

with the water space at 60 minutes (about 30%) and remained constant thereafter. Equilibration of ^3HOH between plasma and tissue water was complete within 10 minutes.

Bile. The ratio of bile water to plasma water is 0.78. Virtually no ^{14}C -inulin was present in the bile after 20 hours. The space at 20 hours for sucrose, mannitol, and chloride ranged from 5 to 22%; ethylene glycol and urea had 35% and 78% spaces, respectively, at this time. At 30 minutes the ^3HOH space was considerably less than the bile water space.

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TRANSPORT OF SODIUM AND Na-K-ATPase IN GILLS OF Anguilla rostrata DURING ADAPTATION TO SALTWATER: THE EFFECT OF PRETREATMENT WITH CORTISOL

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A feature of saltwater adaptation in the European eel, Anguilla anguilla, is reported to be a prompt increase in outflux of isotopic sodium across the gill when freshwater eels are immersed in seawater, so that within 24-48 hours the rate of efflux characteristic of fully adapted saltwater fish is attained. The present studies indicate that the course of adaptation to seawater by the American eel, Anguilla rostrata, is considerably more prolonged, permitting a close analysis of the relationship between Na-K-ATPase activity and gill transport of Na^+ , at a time when both are changing.

Hypophysectomy of saltwater eels results in a lowered sodium outflux across the gills and an elevated serum sodium which may be restored to normal by either ACTH or cortisol. In freshwater Anguilla rostrata, treatment with cortisol induces a rise in gill Na-K-ATPase similar to that elicited by transfer to saltwater (Bull. MDIBL, 9:9-10, 1969). The present experiments were designed to measure both the specific activity of Na-K-ATPase and the gill transport

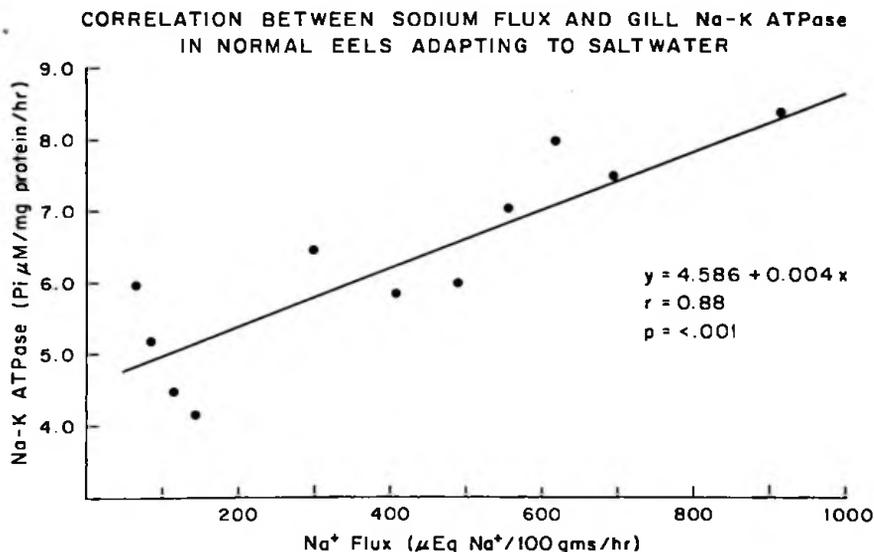


Figure 1

of sodium in normal and cortisol treated eels during adaptation to saltwater. Enzyme activity, gill outflux of sodium measured by ^{22}Na , and serum sodium concentrations were determined in 54 normal and cortisol treated eels after 0-14 days of adaptation.

As shown in Table 1, during early adaptation (1-2 days) sodium outflux of intact eels was low ($126 \pm 27.8 \mu\text{eq}/100 \text{ g/hr}$) and (not shown) hypernatremia ($227 \pm 5.4 \text{ meq/L}$) developed. By 10-14 days sodium outflux had gradually increased to 8 times its original value and serum sodium fell to $169 \pm 7.2 \text{ meq/L}$. Na-K-ATPase activity was doubled by complete adaptation to sea-

Table 1
GILL SODIUM FLUX AFTER SALTWATER ADAPTATION IN NORMAL
AND CORTISOL TREATED EELS

Saltwater adaptation	Normal eels		Cortisol eels	
	n	Na+ flux (meq/100 gm/hr) \pm S.E.	n	Na+ flux (meq/100 gm/hr) \pm S.E.
Immediate transfer	3	67 \pm 16	2	165 \pm 6
1 day	4	135 \pm 25	2	475 \pm 19
2 days	3	115 \pm 63	2	523 \pm 311
3 days	4	82 \pm 30	4	926 \pm 353
4 days	2	298 \pm 153	4	879 \pm 133
5 days	3	555 \pm 91	2	686 \pm 54
6 days	3	618 \pm 81		
7 days	2	488 \pm 16		
8 days	4	408 \pm 28		
9 days	2	693 \pm 141		
14 days	6	918 \pm 50		

water and was correlated with sodium outflux ($r = 0.88$ $p < .001$). In contrast, cortisol-treated eels had slightly elevated sodium fluxes at 0 and 1 days and reached fully adapted levels as early as 3-4 days. The rapid increase in Na^+ outflux in cortisol treated eels was not associated with an increase in Na-K-ATPase above that already achieved by control treatment in fresh water.

These results suggest a direct relationship between the rate of sodium transport and the activity of Na-K-ATPase in the gill of Anguilla rostrata lending credence to the hypothesis that this enzyme is involved in active sodium transport in this species. Cortisol appears to act as a mineralocorticoid both by inducing an increase in Na-K-ATPase activity and permitting a rapid increase in the outflux of sodium thus shortening the time necessary for adaptation to seawater.