PRESS RELEASE

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Detection of Evolutionary Conserved Peptides as Biomarkers for the Search for Life on other Planets

Research from the Centro de Astrobiología (CAB), INTA-CSIC, proposes the detection of selected peptides conserved throughout evolution as biomarkers for the search for life on Mars.

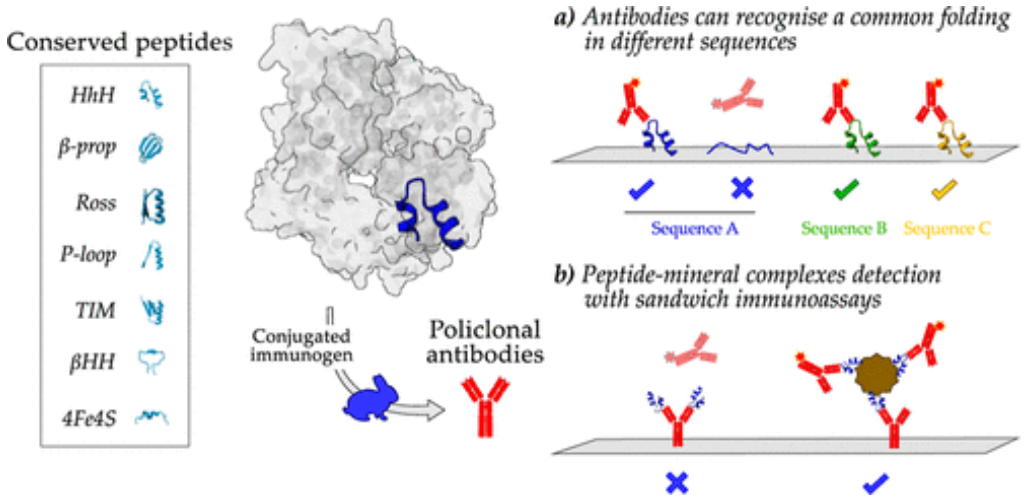
Using antibodies generated against a selection of ancestral peptides -fragments of proteins considered as the oldest traces of current proteins- and analyzing their binding to minerals such as those found on Mars, researchers confirmed their possible use as biomarkers for the search for life in environmental samples. The work has been published in the journal Analytical Chemistry, a journal of the American Chemical Society and a leader in the field of analytical chemistry.

The so-called "ancestral peptides" are small pieces of current proteins that, given their functional or structural importance, have been selected and conserved throughout the evolution of life from the first cell to the present day. They respond to the maxim "if it works, keep it and improve it". These peptides would also have been crucial in the origin of life because of their role in binding to other molecules, and their ability to generate new chemical functions or new structures. If such structures were essential for life on Earth, they could also have been essential for possible life on Mars, when both planets had similar geochemical and habitability conditions.

An important property of peptides is that they have their own folding (structure in space), and very often this is independent of their composition (amino acid chain sequence). That is, different amino acid sequences can show the same three-dimensional structure in an aqueous medium. Thus, it is possible to detect a highly conserved structure without having to encompass the great diversity of amino acid sequences that could form it. As Pedro Mustieles, a PhD student and first author of the work says, “it is just as we would recognize any house of cards by its pyramidal shape regardless of the type and order of the cards that structure it”.

In this research researchers have produced antibodies (similar to those used in COVID tests or those produced by our body to protect us from infections), biological molecules capable of binding to other molecules, developed immunoassays to detect a set of ancestral peptides and validated the assay for their detection. They have shown that some of the antibodies recognize the shape or three-dimensional structure of the peptide, not the specific amino acid sequence, which, together with their ancestral character, makes them suitable biomarkers for searching for biochemical traces of life. “These antibodies are part of the Life Detector Chip (LDChip) collection, a biosensor with more than 200 antibodies developed at the Center for Astrobiology and which is the core sensor of the SOLID instrument (Signs of Life Detector) also developed at the CAB for the search for life in planetary exploration, either in situ or with samples brought back to Earth in future missions”, says Victor Parro, principal investigator of the project.

Moreover, the stable binding of these peptides to some minerals could facilitate their detection, since occupying the surface of the mineral particle improves their exposure, the number of target peptides, and the accessibility of the antibodies. In addition, the same association with the mineral would confer protection against external physical factors, such as the radiation that strikes the surface of Mars. This type of association could therefore be indispensable for the detection of possible extinct Martian life, whose biomarkers would have to remain unaltered.



Selection of highly conserved ancestral peptides in the actual proteins. The antibodies generated against them detect the structure of some fragments independently of their sequence, thus broadening the spectrum of sequences that we can detect. In addition, we can detect such structures when they are associated with mineral particles as they would be found in nature.

About the CAB

The Centro de Astrobiología (CAB) is a joint research center of INTA and CSIC. Created in 1999, it was the first center in the world specifically dedicated to astrobiological research and the first non-US center associated with the NASA Astrobiology Institute (NAI), currently NASA Astrobiology Program. It is a multidisciplinary center whose main objective is to study the origin, presence and influence of life in the universe through a transdisciplinary approach. The CAB was distinguished in 2017 by the Ministry of Science and Innovation as a "María de Maeztu" Unit of Excellence.

The CAB has led the development of the REMS, TWINS and MEDA instruments, operational on Mars since August 2012, November 2018 and February 2021, respectively; as well as the science of the raman instruments RLS and RAX, which will be sent to Mars at the end of this decade as part of the ExoMars mission and to one of its moons in the MMX mission, respectively. It is also developing the SOLID instrument for the search for life in planetary exploration. In addition, the CAB co-leads together with three other European institutions the development of the PLATO space telescope, and participates in different missions and instruments of great astrobiological relevance, such as MMX, CARMENES, CHEOPS, BepiColombo, DART, Hera, the MIRI and NIRSpec instruments at JWST and the HARMONI instrument at ESO's ELT.

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