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Induction and Control of the Acrosome Reaction in the Sperm of *Sicyonia ingentis*

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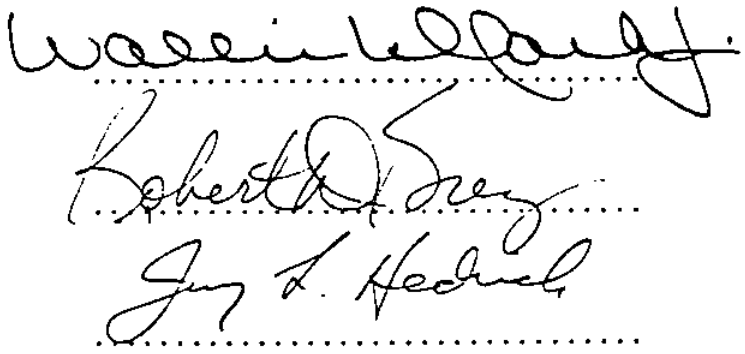

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Abstract

Unactivated sperm of the marine shrimp *Sicyonia ingentis* possess an elevated intracellular pH (pH_i) of 8.5. As a result of the acrosome reaction (exocytosis of the acrosomal vesicle and formation of an acrosomal filament) pH_i is decreased to 7.8 - 8.0. Low external pH elicits acrosomal filament formation in sperm that have undergone acrosomal exocytosis, but does not induce exocytosis in unreacted sperm. The ionophores, nigericin and valinomycin, enhance the % of sperm that form filaments in low pH sea water (pH < 8.0). Nigericin does not elicit filament formation at external pHs ≥ 8.0, whereas, valinomycin induces filament formation over a wide range of external pHs (5.75 - 8.5). Valinomycin induction does, however, become pH dependent at elevated levels of extracellular K^+. These results demonstrate that acrosomal filament formation is associated with a pH_i decrease and suggest that a K^+ efflux is connected to the pH_i decrease.

The acrosome reaction is induced *in vitro* when sperm

are incubated with egg water (EW). The inductively active portion of EW elutes as a high molecular weight complex (> 690 Kd) on gel filtration and includes a 230 Kd glycoprotein(s) and a grouping of 66 Kd and 37 Kd proteins. Several lines of evidence suggest that acrosomal exocytosis and filament formation are elicited by separate inducers or inducing activities and that a trypsin-like protease is the inducer of acrosomal filament formation: (1) the kinetics of induction differ for the two phases of the AR; (2) trypsin inhibitors (SBTI and PAB) block only formation of acrosomal filaments; (3) bovine trypsin induces filament formation in exocytosed sperm, but does not induce sperm to undergo exocytosis; (4) EW contains trypsin-like activity and this proteolytic activity is required for EW induction of filament formation; and (5) SBTI affinity chromatography separates the inductive activities of EW.

The acrosomal filament is a cylindrical structure 0.3 - 0.5 μm in diameter and 10 μm in length. The filament is composed of granular regions and tubular-like structures (TLS), both of which course the length of the filament. The TLS are 30 nm in diameter and do not resemble tubulin containing microtubules. Anteriorly, the filament terminates in 12-15 radiating extensions (petals). Petals possess substructural elements that appear as incomplete TLS.