Integrating Nanotechnology with Cell Biology and Neuroscience

INCBN IGERT Seminar

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Signaling Pathways During Egg Maturation in a Marine Worm

For animal development to proceed normally, eggs must first undergo a maturation process. Since elucidating the mechanisms of this fundamental process can lead to advances in animal husbandry, in vitro fertility practices, and our understanding of cell cycle progression in general, numerous studies have been conducted on maturing eggs. For example, such studies have shown that the secondary messenger cAMP prevents mammalian eggs from maturing, whereas the breakdown of cAMP into AMP promotes maturation. Moreover, the AMP generated from cAMP can stimulate AMP-activated kinase (AMPK) and thereby also induce egg maturation in mice. However, unlike in mammals, cAMP elevations actually trigger egg maturation in some marine worms, and the roles of AMPK in such eggs remain unknown. Thus, AMPK was monitored in eggs of the nemertean worm Cerebratulus during treatment with seawater (SW) or cAMP elevating stimuli in the presence or absence of AMPK agonists. In control assays of SW- or cAMP-induced maturation, AMPK was initially active in immature eggs, but then became deactivated as maturation proceeded. Accordingly, treatment with either ice-cold calcium-free seawater or AMPK agonists added to SW kept AMPK active and inhibited maturation. Conversely, combining cAMP elevators with AMPK activators restored maturation while promoting AMPK deactivation. Collectively, such data suggest that, unlike in mice where AMPK triggers maturation, AMPK activity must decline for Cerebratulus eggs to mature. Furthermore, the selective inhibition of SW-, but not cAMP-induced, egg maturation by AMPK agonists may provide novel insights into interactions between cAMP and AMPK signaling pathways in these and other eggs.