Environmental factors responsible for switching on renal SO_4^{2-} regulatory systems in seawater eels

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Eels live in both SO_4^{2-}-deficient (0.2 mM) freshwater and SO_4^{2-}-excessive (30 mM) seawater, but they maintain plasma SO_4^{2-} concentration lower in seawater (1 mM) than in freshwater (7 mM). This inconsistent phenomenon suggests that drastic changes may occur in SO_4^{2-} regulation after transfer of eels from freshwater to seawater. In this study, we found that: 1) most environmental SO_4^{2-} ions enter the circulation via the gills (85%) and excess SO_4^{2-} ions are excreted via the kidney (95%) in seawater eels using $^{35}SO_4^{2-}$, 2) active renal SO_4^{2-} excretion is achieved by SO_4^{2-} transporters (Slc26a6a, b, c and Slc26a1) that are localized on either apical or basolateral membrane of epithelial cells in different segments of renal proximal tubule of seawater eels, 3) drastic changes in the transporter gene expression (down-regulation of absorptive (freshwater)-type *Slc13a1* and up-regulation of excretory (seawater)-type *Slc26a6a*) occur 3 days after transfer of freshwater eels to seawater, and 4) Na^+ and Cl^- (not SO_4^{2-})in seawater and subsequent elevation of plasma Cl^- concentration by uptake via Na-Cl co-transporter may cause the switching of SO_4^{2-} regulation in the kidney. This is the first report to identify environmental factors responsible for switching the regulatory system in response to environmental changes.