Biologists discover carotenoid transfer between two proteins

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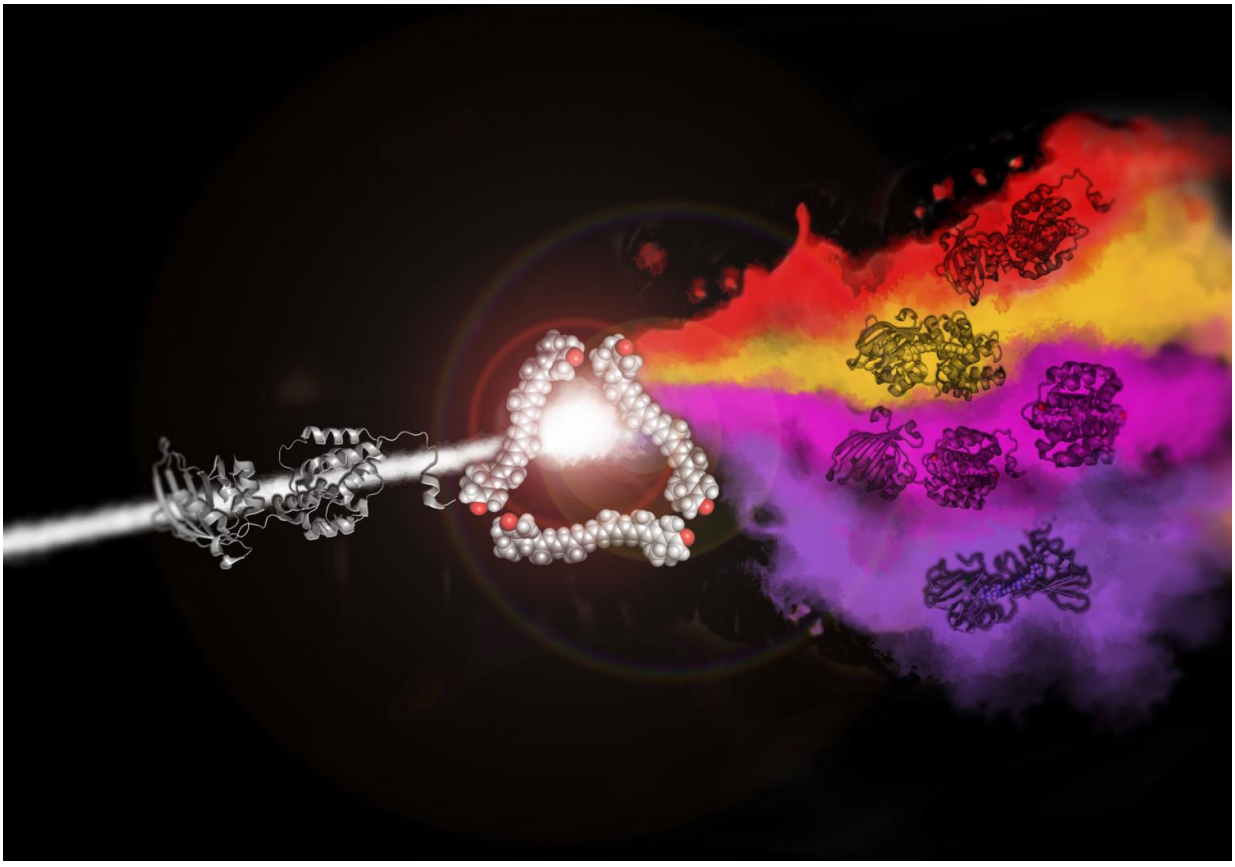

"Cover art" for this article reminds of the cover of the album "The Dark Side of the Moon" by Pink Floyd. It shows how red, purple, orange and violet proteins can be obtained from a colorless protein and one type of a carotenoid. Credit: Eugene Maksimov

Specialists from the biological faculty of Moscow State University have studied how the photoactive orange carotenoid protein (OCP) exchanges carotenoid with proteins of similar structure. The discovery will boost the development of OCP-based antioxidant drugs aimed at protecting healthy cells during cancer treatment. The paper was published in the *Biophysical Journal*.

The orange carotenoid protein (OCP) is a small water-soluble protein that serves as an excitation energy quencher in cyanobacteria. It reduces energy transfer in the photosynthetic apparatus under high light conditions. Cyanobacteria are among the oldest organisms on the Earth capable of photosynthesis, and are responsible for the high concentration of oxygen in the atmosphere.

Under strong light, the structure of orange carotenoid protein changes and interacts with antennas to prevent formation of reactive oxygen species. Carotenoids are long hydrocarbon molecules with a large number of double bonds, which serve as photosensitive chromophores. The color of carotenoids depends on the protein state.

Previously, the biologists from the Moscow State University have described the structure and properties of the OCP domains that appeared to be capable of binding the carotenoid into a complex of bright violet color. One of the interesting and previously unknown properties of the orange carotenoid protein is the ability to transmit the carotenoid to other proteins with a similar structure. The mechanism of the process is described in the*Biophysical Journal* article.

"We studied the interaction of carotenoid-containing violet C-domains of the OCP with a colorless apo form of the OCP. As a result of the interaction, the colorless apo form of the OCP became orange and photoactive (capable of changing its structure and color). The carotenoid transfer process simulates the process of assembling a photoactive

protein from a protein matrix and a chromophore (carotenoid)," said Dr. Eugene Maksimov, senior researcher at the Laboratory of Biophotonics.

The transfer reaction of a hydrophobic carotenoid molecule between two water-soluble proteins offers several interesting research opportunities. This mechanism will allow researchers to create water-soluble protein complexes to deliver antioxidant carotenoid to cells that need protection from the reactive oxygen species—for example, to healthy tissue during photodynamic cancer therapy. The photoactive properties of the complex will be useful in molecular thermometers as their color would show the difference in temperature between the parts of the cell.

More information: Eugene G. Maksimov et al, The Unique Protein-to-Protein Carotenoid Transfer Mechanism, *Biophysical Journal* (2017). DOI: 10.1016/j.bpj.2017.06.002

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