Discovery of bacterial ancestor yields new insight on calcium channels

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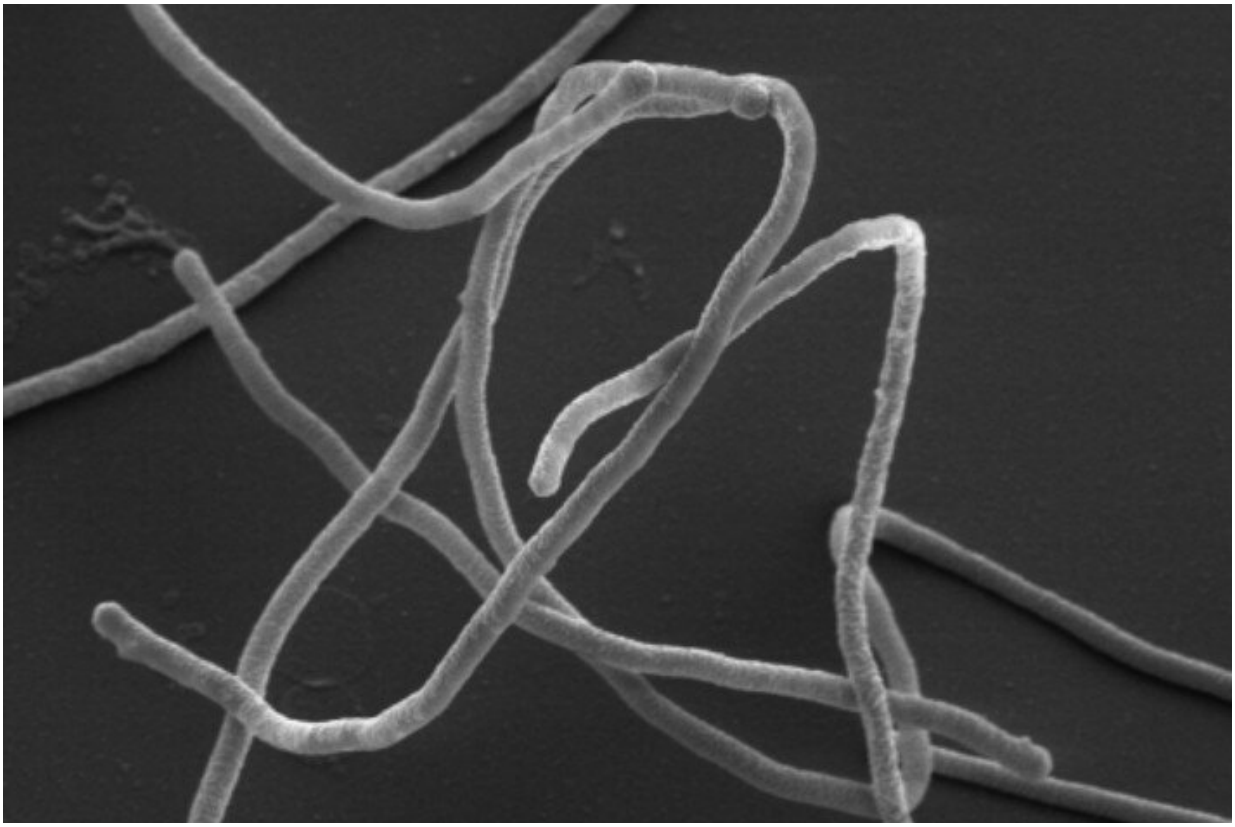

Scanning electron micrograph of the bacterium *Meiothermus ruber*. Credit: Tindall et al., 2010, Stand Genomic Sci (CC BY 2.5)

The discovery of a calcium channel that is likely a 'missing link' in the evolution of mammalian calcium channels has been reported today in the

open-access journal *eLife*.

Calcium channels that open and close in response to electrical signals in the brain are essential for thought, memory and muscle contractions. Studying the structure and evolution of these calcium channels in various organisms has revealed a lot about how they work.

"Based on previous studies, scientists have predicted that the calcium channels found in mammals evolved from a bacterial ancestor, but they haven't been able to find this missing link," explains lead author Takushi Shimomura, Assistant Professor in the Division of Biophysics and Neurobiology, National Institute for Physiological Sciences, Japan. "Identifying this ancestor-like bacteria calcium channel is expected to help us understand the structural, functional and evolutionary relationship between bacterial and mammalian calcium channels."

Shimomura and his team scoured the genetic sequences of bacterial voltage-gated calcium channels (CaVs) for potential ancestor-like candidates. They found one candidate called CavMr in the bacterium *Meiothermus ruber*. CavMr is evolutionarily distinct from other bacterial channels that have been reported.

Next, they studied what happened when they inserted mutations into the gene that encodes CavMr. Their mutational analyses indicated that the small glycine residue in the CavMr selectivity filter is an overlooked feature that determines calcium selectivity. The glycine residue is also well conserved in the selectivity filter of subdomain I and III of mammalian CaVs. These findings led the team to conclude that CavMr links calcium channels to a bacterial ancestor.

"Our work provides new insight on the universal mechanism of calcium selectivity in both mammals and bacteria," says senior author Katsumasa Irie, Assistant Professor at the Cellular and Structural Physiology

Institute, Nagoya University, Japan. "CavMr might also be useful for studies that manipulate calcium signalling to learn more about how it controls brain activity."

Irie adds that studying the structural information of these calcium channels could provide a deeper understanding of channel evolution and help explain the origin and principles underlying calcium selectivity.

More information: Takushi Shimomura et al, A native prokaryotic voltage-dependent calcium channel with a novel selectivity filter sequence, *eLife* (2020). DOI: 10.7554/eLife.52828

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