Dissecting the hydration of glycans on proteins by using total chemical synthesis of glycoproteins

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The unique hydration property of glycans facilitates the interaction between glycoproteins with water molecules. Therefore, increases in the hydrophilicity of the protein moiety have been thought to be one of the functions of glycans on glycoproteins. We hypothesized that the dynamic behavior of water surrounding glycoproteins could be affected by glycans, resulting in the intrinsic functions of glycoproteins.

To address this hypothesis, we carried out the total chemical synthesis of glycoproteins and functional analysis. We have synthesized antifreeze glycoprotein (AFGP) having different sugar modifications.[1,2] AFGP is a highly *O*-glycosylated protein that inhibits the freezing of water. To shed light on the functional role of the O-glycans, we performed functional analysis including a hydrogen-deuterium exchanging (HDX) experiment by using homogeneous AFGPs prepared by chemical synthesis. The HDX experiment indicated that the sugar moiety of AFGP affected the dynamic behavior of surrounding water molecules. Together with other functional studies, it was suggested that sugar residues on AFGP form a unique dynamic water phase that disturbs the absorbance of water molecules onto the ice surface, thereby inhibiting freezing.[2]Upon this result, we further conducted the total chemical several *N*-glycoproteins, of which glycans are larger than those of AFGPs. The functional analysis of these molecules suggested that the unique hydration of N-glycans correlates with the biological function of proteins, such as protein-protein interaction, at a molecular level.

Bibliographic references:

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