ACTIVE SULFATE SECRETION BY THE INTESTINE OF WINTER FLOUNDER (*PLEURONECTES AMERICANUS*)

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Marine teleosts must drink seawater to prevent dehydration; thus, the intestine plays an essential role in ionic and osmotic homeostasis. Fluid entering the intestine is isosmotic with plasma due (in part) to desalination in the esophagus (Hirano, T., and Mayer-Gostan, N., Proc. Natl. Acad.Sci. USA 73: 1348-1350,1976). Active absorption of sodium and chloride by the intestine drives water absorption (Skadhauge, E., J. Physiol. 204: 135-158,1969). Divalent ions are also ingested and absorbed in large quantities during drinking. However, the mechanisms of divalent ion transport by the marine teleost intestine are not well understood. In preliminary experiments reported here we have determined the direction and mechanism of sulfate transport by the intestine of winter flounder (*Pleuronectes americanus*).

Paired Ussing chambers were used to measure unidirectional fluxes of radioactive sulfate ($^{35}SO_4^{2-}$) across the intestinal epithelium of winter flounder. Under short-circuited conditions sulfate was actively secreted (blood-to-lumen) at a rate of 7.42 ± 0.63 nmoles x cm^{-2} x hr^{-1} (n=23). The transepithelial potential difference (TPD) and resistance (TER) averaged 0.83 ± 0.17 mV (mucosal positive) and 37.1 ± 3.81Ω x cm^2, respectively. Short-circuit current (Isc), a measure of chloride absorption across this tissue was −10.0 ± 1.02 μA x cm^{-2}. The electrical properties (TPD, TER and Isc) of this epithelium are in good agreement with published results (Field, M. *et al.*, J. Membrane Biol. 41: 265-293,1978). Application of sodium cyanide (10 mM) abolished net sulfate transport. Ouabain (0.1 mM) lowered net sulfate secretion to 25 % of the control value by reducing the secretory flux. Taken together, the effects of sodium cyanide and ouabain suggest that active sulfate secretion is metabolically and sodium-gradient dependent.

In the marine teleost renal proximal tubule (Renfro, J.L. and Pritchard, J.B., Am. J. Physiol. 244: F488-F496, 1983) sulfate secretion occurs by anion exchange, and this prompted the examination of similar mechanisms in the intestine. In the present study, net sulfate transport decreased to zero following removal of lumenal chloride and bicarbonate. Removal of lumenal chloride alone lowered net sulfate secretion by 75 % while removal of lumenal bicarbonate increased net secretion by 50 %. The anion exchange inhibitor DIDS (4,4'-diisothiocyanatostilbene-2-2'-disulfonic acid, 0.2 mM) had no effect when applied to the serosal side; however, mucosal application reduced net secretion to 52 % of the control value. Neither serosal nor mucosal DIDS altered TPD, TER or Isc. Net sulfate secretion was reduced to zero in fish fed (i.e. food in stomach) just prior to flux measurements. Feeding decreased unidirectional secretion 33% and increased absorption 100 %. Vasoactive intestinal peptide (VIP, 10^{-6} M), a gastrointestinal tract hormone known to stimulate pancreatic duct bicarbonate secretion in mammals, reduced flounder intestinal net sulfate secretion 56% through a reduction in secretion and increase in absorption similar to that elicited by feeding.

This preliminary investigation has identified active sulfate secretion by the marine teleost intestine, a process facilitated by a lumenal anion exchanger with greater affinity for chloride than bicarbonate. Feeding and VIP reduce sulfate secretion indicating that this mechanism may be hormonally controlled. Supported by NSF-IBN0078093.