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# Polymers in bacterial cytoskeleton have different structure than believed so far

*Polymers forming bacterial cytoskeleton are not that long. This finding – out of line with the existing literature reports – has been obtained and documented by researchers from the Institute of Physical Chemistry of the Polish Academy of Sciences in Warsaw. Using an innovative measurement technique they managed to explain the reason for errors in earlier estimations as well.*

Existing beliefs as to the structure of polymers forming bacterial cytoskeleton have been partially erroneous, as proven by a team of researchers from the Institute of Physical Chemistry of the Polish Academy of Sciences (IPC PAS) in Warsaw. „We have shown that FtsZ polymers, elements of the bacterial cytoskeletons, are in fact very short, even a dozen times as short as believed so far", says Dr. Sen Hou from the IPC PAS, the first author of a scientific publication that is going to appear in coming days in the „Journal of Biological Chemistry".

The cytoplasmic skeleton is a 3-dimensional network of protein fibres. Its share in the total cell mass is significant and usually accounts for over a dozen percent. In bacteria, the cytoskeleton plays a role similar to that of the spine in humans. One of the most important cytoskeleton components are tubular structures that in eukaryotic cells (those containing nucleus) are made of a protein called tubulin and polymer fibres. It was believed even not long ago that the cytoplasmic skeleton occurs in eukaryotic cells only. The discoveries of the 1990s revealed, however, that it is also present in bacteria, where tubulin and its homologue, FtsZ protein, have been found.

FtsZ protein plays an important role in the process of bacterial cell division. That's why such cytoskeleton of prokaryotes has been so intensely studied by the researchers looking for new antibiotics. Chemical compounds that would attack the cytoskeleton structure, would prevent the division of bacterial cells, and therefore efficiently inhibit the development of illness. The efficiency of such research heavily depends on the knowledge of structure of the polymers in the cytoplasmic skeleton.

The researchers at the IPC PAS have studied the length of polymers formed by FtsZ proteins of *Caulobacter crescentus* bacteria. For the first time the dynamic light scattering (DLS) technique was used and proven to be highly usable in such measurements.

The DLS technique, also known as photon correlation spectroscopy, relies on recording light scattered due to motions of molecules, e.g., Brownian motions. The scattering is the more uniform

the smaller are the molecules present in the solution. The DLS allows to measure molecular sizes below one micrometer and to study processes with duration from microseconds to minutes.

The dynamic light scattering measurements performed by the team from the IPC PAS led to an unexpected observation. It has been found that a typical fibre of FtsZ protein is in fact very short. It is composed of 9-18 monomers only, and its total length is ca. 100 nanometers, i.e., dozens of times less than assumed so far based on measurements carried out with transmission electron microscopy (TEM).

By increasing and decreasing the polymerisation rate of samples, the researchers from the IPC PAS have shown that when FtsZ solution contacts a copper grid surface used in sample preparation for transmission electron microscopy, small linear polymers start to form large bundles within a few seconds. So, the overestimated lengths of cytoskeletal polymers accepted in the world literature resulted from the procedure of sample preparation for transmission electron microscopy.

„Our result is not only well documented, but it also better fits to the present knowledge of chemical environment in the cell interior. The nanoviscosity of the cytoplasm in bacteria is up to a dozen thousand times as high as that of water. Had the cytoskeleton polymers been long, they would not have been able to move so fast in the cytoplasm", says Prof. Robert Hołyst, IPC PAS.

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The Institute of Physical Chemistry of the Polish Academy of Sciences (http://www.ichf.edu.pl/) was established in 1955 as one of the first chemical institutes of the PAS. The Institute's scientific profile is strongly related to the newest global trends in the development of physical chemistry and chemical physics. Scientific research is conducted in nine scientific departments. CHEMIPAN R&D Laboratories, operating as part of the Institute, implement, produce and commercialise specialist chemicals to be used, in particular, in agriculture and pharmaceutical industry. The Institute publishes approximately 200 original research papers annually.

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The researchers from the Institute of Physical Chemistry of the Polish Academy of Sciences have shown that FtsZ polymers are even a dozen times as small as measured so far. The picture shows Dr. Sen Hou, the first author of the study. (Source: IPC PAS, Grzegorz Krzyżewski)