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Recent development in sugar derivatives

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ABSTRACT

In recent years, the considerable progress has been made in the synthesis of glycosides. The challenging chemistry, due to its versatility, glycosides play a key role in developing novel materials and biological molecules. In this review article we discussed on the variety of applications of these sugar derivatives.

1. Introduction

Carbohydrates are everywhere; from bulk sucrose in the kitchen to cross-linked peptidoglycans (Kikuchi et al., 2011) that comprise cell walls, from micro diverse, post transcriptionally modified cell-surface receptors to the production of papers. However, the carbohydrates have often been relegated to the sidelines of chemistry, one example being the complete omission of essential and challenging sugar portions from many reports on "natural product synthesis (Peltier-Pain, Marchillo, Zhou, Andes, & Thorson, 2012). In sharp contrast to the lack of attention that carbohydrates receive among the broader community, the fundamental scientific and medical importance of glycochemistry/glycobiology (Du et al., 2014) has led to a dedicated and concerted attack on the field by an increasing number of pioneering research groups. Their work has lead to major advances in such diverse subjects as chemical synthesis, analytical chemistry, structural biology and cell-surface recognition.

There is great dependence on amino acids and certain key sugars for a pool of chiral chemical reagents. The basic building blocks of polypeptides and polynucleotides have long been available for routine and advanced studies, as have elegant solution and solid-phase methods for preparing specific peptide or nucleotide sequences. Furthermore, synthetic analogues of natural amino acids, peptides, and nucleic acids have been invaluable in medicinal chemistry and biochemistry, while biotechnology and chemistry require ever more complex nucleotide derivatives. Nature certainly constructs carbohydrates as needed, no matter how complex, using a mixture of elongation, branching, and selective digestion steps. The ability to prepare specific glycopeptide (Liu et al., 2015) constructs with recognition motifs in both the peptide and carbohydrate portions will allow many biologically important questions to be probed at the molecular level. Protein folding is often assisted by chaperones and controlled by post-transcriptional modifications. *N*-Glycosylation is a co-translational process that can occur during translocation of a protein into the endoplasmic reticulum and therefore N-glycosylation appears to assist chaperones with protein folding. In this review mainly focuses on the structures, materials and biological applications of the *N*-, *O*-, *C*- and S-linked saccharide derivatives.

2. *N*-Glycosides

In recent years there is a progress in the synthesis of complex nucleoside antibiotics has paralleled improvements in methods for N-glycosylation of purines and pyrimidines. *O*'Doherty and co-workers have developed a new method on N-glycosylation based on iterative application of palladium catalyzed N-glycosylation reaction methodology. Based on this methodology L-2-deoxy-β-ribo-hexapyranosyl nucleosides (1) from 6-chloropurine and Boc-protected pyranone have been synthesized (Guppi, Zhou, Doherty, & De Novo, 2006). Moreover, Verdine and co-workers have developed an another new and novel methodology for synthesis of ribonucleosides (2) from fluorinated ribofuranoses and nucleobase in presence of NBS and lewis-acid catalyst boron triflouride etherate (Lee, Uttamapinant, & Verdine, 2007). Interestingly, a concise enantioselective total synthesis of 4′-ethynyl-2-fluoro-2′-deoxyadenosine (EFdA), 3 an extremely potent anti-HIV agent, has been accomplished from (*R*)-glyceraldehyde acetonide in 18% overall yield by a 12-step sequence involving a highly diastereoselective ethanoylation of an α-alkoxy ketone intermediate (Fig. 1).

In our group synthesized *N*-Glycosylamines synthesized from 4, 6-*O*-protected D-glucose on reaction with *N*-pyridylamines are known to exist as a new class of organogelators (4) as shown in Fig. 2 (Kageyama,

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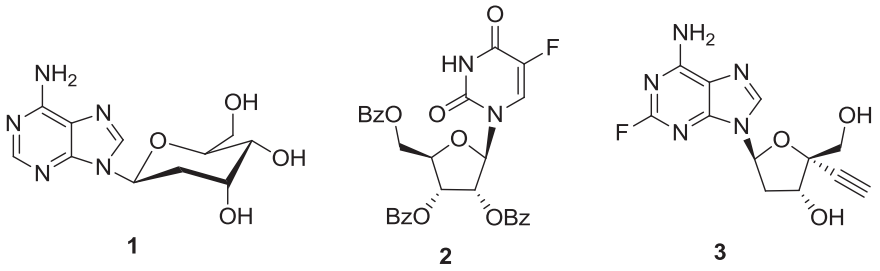

Fig. 1. Synthesis of nucleosides through N-glycosylation methodology.

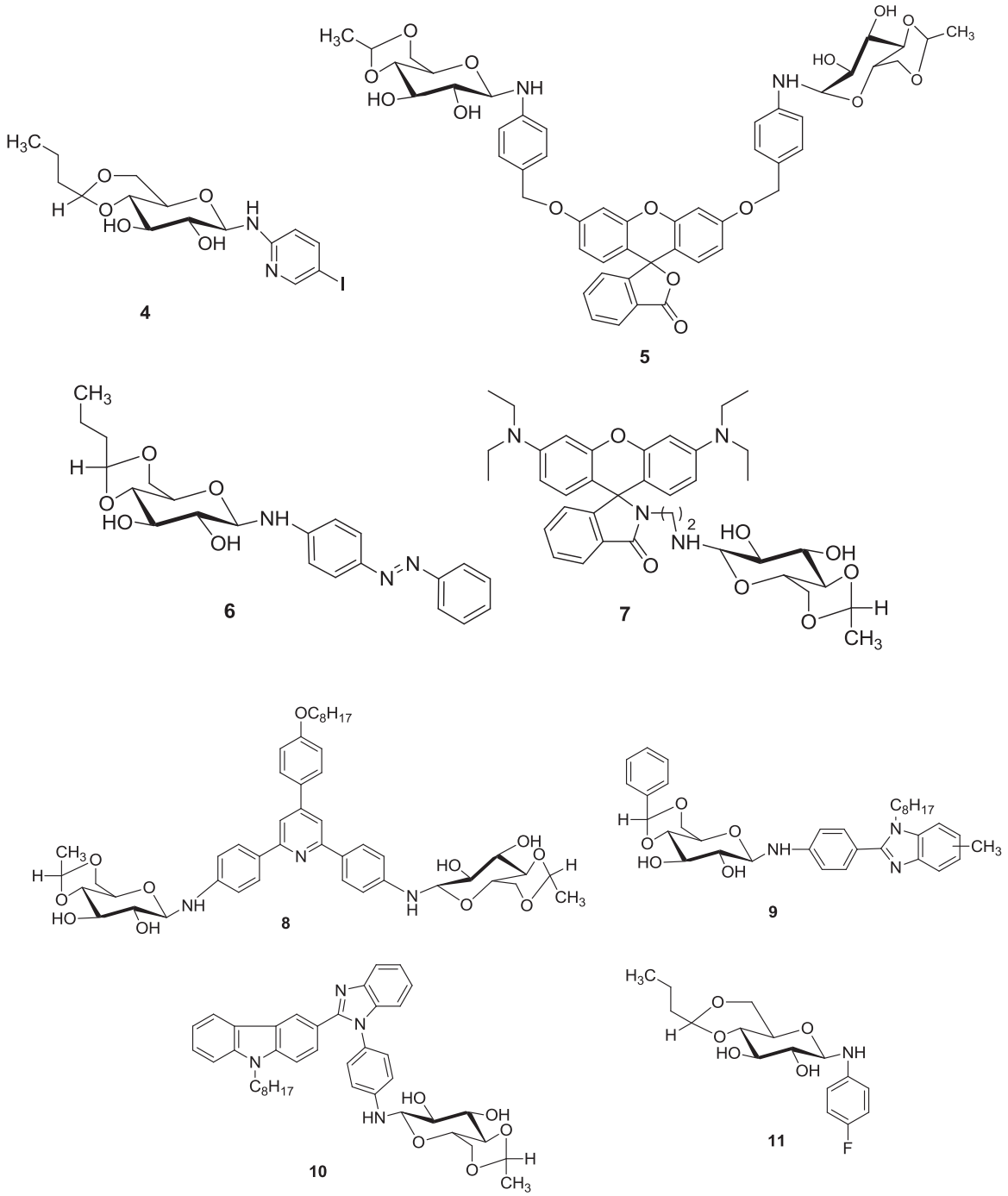

Fig. 2. Structure of *N*-glycosylamines as organogelator, fluorescent probe.