Secrets of a Life-Giving Amino Acid Revealed

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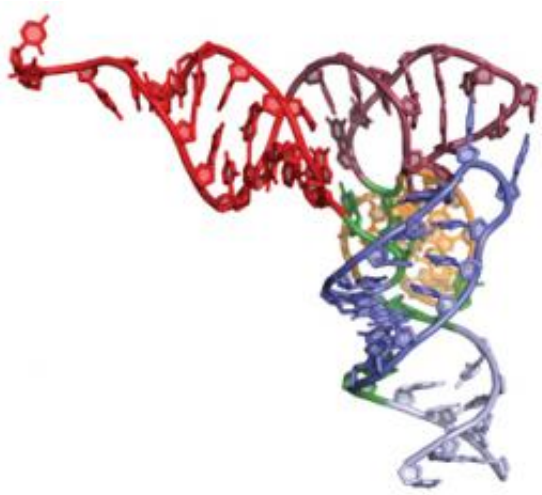

Selonocysteine tRNA molecule

(PhysOrg.com) -- Selenium is a trace element crucial to life -- too little or too much of it is fatal. In the July 17 issue of the journal *Science*, researchers at Yale University and University of Illinois at Chicago detail the molecular mechanisms that govern its metabolism in the human body.

"It must require an intricately regulated uptake system," said Dieter Söll, co-senior author of the paper, Sterling Professor of Molecular Biophysics and Biochemistry at Yale. "There are 25 human selenoproteins, and most of them are probably essential for life."

Selenium is thought to offer protection from diverse human ailments including adverse mood states, cardiovascular disease, viral infections and cancer.

Selenocysteine is the most active metabolite of selenium in humans. It is unique among amino acids because it is the only one synthesized directly on a transfer RNA (tRNA) molecule, which shuttles the amino acids to the protein-making machinery within cells. Proteins that contain selenocysteine are responsible for recycling protective antioxidants such as vitamin C and coenzyme Q10.

Söll's team for the first time captured images of how selenocysteine is created on a super-sized tRNA molecule, which seems to have a highly specialized role in nature. The 20 other amino acids and their associated tRNAs use the same protein vehicle, called an elongation factor, for transport to the ribosome. However, nature has provided this large tRNA molecule with a specialized elongation factor that chauffeurs only selenocysteine to the ribosome.

"This structure reveals most aspects of the mechanism for the formation of selenocysteine and provides an answer to 20 years of biochemical work in the field," said Sotiria Palioura, lead author of the study and an M.D./Ph.D. candidate at Yale.

The findings may lead to greater understanding of autoimmune liver disease. The tRNA complex described in the *Science* paper is the target of antibodies in patients with Type 1 autoimmune hepatitis. "The region that the antibody is supposed to recognize is at the business end of this molecule, where we see the reaction happening," Palioura said.

"Selenocysteine has been found to be a critical component of enzymes involved in a number of normal and disease processes," said Michael Bender of the National Institutes of Health's National Institute of General Medical Sciences. "This basic study, which has shed light on selenocysteine's unique biosynthetic pathway, could ultimately have an impact on many aspects of human health, including the immune response, neurodegeneration, cardiovascular disease, and cancer."

Source: Yale University (news : web)