THIOL GROUPS AND THE EFFECT OF p-CHLOROMERCURIBENZENESULFONATE (PCMBS) ON THE SWELLING OF DOGFISH (SQUALUS ACANTHIAS) RECTAL GLAND CELLS

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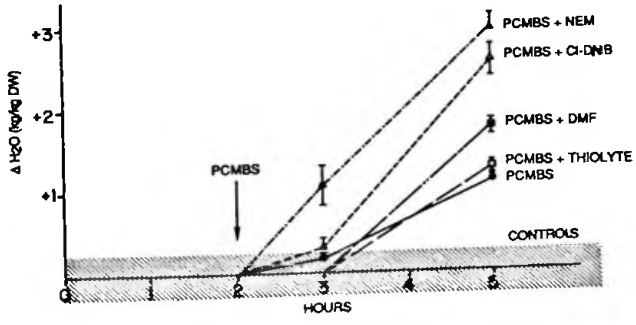
An interaction with (membrane) -SH groups is believed to be the basis of mercurial effects on cellular phenomena (A. Rothstein, Curr. Top. Membr. & Transp. 1:135, 1970). This report focuses on the role of -SH groups in membrane permeability and cell metabolism (cf. Booz et al., MDIBL Bull. 27:1, 1987) as related to volume changes of rectal gland cells.

The experimental procedures for work with rectal gland slices were described previously (Kleinzeller & Goldstein, J. Comp. Physiol. B154:561, 1984).

As opposed to the erythrocyte membrane (cf. Toon & Solomon, Biochem. Biophys. Acta. 860:361, 1986), 1 mM PCMBS does not affect the urea efflux from the cells: The fast rate constant was 0.259 min^{-1} in both controls and tissue treated with the mercurial for 2 h. Also, no effect of 1 mM N-ethylmaleimide (NEM) was found. On the other hand, even a 1 h treatment of the tissue with 1 mM PCMBS (and to a small extent, NEM) permeabilizes the membrane for Na^+ and K^+ (Booz et al., loc. cit.). Thus, a role of -SH in the permeabilization of the membrane can be postulated. A role of superficial -SH groups can be excluded since the selective reagent monobromotrimethyl-ammoniobimane (THIOLYTE MQ) (20 μM) was without effect.

Pretreatment of the tissue with agents reducing the cell level of glutathione (GSH), i.e. Cl-dinitrobenzene (Cl-DNB) (10 mM) or dimethyl-fumarate (DMF) (1 mM) (cf. Plummer et al., Methods in Enzymol. 77:50, 1981), as well as 1 mM NEM, greatly increased the swelling effect of PCMBS, while the reagents alone were without effect on cell volume (Fig. 1). These results are consistent with the following sequence of events: Cell GSH interacts with PCMBS entering the cells, thus protecting cell metabolism. By reducing the level of GSH, the increased cell level of PCMBS inhibits the Na,K-ATPase (cf. Booz et al., MDIBL Bull. 26:163, 1986). At the same time, the mercurial (Mills et al., this Bull.) (but not NEM or the other tested reagents) produces a breakdown of cell F-actin. The combined effects, inhibition of the Na,K-ATase and the breakdown of F-actin then leads to the observed cell swelling.



Effect of pretreatment of cells with thiol reagents on the swelling effect of PCMBS. Shaded area: controls (mean ± SE) without and with the respective thiol reagents (e.g. for tissue H_2O:time 0: 2.80±0.05; 5 h incubation with NEM: 2.97±0.09).

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