Bicelles as versatile platforms for rhodopsin in biophysical applications

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1. Introduction

Rhodopsin is localised within the lipid bilayers of the photoreceptor outer segments discs and is one of the best-characterized membrane proteins that plays a crucial role in processing the light signal into visual information[1]. The lipid composition of the disc membrane in rod outer segments influences rhodopsin activity by modulating its stability, kinetic properties, and functional performance[2]. However, the correlation between the lipid composition and rhodopsin functionality is not well understood. Bicelles, disc-shaped lipid aggregates capable of forming a single lipid bilayer, can provide a compelling medium for investigating this relationship[3].

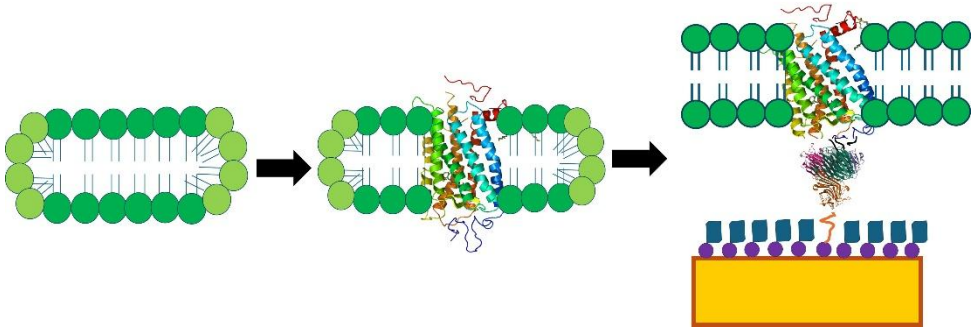

Fig. 1. Schematic model of DMPC/DHPC bicelles with inserted rhodopsin and spreading of bicelles containing rhodopsin on a gold surface, protein structures from PDB.

2. Methods and results

In our research, we characterized the structural properties of rhodopsin reconstituted in bicelles. The size difference of bicelles with and without rhodopsin was confirmed by Dynamic Light Scattering (DLS) measurements, and they were captured by transmission electron microscopy (TEM). Using infrared (IRS) and circular dichroism spectroscopy (CDS), we found that rhodopsin forms a more packed structure compared to the detergent-solubilized condition. Additionally, the bicelle-reconstituted rhodopsin forms exhibited increased thermal stability. The capability to form bilayers starting from bicelles incorporating rhodopsin was investigated by Polarization-Modulation Infrared Reflection-Absorption Spectroscopy PM IRRAS analysis, which revealed that the application of transmembrane potential induces pronounced conformational and orientational changes within the helical bundle of rhodopsin. We also immobilized rhodopsin in bicelles on a sensor chip surface via concanavalin A anchoring and checked the efficiency of binding to the G protein transducin in comparison to the detergent environment by Surface Plasmon Resonance (SPR).

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4. References

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