Mathematical modelling of Actin-Cdc42 cortical dynamics in Budding Yeast

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During cell division, waves of Rho GTPase and filamentous-actin (F-actin) develop in the cell cortex in a process termed "cortical excitability" [1]. Experimental observations have revealed that, under starvation conditions, yeast cells disassemble their cytoskeleton of F-actin and reorganize it into actin bodies. In addition, it was shown that the actin bodies are mostly immobile, and they could not detect any actin filament turnover [2, 3]. These findings directly support the long-standing speculation that the cell cortex is a self-organizing structure. We will use a budding yeast model with nonlinear wave generation of active Cdc42 coupled to slow negative feedback from F-actin, to describe a possible physical mechanism of actin-Cdc42 cortical dynamics. The results show that, at fixed parameter values, cortical dynamics result from an interplay between F-actin inhibition (which permits propagating excitable actin-Cdc42 waves) and spontaneous breaking of symmetry of Cdc42 activity and F-actin (which permits immobile structure formation).

References

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