

University of Southern Denmark

Abstract

Faculty of Science

Department of Biochemistry and Molecular Biology

Doctor of Philosophy

Effect of Molecular Crowding on Cellular Metabolism

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In this thesis I present a summary of my work done during my Ph.D. in the period January 2015 - January 2018 on the subject of glycolytic oscillations in yeast. The results which are summarized in four articles, suggest that the cytoplasm in general, and oscillatory glycolysis in particular, cannot be treated in the framework of dilute system theory. Specifically our results are more consistent with Gilbert Ling's "Association Induction Hypothesis", which to a greater extent considers the specific environment created by a concentrated ion-protein-water solution, such as the cytoplasm. Based on this hypothesis we manage to explain all of our experimental results, and create a new model for glycolytic oscillations in yeast founded in thermodynamics.

I begin by a presentation of the Association Induction Hypothesis against the historical background (chapters 1 and 2), and continue with a description of my used model system of glycolytic oscillations in yeast (chapter 3). Chapter 4 is reserved for theoretical considerations of fluorescent response to dipolar relaxation, which is the primary experimental method used throughout my work. Finally chapter 5 provides a brief introduction to each of the four articles attached in the appendices. These articles, of which two are presently published, one is in review and the last is in the final stages of preparation, are the main outcome of my scientific work on the subject of molecular crowding and oscillating glycolysis performed during my Ph.D.

Additionally chapter 5 contains the essence of my experimental contribution to another paper, which as of yet is a work in progress. Due to my limited contribution this paper should not be considered a part of this thesis, but it is part of the work I have contributed in the Ph.D. period.