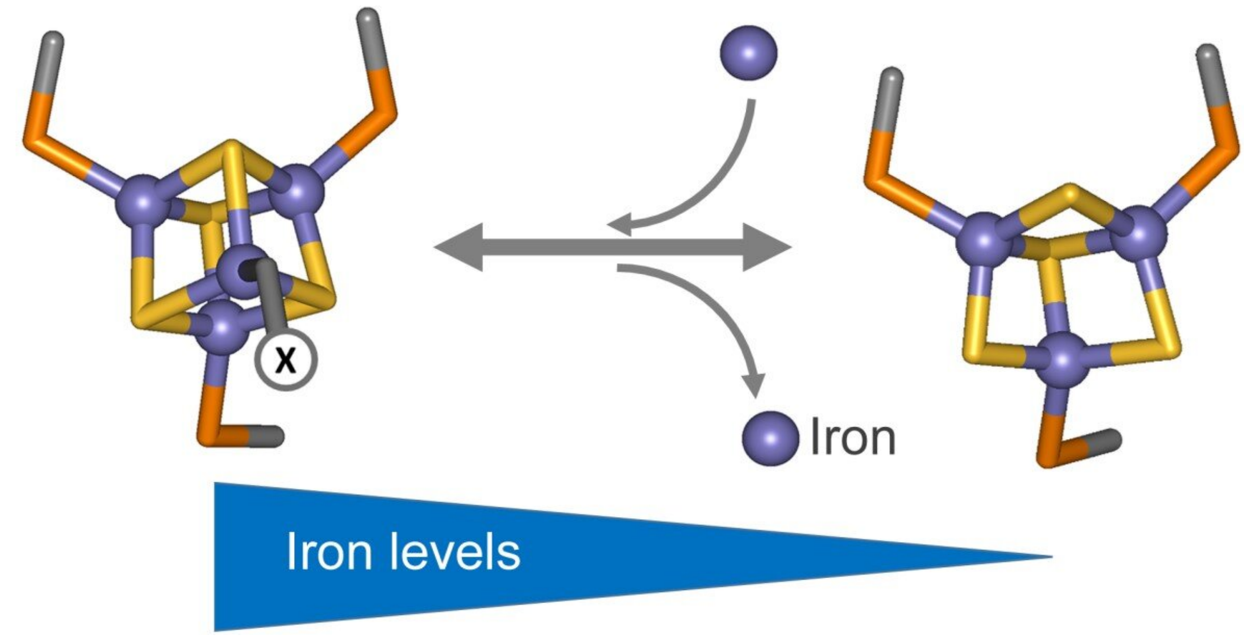
How nitrogen-fixing bacteria sense iron

September 17 2019



University of East Anglia research reveals how nitrogen-fixing bacteria sense iron -- an essential but deadly micronutrient. Credit: University of East Anglia

Researchers at the University of East Anglia have discovered how nitrogen-fixing bacteria sense iron—an essential but deadly micronutrient.

Some bacteria naturally fix nitrogen from the soil into a form that plants can use. In nature, most plants get nitrogen either from soil bacteria that do this work or from plants and microbes that die and recycle their nitrogen into the soil. In agriculture, soil is enriched with synthetic nitrogen fertilizers.

Virtually all life forms require iron to survive, yet too much of the metal can be catastrophic. In healthy cells, many systems regulate this delicate balance.

In many nitrogen-fixing bacteria, a protein called RirA plays a key role in regulating iron. It senses high levels of the metal and helps to shut down the production of proteins that bring in more iron.

RirA contains a cluster of four iron and four sulfur atoms, which acts as a sensor for iron availability. But until now, exactly how this cluster structure detects iron levels in a cell was unclear.

The UEA research team was led by Prof Nick Le Brun from the School of Chemistry in collaboration with researchers at the University of Essex.

They used a technique known as time-resolved mass spectrometry to examine the sensory response of the iron-sulfur cluster of RirA when different levels of iron were available.

The results revealed a 'loose' iron atom in the cluster. When iron levels drop, this atom is rapidly lost as it is scavenged for use in other essential cellular processes.

Without it, the cluster in RirA collapses and the protein becomes inactive, which prompts the cell to produce proteins that enable the cell to take up iron from its surroundings.

Once iron levels are sufficient again, RirA regains its cluster and becomes active again, stopping the production of proteins that bring in more iron.

Iron-sulfur clusters are common in many proteins, and this work offers new insight into their various roles. It also highlights the potential to use time-resolved mass spectrometry to examine biological processes in depth.

Prof Le Brun said 'This research provides unprecedented detail of how the iron-sensing cluster of RirA responds to low iron conditions, and establishes, for the first time, how an iron-sulfur cluster can be used to sense iron.

"This is an important piece in the bigger puzzle of how life deals with iron, a nutrient it cannot do without but one it must also avoid having in excess."

'Mechanisms of iron- and O2-sensing by the [4Fe-1 4S] cluster of the global iron regulator RirA' is published in the journal *eLife* on Tuesday, September 17, 2019.

Provided by University of East Anglia

Citation: How nitrogen-fixing bacteria sense iron (2019, September 17) retrieved 23 April 2024 from https://phys.org/news/2019-09-nitrogen-fixing-bacteria-iron.html