Application of 31P Solid-State Nuclear Magnetic Resonance to Support Regulation of FtsZ in B. subtilis

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Bacterial cell replication requires proteins necessary not only for genome replication, but also those involved in dividing cellular contents. FtsZ, a GTPase that assembles into a multi-protein ring at the site of cytokinesis is essential for proper division of bacterial cells. The Levin lab has discovered that under nutrient rich conditions, FtsZ formation is inhibited, and cells replicate at a faster rate and are abnormally larger. Specifically, the Levin lab has discovered that the protein UgtP may inhibit formation of the FtsZ ring. UgtP’s substrate is UDP-glucose, which is a modified glucose molecule, suggesting that nutrient rich media with more glucose will have increased levels of UDP-glucose and UgtP. With increasing amounts of UgtP, there will presumably be more interference with the formation of the FtsZ ring, and in turn, larger cells. On the other hand, UgtP is an enzyme that is essential in the biosynthesis of lipoteichoic acid (LTA). Thus, by quantifying the amount of LTA, one can indirectly monitor the concentration of UgtP.

By utilizing $^{31}$P solid-state nuclear magnetic resonance, the Schaefer lab has been able to quantify relative amounts lipoteichoic acid on the membrane surfaces of B. subtilis grown under different media conditions; thus, NMR may be able to provide insight into the connection between nutrient levels in media, amount of UgtP, and observed cell size. We expect to observe a larger amount of lipoteichoic acid on the surface of cells grown in nutrient rich media compared to that of nutrient poor media. Such results would support the proposal that UgtP is present in larger amounts in nutrient-rich media, which inhibits FtsZ ring formation and result in larger cells.