Mardi 12 Novembre 2024 à 11h

Attention : jour inhabituelle

Amphithéâtre GREGORY, Ecole Polytechnique

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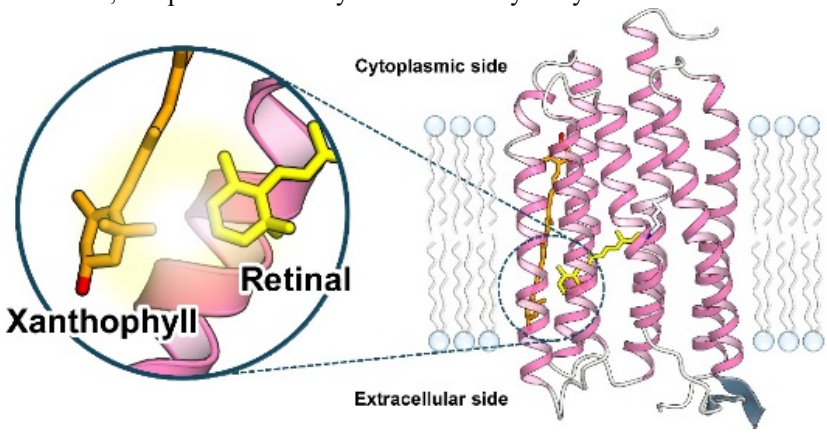
Carotenoids in microbial rhodopsins: emerging roles in expanding rhodopsin functionality

Microbial rhodopsins are photoreceptive membrane proteins found in microorganisms, ranging from bacteria and archaea to unicellular eukaryotes and giant viruses. The structure of microbial rhodopsins consists of a common heptahelical transmembrane protein architecture known as opsin and an all-*trans*-retinal chromophore binding to the seventh helix via a Schiff base linkage. While microbial rhodopsins have diverse functions, including roles as light-driven ion pumps, light-gated ion channels, and light-dependent gene synthesis and enzymes, they are widely used in optogenetics to optically and non-invasively manipulate various biological responses.

We recently revealed that several outward H^+-pumping rhodopsins from bacteria and archaea bind carotenoids with hydroxylated terminal rings, such as lutein and zeaxanthin, which serve as antenna pigments that transfer the absorbed photon energy to the retinal. The three-dimensional structures of these rhodopsins revealed a fenestration near the β-ionone ring of the retinal, facilitating the van der Waals contact between the retinal and carotenoids [1]. This interaction enhances the H^+-pumping activity through blue-light photon absorption by carotenoids, which cannot be achieved using the retinal chromophore alone. Moreover, the photoreaction cycles of these hydroxylated carotenoid-binding rhodopsins were investigated using laser flash photolysis. Interestingly, the carotenoids were found to enhance the photoreaction efficiency and to accelerate the turn-over rate of the photoreaction cycles, suggesting they function not only as photon antennae but also as allosteric enhancers of the H^+-pumping efficiency of rhodopsins. Since hydroxylated carotenoids are found in animal bodies, these H^+-pumping rhodopsins are expected to be used as novel optogenetics tools. In my presentation, I will also introduce other rhodopsins that exhibit unique characteristics [2].



References

1. Chazan et al., ***Nature*** (2023) *615*, 535-540
2. Tzlil et al., ***bioRxiv*** (2024) doi: https://doi.org/10.1101/2024.09.18.613612