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Title of Doctoral Dissertation

Deciphering biological significance of dynamic glycosylation on glycan variants by mass spectrometry

質量分析法による動的で多様な糖鎖修飾の生物学的機能解明

My work revolved around different strategies to prepare a glycopeptide, which is a biomolecule containing a peptide (shorter version of a protein) and a glycan (sugar/carbohydrate) component. In nature, glycoproteins usually have the same protein components but different glycans. With this, studying a glycoprotein with correctly defined glycan components is relevant to understand its biological function. My work involved 4 parts.

Firstly, I differentiated the glycan profiles of 4 quail egg white samples and have identified components unique to Japanese quail. A unique glycan, $\text{Man}_3\text{GlcNAc}_2$, conserved to all other *N*-glycan structures is seen. In the second part, isolation of the conserved $\text{Man}_3\text{GlcNAc}_2$ glycan was conducted and attached it to peptide components. A correctly defined glycopeptide can serve as standards for quantification purposes and can be used in different assays to understand its function in healthy and diseased states. In the third part of the work, glycopeptides with the same peptide component but with different glycan structures were used as standards to measure the amount of those biomolecules in healthy human serum. Even with minute quantities, quantitation was possible and achieved by using a sophisticated and very sensitive equipment called 4000 QTrap Liquid Chromatography-Mass Spectrometry. Since most of my procedures entails the use of different enzymes to release and attach glycans from peptides/protein, the last part of my PhD work involved a strategy on not to waste such precious enzymes and to reuse it multiple times by placing it in a stable support. With the advent of this scientific field, all the parts presented could serve as relevant tools for preparing glycopeptides from natural sources.