Starbulletin.com

Thursday, August 9, 2001

UH team unravels ancestor of human biological system

Scientists say human hemoglobin may have evolved from a protein found in primitive life

By Helen Altonn
haltonn@starbulletin.com

University of Hawaii scientists studying the most ancient group of microorganisms on Earth have made another in a series of discoveries related to the evolution of life.

"We think what we learned tells us how the biological system adapted to early environments of our life," said Maqsudul Alam, associate professor of microbiology and associate director of the Marine Bioproducts Engineering Center.

Alam and Randy Larsen, associate professor in the Department of Chemistry, said they have unraveled the structure of a new class of myoglobin-like proteins discovered last year in the primitive organism Archaea.

Known as globin or heme-proteins, they are able to store and transport oxygen as human hemoglobin does, Alam said.

Larsen added, "There is much stronger evidence now that our globins (hemoglobin and myoglobin) that we have in our bodies may have evolved from more primitive organisms."

Alam said, "Our research was able to identify the core structure of how myoglobin and hemoglobin came."

Archaea are found in extreme environments such as hydrothermal vents and are known as extremophiles.

Alam said the globin-like protein in Archaea "is probably the mother protein of the gases which were in the early era of our planet," likely evolving 3.2 billion to 3.5 billion years ago.

Globin proteins had never been found in ancient organisms until the discovery last year by Alam, Larsen and their team.

"What we found now is they are found in more organisms than we thought, and they are more widespread," Larsen said. "We have a lot more detail about the structure, and they are much closer to myoglobin than we originally thought."

There was no oxygen on Earth 3.8 billion years ago when the first living organisms appeared, so they used other gases, the UH scientists said.

"We predicted, and we believe, this type of protein not only can sense oxygen, but can sense nitric oxide and hydrogen sulfide, and it can sense carbon monoxide because these are the gases at the early time of evolution, before oxygen arrived in our planet," Alam said.

The oxygen-carrying protein could sense gaseous molecules and tell living bacteria it was sending oxygen, he said.

"The organisms were probably around on Earth at the time when oxygen was just starting to come into the atmosphere," Larsen said. "They were sensing oxygen, so the upshot is, those were the proteins that the early bacteria used to detect how much oxygen there was in the environment.

"We now use the same type of proteins to store and transport oxygen," he said, adding that human storage and transport of proteins may have evolved from early proteins that sensed oxygen.

By doing three-dimensional computer modeling, the scientists were able to predict the core structure of the protein, Alam said.

Having done that, he said, they wanted to see if the core structure could be used to predict existence of the proteins in other microorganisms. And it worked.

A paper in the Proceeding of the National Academy of Sciences describes how the globin proteins function and the matrix of the core structure.

Alam credited his team, including graduates and postgraduates, with the discoveries.

"Without their help I would never come to that point. These are local kids and I'm so proud of them. We should be proud of what we produce here."

Larsen is leaving UH in January to join the University of Florida in Tampa, but said he will continue to collaborate with Alam.