

Chapter 3

Fertilization in Starfish and Sea Urchin: Roles of Actin



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Abstract Marine animals relying on “external fertilization” provide advantageous opportunities to study the mechanisms of gamete activation and fusion, as well as the subsequent embryonic development. Owing to the large number of eggs that are easily available and handled, starfish and sea urchins have been chosen as favorable animal models in this line of research for over 150 years. Indeed, much of our knowledge on fertilization came from studies in the echinoderms. Fertilization involves mutual stimulation between eggs and sperm, which leads to morphological, biochemical, and physiological changes on both sides to ensure successful gamete fusion. In this chapter, we review the roles of actin in the fertilization of starfish and sea urchin eggs. As fertilization is essentially an event that takes place on the egg surface, it has been predicted that subolemmal actin filaments would make significant contributions to sperm entry. A growing body of evidence from starfish and sea urchin eggs suggests that the prompt reorganization of the actin pools around the time of fertilization plays crucial regulatory roles not only in guiding sperm entry but also in modulating intracellular Ca^{2+} signaling and egg activation.

3.1 Introduction

Conceptually, fertilization is a simple event: union of sperm and egg from the same species to produce an offspring. The actual fertilization process, however, involves a series of preparatory changes that have to be exquisitely coordinated in both gametes. For example, before reaching the egg, spermatozoa should gain their cytological competence by undergoing acrosome reaction and acquire apt motility for successful fertilization to occur. The substance on the egg surface may induce these changes and emit the cues for chemotaxis. On the other hand, the oocytes

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