RAPID ADJUSTMENT OF SODIUM TRANSPORT SYSTEMS UPON TRANSFER OF THE SHORE CRAB CARCINUS MAENAS FROM HIGH TO LOW SALINITY

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Euryhaline crustaceans such as the green shore crab Carcinus maenas allow their blood osmolarity to parallel that of the environment above a salinity of about 26 parts per thousand (ppt), but osmoregulate below that point using NaCl as the primary osmolyte. One of the major effectors of osmoregulation is the Na^++K^+-ATPase localized in the basolateral membrane of gill epithelial cells (Towle and Kays, J. Exp. Zool. 239:311-318, 1986). Na^++K^+-ATPase activity increases dramatically when Carcinus is transferred from high to low salinity (Siebers et al., Mar. Biol. 69:37-43, 1982). The apically-located electrogenic Na^+/H^+ antiporter also plays an important role in transepithelial movement of Na^+ (Burnett and Towle, J. Exp. Biol. 149:293-305, 1990).

To provide information regarding the regulation of these Na^+ transport systems, we measured the time response of blood Na^+ following abrupt transfer of crabs from full-strength to diluted seawater. Our premise was based on the idea that a rapid adjustment of blood Na^+ would likely depend on activation of the ATPase or antiporter (or both), while a slower adjustment could result from synthesis of new transport proteins. We collected Carcinus from the intertidal zone near Oak Point Lobster Pound, Trenton, Maine, and maintained them in a flow-through tank of ambient seawater (31 ppt salinity, 420 mmol l^{-1} Na^+) for a minimum of one week. We then transferred 10 animals to a recirculating tank of seawater diluted to 10 ppt salinity (123 mmol l^{-1} Na^+). Blood samples of 50-100 μl were collected by puncturing the base of the fourth walking leg. The samples were centrifuged in a microfuge for 10 minutes and then diluted 5X for flame photometry, standardizing the instrument after every five samples. To minimize the effect of repetitive sampling, one group of animals was used for the 0- to 10.5-hour samples, and a second group for the 12- to 24-hour samples.

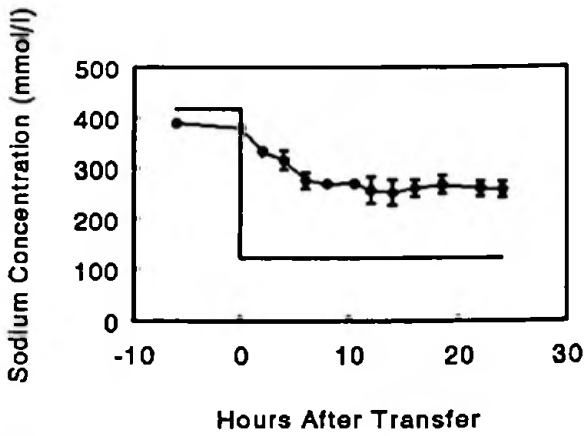

Figure 1. Response of blood Na^+ (circles) following abrupt transfer of Carcinus from 31 to 10 ppt seawater (solid line). (N=5, mean ± S.E.)

We demonstrated that blood sodium levels declined following abrupt transfer of crabs from high to low salinity but approached a level of stability within six hours after the transfer (Fig. 1). The rapidity of response indicates that the effectors of sodium transport in crab gill are regulated by mechanisms other than protein synthesis. The possibility that the antiporter or the Na^++K^+-ATPase may be regulated by phosphorylation is currently under study.

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