SL101

Signaling Molecules in Feather Pattern Formation

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The formation of periodic patterns is fundamental in biology. Theoretical models describing these phenomena have been proposed for feather patterning; however, no molecular candidates have been identified. Here I show that the feather tract is initiated by a continuous stripe of Shh, Fgf-4, and Ptc expression in the epithelium, which then segregates into discrete feather primordia that are more strongly Shh and Fgf-4 positive. The primordia also become Bmp-2 and Bmp-4 positive. Bead-mediated delivery of BMPs inhibits local feather formation in contrast with the activators, SHH and FGF-4, which induce feather formation. Both FGF-4 and SHH induce local expression of Bmp-4, while BMP-4 suppresses local expression of both. FGF-4 also induces Shh. Based on these findings, I propose a model that involves (1) homogeneously distributed global activators that define the field, (2) a position-dependent activator of competence that propagates across the field, and (3) local activators and inhibitors triggered in sites of individual primordia that act in a reaction-diffusion mechanism.

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Induction of Acrosome Reaction in Starfish

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The acrosome reaction (AR) is a prerequisite for fertilization in various animals including mammals. Upon reaching the jelly coat of homologous eggs, starfish spermatozoa undergo the acrosome reaction in response to the action in concert of three egg-jelly components; ARIS, Co-ARIS and asterosap. Yet, ARIS alone is able to elicit the AR in high calcium or high pH seawater, and combinations of ARIS and either Co-ARIS or asterosap also elicit the AR in normal sea water.

ARIS is a proteoglycan-like molecule and its activity is mostly attributable to a linear polysaccharide chain composed of about two thousand repeats of the following sulfated pentasaccharide unit:

-4)-D-Xyl*p*-(b1-3)-D-Gal*p*-(a1-3)-L-Fuc*p*(-4-sulfate)-(a1-3)-L-Fuc*p*(-4-sulfate)-(a1-4)-L-Fuc*p*-(a1-

This saccharide chain is linked to a more acidic inner chain that in turn binds to the core protein by O-glycoside linkage with Ser/Thr residues. The inner chain consists of Fuc, Gal, GalNAc and GlcNAc, presumably in a molar ratio of 2 : 3 : 3 : 2, and branches at some of Gal residues (3, 6 and 4, 6). GlcNAc-6-sulfate, Gal-2-sulfate and Gal-2, 4-disulfate were identified as sulfated sugars besides Fuc-4-sulfate.

Co-ARIS is a group of sulfated steroidal saponins, whereas asterosap is a group of glutamine-rich tetratria- contapeptides with a disulfide linkage. ARIS increases intracellular Ca^{++} of sperm in the presence of Co-ARIS. When asterosap binds to its receptor, namely guanylate cyclase, on the sperm surface, the cGMP level of starfish sperm jumps up from 2.5 × 104 to 67.5 × 104 molecules/sperm within 200 m/sec, then it decreases rapidly, and eventually intracellular pH of sperm increases. If intracellular Ca^{++} and intracellular pH increase simultaneously, spermatozoa undergo the acrosome reaction.