SELECTIVE ANOMERIC TRANSFORMATION STRATEGIES IN CARBOHYDRATE CHEMISTRY

INTRODUCTION

Carbohydrates are central to biology and materials science, and their structural complexity enables diverse chemical modifications. The anomeric position is particularly important due to its unique reactivity and role in molecular recognition and stability. Selective modification of this site without affecting other functional groups remains challenging. Recent advances now allow precise, mild, and efficient anomeric transformations, enabling new approaches to the synthesis of glycoconjugates, pharmaceuticals, and agrochemicals.

TRANSFORMATION STRATEGIES

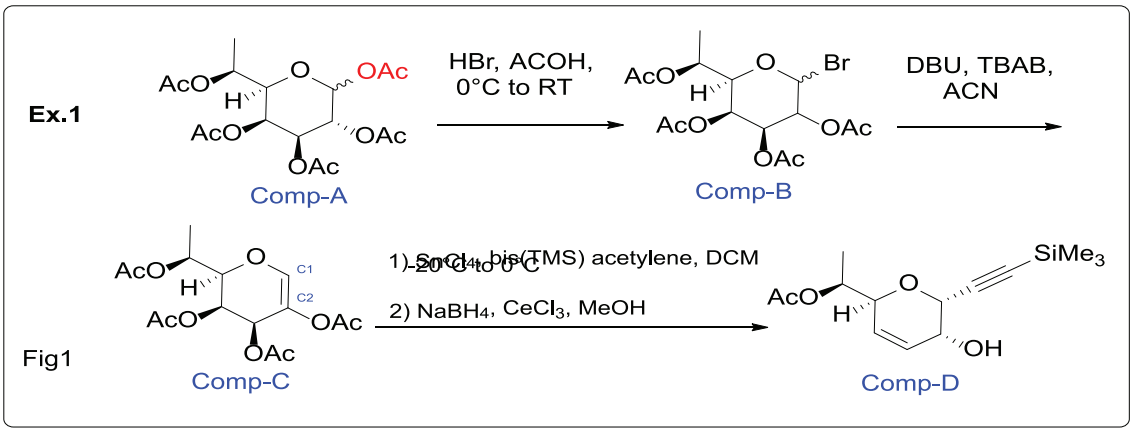
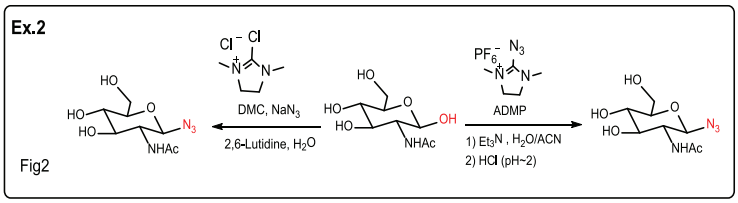
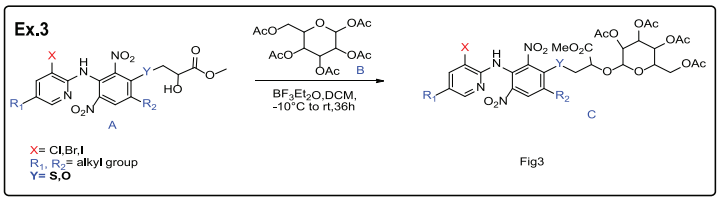


Fig1

The anomeric hydroxyl of Comp-A is selectively brominated under the conditions shown in Figure 1. This step converts the hemiacetal or acetal functionality at the anomeric center into a glycosyl bromide (Comp-B), a key intermediate for further transformations. Following bromination, elimination occurs at the anomeric carbon to generate a glycal structure (Comp-C), characterized by a double bond between C1 and C2. This unsaturation facilitates subsequent glycosylation reactions, providing a reactive site for nucleophilic attack. Comp-C undergoes glycosylation, followed by hydrolysis and elimination, to afford Comp-D. The overall sequence preserves stereochemical integrity at relevant positions and provides a versatile intermediate for further carbohydrate functionalization.

Ex.2: Chemoselective azidation at the anomeric position of unprotected sugars has emerged as a valuable strategy for preparing glycosyl azides, key intermediates in glycoconjugate synthesis and click chemistry.





In our laboratory, a practical glycosylation protocol was employed to convert Compound A into Compound C using $BF_3{\cdot}Et_2O$ as a Lewis acid promoter. The reaction was initiated by adding $BF_3{\cdot}Et_2O$ to a solution of Compound A in DCM at −10 °C under nitrogen, followed by the addition of the (Compound B). The mixture was gradually warmed to room temperature and stirred for 36 hours. After quenching with aqueous $NaHCO_3$, standard extraction and purification afforded Compound C in 70% yield. This method demonstrates an efficient and reliable approach for glycosidic bond formation under mild conditions.

LIMITATIONS AND CHALLENGES

Selective anomeric transformation is difficult due to competing hydroxyl groups and the need for protecting strategies. Challenges in stereocontrol, substrate scope, and harsh conditions limit scalability and practical application.

FUTURE PERSPECTIVES AND OUTLOOK

Future advances in anomeric transformation will focus on improved stereocontrol, efficiency, and functional group tolerance. Protecting-group-free, mild, and sustainable methods will enhance practicality and broaden academic and industrial applications.

CONCLUSION

Chemoselective functionalization at the anomeric position enables precise modification of complex carbohydrates. Recent advances in glycosylation and selective activation provide improved control and efficiency under mild conditions. These methods are increasingly important for the synthesis of glycoconjugates, pharmaceuticals, and agrochemicals.

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