Synthesis and Molecular Structure of New S-nucleosides of 5-(4-Pyridyl)-4-aryl-4*H*-1,2,4-triazole-3-thiols

Huan-Huan Zhang[a] (張歡歡), Xiu-Qin Hu[a]* (胡秀琴),
Gui-Fang Fan[b] (范桂芳) and Peng-Fei Xu[a]* (許鵬飛)
[a]*State Key Laboratory of Applied Organic Chemistry, Lanzhou University, Lanzhou 730000, P. R. China*
[b]*Jinchuan Group Limited, Jinchang, Gansu 737104, P. R. China*

The synthesis of some new S-nucleosides of 5-(4-pyridyl)-4-aryl-4*H*-1,2,4-triazole-3-thiols (**4a-n**) is described. Direct glycosylation of (**4a-n**) with tetra-*O*-acetyl-α-D-glucopyranosyl bromide in the presence of potassium hydroxide followed by deacetylation using dry ammonia in methanol gave the corresponding 3-S-(β-D-glucopyranosyl)-5-(4-pyridyl)-4-aryl-4*H*-1,2,4-triazoles (**6a-n**) in good yields. All the compounds were fully characterized by means of ^{1}H NMR, ^{13}C NMR spectra and elemental analyses. To assist in the interpretation of the spectroscopic data, the crystal structure of 3-S-(2′,3′,4′,6′-tetra-*O*-acetyl-β-D-glucopyranosyl)-5-(4-pyridyl)-4-phenyl-4*H*-1,2,4-triazole (**5a**) was determined by X-ray diffraction.

Keywords: S-nucleosides; 1,2,4-Triazole; Glycosylation; Crystal structure.

INTRODUCTION

1,2,4-Triazole derivatives have a broad spectrum of biological activities such as anti-inflammatory,[1-5] antiviral,[6,7] anticonvulsant,[8-10] antitumor,[11-13] antidepressant,[14] antifungal[15-18] and antimicrobial activity.[19-20] The application of 1,2,4-triazoles is limited because of their poor solubility in both organic solvents and water, so many modified 1,2,4-triazole derivatives have been reported in order to improve their solubility and biological activities. Especially after the recognized biological properties of ribavirin,[21] 1-β-D-ribofuranosyl-1,2,4-triazole-3-carboxamide, the synthesis of N-nucleosides and C-nucleosides as well as their acyclic analogues possessing a 1,2,4-triazole moiety has attracted many workers[22-24] in this field to attempt to enhance the biological activity of these compounds. During past decades, a great deal of modified N-nucleosides[25-27] and C-nucleosides[28-31] have been greatly emphasized, but only a few S-nucleosides have been reported.[32] In view of this, we turned our attention to the synthesis of novel S-nucleosides of 1,2,4-triazole derivatives from 5-(4-pyridyl)-4-aryl-4*H*-1,2,4-triazole-3-thiols and tetra-*O*-acetyl-α-D-glucopyranosyl bromide.

RESULTS AND DISCUSSION

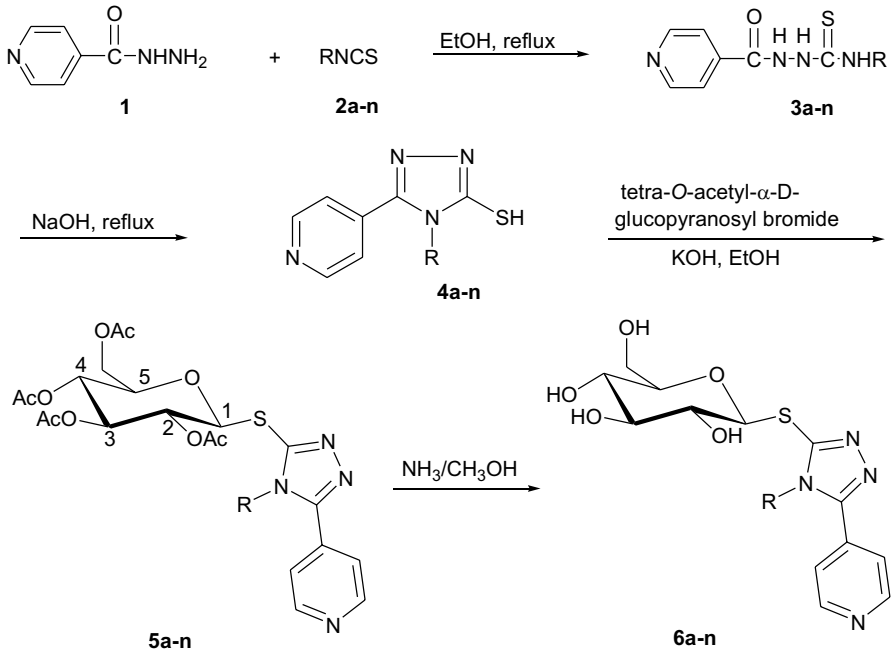
Synthesis

The synthesis pathway leading to the title compounds is given in Scheme I. 1-(4-Pyridyl)-4-aryl thiosemicarbazides (**3a-n**) were prepared by the condensation of 4-pyridyl carboxylic acid hydrazide (**1**) with arylisothiocyanates (**2a-n**) in good yields.[33] The synthesis of 5-(4-pyridyl)-4-aryl-4*H*-1,2,4-triazole-3-thiols (**4a-n**) was achieved by the cyclization of **3a-n** in the presence of sodium hydroxide.[34] Each of the substituted 1,2,4-triazole-3-thiols (**4a-n**) was subjected to coupling with 2,3,4,6-tetra-*O*-acetyl-α-D-glucopyranosyl bromide in the presence of potassium hydroxide using ethanol as the solvent, and yields ranged from 48% to 89%. The subsequent procedure was the removal of the protecting groups which could be easily achieved by treatment of (**5a-n**) with ammonia gas in dry methanol. The final desired S-nucleosides of 5-(4-pyridyl)-4-aryl-4*H*-1,2,4-triazole-3-thiols (**6a-n**) were obtained successfully. The yield of glycosylation was greatly influenced by aryl substitution on the triazole ring. When the electron-donating groups were used, the yields could be greatly improved. Furthermore, only the β-anomer was obtained as judged by ^{1}H NMR, and the anomeric proton (H-1) was exhibited as a doublet at δ 5.51-5.62 ($J_{1,2}$ = 9.0-10.8 Hz).

The structures of **5a-n** and **6a-n** were confirmed by ^{1}H NMR and ^{13}C NMR, as well as by elemental analyses. The ^{1}H NMR spectrum for **5a-n** showed four singlets in the region of δ 1.94-2.06 corresponding to four acetyl groups. The multiplets at δ 3.74-5.76 were attributed to seven protons of the sugar moiety. The aryl and pyridyl groups were

* Corresponding author. E-mail: xupf@lzu.edu.cn

Scheme I Synthesis of S-nucleosides of 5-(4-pyridyl)-4-aryl-4*H*-1,2,4-triazole-3-thiols (**6a-n**)



R: a) Ph b) *o*-C_2H_5OPh c) *p*-C_2H_5OPh d) *o*-CH_3OPh e) *p*-CH_3OPh f) *o*-CH_3Ph g) *m*-CH_3Ph h) *p*-CH_3Ph i) *o*-BrPh j) *m*-BrPh k) *p*-BrPh l) *o*-ClPh m) *m*-ClPh n) *p*-ClPh

found in the region of δ 6.95-8.60. The successful deacetylation of **5a-n** could be easily supported by the disappearance of four sharp singlets around δ 2.00 in the ^{1}H NMR spectrum of **6a-n**.

Biological Activities

The anti-HIV-1 reverse transcriptase (RT), anti-HIV-1 protease (PR) and HIV-1 integrase (IN) activities of these kinds of compounds have been evaluated, but none of these compounds showed obviously anti-HIV activity. Other biological activities are still under investigation.

Crystal Structure

The molecular structure of **5a** is shown in Fig. 1. This crystal was obtained by crystallization of **5a** from ethanol. The structure determination shows clearly that the acetylglucose ring adopts $^4C_1$ chair conformation with all substituents in equatorial positions. Furthermore, compound **5a** is in the β-configuration and the C5-S1-C15 angle is 97.90 (11)°. The heterocyclic ring is planar within experimental error. The endocyclic bond lengths N1-C15 and N2-C16 of 1.307 (3) and 1.314 (3) Å, respectively, clearly indicate they are double bonds. The C-N-N angles in the ring show large deviations from the value of 120° usually found in the trigonal planar arrangement, which is common in five-membered rings.

The methyl H atoms were then constrained to an ideal geometry, with C-H distances of 0.96 Å and U_{iso}(H) = 1.5 U_{eq}(C), but were allowed to rotate freely about their C-C bond. All remaining H atoms were placed in geometrically idealized positions and constrained to ride on their parent

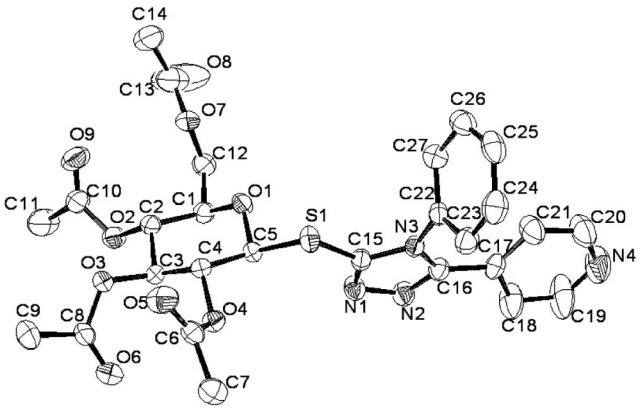


Fig. 1. ORTEP drawing and atom labelling scheme of the compound **5a** with thermal ellipsoids drawn at the 50% probability level.

atoms, with C-H distances in the range of 0.93-0.98 Å and $U_{iso}(H) = 1.2\ U_{eq}(C)$.

CCDC 627631 contains the supplementary crystallographic data for this paper. These data can be obtained free of charge via www.ccdc.cam.ac.uk/conts/retrieving.html (or from the CCDC, 12 Union Road, Cambridge CB2 1EZ, UK; Fax: +44-1223-336033; E-mail: deposit@ccdc.cam.ac.uk). A summary of the crystallographic data and details of the structure refinements is listed in Table 1. Selected bond lengths and angles are listed in Table 2.

CONCLUSIONS

In summary, we have successfully synthesized 14 new S-nucleosides of 5-(4-pyridyl)-4-aryl-4*H*-1,2,4-trizoles-3-thiols (**5a-n**) via nucleophilic substitution reaction and 14 of their deacetylation compounds **6a-n** in acceptable to good yields. The preliminary study indicates that the solubility of these modified 1,2,4-triazole derivatives was indeed improved.

EXPERIMENTAL SECTION

All reagents of analytical grade were used without purification. All melting points were uncorrected and determined on a Yanaco MP micoscropic melting point apparatus. Elemental analyses were carried out on a Vario E1 Elemental meter. ^{1}H NMR spectrum were recorded at 300 MHz and ^{13}C NMR spectrum were recorded at 75 MHz. The X-ray diffractometer data was collected on a Bruker SMART ApexCCD area detector with a graphite-monochromated Mo$K\alpha$ radiation (λ = 0.71073 Å) at 294(2) K. The crystal structure was solved by direct methods using SHELXS-97[35] and refined by full-matrix least-squares methods on $F2$ using SHELXL-97.[36] All H atoms were determined from a difference Fourier map.

Table 1. Crystal and structure refinement summary for compound **5a**

Formula	$C_{27}H_{28}N_4O_9S$
Formula weight	584.59
Crystal system	orthorhombic
Space group	P2(1)2(1)2(1)
Unit-cell dimensions (Å)	a = 8.1215 (10)
	b = 16.471 (2)
	c = 22.119 (3)
	$\alpha = \beta = \gamma = 90°$
Unit-cell volume, V (Å^3)	2958.9(6)
Formula per unit cell, Z	4
D_{calcd} (g/cm^3)	1.312
Absorption coefficient, μ (mm^{-1})	0.166
F(000)	1224
Crystal size (mm)	0.30 × 0.30 × 0.25
Index ranges	$-9 \le h \le 9$
	$-17 \le k \le 19$
	$-25 \le l \le 24$
Max. and min. transmission	0.9518 and 0.9596
Independent reflections	5203 (R_{int} = 0.0361)
Reflections/restraints/parameters	5203/0/375
Final R indices [$I > 2\sigma(I)$]	R_1 = 0.0419, ωR_2 = 0.1178
R indices (all data)	R_1 = 0.0454, ωR_2 = 0.1217
Goodness-of-fit on $F2$	1.072

Table 2. Selected bond lengths [Å] and angles [°] for **5a**

S-C5	1.811 (2)	O7-C12	1.432 (3)
S-C15	1.751 (2)	O7-C13	1.336 (3)
O1-C1	1.432 (3)	O8-C13	1.206 (4)
O1-C5	1.423 (3)	O9-C10	1.188 (4)
O2-C2	1.447 (3)	N1-C15	1.307 (3)
O2-C10	1.370 (3)	N2-C16	1.314 (3)
O3-C3	1.445 (3)	N3-C15	1.370 (3)
O3-C8	1.367 (3)	N3-C16	1.376 (3)
O4-C4	1.442 (3)	N3-C22	1.442 (3)
O4-C6	1.365 (3)	N4-C19	1.300 (5)
O5-C6	1.187 (3)	N4-C20	1.328 (4)
O6-C8	1.188 (3)	N1-N2	1.385 (3)
O1-C1-C12	106.63 (19)	O7-C13-C14	111.9 (3)
O1-C1-C2	108.30 (17)	N1-C15-N3	111.2 (2)
O2-C2-C3	106.58 (18)	N1-C15-S1	127.17 (18)
O2-C2-C1	109.56 (19)	N3-C15-S1	121.67 (17)
O3-C3-C2	106.79 (17)	N2-C16-N3	109.9 (2)
O3-C3-C4	109.89 (18)	N2-C16-C17	122.5 (2)
O4-C4-C3	109.89 (17)	N3-C16-C17	127.5 (2)
O4-C4-C5	105.20 (17)	N4-C19-C18	125.8 (3)
O1-C5-C4	108.98 (18)	N4-C20-C21	124.3 (3)
O1-C5-S1	107.83 (14)	C27-C22-N3	119.1 (2)
C4-C5-S1	110.15 (15)	C23-C22-N3	118.7 (2)
O5-C6-O4	122.7 (2)	C15-N1-N2	106.84 (19)
O5-C6-C7	127.6 (2)	C16-N2-N1	107.84 (19)
O4-C6-C7	109.8 (2)	C15-N3-C16	104.21 (18)
O6-C8-O3	124.2 (2)	C15-N3-C22	126.11 (18)
O6-C8-C9	125.4 (2)	C16-N3-C22	129.67 (19)
O3-C8-C9	110.4 (2)	C19-N4-C20	115.4 (3)
O9-C10-O2	123.7 (3)	C5-O1-C1	111.47 (16)
O9-C10-C11	125.5 (3)	C10-O2-C2	117.9 (2)
O2-C10-C11	110.7 (3)	C8-O3-C3	117.75 (18)
O7-C12-C1	108.11 (19)	C6-O4-C4	117.41 (18)
O8-C13-O7	121.1 (3)	C13-O7-C12	116.6 (2)
O8-C13-C14	126.8 (3)	C15-S1-C5	97.90 (11)

General Procedure for Preparation of S-Nucleoside Derivatives of 1,2,4-Triazoles (5a-n)

5-(4-Pyridyl)-4-aryl-4*H*-1,2,4-triazole-3-thiol (**4a-n**)

(2 mmol) was dissolved in the solution of KOH (2 mmol) in ethanol (25 mL). After the mixture was stirred at room temperature for 30 min, 2,3,4,6-tetra-O-acetyl-α-D-glucopyranosyl bromide (2 mmol, 0.82 g) was added. The reaction mixture was stirred at room temperature for 48 h. The mixture was concentrated and washed with water. The crude product was purified by flash column chromatography.

3-S-(2′,3′,4′,6′-Tetra-*O*-acetyl-β-D-glucopyranosyl)-5-(4-pyridyl)-4-phenyl-4*H*-1,2,4-triazole (5a)

Yield: 65%; Mp: 172-174 °C; $[\alpha]_D^{20}$ +4 (*c* 1, CH_2Cl_2); ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.96-1.99 (m, 12H), 3.78-3.82 (m, 1H), 4.07 (dd, *J* = 12.6 & 2.1 Hz, 1H), 4.21 (dd, *J* = 12.6 & 4.2 Hz, 1H), 5.04-5.11 (m, 2H), 5.25 (t, *J* = 9.3 Hz, 1H), 5.57 (d, *J* = 10.5 Hz, 1H), 7.20 (d, *J* = 7.2 Hz, 2H), 7.25 (d, *J* = 5.7 Hz, 2H), 7.47-7.56 (m, 3H), 8.50 (d, *J* = 5.7 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 20.4, 20.6, 61.4, 67.7, 69.8, 73.6, 76.1, 83.8, 121.4, 127.2, 130.2, 130.6, 133.1, 133.7, 150.1, 150.5, 152.9, 169.3, 169.8, 170.4; Anal. Calcd. for $C_{27}H_{28}N_4O_9S$: C, 55.47; H, 4.83; N, 9.58; Found: C, 55.40; H, 4.47; N, 9.65.

3-S-(2′,3′,4′,6′-Tetra-*O*-acetyl-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*o*-ethoxyphenyl-4*H*-1,2,4-triazole (5b)

Yield: 89%; Mp: 77-78 °C; $[\alpha]_D^{20}$ –12 (*c* 1, CH_2Cl_2); ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.09 (t, *J* = 6.9 Hz, 3H), 1.99-2.03 (m, 12H), 3.74-3.85 (m, 2H), 3.92-3.99 (m, 1H), 4.02-4.12 (m, 1H), 4.19-4.30 (m, 1H), 5.02-5.15 (m, 2H), 5.23-5.30 (m, 1H), 5.54-5.63 (m, 1H), 6.98-7.08 (m, 2H), 7.15-7.25 (m, 1H), 7.32 (d, *J* = 5.7 Hz, 2H), 7.53-7.65 (m, 1H), 8.54 (d, *J* = 5.7 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 14.1, 20.4, 61.4, 64.1, 67.6, 69.8, 73.5, 76.0, 83.4, 84.2, 113.0, 113.4, 120.9, 121.8, 128.3, 128.9, 132.0, 134.4, 150.0, 150.6, 153.3, 153.5, 169.3, 169.8, 170.3; Anal. Calcd. for $C_{29}H_{32}N_4O_{10}S$: C, 55.41; H, 5.13; N, 8.91; Found: C, 55.22; H, 5.30; N, 8.99.

3-S-(2′,3′,4′,6′-Tetra-*O*-acetyl-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*p*-ethoxyphenyl-4*H*-1,2,4-triazole (5c)

Yield: 74%; Mp: 125-127 °C; $[\alpha]_D^{20}$ +2 (*c* 1, CH_2Cl_2); ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.46 (t, *J* = 7.2 Hz, 3H), 1.99-2.02 (m, 12H), 3.81-3.84 (m, 1H), 4.05-4.12 (m, 3H), 4.25 (dd, *J* = 12.6 & 4.2 Hz, 1H), 5.07-5.15 (m, 2H), 5.27 (t, *J* = 9.3 Hz, 1H), 5.62 (d, *J* = 10.5 Hz, 1H), 6.97 (d, *J* = 9.3 Hz, 2H), 7.11 (d, *J* = 9.3 Hz, 2H), 7.30-7.33 (m, 2H), 8.53-8.56 (m, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 14.5, 20.4, 61.4, 63.9, 67.7, 69.7, 73.6, 76.1, 83.6, 115.7, 121.3, 125.2, 128.4, 133.8, 150.1, 151.1, 153.0, 160.3, 169.4, 169.8, 170.4; Anal. Calcd. for $C_{29}H_{32}N_4O_{10}S$: C, 55.41; H, 5.13; N, 8.91; Found: C, 55.19; H, 5.35; N, 8.92.

3-S-(2′,3′,4′,6′-Tetra-*O*-acetyl-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*o*-methoxyphenyl-4*H*-1,2,4-triazole (5d)

Yield: 80%; Mp: 84-86 °C; $[\alpha]_D^{20}$ -11 (*c* 1, CH_2Cl_2); ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.99-2.03 (m, 12H), 3.63 (d, *J* = 9.3 Hz, 3H), 3.75-3.82 (m, 1H), 4.02-4.10 (m, 1H), 4.20-4.30 (m, 1H), 5.03-5.14 (m, 2H), 5.22-5.30 (m, 1H), 5.53-5.58 (m, 1H), 7.01-7.09 (m, 2H), 7.14-7.23 (m, 1H), 7.31 (d, *J* = 5.7 Hz, 2H), 7.53 (t, *J* = 7.8 Hz, 1H), 8.54 (d, *J* = 5.7 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 20.3, 55.4, 61.4, 67.6, 69.6, 73.4, 75.8, 83.6, 84.1, 112.3, 120.7, 121.2, 121.6, 128.3, 128.8, 132.1, 134.1, 149.9, 150.6, 153.2, 154.1, 169.2, 169.8, 170.3; Anal. Calcd. for $C_{28}H_{30}N_4O_{10}S$: C, 54.72; H, 4.92; N, 9.12; Found: C, 54.64; H, 5.03; N, 9.29.

3-S-(2′,3′,4′,6′-Tetra-*O*-acetyl-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*p*-methoxyphenyl-4*H*-1,2,4-triazole (5e)

Yield: 75%; Mp: 148-150 °C; $[\alpha]_D^{20}$ +4 (*c* 1, CH_2Cl_2); ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.98-2.01 (m, 12H), 3.79-3.83 (m, 1H), 3.87 (s, 3H), 4.09 (dd, *J* = 12.6 & 2.1 Hz, 1H), 4.23 (dd, *J* = 12.6 & 4.5 Hz, 1H), 5.05-5.13 (m, 2H), 5.26 (t, *J* = 9.3 Hz, 1H), 5.60 (d, *J* = 9.9 Hz, 1H), 6.98 (d, *J* = 9.0 Hz, 2H), 7.12 (d, *J* = 9.0 Hz, 2H), 7.30 (d, *J* = 6.3 Hz, 2H), 8.53 (d, *J* = 6.3 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 20.4, 20.5, 55.5, 61.3, 67.6, 69.6, 73.5, 75.9, 83.5, 115.2, 121.2, 125.3, 128.4, 133.7, 150.0, 151.0, 152.9, 160.8, 169.3, 169.4, 169.8, 170.4; Anal. Calcd. for $C_{28}H_{30}N_4O_{10}S$: C, 54.72; H, 4.92; N, 9.12; Found: C, 54.43; H, 4.70; N, 9.07.

3-S-(2′,3′,4′,6′-Tetra-*O*-acetyl-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*o*-methylphenyl-4*H*-1,2,4-triazole (5f)

Yield: 71%; Mp: 138-140 °C; $[\alpha]_D^{20}$ +5 (*c* 1, CH_2Cl_2); ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.94-2.02 (m, 15H), 3.80-3.85 (m, 1H), 4.03-4.14 (m, 1H), 4.20-4.29 (m, 1H), 5.05-5.14 (m, 2H), 5.25-5.32 (m, 1H), 5.64-5.76 (m, 1H), 7.14-7.30 (m, 3H), 7.36-7.40 (m, 2H), 7.51 (t, *J* = 7.8 Hz, 1H), 8.53 (d, *J* = 5.7 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 17.2, 20.5, 61.5, 67.8, 69.7, 73.6, 76.1, 83.7, 120.4, 127.7, 128.2, 131.2, 132.1, 133.8, 135.3, 135.6, 150.4, 150.9, 152.4, 169.3, 169.9, 170.4; Anal. Calcd. for $C_{28}H_{30}N_4O_9S$: C, 56.18; H, 5.05; N, 9.36; Found: C, 55.95; H, 5.31; N, 9.46.

3-S-(2′,3′,4′,6′-Tetra-*O*-acetyl-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*m*-methylphenyl-4*H*-1,2,4-triazole (5g)

Yield: 65.1%; Mp: 175-176 °C; $[\alpha]_D^{20}$ +3 (*c* 1, CH_2Cl_2); ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.94-1.97 (m, 12H), 2.35 (s, 3H), 3.75-3.80 (m, 1H), 4.02-4.06 (m, 1H), 4.21 (dd, *J* = 12.9 & 4.5 Hz, 1H), 5.02-5.10 (m, 2H), 5.23 (t,

J = 9.3 Hz, 1H), 5.57 (d, *J* = 10.8 Hz, 1H), 6.96-6.99 (m, 2H), 7.24 (d, *J* = 5.7 Hz, 2H), 7.33-7.35 (m, 2H), 8.48 (d, *J* = 5.7 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 20.4, 20.5, 21.1, 61.4, 67.7, 69.7, 73.6, 76.1, 83.8, 121.2, 124.2, 127.6, 129.9, 131.4, 133.1, 133.7, 140.6, 150.1, 150.6, 152.8, 169.2, 169.3, 169.7, 170.3; Anal. Calcd. for $C_{28}H_{30}N_4O_9S$: C, 56.18; H, 5.05; N, 9.36; Found: C, 56.04; H, 5.34; N, 9.49.

3-S-(2′,3′,4′,6′-Tetra-*O*-acetyl-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*p*-methylphenyl-4*H*-1,2,4-triazole (5h)

Yield: 73.7%; Mp: 177-179 °C; $[\alpha]_D^{20}$ +1 (*c* 1, CH_2Cl_2); ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.99-2.02 (m, 12H), 2.46 (s, 3H), 3.81-3.84 (m, 1H), 4.10 (dd, *J* = 12.3 & 1.8 Hz, 1H), 4.25 (dd, *J* = 12.3 & 4.5 Hz, 1H), 5.07-5.14 (m, 2H), 5.27 (t, *J* = 9.3 Hz, 1H), 5.62 (d, *J* = 10.2 Hz, 1H), 7.09 (d, *J* = 8.1 Hz, 2H), 7.29-7.32 (m, 4H), 8.54 (d, *J* = 6.3 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 20.5, 21.3, 61.5, 67.8, 69.8, 73.7, 76.2, 83.8, 121.4, 127.0, 130.5, 130.9, 133.8, 141.1, 150.2, 150.8, 153.0, 169.5, 169.9, 170.5; Anal. Calcd. for $C_{28}H_{30}N_4O_9S$: C, 56.18; H, 5.05; N, 9.36; Found: C, 55.99; H, 4.79; N, 9.48.

3-S-(2′,3′,4′,6′-Tetra-*O*-acetyl-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*o*-bromophenyl-4*H*-1,2,4-triazole (5i)

Yield: 64.4%; Mp: 84-86 °C; $[\alpha]_D^{20}$ -5 (*c* 1, CH_2Cl_2); ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.99-2.04 (m, 12H), 3.78-3.82 (m, 1H), 4.03-4.13 (m, 1H), 4.22-4.27 (m, 1H), 5.03-5.17 (m, 2H), 5.27 (t, *J* = 9.3 Hz, 1H), 5.58 (d, *J* = 9.9 Hz, 1H), 7.29-7.39 (m, 3H), 7.46-7.52 (m, 2H), 7.75-7.78 (m, 1H), 8.56 (d, *J* = 6 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 20.4, 61.4, 67.7, 69.9, 73.5, 76.1, 84.4, 120.8, 122.4, 129.1, 129.6, 130.0, 132.4, 132.7, 133.7, 134.1, 134.3, 150.2, 169.3, 169.4, 169.8, 170.3; Anal. Calcd. for $C_{27}H_{27}BrN_4O_9S$: C, 48.88; H, 4.10; N, 8.44; Found: C, 49.10; H, 4.28; N, 8.64.

3-S-(2′,3′,4′,6′-Tetra-*O*-acetyl-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*m*-bromophenyl-4*H*-1,2,4-triazole (5j)

Yield: 47.8%; Mp: 94-96 °C; $[\alpha]_D^{20}$ +3 (*c* 1, CH_2Cl_2); ^{1}H NMR (300 MHz, $CDCl_3$) δ 2.00-2.05 (m, 12H), 3.77-3.82 (m, 1H), 4.08-4.13 (m, 1H), 4.24 (dd, *J* = 12.9 & 4.8 Hz, 1H), 5.07-5.16 (m, 2H), 5.28 (t, *J* = 9.3 Hz, 1H), 5.54 (d, *J* = 10.5 Hz, 1H), 7.16-7.18 (m, 1H), 7.30 (d, *J* = 4.5 Hz, 2H), 7.39-7.44 (m, 2H), 7.71-7.74 (m, 1H), 8.59 (d, *J* = 4.5 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 20.8, 20.9, 61.7, 67.9, 70.0, 73.8, 76.5, 84.4, 121.7, 123.8, 126.5, 130.8, 131.7, 133.7, 134.2, 134.6, 150.6, 153.2, 169.6, 169.8, 170.2, 170.7; Anal. Calcd. for $C_{27}H_{27}BrN_4O_9S$: C, 48.88; H, 4.10; N, 8.44; Found: C, 48.61; H, 4.09; N, 8.33.

3-S-(2′,3′,4′,6′-Tetra-*O*-acetyl-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*p*-bromophenyl-4*H*-1,2,4-triazole (5k)

Yield: 53%; Mp: 190-192 °C; $[\alpha]_D^{20}$ +1 (*c* 1, CH_2Cl_2); ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.95-1.99 (m, 12H), 3.74-3.80 (m, 1H), 4.06 (dd, *J* = 12.3 & 1.8 Hz, 1H), 4.18 (dd, *J* = 12.3 & 4.5 Hz, 1H), 5.01-5.10 (m, 2H), 5.23 (t, *J* = 9.0 Hz, 1H), 5.51 (d, *J* = 10.5 Hz, 1H), 7.08 (d, *J* = 9.0 Hz, 2H), 7.25 (d, *J* = 5.1 Hz, 2H), 7.62 (d, *J* = 9.0 Hz, 2H), 8.53 (d, *J* = 5.1 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 20.4, 20.5, 61.3, 67.6, 69.7, 73.4, 76.1, 83.9, 121.4, 124.9, 128.8, 132.0, 133.4, 150.2, 152.8, 169.3, 169.4, 169.8, 170.3; Anal. Calcd. for $C_{27}H_{27}BrN_4O_9S$: C, 48.88; H, 4.10; N, 8.44; Found: C, 49.10; H, 4.28; N, 8.64.

3-S-(2′,3′,4′,6′-Tetra-*O*-acetyl-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*o*-chlorophenyl-4*H*-1,2,4-triazole (5l)

Yield: 60.3%; Mp: 92-94 °C; $[\alpha]_D^{20}$ -6 (*c* 1, CH_2Cl_2); ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.95-2.00 (m, 12H), 3.75-3.80 (m, 1H), 3.99-4.09 (m, 1H), 4.17-4.22 (m, 1H), 4.99-5.12 (m, 2H), 5.24 (t, *J* = 9.0 Hz, 1H), 5.49-5.55 (m, 1H), 7.25-7.37 (m, 3H), 7.43-7.47 (m, 1H), 7.51-7.57 (m, 2H), 8.52 (d, *J* = 6.0 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 20.4, 20.5, 30.8, 61.4, 67.6, 69.8, 73.5, 76.1, 84.0, 120.8, 128.5, 129.5, 129.9, 131.0, 131.2, 132.3, 133.7, 150.2, 150.6, 153.0, 169.4, 169.8, 169.9, 170.4; Anal. Calcd. for $C_{27}H_{27}ClN_4O_9S$: C, 52.39; H, 4.40; N, 9.05; Found: C, 52.41; H, 4.15; N, 9.19.

3-S-(2′,3′,4′,6′-Tetra-*O*-acetyl-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*m*-chlorophenyl-4*H*-1,2,4-triazole (5m)

Yield: 57%; Mp: 161-162 °C; $[\alpha]_D^{20}$ +1 (*c* 1, CH_2Cl_2); ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.98-2.03 (m, 12H), 3.75-3.80 (m, 1H), 4.09 (dd, *J* = 12.3 & 1.8 Hz, 1H), 4.22 (dd, *J* = 12.3 & 4.5 Hz, 1H), 5.04-5.14 (m, 2H), 5.26 (t, *J* = 9.0 Hz, 1H), 5.52 (d, *J* = 9.9 Hz, 1H), 7.11 (d, *J* = 7.2 Hz, 1H), 7.26-7.29 (m, 3H), 7.43-7.48 (m, 1H), 7.54-7.57 (m, 1H), 8.57 (d, *J* = 6.0 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 20.4, 30.8, 61.4, 67.7, 69.8, 73.5, 76.3, 84.2, 121.4, 125.7, 127.7, 131.0, 131.1, 133.4, 134.3, 135.9, 150.3, 169.3, 169.4, 169.8, 170.3; Anal. Calcd. for $C_{27}H_{27}ClN_4O_9S$: C, 52.39; H, 4.40; N, 9.05; Found: C, 52.64; H, 4.38; N, 9.32.

3-S-(2′,3′,4′,6′-Tetra-*O*-acetyl-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*p*-chlorophenyl-4*H*-1,2,4-triazole (5n)

Yield: 51%; Mp: 174-175 °C; $[\alpha]_D^{20}$ +1 (*c* 1, CH_2Cl_2); ^{1}H NMR (300 MHz, $CDCl_3$) δ 2.00-2.03 (m, 12H), 3.77-3.83 (m, 1H), 4.08-4.12 (m, 1H), 4.23 (dd, *J* = 12.3 & 4.8 Hz, 1H), 5.07-5.15 (m, 2H), 5.28 (t, *J* = 9.0 Hz, 1H), 5.57 (d, *J* = 10.2 Hz, 1H), 7.18 (d, *J* = 8.7 Hz, 2H), 7.28-7.29 (m, 2H), 7.51 (d, *J* = 8.7 Hz, 2H), 8.58-8.59 (m, 2H); ^{13}C NMR

(75 MHz, $CDCl_3$) δ 20.7, 20.9, 61.7, 68.0, 70.1, 73.8, 76.5, 84.3, 121.7, 129.0, 130.8, 131.9, 133.7, 137.1, 150.6, 153.2, 169.6, 169.7, 170.1, 170.6; Anal. Calcd. for $C_{27}H_{27}ClN_4O_9S$: C, 52.39; H, 4.40; N, 9.05; Found: C, 52.49; H, 4.12; N, 9.31.

General Procedure for Preparation of Deacetylated S-Nucleosides Derivatives of 1,2,4-Triazoles (6a-n)

The compound (**5a-n**) (0.2 g) was dissolved in dry methanol and a stream of dry ammonia gas was passed through the stirred solution for 1-2 hrs. The solution was concentrated and the crude product was purified by column chromatography.

3-S-(2′,3′,4′,6′-Tetrahydroxy-β-D-glucopyranosyl)-5-(4-pyridyl)-4-phenyl-4*H*-1,2,4-triazole (6a)

Yield: 95.2%; Mp: 134-136 °C; $[\alpha]_D^{20}$ -49 (*c* 1, CH_3OH); ^1H NMR (300 MHz, D_2O) δ 3.25-3.34 (m, 3H), 3.40-3.45 (m, 1H), 3.54-3.59 (m, 1H), 3.70-3.73 (m, 1H), 4.83 (d, *J* = 9.3 Hz, 1H), 7.13-7.20 (m, 4H), 7.37-7.49 (m, 3H), 8.26 (d, *J* = 6.3 Hz, 2H); ^{13}C NMR (75 MHz, D_2O) δ 60.6, 69.0, 72.1, 77.1, 80.4, 86.1, 122.6, 127.7, 130.2, 131.0, 132.6, 133.8, 149.3, 151.0, 153.5; Anal. Calcd. for $C_{19}H_{20}N_4O_5S$: C, 54.80; H, 4.84; N, 13.45; Found: C, 54.64; H, 4.72; N, 13.25.

3-S-(2′,3′,4′,6′-Tetrahydroxy-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*o*-ethoxyphenyl-4*H*-1,2,4-triazole (6b)

Yield: 93.5%; Mp: 120-122 °C; $[\alpha]_D^{20}$ -53 (*c* 1, CH_3OH); ^1H NMR (300 MHz, D_2O) δ 0.81 (t, *J* = 7.2 Hz, 3H), 3.23-3.34 (m, 4H), 3.37-3.64 (m, 2H), 3.70-3.82 (m, 2H), 4.89 (d, *J* = 9.9 Hz, 1H), 6.96-7.04 (m, 2H), 7.21 (d, *J* = 5.7 Hz, 2H), 7.27-7.30 (m, 1H), 7.42 (t, *J* = 7.8 Hz, 1H), 8.32 (d, *J* = 5.7 Hz, 2H); ^{13}C NMR (75 MHz, D_2O) δ 13.7, 60.7, 64.7, 69.1, 72.0, 77.2, 80.4, 86.2, 114.0, 121.2, 121.9, 129.0, 132.8, 134.4, 149.4, 151.4, 153.0, 153.1, 154.0; Anal. Calcd. for $C_{21}H_{24}N_4O_6S$: C, 54.77; H, 5.25; N, 12.17; Found: C, 54.86; H, 5.07; N, 12.35.

3-S-(2′,3′,4′,6′-Tetrahydroxy-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*p*-ethoxyphenyl-4*H*-1,2,4-triazole (6c)

Yield: 92%; Mp: 123-125 °C; $[\alpha]_D^{20}$ -45 (*c* 1, CH_3OH); ^1H NMR (300 MHz, D_2O) δ 1.17 (t, *J* = 6.9 Hz, 3H), 3.30-3.38 (m, 3H), 3.44-3.51 (m, 1H), 3.57-3.63 (m, 1H), 3.73-3.77 (m, 1H), 3.84-3.91 (m, 2H), 4.92 (d, *J* = 9.9 Hz, 1H), 6.84 (d, *J* = 8.7 Hz, 2H), 7.10 (d, *J* = 8.7 Hz, 2H), 7.20 (d, *J* = 5.4 Hz, 2H), 8.27 (d, *J* = 5.4 Hz, 2H); ^{13}C NMR (75 MHz, D_2O) δ 14.1, 60.8, 64.6, 69.1, 72.2, 77.2, 80.5, 86.0, 115.8, 122.6, 125.2, 129.1, 134.1, 149.3, 151.7, 153.4, 159.9; Anal. Calcd. for $C_{21}H_{24}N_4O_6S$: C, 54.77; H, 5.25; N, 12.17; Found: C, 54.63; H, 5.47; N, 12.08.

3-S-(2′,3′,4′,6′-Tetrahydroxy-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*o*-methoxyphenyl-4*H*-1,2,4-triazole (6d)

Yield: 90%; Mp: 127-129 °C; $[\alpha]_D^{20}$ -51 (*c* 1, CH_3OH); ^1H NMR (300 MHz, D_2O) δ 3.24-3.48 (m, 7H), 3.57-3.63 (m, 1H), 3.70-3.76 (m, 1H), 4.83-4.90 (m, 1H), 6.96-7.04 (m, 2H), 7.16-7.25 (m, 3H), 7.42-7.47 (m, 1H), 8.30 (d, *J* = 5.7 Hz, 2H); ^{13}C NMR (75 MHz, D_2O) δ 55.8, 60.7, 69.0, 72.0, 77.1, 80.4, 86.2, 113.3, 121.0, 121.6, 121.8, 128.9, 132.9, 134.2, 149.4, 151.5, 153.9; Anal. Calcd. for $C_{20}H_{22}N_4O_6S$: C, 53.80; H, 4.97; N, 12.55; Found: C, 53.56; H, 5.13; N, 12.66.

3-S-(2′,3′,4′,6′-Tetrahydroxy-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*p*-methoxyphenyl-4*H*-1,2,4-triazole (6e)

Yield: 91.5%; Mp: 138-140 °C; $[\alpha]_D^{20}$ -49 (*c* 1, CH_3OH); ^1H NMR (300 MHz, D_2O) δ 3.27-3.35 (m, 3H), 3.42-3.45 (m, 1H), 3.56-3.61 (m, 1H), 3.67 (s, 3H), 3.74 (d, *J* = 11.7 Hz, 1H), 4.86 (d, *J* = 9.0 Hz, 1H), 6.88 (d, *J* = 8.7 Hz, 2H), 7.11 (d, *J* = 8.7 Hz, 2H), 7.17 (d, *J* = 5.7 Hz, 2H), 8.27 (d, *J* = 5.7 Hz, 2H); ^{13}C NMR (75 MHz, D_2O) δ 55.7, 60.7, 69.1, 72.1, 77.1, 80.4, 86.0, 115.3, 122.5, 125.3, 129.0, 133.9, 149.3, 151.5, 153.6, 160.6; Anal. Calcd. for $C_{20}H_{22}N_4O_6S$: C, 53.80; H, 4.97; N, 12.55; Found: C, 53.47; H, 5.15; N, 12.36.

3-S-(2′,3′,4′,6′-Tetrahydroxy-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*o*-methylphenyl-4*H*-1,2,4-triazole (6f)

Yield: 89%; Mp: 124-126 °C; $[\alpha]_D^{20}$ -48 (*c* 1, CH_3OH); ^1H NMR (300 MHz, D_2O) δ 1.70 (s, 3H), 3.29-3.37 (m, 4H), 3.60-3.66 (m, 1H), 3.76 (t, *J* = 12.3 Hz, 1H), 4.95-4.99 (m, 1H), 7.20 (d, *J* = 6.0 Hz, 2H), 7.23-7.33 (m, 3H), 7.41 (t, *J* = 7.5 Hz, 1H), 8.30 (d, *J* = 6.0 Hz, 2H); ^{13}C NMR (75 MHz, D_2O) δ 16.6, 60.7, 69.1, 72.1, 77.1, 80.4, 86.0, 121.8, 127.9, 128.3, 131.6, 132.0, 133.8, 135.7, 149.6, 151.6, 151.7, 153.3; Anal. Calcd. for $C_{20}H_{22}N_4O_5S$: C, 55.80; H, 5.15; N, 13.02; Found: C, 55.63; H, 5.43; N, 13.25.

3-S-(2′,3′,4′,6′-Tetrahydroxy-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*m*-methylphenyl-4*H*-1,2,4-triazole (6g)

Yield: 98%; Mp: 158-160 °C; $[\alpha]_D^{20}$ -47 (*c* 1, CH_3OH); ^1H NMR (300 MHz, D_2O) δ 2.11 (s, 3H), 3.25-3.35 (m, 3H), 3.41-3.47 (m, 1H), 3.55-3.60 (m, 1H), 3.72 (d, *J* = 11.7 Hz, 1H), 4.87 (d, *J* = 9.9 Hz, 1H), 6.93 (m, 2H), 7.13 (d, *J* = 4.8 Hz, 2H), 7.23 (d, *J* = 4.8 Hz, 2H), 8.22-8.23 (m, 2H); ^{13}C NMR (75 MHz, D_2O) δ 20.4, 60.7, 69.0, 72.1, 77.1, 80.4, 86.0, 122.5, 124.6, 127.9, 130.0, 131.6, 132.5, 133.9, 141.0, 149.3, 151.2, 153.3; Anal. Calcd. for $C_{20}H_{22}N_4O_5S$: C, 55.80; H, 5.15; N, 13.02; Found: C,

55.94; H, 5.36; N, 12.98.

3-S-(2′,3′,4′,6′-Tetrahydroxy-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*p*-methylphenyl-4*H*-1,2,4-triazole (6h)

Yield: 91%; Mp: 136-138 °C; $[\alpha]_D^{20}$ -54 (*c* 1, CH_3OH); ^1H NMR (300 MHz, D_2O) δ 2.27 (s, 3H), 3.29-3.36 (m, 3H), 3.42-3.45 (m, 1H), 3.58-3.63 (m, 1H), 3.75 (d, *J* = 12.3 Hz, 1H), 4.85 (d, *J* = 9.9 Hz, 1H), 7.09 (d, *J* = 8.4 Hz, 2H), 7.20-7.25 (m, 4H), 8.31 (d, *J* = 5.1 Hz, 2H); ^{13}C NMR (75 MHz, D_2O) δ 20.5, 60.6, 69.0, 72.1, 77.1, 80.4, 86.0, 122.6, 127.4, 130.0, 130.7, 134.0, 141.8, 149.3, 151.2, 153.6; Anal. Calcd. for $C_{20}H_{22}N_4O_5S$: C, 55.80; H, 5.15; N, 13.02; Found: C, 56.04; H, 5.36; N, 13.28.

3-S-(2′,3′,4′,6′-Tetrahydroxy-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*o*-bromophenyl-4*H*-1,2,4-triazole (6i)

Yield: 92%; Mp: 138-140 °C; $[\alpha]_D^{20}$ -63 (*c* 1, CH_3OH); ^1H NMR (300 MHz, D_2O) δ 3.26-3.44 (m, 4H), 3.57-3.62 (m, 1H), 3.69-3.76 (m, 1H), 7.17-7.19 (m, 2H), 7.35-7.41 (m, 1H), 7.46-7.55 (m, 3H), 8.27-8.30 (m, 2H); ^{13}C NMR (75 MHz, D_2O) δ 60.9, 68.9, 72.2, 77.2, 80.4, 86.6, 121.8, 122.1, 129.7, 130.5, 131.8, 133.1, 133.7, 133.9, 149.6, 151.0, 153.6; Anal. Calcd. for $C_{19}H_{19}BrN_4O_5S$: C, 46.07; H, 3.87; N, 11.31; Found: C, 45.89; H, 3.69; N, 11.45.

3-S-(2′,3′,4′,6′-Tetrahydroxy-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*m*-bromophenyl-4*H*-1,2,4-triazole (6j)

Yield: 95.7%; Mp: 142-144 °C; $[\alpha]_D^{20}$ -32 (*c* 1, CH_3OH); ^1H NMR (300 MHz, D_2O) δ 3.29-3.39 (m, 3H), 3.41-3.47 (m, 1H), 3.57-3.63 (m, 1H), 3.76 (d, *J* = 12.3 Hz, 1H), 4.83-4.86 (m, 1H), 7.26 (d, *J* = 6.3 Hz, 2H), 7.29-7.39 (m, 2H), 7.50 (s, 1H), 7.64 (d, *J* = 7.8 Hz, 1H), 8.36 (d, *J* = 6.3 Hz, 2H); ^{13}C NMR (75 MHz, D_2O) δ 60.7, 69.1, 72.1, 77.1, 80.4, 86.5, 122.8, 127.0, 130.7, 131.7, 133.8, 134.1, 149.4, 150.7, 153.7; Anal. Calcd. for $C_{19}H_{19}BrN_4O_5S$: C, 46.07; H, 3.87; N, 11.31; Found: C, 46.23; H, 3.65; N, 11.59.

3-S-(2′,3′,4′,6′-Tetrahydroxy-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*p*-bromophenyl-4*H*-1,2,4-triazole (6k)

Yield: 98%; Mp: 152-154 °C; $[\alpha]_D^{20}$ -42 (*c* 1, CH_3OH); ^1H NMR (300 MHz, D_2O) δ 3.29-3.35 (m, 3H), 3.40-3.47 (m, 1H), 3.57-3.64 (m, 1H), 3.76 (d, *J* = 12.3 Hz, 1H), 7.24 (d, *J* = 8.1 Hz, 2H), 7.30 (d, *J* = 6.0 Hz, 2H), 7.64 (d, *J* = 8.1 Hz, 2H), 8.41 (d, *J* = 6.0 Hz, 2H); ^{13}C NMR (75 MHz, D_2O) δ 60.6, 69.1, 72.1, 77.1, 80.4, 86.4, 122.9, 124.7, 129.6, 131.8, 133.3, 133.9, 149.4, 150.7, 153.9; Anal. Calcd. for $C_{19}H_{19}BrN_4O_5S$: C, 46.07; H, 3.87; N, 11.31; Found: C, 45.89; H, 4.06; N, 11.56.

3-S-(2′,3′,4′,6′-Tetrahydroxy-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*o*-chlorophenyl-4*H*-1,2,4-triazole (6l)

Yield: 90%; Mp: 140-142 °C; $[\alpha]_D^{20}$ -79 (*c* 1, CH_3OH); ^1H NMR (300 MHz, D_2O) δ 3.21-3.37 (m, 3H), 3.39-3.48 (m, 1H), 3.52-3.61 (m, 1H), 3.67-3.75 (m, 1H), 7.13-7.16 (m, 2H), 7.33-7.38 (m, 1H), 7.41-7.51 (m, 3H), 8.25-8.27 (m, 2H); ^{13}C NMR (75 MHz, D_2O) δ 60.5, 68.9, 72.1, 77.1, 80.4, 86.6, 121.9, 129.1, 130.2, 130.8, 131.4, 133.0, 133.7, 149.5, 151.0, 153.7; Anal. Calcd. for $C_{19}H_{19}ClN_4O_5S$: C, 50.61; H, 4.25; N, 12.43; Found: C, 50.35; H, 4.53; N, 12.14.

3-S-(2′,3′,4′,6′-Tetrahydroxy-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*m*-chlorophenyl-4*H*-1,2,4-triazole (6m)

Yield: 91.2%; Mp: 132-134 °C; $[\alpha]_D^{20}$ -47 (*c* 1, CH_3OH); ^1H NMR (300 MHz, D_2O) δ 3.30-3.34 (m, 3H), 3.41-3.47 (m, 1H), 3.55-3.61 (m, 1H), 3.74 (d, *J* = 11.1 Hz, 1H), 4.83 (d, *J* = 10.2 Hz, 1H), 7.17-7.27 (m, 4H), 7.38-7.40 (m, 2H), 8.29 (d, *J* = 6.0 Hz, 2H); ^{13}C NMR (75 MHz, D_2O) δ 60.7, 69.1, 72.1, 77.1, 80.4, 86.4, 122.7, 126.6, 127.8, 131.1, 131.5, 133.7, 135.0, 149.4, 150.8, 153.5; Anal. Calcd. for $C_{19}H_{19}ClN_4O_5S$: C, 50.61; H, 4.25; N, 12.43; Found: C, 50.29; H, 4.16; N, 12.38.

3-S-(2′,3′,4′,6′-Tetrahydroxy-β-D-glucopyranosyl)-5-(4-pyridyl)-4-*p*-chlorophenyl-4*H*-1,2,4-triazole (6n)

Yield: 92.2%; Mp: 140-142 °C; $[\alpha]_D^{20}$ -43 (*c* 1, CH_3OH); ^1H NMR (300 MHz, D_2O) δ 3.28-3.36 (m, 3H), 3.41-3.43 (m, 1H), 3.56-3.62 (m, 1H), 3.75 (d, *J* = 12.3 Hz, 1H), 7.27-7.31 (m, 4H), 7.46-7.49 (m, 2H), 8.39-8.41 (m, 2H); ^{13}C NMR (75 MHz, D_2O) δ 60.6, 69.0, 72.1, 77.1, 80.4, 86.4, 122.9, 129.3, 130.3, 131.3, 133.9, 136.5, 149.4, 150.7, 153.9; Anal. Calcd. for $C_{19}H_{19}ClN_4O_5S$: C, 50.61; H, 4.25; N, 12.43; Found: C, 50.47; H, 4.47; N, 12.69.

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