

Functional Analysis of Magnesium Efflux Transporters Localized to the Plasma Membrane and Intracellular Vesicles

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Summary

Marine teleosts live in water containing ~50 mM Mg^{2+} , thus they are at the risk of exposure to excess Mg^{2+} . To maintain plasma Mg^{2+} concentration at 1-2 mM, marine teleosts secrete Mg^{2+} into primary urine and excrete final urine that contains ~150 mM Mg^{2+} . From analyses of the kidney of marine teleosts, we identified solute carrier family 41 member 1 (Slc41a1) and cyclin and CBS domain divalent metal cation transport mediator 3 (Cnm3) as Mg^{2+} efflux transporters, and proposed a molecular model for Mg^{2+} secretion by the proximal tubule of marine teleosts. Interestingly, Slc41a1 and Cnm3 are localized to intracellular vesicles and basolateral membrane, respectively. To compare Mg^{2+} efflux system between human and fish at molecular level, we developed methods to analyze the activities of Slc41 and Cnm Mg^{2+} transporter families expressed in *Xenopus* oocytes. We succeeded to analyze intracellular free Mg^{2+} concentration, whole Mg^{2+} content, and Mg^{2+} -dependent membrane current by ion-selective microelectrode, inductively coupled plasma mass spectrometry (ICP-MS), and two-electrode voltage clamp, respectively. These methods are useful to identify and characterize Mg^{2+} -efflux activities of Slc41 and Cnm families in human and fish.