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Mathematical modelling of the meiosis || exit in Xenopus Oocytes

ABSTRACT

In Xenopus oocytes, the oocytes are arrested at metaphase II (called the cytostatic factor (CSF) arrest) until fertilization. How this arrest is established and released at the systems-level is yet to elucidated. The anaphase promoting complex/cyclosome (APC/C) inhibitor Emi2 plays a key role in blocking the transition from oocyte to embryo. The aim of this work is to develop a mathematical model to study the crosstalk between cell cycle and meiosis-specific components in the regulation of oocyte to embryo transition. The model captures different mutant situations that either promote this arrest or release the cells from it and deduce systems-level insights.

METHOD

- The network was first converted into a set of nonlinear ordinary differential equations (ODEs)
- We considered a dynamic solution for the ENSAP-PP2A:B55 complex in the BEG pathway.
- Phosphorylation and dephosphorylation of the IE and APC/Cdc20is described using Michaelis-Menten kinetics,while all other reactions are represented by the law of mass action.
- The model was simulated numerically using XPPAUT and the parameters were obtained using phenotypes of different mutants gathered from the literature.

RESULTS

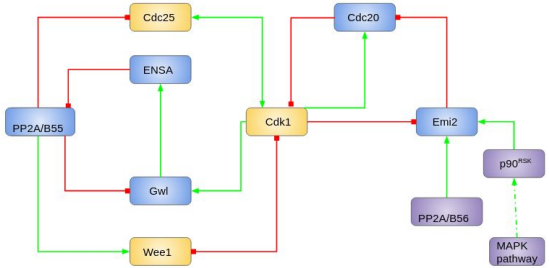

Fig.1 The regulatory network diagram for the MII arrest in xenopus oocytes

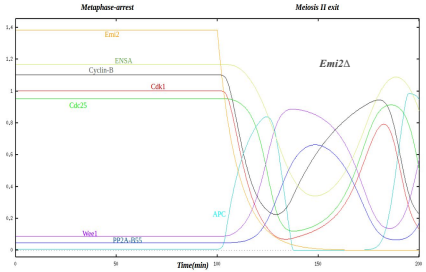

Fig. 2 The dynamics of H1-kinase,PP2A-B55 and APC is shown for the csf arrest and early embryogenesis.

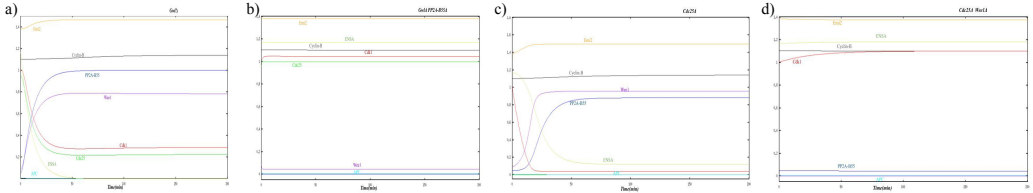

Fig.3 Dynamics of csf arrested oocytes extracts in different mutations. (a)***GwlΔ***, (b) ***GwlΔPP2A-B55Δ***, (c)***Cdc25Δ*** and (d) ***Cdc25Δ Wee1Δ***

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