Importance of RNA structures for protein binding

Imagine how much your life would change if you suddenly found yourself in the gut of a giant. I want you to think about what a drastic change that would be. What is the atmosphere like? How much oxygen is there? What kind of food is available? What obstacles would you need to overcome to survive in there? Bacteria overcome drastic changes to their environment all the time and in order to quickly overcome new obstacles, such as those that come up when entering a host, bacteria need to respond fast.

DNA holds the genetic code but messenger RNA molecules (mRNA) deliver the code to the ribosome, a molecular machine that reads the code and makes proteins. Regulating gene expression at the RNA level allows for rapid responses. The availability of the message determines whether it gets translated into a protein. RNA binding proteins can help by protecting the messenger RNAs and enabling their translation, but they can also bring about the degradation of a message and prevent the ribosome from translating it into a protein.

RNA-binding proteins (RBPs) are important for regulating gene expression, both in eukaryotes and bacteria. Some RBPs are specific and only regulate a single message, while others can bind multiple RNAs, and use various mechanisms to regulate different processes in the cell. A few RBPs in *Escherichia coli* (*E. coli*) and *Salmonella* are known to be "so-called" global regulators. Global regulatory RBPs have a large impact on gene expression by binding to many different RNAs. Recent research has identified the protein ProQ as one of these global regulatory RBPs (Smirnov *et al*. 2016). When a discovery like this is made, several questions need to be answered. To what extent does this protein affect gene expression? Which RNAs does it bind to? What mechanisms does it use to change the levels of RNAs? Does it affect a bacterium's virulence ?

Which RNAs does ProQ bind to and why? While some proteins prefer a certain sequence of nucleotides (the building blocks of RNA) ProQ has not been shown to prefer any specific nucleotide sequence. However, research has indicated that ProQ binds to highly structured RNA. RNA molecules are able to fold and bind to themselves, and other RNAs, forming intricate structures. My research into ProQs binding preferences supports the hypothesis that RNA structures are important for ProQ binding.

An understanding of how bacteria function and overcome challenges can help us understand how life works. The amazing flexibility of bacteria, such as *E. coli* who can go from living in river to thriving in someone's gut is something worth trying to understand. The fine-tuning of gene regulation makes the difference between having an arm or a flipper. As Jacques Monod, a pioneer in the study of gene regulation, said “What is true for *E. coli* is also true for the elephant”.

Smirnov A, Förstner KU, Holmqvist E, Otto A, Günster R, Becher D, Reinhardt R, Vogel J. 2016. Grad-seq guides the discovery of ProQ as a major small RNA binding protein. PNAS 113: 11591-11596.

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