

Mechanism for the Initiation of Sperm Motility in Aquatic Animals

Kang Hee Kho

*Bioresources Utility Program, College of Fisheries and Ocean Sciences,
Chonnam National University*

Initiation and activation of sperm motility are prerequisite processes for the contact and fusion of male and female gametes at fertilization.

Cell signaling for the initiation and activation of sperm motility in the ascidians and salmonid fishes has drawn much attention. In the ascidians, the binding of sperm-activating and sperm-attracting factor(SAAF), derived from the unfertilized egg, to the sperm activates K^+ channels to increase K^+ permeability of the sperm plasma membrane, resulting in membrane hyperpolarization. In turn, the hyperpolarization of the membrane potential activates the adenylyl cyclase and elevates the cAMP level in the sperm cytoplasm. Cyclic AMP activates cAMP-dependent protein kinase (PKA) and phosphorylates a 26 kDa protein and 21 kDa dynein light chain. The phosphorylation of these proteins triggers the final step of the SAAF-induced activation of sperm motility.

The intracellular signaling for the activation of sperm motility in teleosts has been well investigated in salmonid fishes. In these species, high concentration of K^+ in the seminal plasma suppresses the sperm motility in the male reproductive tract. A decrease of the environmental K^+ concentration surrounding the spawned sperm causes K^+ efflux and Ca^{2+} influx through the specific K^+ channel and dihydropyridine-sensitive L-/T-type Ca^{2+} channel, respectively, thereby leading to the membrane hyperpolarization. The membrane hyperpolarization induces synthesis of cAMP, which triggers further cell signaling processes, such as cAMP-dependent protein phosphorylation, to initiate sperm motility in salmonid fishes.

In another group of freshwater spawners, cyprinid fishes such as goldfish, carp, and group of seawater spawners such as puffer fish, flounder, decrease or increase in osmolality surrounding sperm at spawning in hypotonic fresh water or hypertonic seawater are the first triggers for the initiation of the sperm motility. However, the cell signalings for the osmolality dependent initiation of sperm motility do not require cAMP in these groups.

The accumulating evidence may enhance the studies clarifying relationship between several lines concerning the cell signaling for regulating sperm behavior and evolution of creatures which have undergone adaptive radiation in future.