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Disaccharide-Containing Macrocycles by Click Chemistry and Intramolecular Glycosylation

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In this study *o*- and *m*-xylylene moieties in combination with a triazolylmethyl moiety have been successfully employed as a relatively rigid spacer system in intramolecular glycosylation reactions. Phenyl 3,4,6-tri-*O*-benzyl-2-*O*-propargyl-1-thio-D-glucopyranoside was employed as a donor, which could be readily connected by 1,3-dipolar cycloaddition (click reaction) to *O*-(2- or 3-azidomethylbenzyl)-protected acceptors to afford, after liberation of the accepting hydroxy groups, the desired donor–spacer–acceptor-linked intermediates. NIS/TMSOTf-promoted glycosylation furnished disaccharide-containing macrocycles. In general, very good results were obtained. The anomeric selectivity is dependent on various factors, the ring size seeming crucial.

Introduction

Carbohydrate-based molecules play pivotal roles in many physiologically and pathologically important processes including cellular recognition, communication, cell growth regulation, cell differentiation, adhesion, migration, invasion, inflammation, immunological response, tumour metastasis and bacterial and viral infection, and hence the general interest in these compounds, particularly as constituents of glycoconjugates, has greatly increased in recent years.[1,2] This increasing demand for carbohydrate-containing molecules for biological, pharmaceutical and medicinal studies has led to tremendous efforts to develop novel and facile methods for the synthesis of diverse glycosides.[3–7] Recently, carbohydrate-containing macrocycles have also received great attention because of their application in bioorganic and supramolecular chemistry as inhibitors of carbohydrate–protein interactions or carbohydrate–RNA interactions in which the embedded carbohydrate structures are involved in binding to the receptor.[8] They have also found application in host–guest chemistry, in the study of carbohydrate–carbohydrate interactions[9] or in cyclodextrins or cyclodextrin mimetics, for instance, in glycophanes or their hybrids.[10] The incorporation of carbohydrates into macrocycles facilitates the modification of their properties particularly by modification of the functional groups of the carbohydrate residue(s).[11,12]

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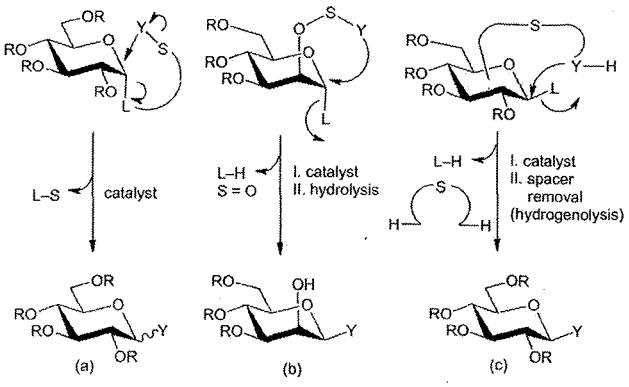
Although a large number of synthetic methods for glycoside bond formation are known,[5–7,13,14] regio- and stereocontrol are not always achieved. To accomplish the desirable high selectivity in glycosidation reactions, intramolecular glycosylation has been studied as an attractive method.[15] In this context it is worth mentioning that glycosyl transfer within the active site of an enzyme formally proceeds intramolecularly: the close proximity between glycosyl donor and acceptor in the active site of an enzyme is gained by specific binding between the enzyme and the substrate, thus leading to a structurally rigid array composed of large rings that enforce (regio- and/or) diastereoselectivity.[16,17] To enforce a similar in vitro reaction course, various approaches to intramolecular glycoside bond formation have been investigated,[15–28] which can be categorized into three major classes: (a) leaving group based,[18] (b) functional substituent based[19] and (c) rigid spacer based, as shown in Scheme 1.[20]



Scheme 1. Intramolecular glycoside bond formation. L = leaving group; R = protecting group; S = spacer; Y = acceptor.

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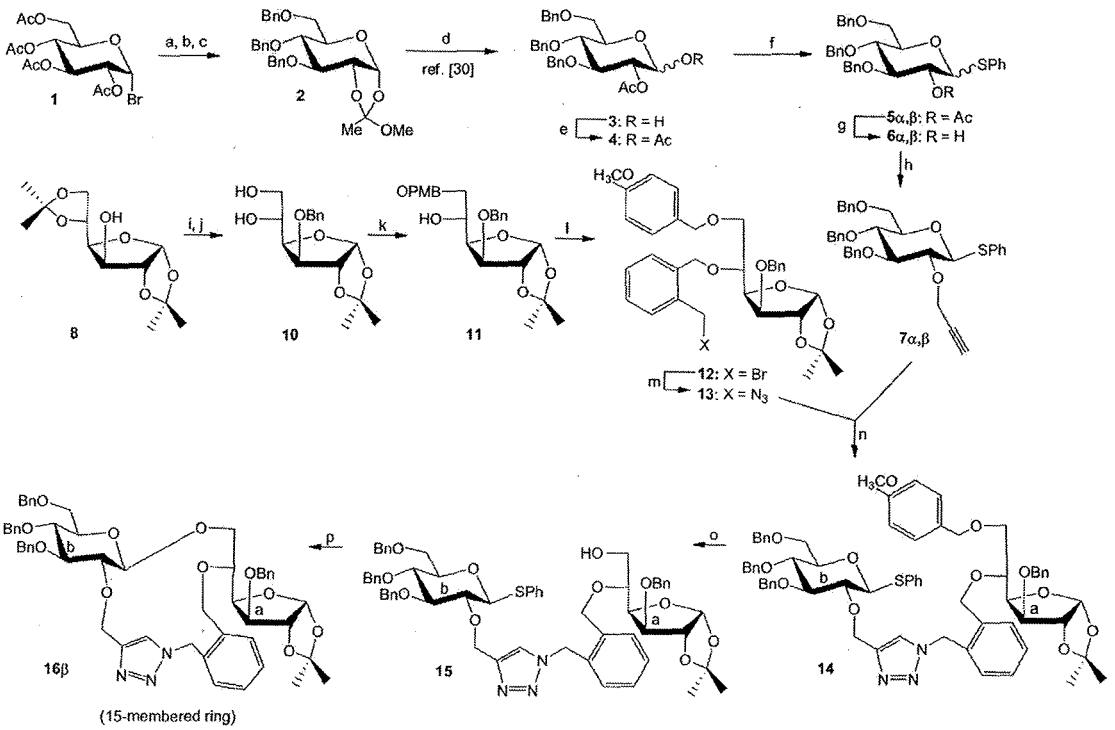
Generally, the functional-substituent-based approach (b), which generates five-membered cyclic transition states, resulted in good anomeric selectivity, yet this selectivity depends on the configuration of the 2-hydroxy group (thus, 2-OH on the β-side gives the β-configuration and vice versa) and also on the spacer type. Larger spacer systems at the 2-OH or any other position of the donor often lead not only to lower anomeric selectivity but also to lower yields. An interesting alternative is spacer-mediated linkage of the glycosyl donor and acceptor by non-reacting centres (c),[20] which lead, with the help of malonyl,[23] succinyl,[24] glutaryl[25] or peptide spacers,[26] to carbohydrate-containing macrocyclic systems. A combination of this approach with quite rigid spacers, for instance, *m*-xylylene,[16,20a] phthaloyl[27] or isophthaloyl,[28] led in many cases to excellent results both in terms of yield and anomeric selectivity.

Herein we combine as rigid spacers *o*- or *m*-xylylene residues with the ease of the triazole-forming click reaction to readily connect a glycosyl donor to an acceptor. The subsequent intramolecular glycosylation reaction gives rise to macrocycles containing the corresponding saccharides. The envisaged proximity of the triazolyl moiety to the anomeric centre will eventually influence the anomeric stereocontrol.

Results and Discussion

Thioglycoside **5**, required as a glycosyl donor, was synthesised in good yield from D-glucose via ortho ester **2** in six steps (Scheme 2). The ortho ester[29a–29c] was prepared by a slightly modified procedure starting from glycosyl bromide **1**; bromide **1** was heated in anhydrous acetonitrile at reflux in the presence of triethylamine, methanol and TBAI at 50 °C for 45 min leading to an improved yield. The acetyl groups were removed with sodium methoxide and the resulting free hydroxy groups were benzylated to give ortho ester **2** in good yield; $HgBr_2$-mediated ring-opening of the ortho ester with thiophenol is known to provide the thioglycoside in relatively low yield.[29a] However, when the ortho ester protection was removed by treatment with *p*TsOH and the compound **3** thus obtained was first *O*-acetyl-protected and then employed in the glycosylation of thiophenol with $BF_3{\cdot}OEt_2$ as promoter, compounds **5α** and **5β** were obtained in good yields. The glycosylation with α isomer **4α** proceeded faster than that of β-isomer **4β**. Both diastereomers **5α** and **5β** were isolated in pure form. The *O*-acetyl groups of compounds **5α** and **5β** were easily removed with NaOMe to give the desired thioglycosides **6α** and **6β**.



Scheme 2. Intramolecular glycosidic bond formation by click reaction with the formation of a 15-membered ring. Reagents and conditions: (a) TBAI, NEt_3, MeOH, CH_3CN, 50 °C, 45 min, 95%; (b) NaOMe, MeOH, 3 h, room temp., 98%; (c) BnBr, DMF, TBAI, 90%; (d) *p*TsOH, acetone, 95%; (e) Ac_2O, Pyr, 99%; (f) PhSH, $BF_3{\cdot}OEt_2$, CH_2Cl_2, –10 °C to room temp., 12 h, 70%; (g) NaOMe, MeOH, 99%; (h) $HCCCH_2Br$, DMF, TBAI, 3 h, room temp., 99%; (i) BnBr, DMF, TBAI, room temp., 8 h, 99% (→ **9**); (j) 70% AcOH (in H_2O), 80 °C, 2 h, 92%; (k) Bu_2SnO, Tol, reflux, 5 h, then PMBCl, NaH, TBAI, 90 °C, 8 h, 90%; (l) α,α′-dibromo-*o*-xylene, 18-crown-6, NaH, CH_2Cl_2, 0 °C to room temp., 14 h, 90%; (m) NaN_3, DMF, 50 °C, 4 h, 99%; (n) CuI, DIPEA, CH_2Cl_2, room temp., 12 h, 96%; (o) DDQ, CH_2Cl_2, 0 °C, 2 h, 82%; (p) NIS, TMSOTf, CH_2Cl_2, 0 °C to room temp., 2 h, 58%.

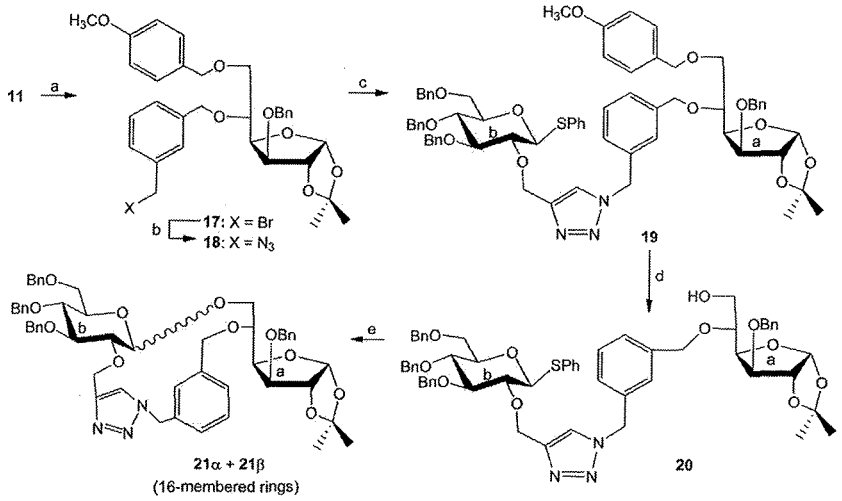
Treatment with propargyl bromide in DMF using NaH (1.5 equiv.) resulted in the formation of **7α** and **7β**, respectively, in quantitative yields.

Sugar-based azide **13** was obtained from D-glucose in seven high-yielding steps. Treatment of diol **10**, obtained in 92% yield from compound **8**, with dibutyltin oxide in toluene and then with *p*-methoxybenzyl chloride (PMBCl) in the presence of tetrabutylammonium iodide resulted in selective 6-*O*-PMB protection by chelation with Bu_2SnO. Treatment of compound **11** with α,α′-dibromo-*o*-xylene in the presence of NaH as base and 18-crown-6 as supporting reagent led to 5-*O*-linked derivative **12** in 90% yield. However, direct reaction of **11** with α,α′-dibromo-*o*-xylene in the presence of NaH and in the absence of 18-crown-6 was not selective and provided three spots by TLC. Compound **12** on reaction with sodium azide at 50 °C afforded the desired azide **13** in quantitative yield.

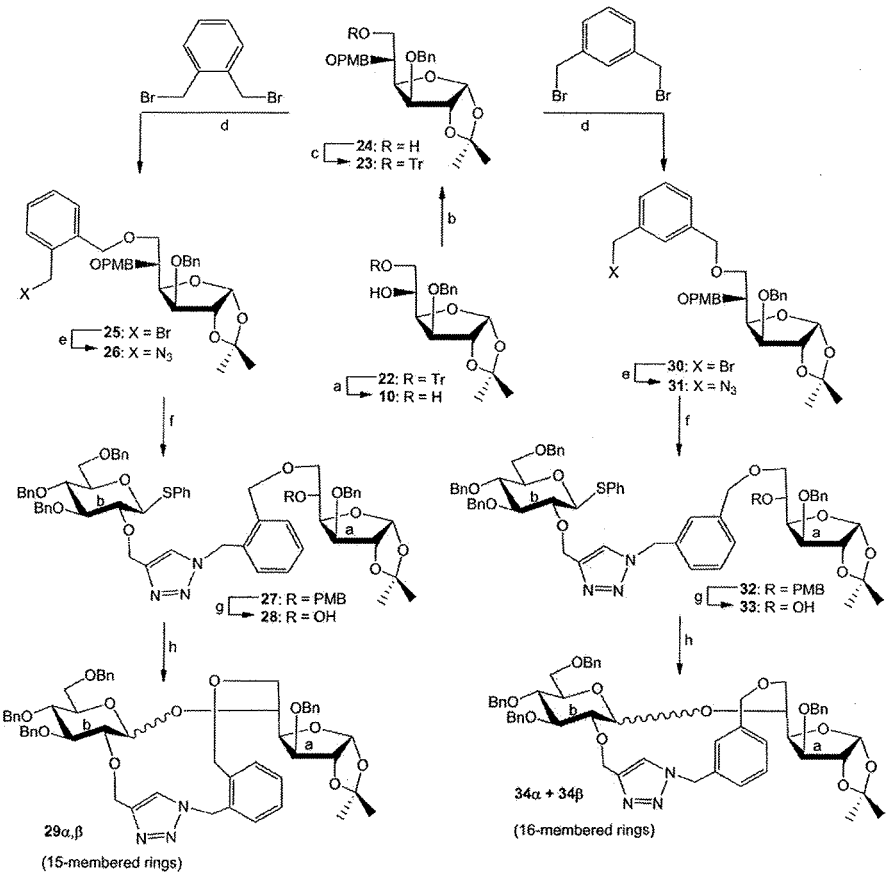
The Cu^I-catalysed Huisgen 1,3-dipolar cycloaddition (click reaction) of an azide and an alkyne has been increasingly used in the field of carbohydrate research for the chemical labelling of biomolecules[30a] as well as for the preparation of oligosaccharide analogues,[30b] glycol dendrimers,[30c] scaffolds[30d] and micro-arrays.[30e] Macrocyclic carbohydrates have recently been synthesized by click chemistry of azido and alkyne groups present in sialic acid containing oligosaccharides.[30f] To explore the concept of intramolecular glycoside bond formation mediated by click reactions, 2-*O*-propargyl-β-D-glucopyranoside (**7β**) was initially treated with glycosyl azide **13** to furnish triazole-containing derivative **14** in excellent yield. The PMB protecting group in compound **14** was removed by treatment with 2,3-dichloro-5,6-dicyanoquinone (DDQ) in CH_2Cl_2/H_2O. Activation of compound **15** with *N*-iodosuccinimide (NIS, 2.0 equiv.) and trimethylsilyl trifluoromethanesulfonate (TMSOTf, 0.2 equiv.) in anhydrous CH_2Cl_2 at 0 °C afforded the desired (1–6)-linked triazole-containing disaccharide **16β**, as part of a 15-membered macrocycle, as the only product (Scheme 2). As the yield of **16β** was practically independent of the concentration of **15** in the 0.01–0.1 molar range, oligomerization does not play a major role in the macrocyclization reaction. The β configuration was assigned with the help of NMR spectroscopic data (^1H: 1b-H, $J_{1,2}$ = 7.6 Hz; ^{13}C: C-1b, δ = 101.75 ppm). The yield of the glycosylation reaction with **15** and NIS/TMSOTf was concentration-dependent because 1.1 equiv. of NIS gave a lower yield of the product than 2 equiv. of NIS. As the reaction with **7α** led to the same result, the diastereofacial control in the intramolecular glycosylation step was independent of the glycosyl donor configuration and even at room temperature the β anomer was exclusively generated.

To further investigate intramolecular glycoside bond formation by the CuI-catalysed click reaction and the formation of 16-membered rings, compound **7β** was first treated with glycosyl azide **18**, obtained from **11** by a similar set of reactions with α,α′-dibromo-*m*-xylene and then with sodium azide, to give triazole-containing carbohydrate **19** (Scheme 3). The removal of PMB from **19** by treatment with DDQ in CH_2Cl_2/H_2O followed by final intramolecular aglycon delivery by activation of compound **20** with NIS (2.0 equiv.) and TMSOTf (0.2 equiv.) in anhydrous CH_2Cl_2 at 0 °C afforded the desired (1–6)-linked triazole-containing disaccharide compounds **21α** and **21β** that could be separated. The β/α selectivity dropped to 3:1 for the formation of the 16-membered macrocyclic rings.

Then we turned our attention to intramolecular glycosylation reactions of acceptors with secondary hydroxy groups. The first studies were performed with 6-*O*-linked glucofuranoses (Scheme 4). To this end, readily available glucofuranose **10**, after regioselective 6-*O*-trityl protection (→ **22**) followed by 5-*O*-PMB protection (→ **23**) and finally treatment with *p*TsOH, afforded 6-*O*-unprotected glucofuranose **24** in an overall yield of 88%. 18-Crown-6-supported reaction of **24** with α,α′-dibromo-*o*- or -*m*-xylene (→ **25** and **30**) followed by treatment with sodium azide afforded 6-*O*-



Scheme 3. Intramolecular glycosidic bond formation by click reaction in the formation of 16-membered rings. Reagents and conditions: (a) α,α′-dibromo-*m*-xylene, 18-crown-6, NaH, CH_2Cl_2, 0 °C to room temp., 14 h, 96%; (b) NaN_3, DMF, 50 °C, 4 h, 99%; (c) **7β**, CuI, DIPEA, CH_2Cl_2, room temp., 10 h, 96%; (d) DDQ, CH_2Cl_2, H_2O, 0 °C, 2 h, 80%;'(e) NIS, TMSOTf, CH_2Cl_2, 0 °C, 2 h, 65%, β/α = 3:1.



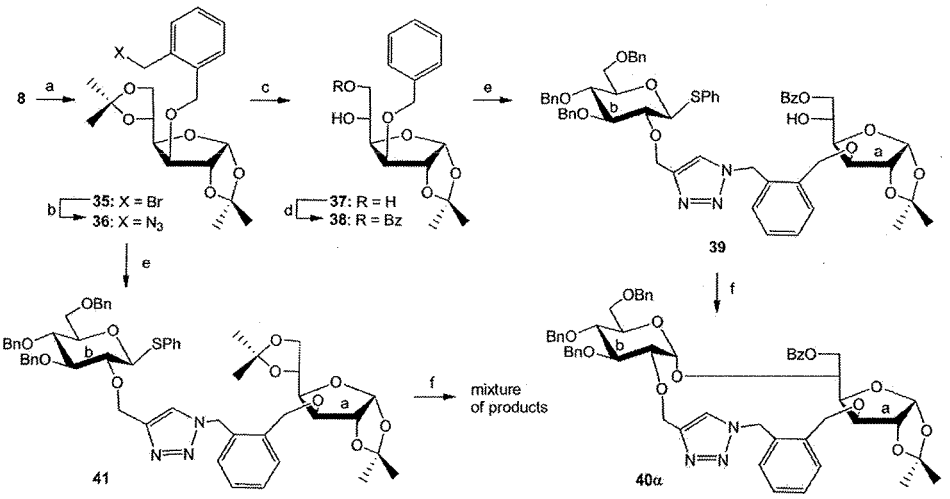
Scheme 4. Intramolecular glycosidic bond formation through click reactions to form 15- or 16-membered rings. Reagents and conditions: (a) CPh_3Cl, Pyr, room temp., 10 h, 95%; (b) PMBBr, DMF, TBAI, room temp., 10 h, 97%; (c) PTSA, CH_2Cl_2, MeOH, room temp., overnight, 95%; (d) 18-crown-6, NaH, CH_2Cl_2, 0 °C to room temp., 14 h, 85 (**25**) and 90% (**30**); (e) NaN_3, DMF, 50 °C, 4 h, 99 (**26**) and 98% (**31**); (f) **7β**, CH_2Cl_2, CuI, DIPEA, room temp., 10 h, 95 (**27**) and 98% (**32**); (g) DDQ, CH_2Cl_2, H_2O, 2 h, 88 (**28**) and 85% (**33**); (h) NIS, TMSOTf, 2 h, 80%, α/β = 3:2 (**29**) and 50%, α/β = 2:1 (**34**).

linked azides **26** and **31**, respectively, in good yields. The CuI-catalysed click reactions of compound **7β** with azides **26** and **31** resulted in nearly quantitative conversion to sugar-containing triazoles **27** and **32**, respectively.

DDQ-mediated cleavage of the PMB group in **27** furnished the required 5a-*O*-unprotected intermediate **28**, which, upon treatment with NIS (2.0 equiv.) and TMSOTf (0.2 equiv.) in CH_2Cl_2 at 0 °C, afforded the desired intramolecular glycosylation products **29α,β** through the formation of a 15-membered macrocycle in 80% yield as a 3:2 α/β mixture. Separation of the anomers was difficult as both compounds had the same R_f value (R_f = 0.35, EtOAc/toluene = 3:7). Similar transformation of **32** into 5a-*O*-unprotected intermediate **33** and then intramolecular glycosylation with NIS/TMSOTf as activating system led to the 16-membered macrocycles **34α,β** (that could not be separated) in good yield with an α/β ratio of 2:1.

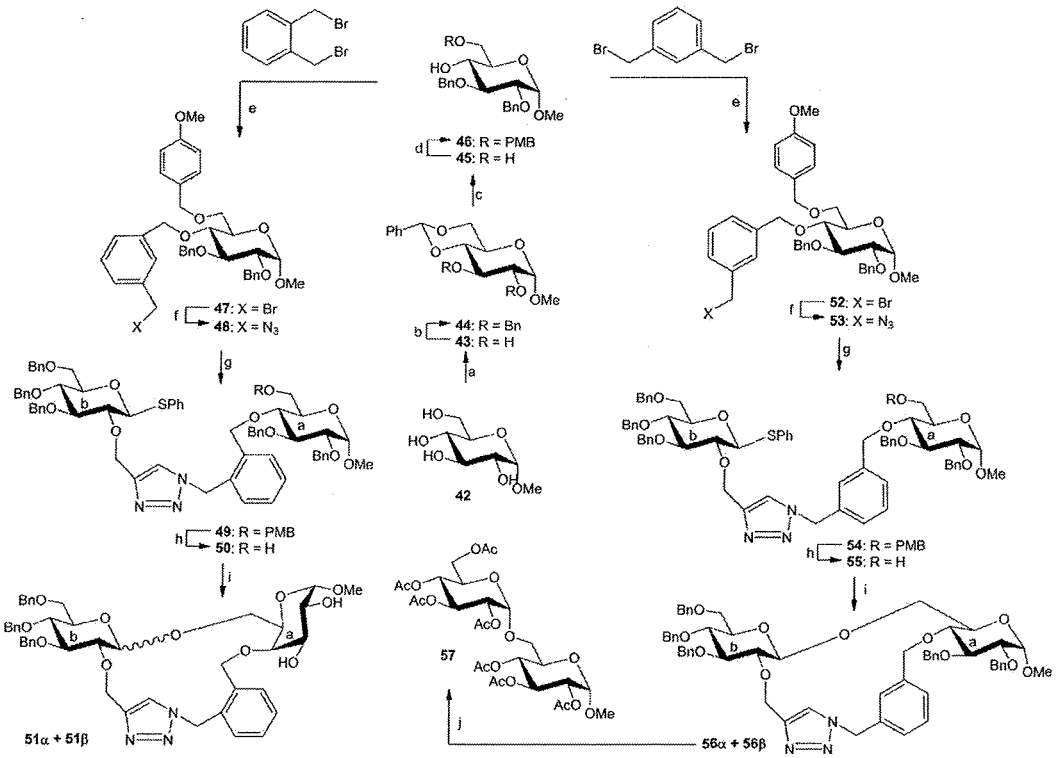
As the models **28** and **33** for intramolecular glycosylation studies possess high conformational flexibility, not only in parts of the linker, but also in the acceptor moiety, a related system with a conformationally more restricted acceptor moiety was investigated. To this end, readily available *O*-isopropylidene-protected glucofuranose **8** was 3-*O*-alkylated with α,α′-dibromo-*o*-xylene to afford bromomethylbenzyl derivative **35**, which on reaction with sodium azide in DMF afforded the corresponding azide **36** (Scheme 5). Selective 5,6-*O*-de-isopropylidenation with aqueous acetic acid (→ **37**) and then regioselective 6-*O*-benzoylation with benzoyl chloride in CH_2Cl_2/pyridine at –30 °C furnished 5-*O*-unprotected intermediate **38**, which gave on reaction with 2-*O*-propargyl derivative **7β** under 1,3-dipolar cycloaddition (click) reaction conditions donor–acceptor-linked intermediate **39** in excellent yield. Glycosylation under the standard conditions gave only the α(1–5)-linked disaccharide **40α** as part of a 16-membered macrocycle in low yield. Therefore it was not surprising that glycosylation studies with *O*-protected **41**, readily obtained by the click reaction of **7β** and **36**, did not lead to glycoside bond formation with concomitant loss of the 5a,6a-*O*-isopropylidene group. The reaction centres do not seem to be well adjusted for intramolecular glycoside bond formation.

After studying the 1,2-*O*-isopropylideneglucofuranose derivatives as acceptors we investigated pyranoside acceptors, which are generally conformationally more rigid.



Scheme 5. Intramolecular glycosidic bond formation by click reaction to form a 16-membered ring. Reagents and conditions: (a) 18-crown-6, NaH, CH_2Cl_2, 0 °C to room temp., 14 h, 90%; (b) NaN_3, DMF, 50 °C, 4 h, 98%; (c) 70% AcOH, room temp., 12 h, 94%; (d) benzoyl chloride, CH_2Cl_2, Pyr, –30 °C, 2 h, 92%; (e) **7β**, CuI, DIPEA, CH_2Cl_2, room temp., 12 h, 96%; (f) NIS, TMSOTf, CH_2Cl_2, 3 h, 20%.

They are also typical of mammalian systems. To this end, known methyl 2,3-di-*O*-benzylglucopyranoside **45** was regioselectively protected with dibutyltin oxide and 4-PMBCl to afford 6-*O*-PMB-protected derivative **46** (Scheme 6). Reaction with α,α′-dibromo-*o*- and -*m*-xylene in the presence of 18-crown-6 and NaH as base furnished 4-*O*-alkylation products **47** and **52**, respectively, which were transformed into azides **48** and **53**. Their click reaction with 2-*O*-prop-



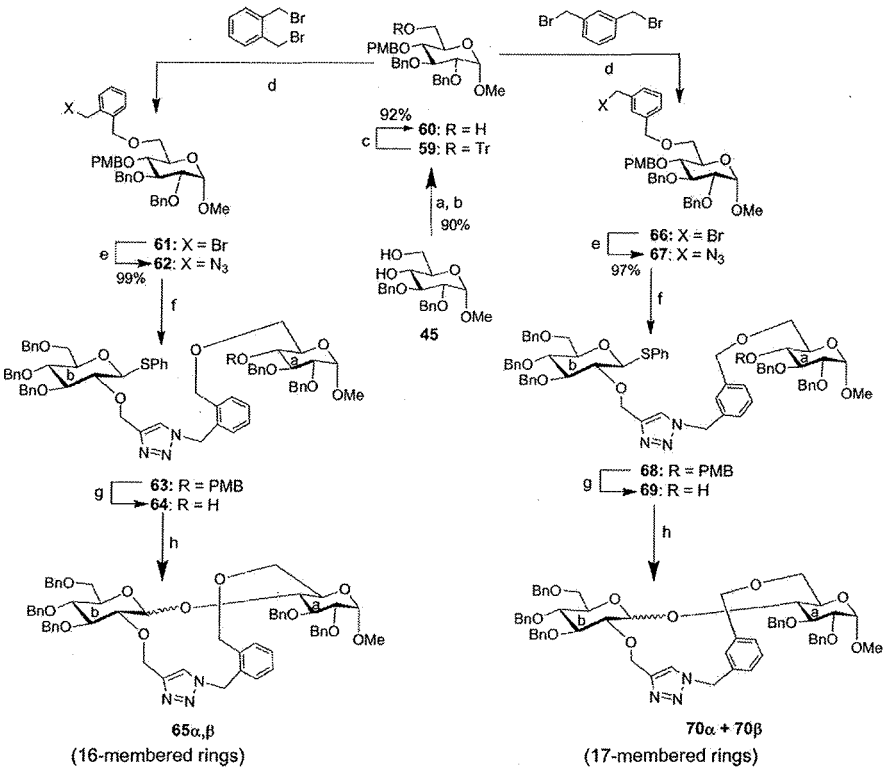
Scheme 6. Intramolecular glycosidic bond formation by click reaction to form 16- and 17-membered rings. Reagents and conditions: (a) $PhCH(OMe)_2$, DMF, PTSA, 1 h, 50 °C, 95% (→ **43**); (b) BnBr, DMF, TBAI, room temp., 10 h, 95%; (c) TFA, CH_2Cl_2, H_2O, 0 °C, 2 h, 96% (→ **45**); (d) Bu_2SnO, Tol, reflux, 5 h, PMBCl, TBAI, 90 °C, 8 h, 94%; (e) 18-crown-6, NaH, CH_2Cl_2, 0 °C to room temp., 14 h, 95 (**47**) and 90% (**52**); (f) NaN_3, DMF, 50 °C, 4 h, 98%; (g) **7β**, CuI, DIPEA, CH_2Cl_2, room temp., 14 h, 96 (**49**) and 92% (**54**); (h) DDQ, CH_2Cl_2, H_2O, 2 h, 90 (**50**) and 86% (**55**); (i) NIS, TMSOTf, 2 h, 95%, α/β = 1:2 (**51**) and 80%, α/β = 3:2 (**56**); (j) H_2, Pd/C, methanol, HCl, 2 d then Ac_2O, Py, 0 °C, 10%.

argyl-protected donor **7β** afforded the donor–acceptor-linked compounds **49** and **54**, respectively. DDQ-mediated removal of the PMB group (→ **50** and **55**) followed by glycosylation under standard conditions afforded the (1–6)-linked intramolecular glycosylation products **51α,β** and **56α/β**, respectively, in high yields but with modest anomeric preferences (**51**: α/β = 1:2, **56**: α/β = 3:2). This and previous results show that the formation of anomers is only marginally influenced, if at all, by anchimeric assistance of the triazolyl moiety, although the N-3 atom could bind to the anomeric carbon to generate a six-membered heterocycle.

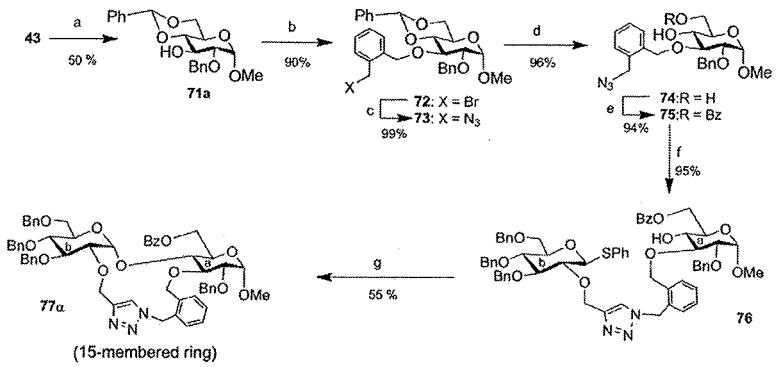
Attempts to remove all the *O*-benzyl groups and the linker were carried out with macrocycle **56α** (Scheme 6). Hydrogenolysis with palladium on carbon as catalyst afforded after *O*-acetylation the known methyl isomaltoside **57**, although in low yield. Hence, conditions for the cleavage of the triazolylmethyl moiety have to be further optimized.[31]

The transformation of glucopyranoside **45** into a 4-*O*-unprotected acceptor was performed to study the formation of an intramolecular (1–4)-linkage between two glucopyranose residues. To this end, 4,6-*O*-unprotected glucose derivative **45** was tritylated with trityl (Trt) chloride in pyridine to afford regioselectively the 6-*O*-trityl derivative. The PMB group was then introduced at 4-*O* under standard conditions to furnish the fully *O*-protected intermediate **59** (Scheme 7). *p*TsOH-catalysed detritylation led to 6-*O*-unprotected compound **60** in high overall yield, thus providing a suitable compound for the envisaged studies. Alkylation with α,α′-dibromo-*o*- and -*m*-xylene afforded compounds **61** and **66**, respectively. Azide introduction (→ **62** and **67**), click reaction with glucopyranosyl donor **7β** (→ **63** and **68**) and then DDQ-mediated PMB cleavage furnished the desired precursors **64** and **69**, respectively, for the intramolecular glycosylation studies. Treatment with NIS/TMSOTf as promoter afforded the desired 16- and 17-membered macrocycles **65α,β** and **70α** and **70β**, respectively, in high yields. Mixtures of α and β anomers were obtained in both cases (**65**: 90%, α/β = 3:1; **70**: 82%, α/β = 1:2). Notably, and in contrast to the formation of **51** and **56**, the 16-membered macrocycle was generated mainly with an α-glycosidic linkage whereas the 17-membered macrocycle was generated with a preference for the β product.

From this result it was concluded that a reduction in ring size, for example, in the transformation of **64** into **65**, will eventually lead to a single anomer, that is, the α anomer. The corresponding 15-membered macrocycle can be easily synthesized by attaching the *o*-xylyl-linker to the 3-hydroxy group of the acceptor. By this approach the formal (5,4)-L-*threo* attachment to the acceptor in intermediate **64** (Scheme 7)[15] is inverted, as can be seen by comparison with the corresponding target molecule **76** (Scheme 8).



Scheme 7. Intramolecular glycosidic bond formation by click reaction to form 16- and 17-membered rings. Reagents and conditions: (a) TrCl, Pyr, 12 h, 0 °C to room temp., 94% (→ **58**); (b) PMBCl, NaH, DMF, room temp., 10 h, 95%; (c) PTSA, MeOH, CH_2Cl_2, 0 °C, 92%, 2 h; (d) 18-crown-6, NaH, CH_2Cl_2, 0 °C to room temp., 14 h, 90 (**61**) and 88% (**66**); (e) NaN_3, DMF, 50 °C, 4 h, 99 (**62**) and 97% (**67**); (f) **7β**, CuI, DIPEA, CH_2Cl_2, 14 h, 95 (**63**) and 96% (**68**); (g) DDQ, CH_2Cl_2, H_2O, 0 °C, 2 h, 87 (**64**) and 90% (**69**); (h) NIS, TMSOTf, CH_2Cl_2, 2 h, 90%, α/β = 3:1 (**65**) and 82%, α/β = 1:2 (**70**).



Scheme 8. Intramolecular glycosidic bond formation by click reaction to form a 15-membered ring. Reagents and conditions: (a) BnBr, CH_2Cl_2, NaOH, Bu_4NHSO_4, 60 °C, 48 h, 50 (**71a**), 20 (**71b**) and 10% (mixture of dibenzyl-protected compounds); (b) α,α′-dibromo-*o*-xylene, Pyr/CH_2Cl_2, 18-crown-6, 0 °C, room temp., 18 h, 90%; (c) NaN_3, DMF, 50 °C, 4 h, 99%; (d) 70% AcOH/H_2O, 70 °C, 3 h, 96%; (e) BzCl, CH_2Cl_2, –40 °C, 1 h, 94%; (f) **7β**, CuI, DIPEA, CH_2Cl_2,14 h, 96%; (g) NIS, TMSOTf, CH_2Cl_2, 55%.

However, from molecular models it can be deduced that this stereochemical change should not negatively influence the result of glycosylation. Thus, 2,3-*O*-unprotected glucopyranoside **43**[32] was monobenzylated under phase-transfer conditions[33] to furnish mainly the 2-*O*-benzyl derivative **71a** (together with some 3-*O*-benzyl derivative **71b**). Subsequent reaction with α,α′-dibromo-*o*-xylene afforded intermediate **72**, which was transformed into azide **73**. Acid-catalysed debenzylidenation (→ **74**) and then benzoylation with benzoyl chloride in pyridine at –40 °C regioselectively furnished 6-*O*-benzoyl derivative **75**. Click reaction of azide **75** with donor **7β** led to the required triazole-containing disaccharide **76** as precursor for the intramolecular glycosylation. NIS/TMSOTf-promoted activation of **76** exclusively afforded, as expected, the α(1–4)-linkage of the 15-membered macrocycle **77*α***, as indicated by ^{13}C NMR spectroscopy (C-1a: δ = 97.72 ppm; C-1b: δ = 97.73 ppm).

Conclusions

The 1,4-substituted triazole-forming click reactions between 2-*O*-propargyl-substituted glucopyranosyl donors and *O*-(2- or 3-azidomethylbenzyl)-protected glycosyl acceptors has provided a convenient access to donor–acceptor-ligated intermediates with a quite rigid spacer. Glycosylation reactions led to the desired disaccharides as part of macrocycles generally in good-to-excellent yields, thus confirming the efficiency of this approach to intramolecular glycoside bond formation. Modest-to-excellent anomeric stereocontrol was observed, hence, further studies with different spacer linkage positions, different ring size and possibly different leaving groups or reaction conditions are required to optimize the anomeric stereoselectivity. Note that anchimeric assistance by the neighbouring triazolyl moiety was negligible in the anomeric stereocontrol.

Experimental Section

General: Solvents were purified by standard procedures. Yields refer to chromatographically pure material. Anomeric selectivities are based on isolated material or on ^1H NMR spectroscopic data. Reactions were monitored by TLC carried out on Merck silica gel (0.2 mm, 60F-254) plastic plates. Compounds were first visualized under UV light and then by using visualizing agent, a solution of $(NH_4)_6Mo_7O_{24}{\cdot}4H_2O$ (20 g) and $Ce(SO_4)_2$ (0.4 g) in sulfuric acid (10%, 400 mL), and heating to 120 °C and/or an ethanolic sulfuric acid solution and heat as developing agents. Flash chromatography was performed on MN silica gel 60 (230–400 mesh) at a pressure of 0.2 bar. NMR spectra, including ^1H and ^{13}C NMR, DEPT, COSY, HSQC and HMBC spectra, were acquired with a Bruker 400 MHz NMR spectrometer at 300 K; tetramethylsilane (TMS) and the resonance of undeuteriated solvent were used as internal standards ($CDCl_3$: δ = 7.25 ppm). The multiplicities are indicated as follows: m = multiplet, s = singlet, d = doublet, dd = double of doublets, t = triplet, dt = doublet of triplets, br. s = broad singlet. Mass spectra were recorded with a Bruker ESI-MS mass spectrometer. HRMS were obtained with a Fourier-transform mass spectrometer. Optical rotations were measured at 20 °C with a Büchi Polar-Monitor (1 dm cell) using the sodium D line.

Synthetic methods for all donors, acceptors and intermediates required to investigate the intramolecular glycosylation reactions are given in the Supporting Information.

General Procedure A – Synthesis of Glycosyl Azides: 18-Crown-6 (480 mg, 1.82 mmol) and sodium hydride (300 mg) were added to a solution of free alcohol (5.69 mmol) in anhydrous dichloromethane (30 mL) and then the mixture was stirred for 10 min at –10 °C under an inert atmosphere. α,α′-Dibromo-*o*- or -*m*-xylene (11.39 mmol) in dichloromethane (15 mL) was added to the reaction mixture at room temp. and stirring was continued overnight. Progress of the reaction was monitored by TLC and the reaction was continued until the starting material had been consumed. The solution was then filtered through Celite (carefully) and concentrated in vacuo. Chromatography (toluene/ethyl acetate) of the residue afforded the desired compound as a colourless oil. The yields refer to the isolated compounds and varied from 80–90% (excess α,α′-dibromo-*o*- or -*m*-xylene was recovered and reused). The pure product thus obtained was dissolved in anhydrous DMF (10–15 mL) and excess of NaN_3 (4 equiv.) was added. The reaction mixture was stirred at 50 °C for 3–4 h. The solvent was then evaporated under reduced pressure and the crude mass was filtered. Flash chromatography revealed an almost quantitative yield of the glycosyl azide as a colourless oil.

General Procedure B – Synthesis of Glycosyl Triazole by Copper-Catalysed Click Reaction: Equimolar amounts of the glycosyl alkyne (2.79 mmol) and glycosyl azide (2.79 mmol) were dissolved in anhydrous CH_2Cl_2 (30 mL) and diisopropylethylamine (3.1 mmol) was added. The solution was mixed for 10 min. Copper(I) iodide powder (0.55 mmol) was then added to the reaction mixture at 0 °C and the solution stirred at room temp. for 9–12 h. The progress of the reaction was monitored by TLC using 30% EtOAc/toluene as developing solvent and 5% H_2SO_4 (in ethanol) solution for sugar staining. The mixture was filtered through Celite and concentrated in vacuo. The crude product thus obtained was subjected to flash column chromatography using silica. The desired triazole was obtained as a colourless oil in almost quantitative yield.

General Procedure C – PMB Group Removal: DDQ (1.01 mmol) was added slowly to a stirring solution of the triazole (1.0 mmol) in a mixture of CH_2Cl_2 (27 mL) and distilled water (3.0 mL) at 0 °C and the resulting reaction mixture was stirred at the same temperature for 2 h. The reaction mixture was filtered, extracted with CH_2Cl_2, washed with H_2O (10 mL), the solvent evaporated under reduced pressure, and the residue purified by column chromatography using 40% EtOAc/toluene as eluent to give the desired free alcohol.

General Procedure D – Intramolecular Glycosylation of Triazole-Containing Carbohydrates: Trimethylsilyl trifluoromethanesulfonate (0.3 equiv.) was added through a syringe under argon to a stirring solution of triazole-containing carbohydrate (1.0 mmol) and *N*-iodosuccinimide (2.0 mmol) in anhydrous dichloromethane (20 mL) at –10 °C under an inert atmosphere. The reaction was stirred for 1–2 h at room temp. if not indicated otherwise. The solution was neutralized with triethylamine at 0 °C, sodium dithionite was added and then stirring was continued until the solution became colourless. The solid was filtered off and the solution was extracted with CH_2Cl_2 (2× 75mL), washed with H_2O (10 mL), dried with anhydrous Na_2SO_4 and the solvent removed under vacuo. The residue thus obtained was subjected to flash chromatography (20% EtOAc/toluene) to give the sugar-based macrocycle as a colourless oil. The yields refer to the isolated pure products obtained by column chromatography and the selectivities were determined by NMR analysis of the crude reaction mixtures.

Compound 16β: TMSOTf (15 μL, 0.07 mmol) was added through a syringe under argon to a stirring solution of **15** (314 mg, 0.303 mmol) and *N*-iodosuccinimide (136 mg, 0.606 mmol) in dry dichloromethane (20 mL) at –10 °C under an inert atmosphere. The reaction was stirred for 90 min at room temp. The solution was neutralized with triethylamine at 0 °C, sodium dithionite was added, and then stirring was continued until the solution became colourless. The solid was filtered off and the solution extracted with CH_2Cl_2 (2× 75 mL), washed with H_2O (10 mL), dried with anhydrous Na_2SO_4 and the solvent removed in vacuo. The residue thus obtained was subjected to flash chromatography (20% EtOAc/toluene) to give sugar-based macrocycle **16β** as a colourless oil (163 mg, 58%; β selectivity over 98%). R_f = 0.42 (35% EtOAc/toluene). $[\alpha]_D^{25}$ = +0.35 (*c* = 1, $CHCl_3$). ^{1}H NMR ($CDCl_3$, 400 MHz): δ = 8.14 (s, 1 H, triazole H), 7.47–7.29 (m, 28 H, Ar-H), 5.92 (d, *J* = 4.0 Hz, 1 H, 1a-H), 5.53 (d, *J* = 14.0 Hz, 1 H, *N*-benzylic H), 5.45 (d, *J* = 14.0 Hz, 1 H, *N*-benzylic H), 4.99 (d, *J* = 12.0 Hz, 1 H, benzylic H), 4.93–4.89 (m, 3 H, benzylic H), 4.82 (d, *J* = 11.2 Hz, 1 H, benzylic H), 4.77 (d, *J* = 11.6 Hz, 1 H, benzylic H), 4.68 (d, *J* = 4.0 Hz, 1 H, 2a-H), 4.65 (d, *J* = 12.4 Hz, 1 H, benzylic H), 4.63–4.52 (m, 4 H, benzylic H), 4.45 (d, *J* = 11.6 Hz, 1 H, benzylic H), 4.43 (d, *J* = 7.6 Hz, 1 H, 1b-H), 4.29 (dd, *J* = 8.4, 2.8 Hz, 1 H, 4a-H), 4.25 (dd, *J* = 12.0, 2.0 Hz, 1 H, 6a-H), 4.11 (d, *J* = 2.8 Hz, 1 H, 3a-H), 4.06 (dt, *J* = 7.2, 2.0 Hz, 1 H, 5a-H), 3.85 (dd, *J* = 12.0, 4.8 Hz, 1 H, 6b-H), 3.77 (dd, *J* = 11.4, 2.0 Hz, 1 H, 6a-H), 3.72–3.67 (m, 2 H, 6a′-H, 5b-H), 3.65 (dd, *J* = 9.2 Hz, 1 H, 3b-H), 3.49 (m, 1 H, 4b-H), 3.42 (dd, *J* = 8.4 Hz, 1 H, 2b-H), 1.60 and 1.36 [each s, each 3 H, 2 $C(CH_3)_2$] ppm. ^{13}C NMR (100 MHz): δ = 145.70, 138.38, 138.21, 138.11, 137.65, 137.57, 132.19, 131.71, 130.48, 129.47, 128.89, 128.51, 128.04, 127.99, 127.94, 127.88, 127.79, 127.72, 127.62, 125.11 (Ar-C), 111.94 (CMe_2), 104.89 (C-1a), 101.75 (C-1b), 86.48 (C-3b), 81.82 (C-2a, C-3a, merged), 80.25 (C-2b), 78.14 (C-4a), 78.03 (C-5b), 76.54 (C-5a), 75.73 (OCH_2), 74.93 (C-4b merged with OCH_2), 73.47, 72.02, 69.54 (OCH_2Ar), 68.66 (C-6b), 67.89 (C-6a), 66.34 (OCH_2Ar), 51.87 (NCH_2Ar), 26.59 and 26.41 [2 $C(CH_3)_2$] ppm. HRMS (+ mode): calcd. for $C_{54}H_{61}N_3O_{11}$ $[M + H]^+$ 926.4228; found 926.4185.

Compounds 21α,β: Compound **20** (0.2 g, 0.193 mmol) on treatment with NIS (80 mg, 0.38 mmol) and TMSOTf (15 μL, 0.076 mmol) in dry CH_2Cl_2 for 2 h and workup as described in general procedure D afforded **21α,β** (116 mg, 65%) as a colourless oil. α/β = 1:3.

21β: R_f = 0.35 (30% EtOAc/toluene). ^{1}H NMR ($CDCl_3$, 400 MHz): δ = 7.66 (s, 1 H, Ar-H), 7.38–7.15 (m, 22 H, Ar-H), 6.89 (s, 1 H, Ar-H), 6.86 (d, *J* = 7.2 Hz, 1 H, Ar-H), 5.74 (d, *J* = 4.0 Hz, 1 H, 1a-H), 5.62 and 5.49 (each d, each *J* = 14.8 Hz, each 1 H, *N*-benzylic H), 4.94 (d, *J* = 12.4 Hz, 1 H, benzylic H), 4.90 (d, *J* = 12.0 Hz, 1 H, benzylic H), 4.85 (d, *J* = 11.6 Hz, 1 H, benzylic H), 4.80 (d, *J* = 11.2 Hz, 1 H, benzylic H), 4.68 (d, *J* = 10.8 Hz, 1 H, benzylic H), 4.59 (d, *J* = 12.0 Hz, 1 H, benzylic H), 4.50 (d, *J* = 4.0 Hz, 1 H, 2a-H), 4.47 and 4.46 (each d, each *J* = 12.4 Hz, each 1 H, benzylic H), 4.38 (d, *J* = 12.0 Hz, 1 H, benzylic H), 4.34–4.29 (m, 4 H, 1b-H merged with 3 benzylic H), 3.99–3.96 (m, 3 H, 3a-H, 4a-H, 5b-H), 3.81–3.79 (m, 2 H, 6a-H), 3.62–3.57 (m, 3 H, 6b-H, 5a-H), 4.53 (dd, *J* = 9.2 Hz, 1 H, 3b-H), 3.35 (dd, *J* = 9.2 Hz, 1 H, 4b-H), 3.27 (dd, *J* = 8.0, 8.4 Hz, 1 H, 2b-H), 1.41 and 1.22 [each s, each 3 H, 2 $C(CH_3)_2$] ppm. ^{13}C NMR (100 MHz): δ = 140.78, 138.46, 138.41, 138.28, 137.70, 135.77, 129.71 (Ar-Cq), 128.49, 128.42, 128.33, 128.23, 127.90, 12.82, 127.80, 127.72, 127.66, 127.63, 127.41, 126.31, 125.91, 125.66 (Ar-C), 111.78 (CMe_2), 105.01 (C-1a), 103.68 (C-1b), 86.42 (C-3b), 81.96 (C-2a), 81.86 (C-3a), 79.07 (C-4a), 78.33 (C-2b), 78.28 (C-5a), 75.29 (CH_2Ar), 75.00 (C-5b), 74.71, 73.55, 72.31 (CH_2Ar), 72.08 (C-6a), 71.84 (OCH_2), 69.25 (C-6b), 64.38 (OCH_2), 53.49 (NCH_2Ar), 26.70 and 26.39 [2 $C(CH_3)_2$] ppm. HRMS (+ mode): calcd. for $C_{54}H_{61}N_3O_{11}$ $[M + H]^+$ 926.4228; found 926.3905.

Compounds 29α,β: Compound **28** (0.4 g, 0.386 mmol) on treatment with NIS (173 mg, 0.773 mmol) and TMSOTf (30 μL, 0.16 mmol) in dry CH_2Cl_2 (15 mL) for 2 h and workup as described in general procedure D afforded an anomeric mixture of **29α,β** (286 mg, 80%) as a colourless oil. The anomers could not be separated. α/β = 3:2. R_f = 0.35 (30% EtOAc/toluene); both anomers have the same R_f on TLC. ^{1}H NMR ($CDCl_3$, 400 MHz): δ = 8.08 (s, 1 H, triazole H, minor isomer), 7.43–7.06 (m, 25 H, Ar-H, major and minor isomer, triazole H, minor isomer), 5.84 (d, *J* = 3.6 Hz, 1 H, 1a-H, major isomer), 5.79 (d, *J* = 3.6 Hz, 1 H, 1a-H, minor isomer), 5.62 (d, *J* = 14.4 Hz, 1 H, *N*-benzylic H, major isomer), 5.48 (s, 2 H, NCH_2Ar, minor isomer), 5.39 (d, *J* = 14.4 Hz, 1 H, *N*-benzylic H, major isomer), 5.05 (d, *J* = 13.6 Hz, 1 H, benzylic H, minor isomer), 4.95 (d, *J* = 4.4 Hz, 1 H, 1b-H, major isomer), 4.93 (d, *J* = 12.0 Hz, 1 H, benzylic H, major isomer), 4.91 (d, *J* = 11.2 Hz, 1 H, benzylic H, major isomer), 4.88 (d, *J* = 10.8 Hz, 1 H, benzylic H, major isomer), 4.85 and 4.83 (each d, each *J* = 12.4 Hz, each 1 H, benzylic H, major isomer), 4.64 (d, *J* = 12.8 Hz, 1 H, benzylic H, minor isomer), 4.59–4.52 (m, 3 H, benzylic H, major and minor

isomer), 4.50 (d, J = 4.0 Hz, 1 H, 2a-H, major isomer), 4.46–4.30 (m, 4 H, 2a-H, 3a-H, minor isomer, 4a-H, major isomer), 4.26 (d, J = 8.0 Hz, 1 H, 1b-H, minor isomer), 4.21 (dd, J = 9.6, 4.0 Hz, 1 H, major isomer), 4.15–4.13 (m, 2 H, 5b-H, major and minor isomer), 3.89 (d, J = 2.8 Hz, 1 H, 3a-H, major isomer), 3.74 (dd, J = 10.8, 1.6 Hz, 1 H, 6'b-H, major isomer), 3.70–3.66 (m, 2 H, 6b-H minor isomer, 4b-H, major isomer), 3.62 (dd, J = 9.2, 1.6 Hz, 6a-H), 3.50–3.32 (m, 3 H, 2b-H, 3b-H, major and minor isomer, 4b-H, minor isomer), 3.20 (m, 1 H, 5a-H, minor isomer), 1.45 and 1.20 [each s, each 3 H, 2 $C(CH_3)_2$, minor isomer], 1.40 and 1.26 [each s, each 3 H, 2 $C(CH_3)_2$, major isomer] ppm. ^{13}C NMR (100 MHz): δ = 146.71, 145.41, 138.97, 138.54, 138.30, 138.25, 138.06, 137.61, 137.26, 136.93, 133.26, 133.25, 132.56, 132.21, 131.81, 131.44, 129.79, 129.35, 129.28, 129.24, 129.10, 128.56, 128.50, 128.44, 128.42, 128.41, 128.38, 128.35, 128.11, 128.03, 127.94, 127.92, 127.89, 127.86, 127.33, 125.34, 124.32, 123.60 (Ar-C, major and minor isomer), 111.74 (CMe_2, major isomer), 111.71 (CMe_2, minor isomer), 104.78 (C-1a, merged for major and minor isomer), 102.53 (C-1b, minor isomer), 94.86 (C-1b, major isomer), 85.59 (C-2b, minor isomer), 84.31 (C-4b, minor isomer), 82.49, 81.99, 81.89, 81.85, 81.46, 81.01, 80.35, 78.08, 78.92, 77.63, 76.48, 75.66, 74.89, 74.69, 74.11, 73.62, 73.49, 72.07, 71.60, 71.59, 71.56, 71.49, 70.70 (C-5a, major isomer), 69.59, 69.27, 68.55, 68.12, 66.64 (C-6, minor isomer), 52.72 (NCH_2, major isomer), 51.79 (NCH_2, minor isomer), 29.72, 26.97, 26.89, 26.43 (2 CH_3, major and minor isomer) ppm. HRMS (+ mode): calcd. for $C_{54}H_{61}N_3O_{11}$ $[M + H]^+$ 926.4228; found 926.3927.

Compounds 34α and 34β: Compound **33** (0.7 g, 0.68 mmol) on treatment with NIS (0.24 g, 1.35 mmol) and TMSOTf (35 µL, 0.19 mmol) in dry CH_2Cl_2 (20 mL) for 2 h and workup as described in general procedure D afforded **34α,β** as a colourless oil (313 mg, 50%). The two anomers were successfully separated in pure form (α/β = 2:1) and characterized by their spectroscopic data.

34α: Colourless oil. R_f = 0.68 (30% EtOAc/toluene). ^1H NMR ($CDCl_3$, 400 MHz): δ = 7.43 (dd, J = 8.0, 2.0 Hz, 2 H, Ar-H), 7.29–7.27 (m, 23 H, Ar-H), 5.81 (d, J = 4.0 Hz, 1 H, 1a-H), 5.37 and 5.32 (each d, each J = 14.8 Hz, each 1 H, N-benzylic H), 4.90 and 4.84 (each d, each J = 11.6 Hz, each 1 H, benzylic H), 4.81 (d, J = 10.8 Hz, 1 H, benzylic H), 4.71 and 4.72 (each d, each J = 10.8 Hz, each 1 H, benzylic H), 4.59 (d, J = 12.4 Hz, 1 H, benzylic H), 4.53–4.52 (m, 2 H, 1b-H merged with benzylic H), 4.50 (d, J = 4.0 Hz, 2a-H), 4.49–4.43 (m, 4 H, benzylic H), 4.41 (d, J = 12.4 Hz, 1 H, benzylic H), 4.18–4.11 (m, 2 H, 5b-H, 4a-H), 3.98 (d, J = 2.8 Hz, 1 H, 3a-H), 3.69 (dd, J = 10.8, 2.0 Hz, 1 H, 6a-H), 3.65, 3.69 (dd, J = 10.8, 6.4 Hz, 1 H, 6b-H), 3.62 (dd, J = 10.8, 3.6 Hz, 1 H, 6a'-H), 3.57–3.51 (dd, J = 8.4 Hz, 2 H, 3b-H merged with 5b-H), 3.45 (dd, J = 10.0, 5.6 Hz, 1 H, 6b'-H), 3.42–3.38 (m, 2 H, 2b-H, 4b-H), 1.42 and 1.22 [each s, each 3 H, 2 $C(CH_3)_2$] ppm. ^{13}C NMR (100 MHz): δ = 138.91, 137.70, 137.65, 137.42, 137.05, 134.02 and 132.92 (Cq), 131.28, 128.39, 128.22, 127.95, 127.79, 127.77, 127.75, 127.68, 127.24, 127.13, 127.01, 126.98, 126.88, 126.79, 126.74, 126.48, 126.45, 121.96 (Ar-C), 111.11 (CMe_2), 104.63 (C-1a), 86.50 (C-1b), 85.81 (C-3b), 81.32 (C-3a), 80.91 (C-2a), 80.32 (C-2b), 79.59 (C-4a), 78.48 (C-4b), 77.09 (C-5b), 75.05, 74.37, 72.76, 72.71, 72.08 and 71.41 (CH_2Ar, OCH_2Ph, C-6a), 68.41 (C-6b), 68.39 (C-5a), 66.05 (OCH_2Ar), 53.36 (NCH_2Ar), 26.15 and 25.67 [2 $C(CH_3)_2$] ppm. HRMS (+ mode): calcd. for $C_{54}H_{61}N_3O_{11}$ $[M + H]^+$ 926.4228; found 926.3862.

34β: Colourless oil. R_f = 0.55 (30% EtOAc/toluene). ^1H NMR ($CDCl_3$, 400 MHz): δ = 7.42 (d, J = 8.0 Hz, 1 H, Ar-H), 7.28–7.18 (m, 22 H, Ar-H), 7.10 (d, J = 8.0 Hz, 1 H, Ar-H), 6.67 (s, 1 H, Ar-H), 5.80 (d, J = 3.6 Hz, 1 H, 1a-H), 5.67 and 5.23 (each d, each J = 15.6 Hz, each 1 H, N-benzylic H), 4.84 and 4.80 (each d, each J = 11.2 Hz, each 1 H, benzylic H), 4.76 (d, J = 8.4 Hz, 1 H, 1b-H), 4.74 and 4.73 (each d, each J = 11.2 Hz, each 1 H, benzylic H), 4.65 (d, J = 13.6 Hz, 1 H, benzylic H), 4.60 (d, J = 11.6 Hz, 1 H, benzylic H), 4.58 (d, J = 12.0 Hz, 1 H, benzylic H), 4.53 (d, J = 12.4 Hz, 1 H, benzylic H), 4.49 (d, J = 12.4 Hz, 1 H, benzylic H), 4.48–4.45 (m, 2 H, benzylic H), 4.44 (d, J = 3.2 Hz, 2a-H), 4.42 (d, J = 10.8 Hz, 1 H, benzylic H), 4.39 (d, J = 12.4 Hz, 1 H, benzylic H), 4.25 (d, J = 12.4 Hz, 1 H, benzylic H), 3.95–3.91 (m, 3 H, 3a-H, 4a-H, 5b-H), 3.82 (dd, J = 10.4, 4.4 Hz, 1 H, 6a-H), 3.81–3.74 (m, 3 H, 5a-H, 3b-H, 6b'-H), 3.55 (dd, J = 8.4, 4.4 Hz, 1 H, 6'a-H), 3.54–3.48 (m, 3 H, 6'b-H, 4b-H, 2b-H), 1.40 and 1.22 [each s, each 3 H, 2 $C(CH_3)_2$] ppm. ^{13}C NMR (100 MHz): δ = 140.54, 138.94, 138.51, 138.26, 138.24, 133.71 and 129.12 (Ar-Cq), 128.41, 128.32, 128.09, 127.81, 127.78, 127.61, 127.54, 127.22, 127.20, 126.87, 125.89, 124.98 (Ar-C), 111.95 (CMe_2), 105.09 (C-1a), 96.70 (C-1b), 82.69 (C-2a), 82.20 (C-3a), 81.48 (C-4a), 79.76 (C-2b), 79.17 (C-3a), 78.39 (C-4b), 77.23 (C-5b), 75.52, 75.15, 73.40, 73.03 (CH_2Ar, OCH_2Ph), 72.78 (C-6a), 72.32 (OCH_2), 70.92 (C-5a), 68.97 (C-6b), 53.54 (NCH_2Ar), 26.89 and 26.30 [2 $C(CH_3)_2$] ppm. HRMS (+ mode): calcd. for $C_{54}H_{61}N_3O_{11}$ $[M + H]^+$ 926.4228; found 926.3962.

Compound 40α: Compound **39** (1.0 g, 0.953 mmol) on treatment with NIS (427 mg, 1.90 mmol) and TMSOTf (35 µL, 0.19 mmol) in dry CH_2Cl_2 for 4 h and workup as described in general procedure D afforded **40α** as a colourless oil (180 mg, 20%). R_f = 0.54 (30% EtOAc/toluene). $[\alpha]_D^{25}$ = +0.47 (c = 1, $CHCl_3$). ^1H NMR ($CDCl_3$, 400 MHz): δ = 8.03 (d, J = 8.4 Hz, 2 H, Ar-H), 7.50–7.18 (m, 23 H, Ar-H), 5.93 (d, J = 3.6 Hz, 1 H, 1a-H), 5.65 and 5.36 (each d, each J = 15.2 Hz, each 1 H, N-benzylic H), 4.96 (d, J = 11.6 Hz, 1 H, benzylic H), 4.91 and 4.87 (each d, each J = 10.8 Hz, 1 H, benzylic H), 4.85–4.77 (m, 3 H, benzylic H), 4.71 (d, J = 3.6 Hz, 1 H, 2a-H), 4.65 (dd, J = 9.6, 4.8 Hz, 1 H, 6a'-H), 4.59 (d, J = 11.6 Hz, 1 H, benzylic H), 4.57–4.54 (m, 3 H, 1-H merged with benzylic H), 4.52 (d, J = 12.0 Hz, 1 H, benzylic H), 4.44 (d, J = 11.6 Hz, 1 H, benzylic H), 4.33–4.28 (m, 2 H, 5a-H, 6b'-H), 4.25 (dd, J = 8.8, 2.8 Hz, 1 H, 4a-H), 4.06 (d, J = 2.8 Hz, 1 H, 3a-H), 3.76 (dd, J = 10.8, 1.6 Hz, 1 H, 6a-H), 3.69 (dd, J = 10.8, 4.8 Hz, 1 H, 6b-H), 3.64 (m, 1 H, 5b-H), 3.61 (dd, J = 9.2 Hz, 1 H, 3b-H), 3.48–3.44 (m, 2 H, 4b-H, 2b-H), 1.50 and 1.32 [each s, each 3 H, 2 $C(CH_3)_2$] ppm. ^{13}C NMR (100 MHz): δ = 165.93 (C=O), 137.89, 137.80, 137.57, 135.62, 133.09, 132.54, 132.39 (Ar-Cq), 131.44, 129.84, 129.53, 129.37, 129.20, 128.63, 128.49, 128.43, 127.98, 127.97, 127.88, 127.44, 127.39, 127.19, 127.10, 127.00 (Ar-C), 111.41 (CMe_2), 104.84 (C-1a), 86.67 (C-1b), 86.01 (C-5b), 81.85 (C-3a), 80.59 (C-2b), 80.20 (C-2a), 79.78 (C-4a), 78.65 (C-4b), 77.27 (C-3b), 75.23, 74.58, 72.96 (CH_2Ar), 69.26 (C-6a), 68.33 (C-6b), 67.33 (OCH_2Ar), 67.24 (C-5a), 66.26 (OCH_2Ar), 50.92 (NCH_2Ar), 26.23 and 25.86 [2 $C(CH_3)_2$] ppm. HRMS (+ mode): calcd. for $C_{54}H_{59}N_3O_{12}$ $[M + H]^+$ 940.4021; found 940.3940.

Compounds 51α and 51β: Compound **50** (0.76 g, 0.69 mmol) on treatment with NIS (309 mg, 1.38 mmol) and TMSOTf (35 µL, 0.19 mmol) in dry CH_2Cl_2 for 2 h and workup as described in general procedure D afforded **51α** and **51β** as a colourless oil (0.65 g, 95%). α/β = 1:2. Compounds **51α** and **51β** were successfully separated in pure form and characterized by comparing their spectroscopic data.

51α: Colourless oil. R_f = 0.40 (30% EtOAc/toluene). $[\alpha]_D^{25}$ = +26.0 (c = 1, $CHCl_3$). ^1H NMR ($CDCl_3$, 400 MHz): δ = 7.46 (dd, J = 7.6, 0.8 Hz, 1 H, Ar-H), 7.44 (s, 1 H, triazole H), 7.32–7.15 (m, 25 H, Ar-H), 7.09 (d, J = 7.6, 1.2 Hz, 1 H, Ar-H), 7.03 (dd, J = 8.0, 2.4 Hz, 2 H, Ar-H), 5.47 (s, 2 H, NCH_2), 5.02 (d, J = 10.8 Hz, 1

H, benzylic H), 5.00 (d, J = 12.0 Hz, 1 H, benzylic H), 4.97 (d, J = 12.8 Hz, 1 H, benzylic H), 4.81 and 4.80 (each d, each J = 11.2 Hz, each 1 H, benzylic H), 4.72 (d, J = 11.2 Hz, 1 H, benzylic H), 4.65 (d, J = 12.0 Hz, 1 H, benzylic H), 4.54 (d, J = 10.0 Hz, 1 H, benzylic H), 4.57 and 4.55 (each d, each J = 12.0 Hz, each 1 H, benzylic H), 4.50 (d, J = 14.0 Hz, 1 H, benzylic H), 4.46 (d, J = 3.2 Hz, 1 H, 1b-H), 4.43 (d, J = 12.0 Hz, 1 H, benzylic H), 4.38 (d, J = 10.8 Hz, 1 H, benzylic H), 4.30 (d, J = 12.4 Hz, 1 H, benzylic H), 3.98 (dd, J = 9.2, 8.4 Hz, 1 H, 3b-H), 3.82 (d, J = 3.6 Hz, 1 H, 1a-H), 3.70–3.60 (m, 3 H, 3a-H, 5b-H, 5a-H), 3.53 (dd, J = 10.0, 4.0 Hz, 1 H, 6a-H), 3.46–3.34 (m, 4 H, 2b-H, 2a-H, 4a-H, 6b-H), 3.30 (s, 3 H, OCH_3), 3.15 (dd, J = 10.0, 6.8 Hz, 1 H, 6'a-H), 3.07 (dd, J = 10.8, 8.4 Hz, 1 H, 4b-H), 2.40 (d, J = 10.0 Hz, 1 H, 6b'-H) ppm. ^{13}C NMR (100 MHz): δ = 147.56, 139.19, 138.53, 138.43, 138.30, 138.10, 135.86, 133.54 (Ar-Cq), 131.14, 130.86, 129.65, 129.03, 128.52, 128.31, 128.29, 128.27, 128.08, 127.99, 127.81, 127.78, 127.53, 122.88 (Ar-C), 97.96 (C-1a), 97.28 (C-1b), 84.00 (C-2a), 82.63 (C-3b), 81.72 (C-3a), 80.24 (C-2b), 77.55 (C-4a), 77.42 (C-4b), 75.68, 75.43, 74.88, 73.31, 73.14, 71.92 (OCH_2Ar), 70.99 (C-5b), 70.12 (C-5a), 69.14 (C-6b), 68.77 (C-6a), 66.67 (OCH_2Ar), 55.19 (OCH_3), 50.60 (NCH_2Ar) ppm. HRMS (+ mode): calcd. for $C_{59}H_{65}N_3O_{11}$ $[M + H]^+$ 990.4541; found 990.4512.

51β: Colourless oil. R_f = 0.34 (30% EtOAc/toluene). $[\alpha]_D^{25}$ = –11.3 (c = 1, $CHCl_3$). ^1H NMR ($CDCl_3$, 400 MHz): δ = 7.36 (s, 1 H, triazole H), 7.31–7.16 (m, 27 H, Ar-H), 7.07 (dd, J = 7.6, 2.0 Hz, 1 H, Ar-H), 5.37 and 5.27 (each d, each J = 14.4 Hz, each 1 H, N-benzylic H), 4.92 (d, J = 12.4 Hz, 1 H, benzylic H), 4.92 (d, J = 13.2 Hz, 1 H, benzylic H), 4.82–4.75 (m, 3 H, benzylic H), 4.69 (d, J = 10.8 Hz, 1 H, benzylic H), 4.68 and 4.66 (each d, each J = 12.0 Hz, each 1 H, benzylic H), 4.64 (d, J = 12.8 Hz, 1 H, benzylic H), 4.52 (d, J = 12.0 Hz, 1 H, benzylic H), 4.49–4.42 (m, 3 H, 1a-H merged with two benzylic H), 4.40 (d, J = 12.0 Hz, 1 H, benzylic H), 4.14 (d, J = 7.2 Hz, 1 H, 1b-H), 4.9 (d, J = 12.8 Hz, 1 H, benzylic H), 3.87 (dd, J = 9.2 Hz, 1 H, 3b-H), 3.64 (dd, J = 11.6, 3.6 Hz, 1 H, 6a-H), 3.60–3.45 (m, 6 H, 6b-H, 6a-H, 4a-H, 5b-H, 3a-H), 3.39 (dd, J = 9.6, 3.2 Hz, 1 H, 2a-H), 3.33–3.28 (m, 3 H, 2b-H, 4b-H, 5a-H), 3.26 (s, 3 H, OCH_3) ppm. ^{13}C NMR (100 MHz): δ = 145.97, 138.76, 138.42, 138.35, 138.31, 138.15, 138.02, 131.35 (Ar-Cq), 131.05, 129.42, 128.49, 128.45, 128.42, 128.40, 128.39, 128.05, 128.01, 127.94, 127.87, 127.82, 127.76, 127.72, 127.60, 127.56, 123.28 (Ar-C), 101.76 (C-1b), 98.20 (C-1a), 85.68 (C-3a), 81.96 (C-4b), 81.47 (C-3b), 79.88 (C-2a), 78.78 (C-2b), 77.97 (C-4a), 75.38 (OCH_2Ar), 75.36 (C-5a), 75.25, 74.86, 73.47, 73.26, 71.23 (OCH_2Ar), 70.37 (C-5b), 69.11 and 69.06 (C-6b, C-6a), 66.79 (OCH_2), 55.61 (OCH_3), 52.27 (NCH_2Ar) ppm. HRMS (+ mode): calcd. for $C_{59}H_{65}N_3O_{11}$ $[M + H]^+$ 990.4541; found 990.4489.

Compounds 56α and 56β: Compound **55** (0.7 mg, 0.63 mmol) on treatment with NIS (0.3 mg, 1.27 mmol) and TMSOTf (40 µL, 0.20 mmol) in dry CH_2Cl_2 (30 mL) for 2 h and workup as described in general procedure D afforded **56α** and **56β** as a colourless oil (0.5 mg, 80%). The two compounds were successfully separated in pure form and characterized by their spectroscopic data. The configuration of glycosidation product **56α** was successfully confirmed by treatment with H_2 and Pd/C in methanol for 2 d in the presence of 2 drops of concentrated HCl followed by acetylation using Ac_2O in pyridine. The compound, although obtained in low yield (10%), had spectroscopic data (^1H and ^{13}C NMR) that closely matched those of known material **57**.

56α: Colourless oil. R_f = 0.35 (30% EtOAc/toluene). $[\alpha]_D^{25}$ = +47.5 (c = 1, $CHCl_3$). ^1H NMR ($CDCl_3$, 400 MHz): δ = 7.47 (s, 1 H, triazole H), 7.30–7.12 (m, 29 H, Ar-H), 5.61 and 5.14 (each d, each J = 14.8 Hz, each 1 H, N-benzylic H), 4.91 (d, J = 13.2 Hz, 1 H, benzylic H), 4.87 (d, J = 10.0 Hz, 1 H, benzylic H), 4.79 (d, J = 10.8 Hz, 1 H, benzylic H), 4.75 (d, J = 11.6 Hz, 1 H, benzylic H), 4.70 (d, J = 10.8 Hz, 1 H, benzylic H), 4.69 and 4.63 (each d, each J = 11.2 Hz, each 1 H, benzylic H), 4.58 (d, J = 12.0 Hz, 1 H, benzylic H), 4.51 (d, J = 12.0 Hz, 1 H, benzylic H), 4.50 (d, J = 14.0 Hz, 1 H, benzylic H), 4.43 (d, J = 12.0 Hz, 1 H, benzylic H), 4.38 (d, J = 4.0 Hz, 1 H, 1b-H), 4.35 (d, J = 11.6 Hz, 1 H, benzylic H), 4.29 (d, J = 12.0 Hz, 1 H, benzylic H), 4.22 (d, J = 11.6 Hz, 1 H, benzylic H), 4.03 (d, J = 3.6 Hz, 1 H, 1a-H), 3.81 (dd, J = 9.2 Hz, 1 H, 3b-H), 3.75 (ddd, J = 8.8, 2.0, 1.2 Hz, 1 H, 5a-H), 3.69 (m, 1 H, 5b-H), 4.65 (d, J = 9.2 Hz, 1 H, 3a-H), 3.54–3.48 (m, 3 H, 4b-H, 4a-H, 6a-H), 3.41 (dd, J = 10.8, 2.0 Hz, 1 H, 6b-H), 3.31 (dd, J = 10.0, 3.6 Hz, 1 H, 2a-H), 3.21 (s, 3 H, OCH_3), 3.05 (d, J = 9.6 Hz, 1 H, 3b-H), 2.92–2.88 (m, 2 H, 6b'-H, 2b-H) ppm. ^{13}C NMR (100 MHz): δ = 147.09, 139.44, 139.09, 138.82, 138.78, 138.30, 138.12, 135.55 (Ar-Cq), 129.23, 128.67, 128.52, 128.50, 128.38, 128.34, 128.27, 128.14, 128.09, 128.05, 127.94, 127.85, 127.79, 127.77, 127.62, 127.58, 127.54, 127.49, 122.68 (Ar-C), 97.53 (C-1a), 97.37 (C-1b), 83.65 (C-4b), 81.78 (C-3b), 81.78 (C-3a), 79.99 (C-2b), 79.12 (C-2a), 77.70 (C-4a), 75.90, 75.58, 74.89, 74.73, 73.26, 73.12 (OCH_2Ar), 69.97 and 69.94 (C-5b, C-5a), 68.73 (C-6b), 68.43 (C-6a), 66.28 (OCH_2Ar), 55.32 (OCH_3), 54.14 (NCH_2Ar) ppm. HRMS (+ mode): calcd. for $C_{59}H_{65}N_3O_{11}$ $[M + H]^+$ 990.4541; found 990.4548.

56β: Colourless oil. R_f = 0.30 (30% EtOAc/toluene). $[\alpha]_D^{25}$ = –13.5 (c = 1, $CHCl_3$). ^1H NMR ($CDCl_3$, 400 MHz): δ = 7.61 (s, 1 H, triazole H), 7.40–7.21 (m, 28 H, Ar-H), 6.93 (s, 1 H, Ar-H), 5.63 and 5.59 (each d, each J = 16.0 Hz, each 1 H, N-benzylic H), 5.08 (d, J = 10.0 Hz, 1 H, benzylic H), 5.06 (d, J = 11.2 Hz, 1 H, benzylic H), 4.95 (d, J = 11.2 Hz, 1 H, benzylic H), 4.92 and 4.90 (each d, each J = 12.0 Hz, each 1 H, benzylic H), 4.89–4.83 (m, 2 H, benzylic H), 4.80 (d, J = 12.0 Hz, 1 H, benzylic H), 4.72 (d, J = 12.0 Hz, 1 H, benzylic H), 4.61–4.57 (m, 3 H, benzylic H), 4.54 (d, J = 12.0 Hz, 1 H, benzylic H), 4.53 (d, J = 3.6 Hz, 1 H, 1a-H), 4.50 (d, J = 11.6 Hz, 1 H, benzylic H), 4.29 (d, J = 7.6 Hz, 1 H, 1b-H), 3.96 (dd, J = 9.2 Hz, 1 H, 3b-H), 3.69–3.62 (m, 4 H, 4b-H, 3a-H, 5b-H, 6a'-H), 3.58 (d, J = 11.6 Hz, 1 H, 6b-H), 3.51–3.45 (m, 4 H, 6a-H, 4a-H, 2b-H), 3.40–3.35 (m, 5 H, 2a-H, 5a-H, OCH_3) ppm. ^{13}C NMR (100 MHz): δ = 146.57, 139.70, 139.02, 138.52, 138.26, 138.17, 138.14, 135.84 (Ar-Cq), 128.70, 128.56, 128.45, 128.41, 128.02, 128.01, 127.90, 127.72, 127.56, 127.52, 126.82, 123.04 (Ar-C), 104.37 (C-1b), 97.92 (C-1a), 85.44 (C-3a), 82.25 (C-3b, C-2a), 80.22 (C-2b), 78.43 (C-4a), 77.65 (C-4b), 75.60, 75.32 (OCH_2Ar), 75.11 (C-5a), 74.94, 74.87, 73.38, 73.11 (OCH_2Ar), 71.70 (C-6b), 70.49 (C-5b), 68.84 (C-6a), 65.69 (OCH_2), 55.32 (OCH_3), 53.54 (NCH_2Ar) ppm. HRMS (+ mode): calcd. for $C_{59}H_{65}N_3O_{11}$ $[M + H]^+$ 990.4541; found 990.4479.

Compounds 65α,β: Compound **64** (0.6 g, 0.546 mmol) on treatment with NIS (245 mg, 1.09 mmol) and TMSOTf (25 µL, 0.13 mmol) in dry CH_2Cl_2 (20 mL) for 2 h and workup as described in general procedure D afforded an anomeric mixture of **65α,β** as a colourless oil (486 mg, 90%) The pure isomers could not be separated (α/β = 3:1). R_f = 0.3 (35% EtOAc/toluene). ^1H NMR ($CDCl_3$, 400 MHz): δ = 7.61 (s, 1 H, triazole H, minor isomer), 7.45–7.01 (m, 30 H, triazole H, major isomer, Ar-H, major and minor isomer), 5.62 (d, J = 14.4 Hz, 1 H, N-benzylic H, minor isomer), 5.56 (d, J = 14.0 Hz, 1 H, N-benzylic H, major isomer), 5.47 (d, J = 14.0 Hz, 1 H, N-benzylic H, major isomer), 5.42 (d, J = 14.4 Hz, 1 H, N-benzylic H, minor isomer), 5.09 (d, J = 10.8 Hz, 1 H, benzylic H, major isomer), 5.02 (d, J = 12.8 Hz, 1 H, benzylic H, minor isomer), 4.87 (d, J = 10.8 Hz, 1 H, benzylic H, major isomer), 4.86 (d, J = 10.4 Hz, 1 H, benzylic H, minor isomer), 4.81 (d, J = 10.8 Hz, 1 H, benzylic H, minor isomer), 4.79 (d, J = 11.6 Hz, 1 H, benzylic

H, major isomer), 4.76–4.63 (m, 5 benzylic H for each major and minor isomer, 1 H, benzylic H for minor isomer), 4.61–4.53 (m, 2 H, benzylic H for each major and minor isomer), 4.52–04.50 (m, 1 H, for 1b-H major isomer, J = 5.6 Hz and 1b-H for minor isomer J = 9.2 Hz), 4.48–4.34 (m, 2 benzylic H for each major and minor isomer, 1 H, benzylic H for major isomer), 4.30 (d, J = 4.8 Hz, 1 H, 1a-H, minor isomer), 4.25 (d, J = 12.8 Hz, 1 H, benzylic H, minor isomer), 4.19 (d, J = 3.2 Hz, 1 H, 1a-H, major isomer), 4.10 (d, J = 12.0 Hz, 1 H, benzylic H, minor isomer), 4.06 (dd, J = 12.8, 2.4 Hz, 1 H, 6a-H, major isomer), 3.96 (dd, J = 9.2 Hz, 1 H, 3b-H, minor isomer), 3.88 (m, 1 H, 5b-H, minor isomer), 3.86 (m, 1 H, 5a-H, minor isomer), 3.82 and 3.80 (each dd, each J = 9.2 Hz, 3b-H, 3a-H, major isomer), 3.72 (dd, J = 10.4, 5.6 Hz, 4a-H, minor isomer), 3.60–3.40 (m, 13 H, 5b-H, major isomer, 4b-H, major isomer, 3a-H, minor isomer, 5a-H, major isomer, 4a-H, major isomer, 2a-H major isomer, 4b-H, minor isomer, 6b-H, minor isomer, 6b-H, 6a′-H, 6b′-H, major isomer), 3.32–3.31 (m, 4 H, 2a-H of minor isomer merged with OCH_3 of major isomer), 3.28 (s, 3 H, OCH_3, minor isomer), 3.23 (dd, J = 9.2, 3.6 Hz, 1 H, 2b-H, major isomer) ppm. ^{13}C NMR (100 MHz): δ = 145.31, 145.30, 139.35, 139.31, 139.03, 138.68, 138.38, 138.33, 138.22, 138.13, 138.10, 138.06, 136.72, 133.03, 132.07, 131.81, 131.69, 131.35, 131.23, 129.62, 129.34, 129.19, 128.92, 128.46, 128.41, 128.37, 128.35, 128.32, 128.21, 128.03, 127.99, 127.95, 127.72, 127.60, 127.55, 127.40, 127.38, 127.22, 124.65, 123.47 (Ar-C, major and minor isomer), 101.61 (C-1b, minor isomer), 98.34 (C-1b, major isomer), 97.74, (C-1a, minor isomer), 97.13, (C-1a, major isomer), 85.41, 81.92, 81.91, 80.41, 80.26, 80.25, 78.96, 78.85, 78.19, 77.84, 75.83, 75.33, 75.32, 74.97, 74.90, 74.46, 73.63, 73.38, 73.33, 73.25, 72.08, 71.29, 71.12, 70.44, 69.48, 69.09, 68.83, 66.17 (C-6b, minor isomer), 65.65 (C-6a, major isomer), 55.54 (OCH_3, major isomer), 55.06 (OCH_3, minor isomer), 52.69 (NCH_2Ar, minor isomer), 52.05 (NCH_2Ar, major isomer) ppm. HRMS (+ mode): calcd. for $C_{59}H_{65}N_3O_{11}$ [M + H]$^+$ 990.4541; found 990.4547.

Compounds 70α and 70β: Compound **69** (250 mg, 0.227 mmol) on treatment with NIS (101 mg, 0.455 mmol) and TMSOTf (25 µL, 0.13 mmol) in dry CH_2Cl_2 (15 mL) for 2 h and workup as described in general procedure D afforded **70α** and **70β** as a colourless oil (185 mg, 82%, α/β = 1:2). The two compounds were successfully separated in pure form and characterized by their comparative spectroscopic data.

70α: R_f = 0.32 (30% EtOAc/toluene). $[\alpha]_D^{25}$ = +27.2 (c = 1, $CHCl_3$). ^{1}H NMR ($CDCl_3$, 400 MHz): δ = 7.73 (s, 1 H, triazole H), 7.30–7.15 (m, 29 H, Ar-H), 7.12 (s, 1 H, Ar-H), 7.10 and 7.08 (each d, each J = 8.0 Hz, each 1 H, Ar-H), 7.02 (d, J = 8.0 Hz, 1 H, Ar-H), 5.59 and 5.22 (each d, each J = 15.2 Hz, each 1 H, N-benzylic H), 4.98, 4.91, 4.86, 4.82, 4.79 and 4.77 (each d, each J = 12.0 Hz, each 1 H, benzylic H), 4.71–4.65 (m, 1 H, benzylic H), 4.55 (d, J = 12.0 Hz, 1 H, benzylic H), 4.52 (d, J = 4.0 Hz, 1 H, 1a-H), 4.49 (d, J = 4.0 Hz, 1 H, 1b-H), 4.42 (d, J = 12.0 Hz, 1 H, benzylic H), 4.35 and 4.31 (each d, each J = 12.8 Hz, each 1 H, benzylic H), 4.23 (d, J = 12.0 Hz, 1 H, benzylic H), 4.07 and 4.05 (each dd, each J = 9.6 Hz, each 1 H, 3b-H, 3a-H), 3.93 (d, J = 9.6 Hz, 1 H, 4b-H), 3.66 (dd, J = 12.0, 4.0 Hz, 1 H, 6a-H), 3.59–3.50 (m, 2 H, 5b-H, 5a-H), 3.49 (dd, J = 8.8 Hz, 1 H, 6a′-H), 3.45 (d, J = 12.0 Hz, 1 H, 6b-H), 3.37–3.30 (m, 3 H, 6b′-H, 2a-H, 4a-H), 3.17–3.12 (m, 4 H, 2b-H, 4a-H), 3.17–3.12 (m, 5 H, OCH_3, 3b-H, 4a-H) ppm. ^{13}C NMR (100 MHz): δ = 139.96, 138.66, 138.18, 138.13, 138.06, 137.99, 137.93, 135.65 (Ar-Cq), 128.72, 128.49, 128.45, 128.40, 128.36, 128.26, 128.17, 127.99, 127.96, 127.84, 127.80, 127.66, 127.62, 127.59, 127.36, 127.21, 127.22, 124.04 (Ar-C), 97.72 (C-1b), 97.63 (C-1a), 86.32 (C-5b), 80.99 (C-5a), 78.43 (C-2b), 77.98 (C-2a), 75.89 (C-4a), 75.46 (C-3b), 75.38 (C-3a), 74.88, 74.79, 74.64, 73.45, 73.34 and 72.86 (OCH_2Ar), 69.20 (C-6a), 68.95 (C-6b), 68.74 (C-4b), 65.44 (CH_2Ar), 55.08 (OCH_3), 53.99 (NCH_2Ar) ppm. HRMS (+ mode): calcd. for $C_{59}H_{65}N_3O_{11}$ [M + H]$^+$ 990.4541; found 990.4167.

70β: R_f = 0.41 (30% EtOAc/toluene). $[\alpha]_D^{25}$ = –9.4 (c = 1, $CHCl_3$). ^{1}H NMR ($CDCl_3$, 400 MHz): δ = 7.70 (s, 1 H, triazole H), 7.32 (m, 23 H, Ar-H), 7.12 (dd, J = 8.0, 1.6 Hz, 2 H, Ar-H), 6.98 (d, J = 8.0 Hz, 1 H, Ar-H), 6.63 (s, 1 H, Ar-H), 5.72 (d, J = 12.0 Hz, 1 H, benzylic H), 5.35 (d, J = 12.8 Hz, 1 H, benzylic H), 5.20 (d, J = 10.8 Hz, 1 H, benzylic H), 8.77–8.74 (m, 4 H, benzylic H), 4.70 (d, J = 12.0 Hz, 1 H, benzylic H), 4.61 (d, J = 12.0 Hz, 1 H, benzylic H), 4.53 (d, J = 12.0 Hz, 1 H, benzylic H), 4.46 (d, J = 4.0 Hz, 1 H, 1a-H), 4.44 (d, J = 8.0 Hz, 1 H, 1b-H), 4.42 (d, J = 12.0 Hz, 1 H, benzylic H), 4.41 (d, J = 12.0 Hz, 1 H, benzylic H), 4.39 (d, J = 12.0 Hz, 1 H, benzylic H), 4.38–4.29 (m, 4 H, 6a-H merged with 3 benzylic H), 3.94–3.88 (m, 2 H, 3b-H, 5a-H), 3.80–3.72 (m, 2 H, 3a-H, 5-H), 3.54 (dd, J = 12.0, 1.6 Hz, 1 H, 6b-H), 3.48–3.36 (m, 4 H, 6a′-H, 4a-H, 2a-H, 6b′-H), 3.35 (d, J = 9.2 Hz, 1 H, 4a-H), 3.27 (s, 3 H, OCH_3), 3.24 (d, J = 4.0 Hz, 1 H, 2a-H) ppm. ^{13}C NMR (100 MHz): δ = 146.71, 140.08, 140.01, 138.82, 138.53, 138.13, 138.10, 135.57 (Ar-Cq), 128.41, 128.40, 128.39, 128.38, 128.35, 128.32, 128.31, 128.10, 127.99, 127.97, 127.75, 127.74, 127.69, 127.68, 127.35, 127.34, 125.72, 124.45, 124.03 (Ar-C), 101.28 (C-1b), 98.02 (C-1a), 82.25 (C-3b), 81.28 (C-3a), 80.67 (C-5b), 79.21 (C-2a), 78.74 (C-4b), 78.25 (C-2b), 75.96, 75.73, 75.06, 73.51, 73.39, 72.60 (OCH_2Ar), 71.21 (C-5b), 70.69 (C-4a), 69.72 (C-6a), 69.59 (C-6b), 65.01 (OCH_2), 55.33 (OCH_3), 53.48 (NCH_2Ar) ppm. HRMS: HRMS (+ mode): calcd. for $C_{59}H_{65}N_3O_{11}$ [M + H]$^+$ 990.4541; found 990.4168.

Compound 77α: Compound **76** (0.4 g, 0.357 mmol) on treatment with NIS (160 mg, 0.715 mmol) and TMSOTf (45 µL, 0.24 mmol) in dry CH_2Cl_2 for 2 h and workup as described in general procedure D afforded **77α** as a colourless oil (0.19 g, 55%). R_f = 0.33 (30% EtOAc/toluene). $[\alpha]_D^{25}$ = +1.5 (c = 1, $CHCl_3$). ^{1}H NMR ($CDCl_3$, 400 MHz): δ = 7.96 (d, J = 8.0 Hz, 2 H, Ar-H), 7.50–7.37 (m, 5 H, Ar-H), 7.34–7.11 (m, 22 H, triazole H, Ar-H), 7.01 (dd, J = 8.4, 2.0 Hz, 1 H, Ar-H), 5.88 and 5.57 (each d, each J = 14.8 Hz, each 1 H, N-benzylic H), 4.85 and 4.83 (each d, each J = 10.8 Hz, each 1 H, benzylic H), 4.79 (d, J = 10.8 Hz, 1 H, benzylic H), 4.74 (d, J = 11.2 Hz, 1 H, benzylic H), 4.72–4.66 (m, 3 H, 6a-H merged with benzylic H), 4.66 (d, J = 12.0 Hz, 1 H, benzylic H), 4.62 (d, J = 4.0 Hz, 1 H, 1b-H), 4.57 and 4.53 (each d, each J = 12.0 Hz, each 1 H, benzylic H), 4.51–4.48 (m, 3 H, 1a-H, benzylic H), 5.45 (d, J = 10.8 Hz, 1 H, benzylic H), 5.43 (d, J = 10.4 Hz, 1 H, benzylic H), 3.76–3.71 (m, 2 H, 5a-H, 3a-H), 3.67 (dd, J = 11.2, 2.0 Hz, 1 H, 6b-H), 3.66–3.57 (m, 3 H, 6b′-H, 5b-H, 4b-H), 3.55 (dd, J = 9.6 Hz, 1 H, 3b-H), 3.49–3.38 (m, 3 H, 2b-H, 2a-H, 4a-H), 3.28 (s, 3 H, OCH_3) ppm. ^{13}C NMR (100 MHz): δ = 166.91 (COPh), 145.31, 138.61, 138.36, 138.32, 138.10, 136.02, 134.25, 133.23, 131.93, 130.28, 129.81, 127.51, 129.16, 128.92, 128.86, 128.63, 128.48, 128.45, 128.37, 128.27, 128.00, 127.93, 127.82, 127.72, 127.88, 127.59, 127.48, 123.00 (Ar-C), 97.73 (C-1b), 97.72 (C-1a), 87.12 (C-3a), 86.57 (C-3b), 81.21 (C-2b), 80.95 (C-2a), 80.12 (C-4b), 79.17 (C-4a), 76.77, 75.77, 75.59, 75.06, 73.45, 71.13 (CH_2Ar), 70.39 (C-5a), 67.62 (C-5b), 66.72, 63.73 (C-6b, C-6a), 55.13 (OCH_3), 50.98 (NCH_2Ar) ppm. HRMS (+ mode): calcd. for $C_{59}H_{63}N_3O_{12}$ [M + H]$^+$ 1004.4334; found 1004.4298.

Supporting Information (see footnote on the first page of this article): Synthetic methods for all donors, acceptors and intermediates required to investigate the intramolecular glycosylation reactions and the ^{1}H and ^{13}C NMR spectra of all the synthesized compounds.

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[31] Note added during revision of the paper: Model studies with methyl 2,3,4-tri-*O*-benzyl-6-*O*-(1-phenyl-1,2,3-triazolyl-4-ylmethyl)-α-D-glucopyranoside revealed that under Birch reduction conditions (Na in liquid ammonia, –78 °C, 40 min) complete removal of the *O*-benzyl and the *O*-triazolylmethyl groups is possible.

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