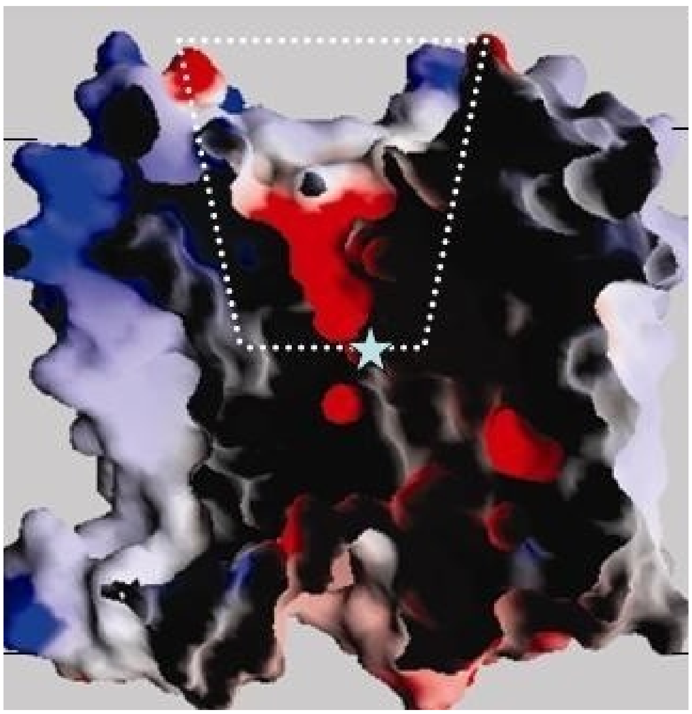
Breakthrough: structure of membrane protein described by Hebrew University, German researchers

August 4 2005



The structure of the membrane protein NhaA has been revealed by researchers at the Hebrew University of Jerusalem and the Max Planck Institute of Germany. Membrane protein research is at the forefront of modern biological study, with great potential consequences for development of new medicinal treatments and genetic engineering of plants.

Image: Illustration of the membrane protein NhaA. Area outlined by the white dots indicate the funnel of the protein extending into the cell membrane.

The research on NhaA has been carried out by Etana Padan, the Adelina and Massimo DellaPergola Professor of Life Sciences, with Dr. Rimon Avraham, both of the Silberman Institute of Life Sciences at the Hebrew University, and Prof. Hartmut Michel, Nobel prize winner for chemistry in 1988, of the Max Planck for biophysics in Frankfurt, Germany. Their work, described in a recent edition of the journal Nature, was supported by a grant from the German-Israel Binational Science Foundation;

Proteins such as NhaA are found in the membranes of every living cell, from bacteria and up to humans. Until now, the structure of fewer than 50 cell membrane proteins have been discovered, as opposed to 30,000 soluble proteins.

“The location of the proteins in the cell membranes presents tremendous difficulties in research,” said Prof. Padan. “Unlike the majority of those proteins which are soluble in water, the membrane proteins are soluble only in fats or in the presence of detergents.”

The cell membrane is the crossroads of busy, two-way “traffic” through which materials and impulses travel into and out of the cell. The fatty cell membrane is impenetrable to most of these materials and signals; and it is therefore the proteins within the membranes that are responsible for the communication between the cell and its environment. Indeed, more than 60 percent of the medicines in use today are directed at the cell membrane proteins. Since the cell membrane proteins are exposed, in part, to areas extending outside the cells, the medicines are able to reach them without entering the cell itself.

In Prof. Padan's laboratory, the researchers succeeded in isolating the gene that encodes NhaA in bacteria and in producing a large quantity of the protein in its active state. This achievement paved the way for determining the structure of the protein, providing an essential insight into its mechanism of activity and regulation. NhaA protects the volume of the cell and its internal, normative state in terms of its salinity and acidity.

The deciphering of the NhaA protein's structure was done utilizing three-dimensional crystals of the protein which diffract x-rays. The work of analyzing the diffraction was done using the powerful electron accelerators in Grenoble, France, and Zurich, Switzerland.

"In this way we were able to reveal the wonderful architecture of the membrane protein, which was unknown before," said Prof. Padan. "In the center of the protein we found a wide funnel which extends into the cell. The funnel narrows and ends at the point at which it binds with the sodium or the hydrogen deep within the cell membrane. Near that point two chains of the protein unite into a unique structure."

The researchers believe that this unique structure is the basis for the activity of the protein. The protein operates as a kind of pump, utilizing energy which it receives from processes taking place within the cell. The protein structure thus acts as a kind of molecular motor. This "motor" is connected to the area found at the mouth of the funnel that apparently conveys signals to "modulate" the motor according to the acidity within the cell. The result is that the protein's activity is controlled in accordance with the needs of the cell in relation to its acidic and basic levels.

researchers (2005, August 4) retrieved 3 May 2024 from
https://phys.org/news/2005-08-breakthrough-membrane-protein-hebrew-university.html