Crystal structure of archael chromatin clarified in new study

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Researchers at the RIKEN SPring-8 Center in Harima, Japan, have clarified for the first time how chromatin in archaea, one of the three evolutionary branches of organisms in nature, binds to DNA. The results offer valuable clues into the evolution of chromatin structure in multi-cellular organisms and promise insights into how abnormalities in such structure can contribute to cancers and gene disorders.

Three distinct evolutionary branches of organisms make up all natural forms of life on the planet: bacteria, archaea and eukaryotes. Among these three, the domain known as archaea includes a variety of organisms that live in harsh environments similar to those of an early Earth, thus offering arguably the greatest glimpse of what life may have looked like 4 billion years ago.

One area of great interest is the process by which DNA bind to proteins to compact and regulate the availability of genetic material, a process which is essential in all cellular organisms. In eukaryotes, proteins known as "histones" package and order DNA into a compact protein-DNA structure called chromatin. Archaea, in contrast, have no such universal chromatin proteins, instead using two or more DNA-binding proteins to package DNA. Alba is the most widespread and abundant such archaeal chromatin protein, present in the genome sequence of every archaeal species that lives in high-temperature environments (thermophilic or hyperthermophilic).

While researchers know about the existence of Alba in archaea, the question of how these proteins bind to and compact DNA has remained a mystery. To answer this question, the researchers analyzed the crystal structure of the Alba2-DNA complex from the archaea A. pernix K1 at atomic-level resolution using synchrotron radiation from the RIKEN SPring-8 facility in Harima, Japan. Their results indicate that unlike the chromatin structure of eukaryotes, Alba2 in archaea forms a hollow pipe with the duplex DNA running through it, with the hairpin structure of Alba2 stabilizing the pipe.

Published in the February 10th issue of the *Journal of Biological Chemistry*, this newly-discovered mechanism for compacting DNA marks a major step forward in our understanding of the evolution of chromatin structure. The results promise to clarify how abnormalities in chromatin structure can contribute to cancers and gene disorders, while also providing inspiration for the development of new types of biodevices.

Provided by RIKEN