metals (Ag, Ca, Cd, Co, Cu, Hg and Pb) enter the soft tissues of mussels via the gills. In mussels, as is the case in other aquatic species, gills are the main entry point into organisms for most dissolved ions in the water. Metal uptake experiments were conducted at different ambient metal concentrations and results showed a clear linear relationship between ambient and accumulated metals in the gills. The uptake pathways investigated include calcium channels, Na/K pump, anion exchangers and ATP dependent transport. Groups of gills were exposed to inhibitors of these pathways prior to exposure to metals. Results showed that each of the metals studied was affected by more than one type of inhibitor and interestingly, the metabolic inhibitors were effective in decreasing uptake of all the metals. From these results, it can be concluded that at least in marine mussels, entry into the gills for most trace elements is not restricted to one or two specific routes but rather may involve multiple pathways and that the involvement of energy in the form of ATP is probably more widespread than often assumed in some literature. The study has also shown that non -essential elements (i.e. Ag, Cd, Hg, Pb) can be transported via the pathways that are designed for biologically essential elements such as Na, K and Ca.

Key words: Climate change, proxies, calcium, trace elements, transport, gills, marine bivalves