The roles of RhlE and Hfq in sRNA-dependent gene regulation

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Bacteria are adapted to live in diverse environmental conditions. Thus, they show excellent tolerance and response to extreme environmental conditions caused by low or high temperatures, high salinity, reactive oxygen species or high nutrient concentrations. sRNAs have been identified and characterized as cis-acting or trans-acting post-transcriptional regulators in diverse cellular processes including virulence and adaptation to environmental stress. Interactions of sRNAs and target mRNAs result in translational repression, translational activation or/and degradation of the target. The majority of regulatory small RNAs found in E.coli require the RNA binding protein Hfq to perform their roles in gene regulation.

Although Hfq is a central player in sRNA mediated gene regulation, how it facilitates these RNA interactions is yet to be discovered. Several studies have shown that Hfq makes Hfq-RNP complexes to mediate its regulatory roles. Previous work in our lab identified RhlE, as a protein partner in SgrS-Hfq and DsrA-Hfq RNP complexes. RhlE is an ATP-dependent E.coli DEAD-box RNA helicase. In the present study it was hypothesized that Hfq and RhlE have a synergistic effect on sRNA-mediated gene regulation. To address this problem, a series of in vivo and in vitro experiments was carried out.

The growth curve analysis of wt, Δ*rhlE*, Δ*hfq* and Δ*rhlE*/Δ*hfq* revealed that RhlE has a role in Hfq-dependent sRNA-mediated gene regulation under sugar stress and oxidative stress. Furthermore, the finding that OxyS sRNA which is transcribed under oxidative stress and its target fhlA mRNA stimulate the ATPase activity of RhlE supports the above idea. Δ*rhlE*/Δ*hfq* also restored the slow growth of Δ*hfq*, indicating that RhlE may have a role under sugar phosphate stress. However, the present study did not identify any physical interaction of the two proteins. These findings have implications for understanding the mechanisms underlying Hfq-dependent sRNA-mediated gene regulation. Complete understanding on sRNA-mediated gene regulation and the protein components that are associated with sRNAs, will allow us to use these regulation processes as potential targets for the successful eradication of pathogenic bacteria.