Scientist uses form to explain function of key building blocks of life

September 30 2005

UW-Madison biochemists have developed an approach that allows them to measure with unprecedented accuracy the strengths of hydrogen bonds in a protein. The scientists were then able to predict the function of different versions of the protein based on structural information, a novel outcome that was published recently in the Proceedings of the National Academy of Sciences.

Professor of biochemistry John Markley, along with a team that included graduate student I-Jin Lin, studied iron-sulfur proteins called rubredoxins that transfer energy in the form of electrons throughout living systems.

Rubredoxin is a key part of processes like photosynthesis and respiration, where energy is converted from one form to another.

"Variants of rubredoxin have evolved different sequences to transport electrons in the most efficient manner possible," Markley explains. "Different mechanisms have been put forward to explain this, and we wanted to understand how the proteins evolved to have different electron affinities."

Markley and his team used nuclear magnetic resonance spectroscopy, a technique that allowed them to observe signals from atoms in the proteins, to determine the strength of hydrogen bonds in ten different variants of the protein. From that data, the team was able to explain changes in protein function.

"In science, you try to build theories that will explain the properties of the systems you are looking at," explains Markley. "Proteins are the basic building blocks of life, and are coded for by the genes in DNA. We'd like to be able to start with a gene sequence and predict the structure of a protein and its function. In this case, given an NMR pattern, we can tell you how the protein will act. In general, this method may provide information about even more complex biological systems. This is an approach that will be important for larger proteins."

Markley notes that an undergraduate and graduate student played key roles in the study. Lin, who plans to complete her Ph.D. this spring, spent years tackling what Markley described as a "complex and difficult project."

Erika Gebel, the undergraduate on the study, is now pursuing a graduate degree of her own, a pursuit that was enhanced by this project, says Markley.

"(Undergraduate research) enables them to understand what research is and what's involved in exploring something that hasn't been observed before," he says.

Funded by a grant from the National Institutes of Health and by the state of Wisconsin, the study also relied upon the National Magnetic Resonance Facility at Madison, an NIH-funded laboratory located in the biochemistry department. William Westler, director of the NMR facility, was a co-author on the paper.

Source: University of Wisconsin System