Abstract

The bacterium *Bacillus subtilis* lives in the environmentally diverse soil habitat. Various stresses challenge *B. subtilis*, and its stressosome is one of the sensors for physical and chemical insults. This pseudo-icosahedral complex is composed of three protein classes: 1) the sensor RsbR, 2) the scaffold RsbS, and 3) the kinase RsbT. Stimulation of the stressosome modifies its phosphorylation patterns and protein interactions, and results in the dissociation of RsbT. Cytoplasmic RsbT activates an additional cascade, ultimately releasing the general stress response transcription factor σ^{B}. Biochemical and molecular biological experiments have identified the reactions and interactions of the proteins, but these techniques are currently unable to identify structure-related functions. By contrast, computational models can consider the geometry of the stressosome, but despite this advantage, no such model exists for the stressosome. Using cellular automata, I introduce here the first computational models for the stressosome. Futhermore, the icosahedral structure enables the construction of a geometric model by modular origami folding that highlights motions within icosahedral structures. The conditions associated with the release of σ^{B} are amenable to ordinary differential equation models, which I used to reproduce the dynamics of a reporter protein. My analysis shows that different stimuli are processed identically, suggesting their identical perception. Theoretical reproduction of the dynamics of a reporter protein show that the proteolytic decay of the reporter protein is part of the σ^{B}-mediated general stress response, which was confirmed by subsequent experiments. The thesis confirms the activation effect of RsbR-P on the kinase activity of RsbT and the preferential dephosphorylation of RsbS-P over RsbR-P by RsbX. The Collapse Hypothesis suggested in this thesis, concerns information transmission between RsbR and RsbT and suggests a coordinated motion of three dimers. The modelling process emphasizes an activation loop for RsbT that disconnects the duration of response from that of the stimulus. Overall, the new insights enhance our understanding of the σ^{B}-mediated general stress response and raise our awareness of the environmental integration of *B. subtilis*.