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Interaction of Glycolipid S-TGA-1 with Bacteriorhodopsin and Its Functional Role

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Abstract : It has been demonstrated that lipid molecules in biological membranes are responsible for the functionalization and structuration of membrane proteins. However, it is still unclear how the interaction of lipid molecules with membrane proteins is correlated with the function of the membrane proteins. Here we first developed an evaluation method for the interaction between membrane proteins and lipid molecules via surface plasmon resonance (SPR) analysis. Bacteriorhodopsin (bR), which was obtained by the culture of halobacteria, was used as a membrane protein. We prepared SPR sensor chips covered with self-assembled monolayer containing mercaptocarboxylic acids, and immobilized bR onto them. Then, we evaluated the interactions with various lipids that have different structures. As a result, the halobacterium-specific glycolipid S-TGA-1 was found to have much higher affinity with bRs than other lipids. This is probably due to not only hydrophobic and electrostatic interactions but also hydrogen bonds with sugar moieties in the glycolipid. Next, we analyzed the roles of the lipid in the structuration and functionalization of bR. CD analysis showed that S-TGA-1 could promote trimerization of bR monomers more efficiently than any other lipids. Flash photolysis further indicated that bR trimers formed by S-TGA-1 reproduced the photocyclic activity of bR in purple membrane, halobacterium-membrane. These results suggest that S-TGA-1 promotes trimerization of bR through strong interactions and consequently fulfills the bR’s function efficiently.

Keywords : membrane protein, lipid, interaction, bacteriorhodopsin, glycolipid
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