

Gamete activation: what else?

Fertilization is the complex and unique process that marks the creation of a new individual. Mutual activation of gametes is a crucial event during fertilization where the two metabolically quiescent cells, upon a reciprocal signal, undergo structural and functional changes acquiring the ability for recognition and interaction. In an attempt to describe step by step the process of gamete activation, first the extracellular membranes of the oocyte activate sperm by inducing motility, attracting them and triggering first binding.



Fig. 1.

This first contact between gametes induces the crucial event of acrosome reaction that allows sperm to penetrate the barrier of extracellular membranes and reach the plasma membrane where fusion of the two cells occurs. At the end of this first step, the activated sperm starts to activate the oocyte by releasing inside the cytoplasm a soluble factor triggering, in turn, a cascade of metabolic events which allow the transition from an arrested to developmentally competent oocyte (Fig. 1). Here, the synergy between electrical events as passage of ion currents, morphological modifications as the cortical reaction and the central event of calcium release (Fig. 2) triggers meiosis resumption and the formation the zygote, the first cell of the new individual. The idea that the contact between gametes was instrumental for successful fertilization and development was reported by Lazzaro Spallanzani in the late 1700s. However only in the early '50 studies on marine animals started to ascertain that changes in sperm behavior and morphology were necessary to ensure oocyte fertilization.

To date, gamete activation has been demonstrated to be the basis of reproductive events and the

absolute pre-requisite for fertilization in all the species studied from marine invertebrates to mammals and human. A large amount of molecules metabolic pathways, mechanisms of cell interaction and signal transduction underlying this process are sometime common to all species whereas in others are species-specific. Nowadays, basic knowledge on gamete activation have helped scientists to develop new techniques of gamete manipulation to improve the fertilization rate in the assisted reproductive technologies, representing a promising alternative resource for treatment of human infertility. Furthermore to study the transition from quiescent to pluripotent cell, offers a tremendous clinical potential in elucidating the regulation of stem cells.

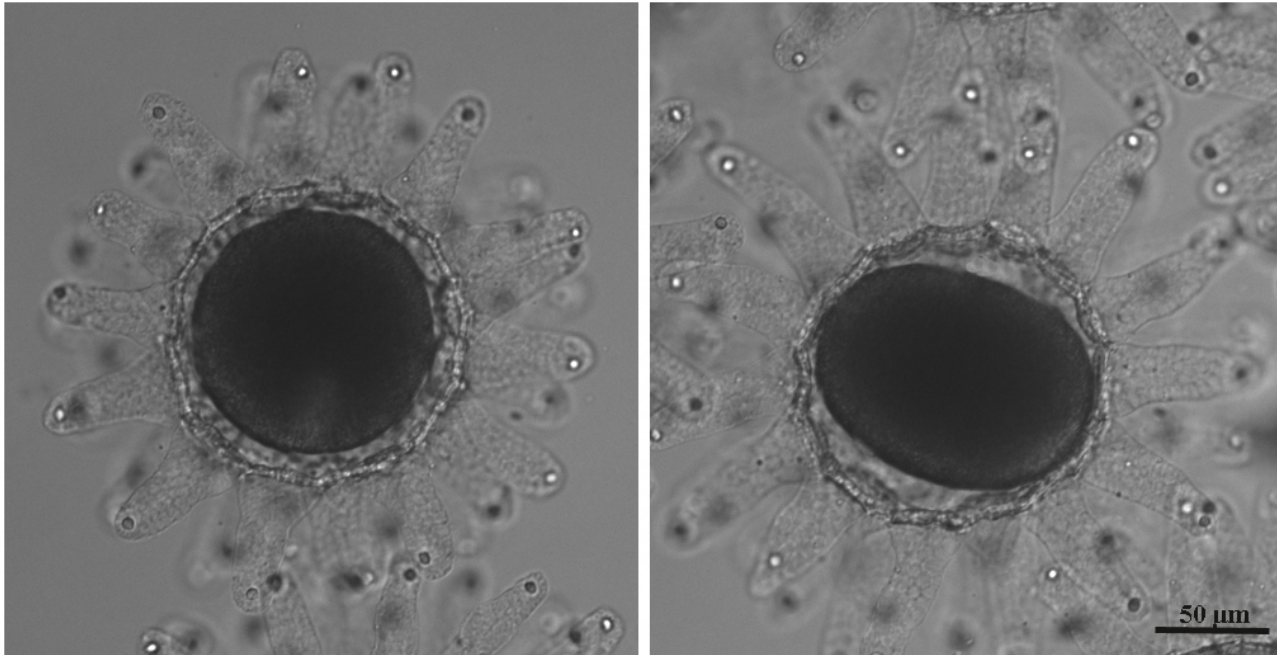


Fig. 2.

Gamete activation may be depicted as a chain where each ring plays a crucial role and is so intimately connected with either previous and the successive ones that a failure in whatever step may seriously affect the fertilization success and the following embryo development.

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