Ca^{2+} AND THE MAINTENANCE OF CELL VOLUME IN THE DOGFISH (*Squalus acanthias*) RECTAL GLAND

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Ca^{2+} is involved in cell volume regulation (Foskett and Spring, Am. J. Physiol. 248:C27,1986). We have examined the effect of Ca^{2+} on cell volume maintenance in slices of the dogfish rectal gland. Values for tissue H_2O (cellular, H_2O_i, and extracellular, H_2O_e), apparent Na_i^+, K_i^+, and Cl_i^-, as well as fluxes of $^{86}Rb^+$ in controls (standard elasmobranch saline, 3 mM Ca^{2+}) were compared with Ca^{2+}-free media (plus 0.2 mM EGTA). The effect of Ca^{2+} on the entry of ^3H-mannitol into the cells was determined as the difference between the steady-state tissue level of ^{14}C-polyethylene glycol and the tissue uptake of ^3H.

As compared with controls, the absence of Ca^{2+} increased H_2O_e by 33% ($P<0.05$, n=12) without affecting total tissue H_2O; hence, a slight contraction of cell volume was seen (Fig. 1, left); such conclusion was also borne out by light microscopy. These changes were associated with an uptake of cell Na and a loss of K (Fig. 1, right); a net increase of $(Na_i^+ + K_i^+)$ from 231 + 6 to 282 + 8mM,SE,n=4, also took place. A significant depolarization of the membrane was indicated by a decrease of the Donnan ratios for K^+ and Cl^- by 30%. No effect of Ca^{2+}-free conditions on the ouabain-sensitive $^{86}Rb^+$ influx (in μmole/g H_2O_i.min) was found: control: 0.650+0.041 SE; Ca^{2+}-free: 0.720+0.033 while the fast component of Rb^+ efflux from the cells was increased from 0.140.min^{-1} in controls to 0.212.min^{-1} in the absence of Ca^{2+}. The absence of external Ca^{2+} thus decreases tissue K^+ by increasing the efflux, without affecting the operation of the Na^+-pump. The absence of Ca^{2+} also increases the permability of the cell membrane to mannitol.

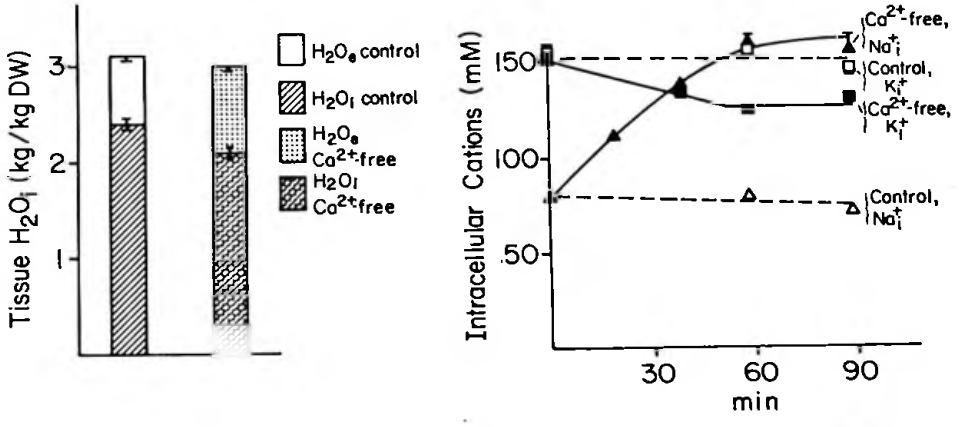

Fig. 1.
Effect of Ca^{2+}-free conditions on tissue H_2O and cations in slices of dogfish rectal gland.

The presence of the calcium ionophore, A 23187 (1 μM) in standard saline produced no effects on tissue water and electrolytes; hence, the effects of Ca^{2+} may be localized at the outer face of the cell membrane.

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