Cell Size Control By Synchronizing Min Oscillation With Nutrient Availability in Escherichia Coli

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Abstract
Cell growth, division, and morphogenesis are fundamental processes that can affect fitness and survival of bacteria in a given environment. The cytoskeletal proteins are the key factors mediating these processes by guiding the cell wall synthesis. Importantly, the tubulin homolog FtsZ underpins formation of the division septum and separation of the daughter cells. Thus, position of the FtsZ-ring and timing of the ring formation can influence size and morphology of the progeny cells. The Min system of Escherichia coli mediates placement of the FtsZ ring at the midcell. Asymmetrical division, that gives rise to unequal sized daughter cells, occurs in the absence of the Min system. The Min proteins oscillate from pole to pole to establish a concentration gradient of the division inhibition that prevents the FtsZ-ring assembly at the poles. Since the oscillation cycle is an energy-dependent process, we asked whether the cellular metabolic state could influence the Min oscillation and studied the oscillation behavior in response to the carbon availability. The results showed that oscillation period and velocity depended on the type and the concentration of the carbon source. Furthermore, the interplay between the Min oscillation and the carbon availability was mediated through the nutrient stress response pathway. In summary, our current study reveals that the nutrient stress response can signal to the Min oscillation to allow synchronization with the cellular metabolism. Whether adjusting the Min oscillation under different nutrient conditions can influence position and timing of the FtsZ ring formation and affect the cell size will be discussed.

Selected Relevant Publications for Reference