

Phase Model Analysis of Yeast Glycolytic Oscillation

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The glycolysis is one of the most important metabolic reactions through which the glucose is broken and the released energy is stored in the form of ATP. Rhythmic oscillation of the intracellular ATP is observed as the amount of the influx glucose is small in the yeast. The oscillation is also observed in the population of the yeast cells, which implies that the glycolytic oscillation of the yeasts is synchronous. It is not clear how the synchronous oscillation could be organized among the yeast cells. Although detailed mathematical models are available that show synchronization of the glycolytic oscillation, the stability of the synchronous oscillation is not clear. We introduce a phase model analysis that reduces a higher dimensional mathematical model to a much simpler one dimensional phase model. Then, the stability of the synchronous oscillation is easily determined by the stability of the corresponding fixed solution in the phase model. The effect of perturbation on the oscillatory rhythm is also easily analyzed in the reduced phase model.