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The role of the concentration of hydroxylions in the antagonistic action of K and Ca upon Na.

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It has been proved during the last years that quite generally in animals, plants and bacteria, a poisonous solution of NaCl can be rendered harmless through the additon of small quantities of $\text{CaCl}_2 + \text{KCl}$. A number of years ago I published results of experiments which indicated that the rôle of Ca in these experiments was fundamentally different from that of K. When fertilized eggs of *Fundulus* were put into $m/2$ solution of NaCl which killed the eggs in a comparatively short time it was found that small quantities of CaCl_2 or certain other salts with a bivalent metal rendered the solution comparatively harmless; while the same cannot be accomplished through the addition of KCl, LiCl or NH_4Cl to the $m/2$ solutions of NaCl.

Recently I was able to show this difference in the action of Ca and K in a rather striking way. The fertilized eggs of *Strongylocentrotus* were put in the following four solutions: first NaCl; second, Na+K; third, Na+Ca; fourth, Na+Ca+K. The experiments were made with neutral as well as with acid and alkaline solutions. It was found that in the neutral and acid solution the antagonistic effect of K prevailed over that of Ca, which was very slight; while in alkaline solutions the antagonistic effect of Ca was comparatively strong, while that of K was rather slight.

If newly fertilized eggs of the sea urchin are put into a mixture of $\text{NaCl} + \text{KCl}$, one finds that if the solution is neutral, the eggs segment rather normally and they may reach the 64 cell stage. If, however, the solution is made faintly alkaline the eggs are cytolized without segmenting.

If, however, the similar experiment is made with a mixture of Na+Ca one finds that the eggs segment better and further when the solution is faintly alkaline than when it is neutral. To give an example: In a neutral mixture of Na+Ca in one experiment only 40 per cent. of the eggs of *Arbacia* segmented and these did not go

beyond the 2 cell stage; while in the alkaline solution all segmented and reached the 8 or even 16 cell stage. It should be added that the eggs of *Arbacia* will develop in a neutral solution of Na+K+Ca to the blastula stage.

I found also that in mixtures of Na+Mg or Na+Sr or Na+Ba more eggs of *Arbacia* segmented and reached a higher stage of segmentation, when the solutions were slightly alkaline than when they were neutral. These experiments seem to indicate that for the fertilized eggs of the sea urchins the antagonistic action of Ca to NaCl makes itself felt mostly in such processes in which a concentration of HO ions higher than 10^{-7} N is required, while the K ions act antagonistically to NaCl through their participation in processes which may take place in neutral or even slightly acid mediums.

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Digestion of protein in the stomach and intestine of the dogfish.

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Dogfish were fed by a tube with chopped, coagulated beef, and killed after 6, 12, 24, 48 and 72 hours. In the contents of the intestine and stomach determinations were made of (a) insoluble nitrogen, (b) soluble nitrogen, (c) soluble nitrogen in amino form,¹ and (d) soluble nitrogen in amino form after complete hydrolysis. The ratio $d : c$ indicates the average size of the peptides composing the peptone mixture.

During the first six hours about one half the ingested protein is dissolved and one fourth absorbed. The unabsorbed peptones are, on the average, of pentapeptid complexity. Very little transfer of stomach contents to the intestine occurs.

At the end of 12 hours 30-45 per cent. of the protein in the tract, including both solid and dissolved matter, is found in the intestine. The peptone in the stomach is broken down to the tripeptid stage, that in the intestine slightly farther.

¹Van Slyke, these *Proceedings*.