

Characterization of Rhamnosyl Dioxanium Ions and Their Application in Oligosaccharide Synthesis

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Attaining complete anomeric control remains to be one of the biggest challenges in carbohydrate chemistry. Glycosyl cations such as oxocarbenium and dioxanium ions are key intermediates of glycosylation reactions. Characterizing these highly-reactive intermediates and understanding their glycosylation mechanisms is essential in the stereoselective synthesis of complex carbohydrates. Although C-2 acyl neighbouring-group participation (NGP) has been well-studied, remote participation remains a more elusive process and is difficult to study. Herein, we report the consecutive characterization of rhamnosyl 1,3-bridged dioxanium ions derived from C-3 p-anisoyl ester rhamnosyl donors. First, we used a combination of quantum chemical calculations and infrared ion spectroscopy (IRIS) to determine the preferred glycosylation intermediate in the gas-phase. In addition, we established the structure and exchange kinetics of highly-reactive, low-populated species in the solution-phase using chemical exchange saturation transfer (CEST), COSY, HSQC and HMBC NMR spectroscopy. Finally, we applied this methodology to the synthesis of complex bacterial oligosaccharides. This combination of answering fundamental chemical questions using stated methods and applying them in organic synthesis provides a robust basis for developing stereoselective glycosylation tools and reactions.

