Researchers discover how bacteria sense salt stress

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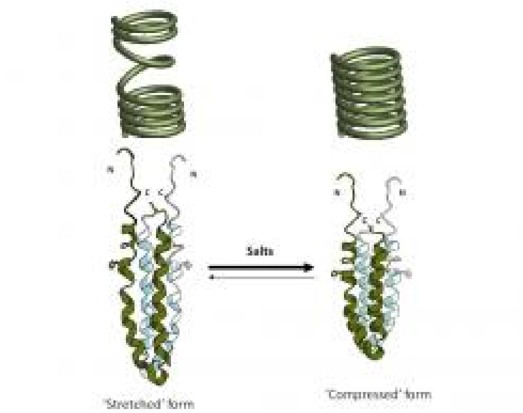

Salt-sensor proteins in bacteria operate like molecular springs. Under low salt conditions salts in the environment, the proteins oscillate between 'stretched' and 'compressed' forms. The 3-Dimensional structure of the proteins are shown as blue-white and green ribbons where 'N' denotes the front end (N-terminus) of the protein while 'C' denotes the back end of the protein (C-terminus). A cartoon of stretched and compressed forms of springs are represented in green above the model of the salt-sensor proteins. Salts in the environment dampen these spring-like movements and favor the 'compressed' form. This change in springiness is used by the bacteria to detect salts in their environments. Credit: National University of Singapore

A team of scientists led by Assistant Professor Ganesh S Anand and Professor Linda J. Kenney from the National University of Singapore (NUS) Department of Biological Sciences (DBS) and the Mechanobiology Institute (MBI) has discovered how bacteria respond to salts in their environment and the ways in which salts can alter the behaviour of specialised salt sensor bacterial proteins.

This novel finding sheds light on how microbes detect levels of salts or sugars in their watery environments – a problem in biology that has been studied for more than 30 years.

The NUS scientists found that microbes do this by specialised molecules or proteins on the bacterial surface that change shape in response to changes in salt concentration. This is relevant not only to bacteria, but also cells from all organisms which detect and respond to changes in environmental salts and sugars.

The scientists from NUS and the University of Illinois-Chicago (UIC) first published their findings in the *EMBO Journal* on 30 May 2012.

Bacteria have elaborate mechanisms for sensing and responding to changes in the environment. One of the important environmental stresses for bacteria is the changing concentration of salts. For instance, some can live in fresh water (a low salt environment) or in the guts of humans (high salt environment).

Using a powerful combination of a tool called amide hydrogen/deuterium exchange mass spectrometry (HDXMS), accompanied by molecular biology and biochemistry, the scientists from NUS probed how changes in salt concentrations are sensed by a receptor protein.

They found that salt detecting proteins are like molecular springs, or "slinky toys". The proteins are constantly shifting from a condensed spring form to an extended form. Increasing the salt concentration dampens this spring-like movement, which activates the protein. In other words, the less spring-like the protein, the higher is its activity. This

This study is an example of basic science with immediate applications. Recognising that diverse proteins operate as molecular springs whose spring-like movement can be dampened is fundamental to understanding how these proteins work. This study also underscores the role of water in biology. It demonstrates how salts and sugars can alter biological properties of proteins through the effects on water and is relevant for understanding life processes across species from bacteria to humans.

The NUS research team is now working on studying the protein in its native membrane by embedding the bacterial sensor protein in an artificial membrane. They hope to understand how the membrane contributes to overall protein activity, structure, stability and responses to salts.

Provided by National University of Singapore

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