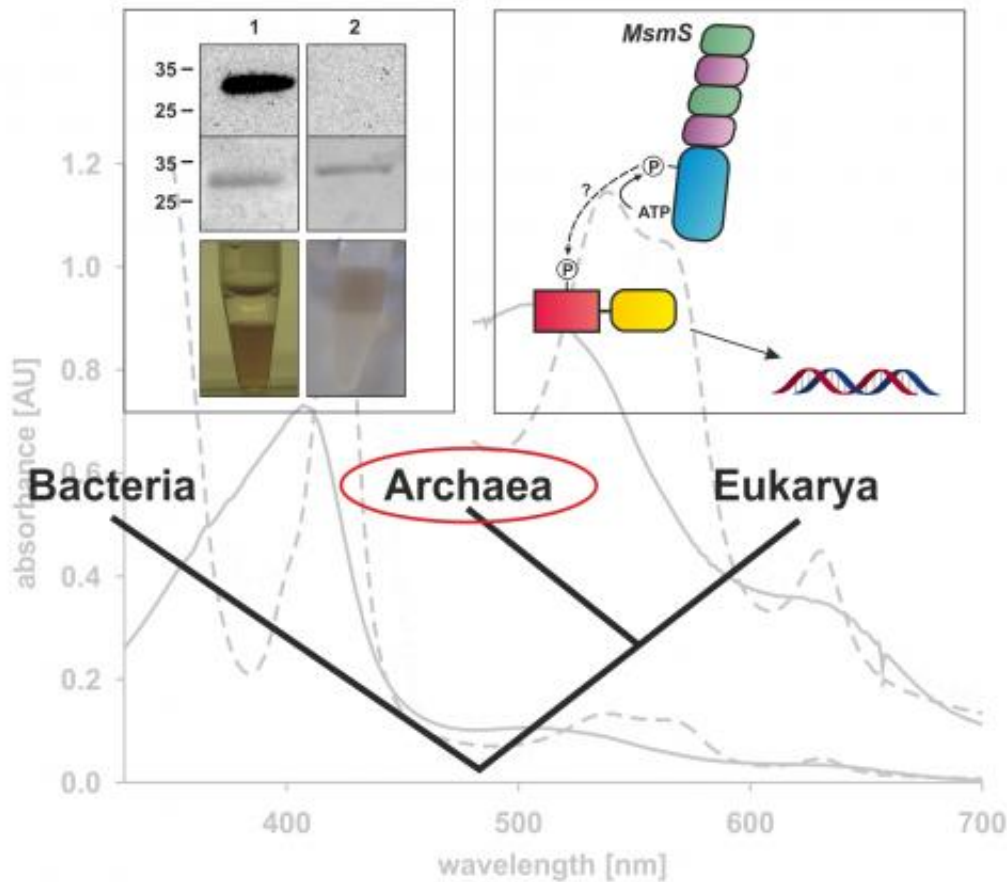


How Archaea might find their food

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The phylogenetic tree shows the division of all beings into the three domains of life: Bacteria, Archaea and Eukarya (organisms with true nuclei). Top right: the protein MsmS from the model organism *Methanosarcina acetivorans*, a methanogenic archaeon, is probably involved in the transduction of signals within the cell and uses phosphorylation mechanisms. The phosphate group (P) for the phosphorylation originates from the energy storage molecule ATP. Top left: MsmS binds a heme cofactor that is covalently bound to the protein. Two methods are shown by which the researchers demonstrated the covalent bond: a gel-based, specific heme staining and a two-phase extraction with the organic

solvent butanone. © Bastian Molitor

The microorganism *Methanosarcina acetivorans* lives off everything it can metabolize into methane. How it finds its sources of energy, is not yet clear. Scientists at the Ruhr-Universität Bochum together with colleagues from Dresden, Frankfurt, Muelheim and the USA have identified a protein that might act as a "food sensor". They characterized the molecule in detail and found both similarities and differences to the system that is responsible for the search for food in bacteria.

The team reports in the *Journal of Biological Chemistry*.

MsmS has a different function to that thought

The protein MsmS has so far only been studied from a bioinformatics point of view. Computer of its [gene sequence](#) had predicted that it might be a phytochrome, i.e. a red [light sensor](#). Using spectroscopic methods, the research team of the current study have refuted this theory. MsmS has a heme cofactor, like haemoglobin in [red blood cells](#), and can, among other things, bind the substance dimethyl sulphide. This is one of the energy sources of *Methanosarcina acetivorans*. MsmS might thus serve the microorganism as a sensor to directly or indirectly detect this energy source. In genetic studies, the scientists also found evidence that MsmS regulates systems which are important for the exploitation of dimethyl sulphide.

Archaea: flexible "eaters"

Methanosarcina acetivorans belongs to the Archaea which constitute the third domain of life, alongside Bacteria and Eukarya; the term Eukarya

comprising all [living organisms](#) with a [cell nucleus](#). Many of them are adapted to extreme conditions or are able to use unusual energy sources. Among the organisms that live from methane production, the so-called methanogenic organisms, *M. acetivorans* is one of the most flexible when it comes to the choice of food sources. It converts many different molecules into methane, and thus produces energy. How *M. acetivorans* detects the different food sources, is still largely unknown.

In Archaea, unlike bacteria

For this purpose, bacteria use the so-called two-component system: when a sensor protein comes in contact with the food source, the protein modifies itself; it attaches a phosphate group to a certain amino acid residue, the histidine. The phosphate group is then transferred to a second protein. In methanogenic organisms such a process could trigger cellular processes that activate the [methane production](#). Archaea might also use comparable sensor proteins in a way similar to bacteria. MsmS would be a candidate for such a task, because the analyses of the research team showed that it is able to transfer a phosphate residue to an amino acid. The target site of this phosphorylation is, however, probably not histidine. "So there could be differences between the signal transduction systems of Archaea and Bacteria" speculates Prof. Dr. Nicole Frankenberg-Dinkel from the work group Physiology of [Microorganisms](#). "It is also interesting that the heme cofactor is covalently bound, i.e. linked with the protein by an electron-pair bond. This is very uncommon for sensor proteins which are present in the cell fluid."

More information: B. Molitor, M. Stassen, A. Modi, S.F. El-Mashtoly, C. Laurich, W. Lubitz, J.H. Dawson, M. Rother, N. Frankenberg-Dinkel (2013): A heme-based redox sensor in the methanogenic archaeon *Methanosarcina acetivorans*, *Journal of Biological Chemistry*, [doi:10.1074/jbc.M113.476267](https://doi.org/10.1074/jbc.M113.476267)

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