GENETICS, BIOINFORMATICS, AND SYSTEMS BIOLOGY COLLOQUIUM

THURSDAY APRIL 14TH
12:00 PM PST
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PRESENTED BY: IGM Institute for Genomic Medicine | UC San Diego Bioinformatics & Systems Biology

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MARKUS BASAN, PHD
ASSISTANT PROFESSOR, HARVARD MEDICAL SCHOOL
DEPARTMENT OF SYSTEMS BIOLOGY

GLUTAMATE COORDINATES CELL VOLUME AND BIOMASS GROWTH VIA TURGOR PRESSURE IN BACTERIA

Glutamate is a metabolic hub and by far the most abundant cellular metabolite in E. coli. Moreover, glutamate concentration shows a striking direct proportionality with growth rate in E. coli exists. However, the physiological role of this large metabolite pool is not known. Controlling glutamate synthesis, we found that glutamate concentration directly controls cellular dry mass density, resembling hypo- and hyperosmotic conditions. Hence, we hypothesized that intracellular glutamate may control Turgor pressure. Indeed, we experimentally confirmed that Turgor is determined by intracellular glutamate concentration. To understand the crucial role of glutamate and Turgor pressure for maintaining dry mass density, we formulated a mathematical model of viscoelastic cell envelope expansion that naturally couples Turgor pressure with volume growth. In this model, increasing Turgor pressure is required at faster growth rates to maintain constant dry mass density and prevent molecular crowding. We experimentally validated an inverse proportionality between dry mass density and cell width predicted by the model, as well as the effect of sublethal doses of cell wall synthesis inhibitors and the effect of increasing cell wall viscosity by downregulating essential cell wall hydrolases. Together, this work demonstrates an elegant physiological interplay of metabolism and mechanics that maintains the density of the cellular cytoplasm with changing growth rates.

Organization Committee: J. Gleeson, J. Sebat
GBSBC Seminar Coordinator: R. White

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