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Editorial

Ola Blixt

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The introduction of the microarray technique have dramatically improved analysis of interaction between proteins and complex carbohydrates as evidenced by these series of papers presented in this special issue of the Journal. Protein–glycan and glycan–glycan interactions mediate diverse biological processes in cell communication and immunity and they involve the binding of a protein on one cell surface to a glycosylated protein or lipid on an opposing cell surface. Understanding the functional significance of these interactions is of major interest to the scientific community. Prokaryotes are also known to utilize a glycome even more complex than is presently known to exist in mammals.

One of the major advancements with the glycan microarray technology is the low amount of glycans needed to populate an array and that the miniaturized format allows simultaneous studies of many biological samples in one experiment. Despite minimal glycan consumption the glycans are generally densely immobilized and as a result high signal-to-noise ratio is obtained from stable glycan–analyst interactions via increased avidities.

Although various elegant chemical approaches for immobilization of glycans flourish, the development of comprehensive glycan microarrays has been very slow, mostly because of difficulties to assemble relevant glycan libraries. Efficient methods for tagging minute amounts of complex natural glycans have also been a problem. Multiple strategies, many that are only available through expert laboratories, are needed to achieve this goal. Recently, a large collaborative effort under the auspicious of The Consortium for Functional Glycomics (CFG) funded by NIGMS (USA), demonstrated the effectiveness how such efforts could be centralized and successfully executed. A systematic effort to assemble a diverse glycan library was achieved with generous support from Participating Investigators and secured long-term financial stability. The CFG glycan array has become the leading workhorse in generating glycan–protein specificity information and comprehensive data collections are being accessible to the public through the user-friendly CFG database (www.functionalglycomics.org). Still, there are needs for further technology improvements and this special glycan microarray issue highlights recent advances in this field ranging from procedures for efficient tagging of natural glycans, high-throughput specificity studies and detection techniques.

Briefly, several glycan microarray technologies are based on covalent coupling of the glycans to the solid support surface and require chemical modification of the glycan, which may add extra work to the process and also be relatively complicated. In the mini-review by Carrol *et al*., photochemical methods are highlighted as a promising alternative that does not require pre-modification of the glycans and can in many situations be an advantage when immobilization of large and complex polysaccharides are needed. Alternatively, CFG (Blixt *et al*.) demonstrated that bacterial polysaccharides and fragments thereof could be efficiently covalently conjugated with bi-functional amines onto glass slides. Regardless of what coupling method is used there have been no reliable ways to quantify the incorporation of glycans to the surface. This special issue highlights a communication (Shiliva *et al*.) and a full article (Song *et al*.) describing derivatization of glycan by reductive amination using fluorescent aromatic amines for quantitation of immobilized glycans.

O. Blixt (✉)
Department of Cellular and Molecular Medicine,
University of Copenhagen,
Copenhagen, Denmark
e-mail: olablixt@imbg.ku.dk

Applications of glycan microarray technologies include analysis of various GBPs, but also screening of monoclonal antibodies which are powerful tools for investigating biological roles of glycans. In this issue, Moller *et al*. describe utilities of glycan microarrays for screening hybridoma supernatant in order to produce mAbs against cell wall glycans. Another use is to investigate glycosyltransferase specificities. A series of sialyltransferases was successfully investigated by the transfer of biotinylated sugar-nucleotide to the array surface and subsequent detection with fluorescent labeled streptavidin (Blixt *et al*.). In addition, Shipp *et al*. demonstrated monitoring of glycosyltransferase activities involved in plant cell wall polysaccharide biosynthesis by incorporation of [^{14}C]-radiolabeled sugar nucleotide followed by detection with a standard phosphoimager scanner.

Most commonly used detection methods for glycan microarray analysis are fluorescently labeled GBPs or antibodies. Recently, other detection methods such as labeled-free analysts have been developed along with advancements of new commercial technologies. Two examples appear in this issue, one presented by Karamanska *et al*. that utilize the surface plasmon resonance (SPR) imaging technology for analysis of GBPs with biotinylated glycans immobilized on a neutravidin coated gold surface. The other contribution by de Boer *et al.,* also use the SPR array technology but elegantly integrated with labeling and HPLC fractionation of natural glycans for serum antibody screening.