Chem. Pharm. Bull.
29(7)1838—1842(1981)

Studies on Nucleoside Analogs. XX. Syntheses of 1,2,4-Triazole and 1,3,5-Triazine Glycosides[1)]

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(Received December 15, 1980)

The reaction of glycosyl isothiocyanate (**1a**) with thiourea in the presence of MeI–NEt_3 gave a di-SMe compound (**2a**) and a mono-SMe compound (**3a**). Glycosyl isothiocyanates (**1a**, **b**, and **c**) reacted with amidino compounds ($HN=CRNH_2$; R=H, Me, OMe, SMe, NH_2) to afforded the corresponding glycosyl isothiobiurets (**3a**, **c**, and **6a**, **b**), *N*-glycosyl-*N'*-amidino thioureides (**4a**, **b**, and **5a**, **b**) or *N*-glycosyl-*N'*-guanidyl thioureides (**7a** and **b**) in good yields. Treatment of **3a**, **6b**, or **7a**, **b** with $HC(OEt)_3$ gave the corresponding *s*-triazine glycosides (**8a**, **9a**, **b**, and **10b**) in fair yields. On the other hand, similar treatment of **4a**, **b** or **5a**, **b** with $HC(OEt)_3$ did not give *s*-triazine glycosides, but the starting material was recovered. N-Bromosuccinimide oxidation of **4a**, **b**, **5a**, **b**, **3a**, **c** or **7a**, **b** gave the corresponding 5-substituted-1,2,4-triazole-3-thiones (**11a**, **b**, **12a**, **b**, or **14a**, **b**) in excellent yields.

Keywords——glycosyl isothiocyanate; glycosyl isothiobiuret; *N*-glycosyl-*N'*-amidino thioureide; *N*-glycosyl-*N'*-guanidyl thioureide; *s*-triazine glycoside; 1,2,4-triazole-3-thione glycoside; NBS oxidation

5-Azacytidine, which is biologically important,[2)] was first prepared by Piskala and Šorm.[3)] Niedball and Vorbrüggen[4)] reported that the reaction of silylated 5-azacytosine or 5-azathiocytosine with sugar derivatives afforded 5-azacytidine or 5-azathiocytidine along with a by-product. Previously, we reported a convenient method for synthesizing of nucleoside analogs. For example, glycosyl isothiocyanates react with nitrogen nucleophiles to give the corresponding nucleoside analogs, and also react with carbon nucleophiles, such as enamines, to afford glycosylaminoisothiazoles, glycosylaminoisothiazolo[3,4-*d*]pyrimidines, and glycosylaminopyrazolo[3,4-*d*]pyrimidines.[5)]

In this paper, we describe a general synthetic method for *s*-triazine and 1,2,4-triazole glycosides using glycosyl isothiocyanates, *e.g.*, 2,3,4,6-tetra-*O*-acetyl-*β*-D-glucopyranosyl isothiocyanate (**1a**), 2,3,4-tri-*O*-acetyl-*α*-D-arabinopyranosyl isothiocyanate (**1b**) and 2,3,5-tri-*O*-benzoyl-*β*-D-ribofuranosyl isothiocyanate (**1c**).

The reaction of **1a** with thiourea in the presence of an excess of methyl iodide–triethylamine, followed by chromatography gave a di-SMe compound (**2a**) and a mono-SMe compound (**3a**) in 2:1 ratio. The nuclear magnetic resonance (NMR) spectrum of **2a** showed singlets at δ 2.55 and 2.58 due to the SMe protons. The NMR spectrum of **3a** showed a singlet at δ 2.36 due to the SMe protons and a doublet at δ 7.08 which was assigned to the 1'-NH. In this reaction, the yield of **3a**, a key intermediate, is low.

Treatment of glycosyl isothiocyanates (**1a** and **b**) with formamidine or acetoamidine in acetonitrile (MeCN) solution gave *N*-glycosyl-*N'*-formamidino (**4a** and **b**) and *N*-glycosyl-*N'*-acetoamidinothiocarboxamides (**5a** and **b**) in good yields. The structures of **4a**, **b**, and **5a**, **b** were suggested by their spectral data and the results of elemental analyses. Similarly, **1a**, **b**, and **c** reacted with *S*-methyl isourea or *O*-methyl isourea to give 1-glycosyl-4-*S*-methylisothiobiurets (**3a** and **c**) and 1-glycosyl-4-*O*-methylisothiobiurets (**6a** and **b**) after chromatography in fair yields. The reaction of **1a**, **b**, and **c** with guanidine carbonate in the presence of NEt_3 under stirring at room temperature afforded 1-glycosyl-2-guanidylthiocarboxamides (**7a** and **b**). The spectral data and the results of elemental analyses of these products were in good agreement with the structures shown.

Treatment of **3a** with ethyl orthoformate under reflux afforded *s*-triazine glucopyranoside (**8a**). Similarly, glycosyl isothiobiuret (**6a**) or glycosyl-2-guanidylthiocarboxamides (**7a** and **b**) reacted with HC(OEt)$_3$ to afford the corresponding *s*-triazine glycosides (**8a** and **10a**) and 5-azathiocytosine glycosides (**9a** and **b**) in fair yields (Table I). The NMR spectra of **9a** and **b** exhibited a one-proton signal due C(6)-H at δ 8.72—8.40 and showed a pattern similar to

TABLE I. 1-Glycosyl-4-substituted *s*-Triazine-2-thiones (**8a**, **9a**, **b**, **10a**) and 2-Glycosyl-5-substituted 1,2,4-Triazole-3-thiones (**11a**, **b**, **12a**, **b**, **13a**, **c**, **14a**, **b**)

Compd. No.	R′	Yield (%)	mp (°C) or *Rf*	IR ν_{max}^{KBr} cm^{-1}	NMR (DMSO-d_6)	Mass (*m*/*z*) or $[\alpha]_D^{19}$ (c=1.0, CHCl$_3$)	Formula	Analysis (%) Calcd (Found)		
								C	H	N
8a	SMe	84	Syrup[a] 0.52	3450, 3300, 1740, 1220, 1040	2.60 (3H, s, SMe) 8.14 (1H, s, 6-H)	457(M$^+$)	$C_{18}H_{23}N_3O_9S$	47.26 (47.34	5.07 5.11	9.19 9.87)
9a	NH$_2$	87	227 (dec)	3450, 3400, 3200, 1740, 1640, 1600, 1460, 1380, 1220	8.40 (2H, bs, NH$_2$) 8.72 (1H, s, 6-H)	458(M$^+$)	$C_{17}H_{22}N_4O_9S$	44.54 (44.58	4.84 4.80	12.22 12.32)
9b	NH$_2$	92	214—217	3200, 2950, 1740, 1600, 1560, 1380, 1220, 1080	8.20 (2H, bs, NH$_2$) 8.40 (1H, s, 6-H)	386(M$^+$)	$C_{14}H_{18}N_4O_7S$	43.52 (43.47	4.70 4.69	14.50 14.45)
10a	OMe	80	0.60[b]	2950, 1740, 1620, 1380, 1240, 1050	4.06 (3H, s, OMe) 8.32 (1H, s, 6-H)	473(M$^+$)	$C_{18}H_{23}N_3O_{10}S$	45.66 (45.72	4.90 4.86	8.88 8.92)
11a	H	87	0.43[a]	3350, 1740, 1550, 1440, 1370, 1210, 1030	8.02 (1H, s, 3-H) 7.55 (1H, bs, NH)	431(M$^+$) −5°	$C_{16}H_{21}N_3O_9S$	44.55 (44.48	4.91 4.96	9.74 9.65)
11b	H	92	Syrup[a] 0.50	3350, 1740, 1550, 1440, 1220, 1100	7.82 (1H, s, 3-H) 7.28 (1H, bs, NH)	359(M$^+$) −20°	$C_{13}H_{17}N_3O_7S$	43.45 (43.40	4.77 4.82	11.69 11.70)
12a	Me	90	158—162	3250, 1740, 1550, 1420, 1370, 1320, 1220, 1030	2.42 (3H, s, Me) 5.82 (1H, bs, NH)	445(M$^+$) −15°	$C_{17}H_{23}N_3O_9S$	45.84 (45.90	5.20 5.31	9.43 9.39)
12b	Me	95	153—156	3350, 2900, 1740, 1520, 1420, 1360, 1250, 1140, 1110	2.25 (3H, s, Me) 7.50 (1H, bs, NH)	−23°				
13a	SMe	97	Syrup[a] 0.47	3350, 1740, 1550, 1220, 1030,	2.58 (3H, s, SMe) 7.98 (1H, bs, NH)	477(M$^+$)	$C_{17}H_{23}N_3O_9S_2$	42.76 (42.75	4.86 4.82	8.80 8.85)
13c	SMe	93	Syrup[b] 0.80	3200, 1720, 1605, 1550, 1240, 750	2.40 (3H, s, SMe)	445 (sugar)	$C_{29}H_{25}N_3O_7S_2$	58.87 (58.83	4.26 4.30	7.10 7.13)
14a	NH$_2$	94	Syrup[b] 0.75	3500, 3350, 3250, 1740, 1620, 1380, 1220, 1050	8.70 (2H, bs, NH$_2$)	446(M$^+$) −22°	$C_{16}H_{22}N_4O_9S$	43.05 (43.12	4.97 4.95	12.55 12.49)
14b	NH$_2$	87	Syrup[b] 0.65	3500, 3400, 3250, 1740, 1620, 1380, 1240, 1060	8.75 (2H, bs, NH$_2$)	374(M$^+$) −54°	$C_{13}H_{18}N_4O_7S$	41.71 (41.68	4.85 4.89	14.97 14.92)

a) TLC (silica gel) benzene–acetone (4: 1).
b) TLC (silica gel) benzene–acetone (3: 2).

that of **10a**. A similar reaction of *N*-glycosyl-*N'*-amidinothiocarboxamides (**4a** and **b**; **5a** and **b**) did not proceed, and the starting material (**1a** or **b**) was recovered because of the thermal dissociation.[6]

The reaction of **7a** with carbonyldiimidazole[7] in dry xylene or benzene under reflux did not proceed and the starting material was recovered. Treatment of **7a** with CS_2–pyridine[8] under heating or at room temperature did not yield any products. The reaction solution became brownish and gradually decomposed, and the desired product could not be isolated.

9a was treated with methanolic ammonia under cooling according to the reported method.[9] The resulting product, without purification, was acetylated with Ac_2O–pyridine to give an unknown product as crystals in 95% yield instead of the free *s*-triazine glycoside.

Previously, we reported a synthetic method for polyhydroxyalkyl theophylline[10] and glycosylamino[4,5-*e*]-1,3,4-thiadiazine[11] by the *N*-bromosuccinimide (NBS) oxaidation of Schiff bases and glycosylhydrazinethiocarboxamides. We found that the oxidative agent, NBS, was useful for this cyclization reaction. Treatment of **3a**, **4a**, **b**, and **5a**, **b** with NBS gave the corresponding 1,2,4-triazole-2-thione glycosides (**11a**, **b**, **12a**, **b**, and **13a**, **c**) in good yields. Similarly, **7a** or **b** was easily oxidized to give amino-1,2,4-triazole-2-thione glycoside (**14a** or **b**) in fair yield (Table I).

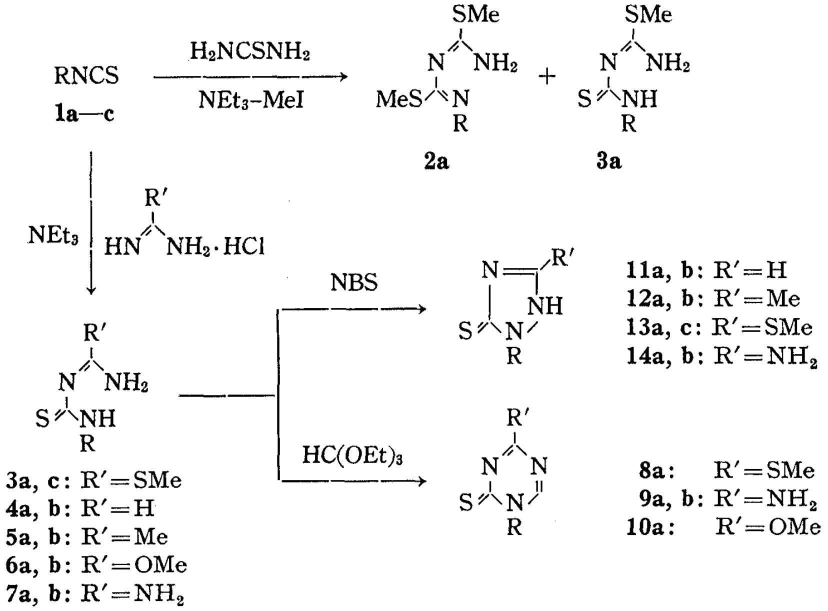

Chart 1

Experimental

All melting points are uncorrected. Infrared (IR) spectra were measured with a JASCO A-2 spectrometer and NMR spectra on a Varian T-60 spectrometer. Tetramethylsilane was used as an internal reference. Mass spectra (MS) were determined with a JMS-D-100 spectrometer using a direct inlet system at 75 eV. Optical rotations were measured in EtOH or $CHCl_3$ in a 50 mm cell with a JASCO DIP-181 automatic poralimeter.

1-(2,3,4,6-Tetra-O-acetyl-β-D-glucopyranosyl)-2,4-di-S-methylisothiobiuret (2a) and 1-(2,3,4,6-Tetra-O-acetyl-β-D-glucopyranosyl)-4-methylisothiobiuret (3a)——MeI (2 ml) was added dropwise to a mixture of 2,3,4,6-tetra-*O*-acetyl-*β*-D-glucopyranosyl isothiocyanate (**1a**) (389 mg, 0.001 mol), thiourea (76 mg, 0.001 mol) and dry NEt_3 (2 ml) in tetrahydrofuran (THF) (15 ml). The reaction mixture was refluxed for 3 hr and allowed to stand at room temperature, then the solvent was evaporated off under reduced pressure to give a brownish residue. The residue was chromatographed on silica gel with benzene–acetone. Elution with benzene–acetone (97: 3, v/v) gave 172 mg (35%) of **2a** as a colorless syrup. *Rf* 0.75 [benzene–acetone (3: 2)]. IR $\nu_{\max}^{\text{KBr}}$ cm^{-1}: 3350 (NH), 1740 ($OCOCH_3$), 1220, 1050. NMR ($CDCl_3$) δ: 2.55, 2.58 (6H, s, SMe×2), 6.20 (2H, bs, NH_2). MS (*m/z*): 493 (M^+). *Anal.* Calcd for $C_{18}H_{27}N_3O_9S_2$: C, 43.81; H, 5.51; N, 8.51. Found: C, 43.90; H, 5.47; N, 8.57.

Elution with benzene–acetone (95: 5, v/v) gave 290 mg (60%) of **3a** as colorless needles. Recrystallization from Et_2O–*i*-Pr_2O (2: 1) gave **3a** as colorless fine needles, mp 162—164°C. IR $\nu_{\max}^{\mathrm{KBr}}$ cm^{-1}: 3500 (NH), 3250 (NH), 1740 ($OCOCH_3$), 1220, 1040. NMR ($CDCl_3$) δ: 2.36 (3H, s, SMe), 7.08 (1H, d, 1′-NH), 8.70 (2H, bs, NH_2). MS (*m/z*): 479 (M^+). *Anal.* Calcd for $C_{17}H_{25}N_3O_9S_2$: C, 42.58; H, 5.26; N, 8.76. Found: C, 42.53; H, 5.19; N, 8.70.

1-Glycosyl-4-S-methylisothiobiuret (3a, c), **1-Glycosyl-4-O-methylisothiobiuret (6a, b) and N-Glycosyl-N′-guanidyl Thioureide** (7a, b)——a) A mixture of **1a** or **c** (0.001 mol), S-methylisourea hydrochloride (125 mg, 0.001 mol) and dry NEt_3 (2 ml) in MeCN (10 ml) was stirred for 3 h at room temperature, then the reaction mixture was concentrated under reduced pressure to give a slightly brownish residue. The residue was chromatographed on silica gel. Elution with benzene–acetone (97: 3) gave **2a** or **3c** as crystals. **2a**: Yield: 416 mg (87%).

1-(2,3,5-Tri-*O*-benzoyl-*β*-ᴅ-ribofuranosyl-4-S-methylisothiobiuret (**3c**): Yield: 545 mg (92%), *Rf* 0.45 [benzene–acetone (5: 1)]. IR $\nu_{\max}^{\mathrm{KBr}}$ cm^{-1}: 3300, 3200 (NH), 1720 (OCOPh). UV $\lambda_{\max}^{\mathrm{MeOH}}$ nm (log ε): 229 (4.7), 261 (4.3), 281 (sh) (4.1), 293 (sh) (4.0). NMR ($CDCl_3$) δ: 2.24 (3H, s, SMe), 7.12 (1H, d, $J=8.0$ Hz, 1′-NH). *Anal.* Calcd for $C_{29}H_{27}O_7N_3S_2$: C, 58.67; H, 4.58; N, 7.08. Found: C, 58.73; H, 4.62; N, 7.10.

b) A mixture of **1a** or **b** (0.001 mol), O-methylisourea sulfate (115 mg, 0.0005 mol) and NEt_3 (3 ml) in MeCN (20 ml) was stirred for 24 h at room temperature. The reaction mixture was concentrated under reduced pressure to give a residue. The residue was dissolved in $CHCl_3$ (100 ml) and washed with H_2O, and the organic layer was dried over $MgSO_4$. Removal of the solvent left a slightly brownish residue. The residue was purified by chromatography as described above in a). **6a**: Yield: 412 mg (89%). mp 155—156°C. [Et_2O–benzene (4: 1)]. IR $\nu_{\max}^{\mathrm{KBr}}$ cm^{-1}: 3250 (NH), 1740 ($OCOCH_3$), 1630 (C=N), 1520, 1220, 1030. NMR ($CDCl_3$) δ: 3.70 (3H, s, OMe), 7.20 (1H, d, $J=8.0$ Hz, 1′-NH). MS (*m/z*): 461 (M^+-2H). *Anal.* Calcd for $C_{17}H_{25}O_{10}N_3S$: C, 44.06; H, 5.44; N, 9.07. Found: C, 44.12; H, 5.43; N, 9.10. **6b**: Colorless syrup. Yield: 363 mg (93%). *Rf* 0.47 [benzene–acetone (1: 1)]. IR $\nu_{\max}^{\mathrm{KBr}}$ cm^{-1}: 3250 (NH), 1740 ($OCOCH_3$), 1630 (C=N), 1530, 1210, 1050. NMR ($CDCl_3$) δ: 3.60 (3H, s, OMe), 7.20 (1H, d, $J=8.0$ Hz, 1′-NH). MS (*m/z*): 389 (M^+-2H). *Anal.* Calcd for $C_{14}H_{21}O_8N_3S$: C, 42.96; H, 5.41; N, 10.74. Found: C, 42.90; H, 5.47; N, 10.68.

c) A mixture of **1a** or **b** (0.001 mol), guanidine carbonate (90 mg, 0.0005 mol) and NEt_3 (3 ml) in MeCN (15 ml) was treated as described above in b).

N-(2,3,4,6-tetra-*O*-acetyl-*β*-ᴅ-glucopyranosyl)-*N*′-guanidylthioureide (**7a**): Yield: 425 mg (95%). mp 169—170°C [iso-Pr_2O–benzene (3: 1)]. IR $\nu_{\max}^{\mathrm{KBr}}$ cm^{-1}: 3450, 3400, 3350 (NH_2, NH), 1740 ($OCOCH_3$), 1660, 1620, 1240, 1040. NMR ($CDCl_3$) δ: 7.38 (2H, bs, NH_2), 7.20 (1H, d, $J=8.0$ Hz, 1′-NH). $[\alpha]_{\mathrm{D}}^{25}=+4°$ (*c* 1.0, $CHCl_3$). MS (*m/z*): 446 (M^+-2H). *Anal.* Calcd for $C_{16}H_{24}O_9N_4S$: C, 42.85; H, 5.39; N, 12.49. Found: C, 42.80; H, 5.43; N, 12.53.

N-(2,3,4-tri-*O*-acetyl-*α*-ᴅ-arabinopyranosyl)-*N*′-guanidylthioureide (**7b**): Yield: 349 mg (93%). mp 169°C (dec.) [Et_2O–benzene (3: 1)]. IR $\nu_{\max}^{\mathrm{KBr}}$ cm^{-1}: 3400 (NH_2, NH), 1740 ($OCOCH_3$), 1600, 1510, 1220, 1040. NMR ($CDCl_3$) δ: 7.40 (2H, bs, NH_2), 7.20 (1H, d, $J=8.0$ Hz, 1′-NH). $[\alpha]_{\mathrm{D}}^{25}$ $-89°$ ($c=1.0$, dioxane). MS (*m/z*): 374 (M^+-2H). *Anal.* Calcd for $C_{13}H_{20}N_4O_7S$: C, 41.49; H, 5.36; N, 14.89. Found: C, 4154; H, 5.50; N, 14.79.

N-Glycosyl-N′-formamidinothiocarboxamide (4a, b) **and N-Glycosyl-N′-acetoamidinothiocarboxamide** (5a, **b**)——a) NEt_3 (3 ml) was added dropwise to a stirred solution of **1a** or **b** (0.001 mol) in MeCN (30 ml) at room temperature. After 3—5 h, the reaction solution was concentrated under reduced pressure to give a slightly yellow residue. The residue was dissolved in $CHCl_3$, washed with H_2O and dried over $MgSO_4$. The syrup was chromatographed on silica gel with benzene–acetone (97: 3) to give **4a** or **b** as crystals. Recrystallization from Et_2O–iso-Pr_2O (1: 1) afforded **4a** or **b** as colorless fine needles.

N-(2,3,4,6-Tetra-*O*-acetyl-*β*-ᴅ-glucopyranosyl)-*N*′-formamidinothiocarboxamides (**4a**): Yield: 420 mg (97%), mp 168—169°C. IR $\nu_{\max}^{\mathrm{KBr}}$ cm^{-1}: 3400, 3250, 3200 (NH_2, NH), 1740 ($OCOCH_3$), 1610, (C=N), 1220, 1040. NMR ($CDCl_3$) δ: 8.22 (1H, s, –N=CH–), 8.10 (1H, d, $J=8.0$ Hz, 1′-NH), 7.20 (2H, bs, NH_2). $[\alpha]_{\mathrm{D}}^{24}$ +13°C ($c=1.0$, $CHCl_3$). MS (*m/z*): 431 (M^+-2H). *Anal.* Calcd for $C_{16}H_{23}N_3O_9S$: C, 44.43; H, 5.35; N, 9.69. Found: C, 44.35; H, 5.30; N, 9.63.

N-(2,3,4-Tri-*O*-acetyl-*α*-ᴅ-arabinopyranosyl)-*N*′-formamidinothiocarboxamides (**4b**): Yield: 332 mg (93%), mp 154—155°C. IR $\nu_{\max}^{\mathrm{KBr}}$ cm^{-1}: 3500, 3400, 3300 (NH_2, NH), 1740 ($OCOCH_3$), 1640 (C=N), 1240, 1040. $[\alpha]_{\mathrm{D}}^{24}$ $-71°$ ($c=1.0$, EtOH). MS (*m/z*): 359 (M^+-2H). *Anal.* Calcd for $C_{13}H_{19}N_3O_7S$: C, 43.21; H, 5.30; N, 11.63. Found: C, 43.19; H, 5.32; N, 11.60.

b) A mixture of **1a** or **b** (0.001 mol), acetoamidine hydrochloride (94 mg, 0.001 mol) and NEt_3 (3 ml) was treated as described above in a).

N-(2,3,4,6-Tetra-*O*-acetyl-*β*-ᴅ-glucopyranosyl)-*N*′-acetoamidinothiocarboxamides (**5a**): Yield: 492 mg (90%), mp 160—162°C. IR $\nu_{\max}^{\mathrm{KBr}}$ cm^{-1}: 3400, 3200 (NH_2, NH), 1740 ($OCOCH_3$), 1620 (C=N), 1220, 1050. NMR ($CDCl_3$) δ: 7.30 (1H, d, $J=8.0$ Hz, 1′-NH), 6.68 (2H, bs, NH_2), 2.30 (3H, s, N=CMe–N–), $[\alpha]_{\mathrm{D}}^{24}$ +14°C ($c=1.0$, EtOH). MS (*m/z*): 445 (M^+-2H). *Anal.* Calcd for $C_{17}H_{25}N_3O_9S$: C, 45.63; H, 5.63; N, 9.39. Found: C, 45.72; H, 5.69; N, 9.43.

N-(2,3,4-Tri-*O*-acetyl-*α*-ᴅ-arabinopyranosyl)-*N*′-acetoamidinothiocarboxamide (**5b**): Yield: 363 mg (94 %), mp 148—149°C. IR $\nu_{\max}^{\mathrm{KBr}}$ cm^{-1}: 3400, 3200 (NH_2, NH), 1740 ($OCOCH_3$), 1600, 1520, 1210, 1040. NMR

($CDCl_3$) δ: 7.10 (1H, d, $J=8.0$ Hz, 1'-NH), 6.45 (2H, bs, NH_2), 2.16 (3H, s, N=CMe–N–). MS (m/z): 373 (M^+-2H). *Anal.* Calcd for $C_{14}H_{21}N_3O_7S$: C, 44.79; H, 5.64; N, 11.19. Found: C, 44.72; H, 5.70; N, 11.23.

Glycosyl s-Triazine-2-thione (8a, 9a, b, 10a) (Table I)——a) A solution of **3a** or **6a** (0.001 mol) and $HC(OEt)_3$ (2 ml) in dry xylene (10 ml) was heated at 110°C for 3 h. The reaction solution was concentrated under reduced pressure to give a slightly yellow residue. The residue was chromatographed on silice gel with benzene–acetone (97: 3) to give **8a**, or **10b** as a colorless syrup.

b) A solution of **7a** or **b** (0.001 mol) and $HC(OEt)_3$ (3 ml) in dry toluene or xylene (10 ml) was heated at 110°C for 2 h and allowed to stand at room temperature. The crystals that separated were collected by filtration and recrystallized from toluene to afford **9a** or **b** as colorless fine needles.

Reactions of N-Glycosyl-N'-formamidino- or acetoamidinothiocarboxamide with Triethyl Orthoformate ($HC(OEt)_3$)——A mixture of **4a** or **5b** (0.001 mol) and $HC(OEt)_3$ (3 ml) in dry xylene (10 ml) was treated as described for **8a** and the starting material was recovered. The reaction solution was refluxed for 2 h and became brownish, showing many spots on TLC.

Treatment of 9a with Methanolic Ammonia——A solution of **9a** (458 mg, 0.001 mol) in $MeOH-NH_3$ (10 ml) was stirred for 1 h under ice-cooling. Removal of the solvent left a powder. Then, without purification, the powder was dissolved in Ac_2O (5 ml) and dry pyridine (5 ml). The reaction mixture was stirred for 3 h, then poured into ice–H_2O and extracted with $CHCl_3$. The organic layer was washed with sat. $NaHCO_3$ solution and H_2O and dried over $MgSO_4$. Removal of the solvent by evaporation under reduced pressure gave a solid, which was recrystallized from AcOEt–benzene (1: 1) to give 464 mg of an unknown product as colorless fine needles, mp 122—123°C, IR ν_{max}^{KBr} cm^{-1}: 3400 (NH), 1740 ($OCOCH_3$), 1620, 1600, 1530, 1210, 1020. MS (m/z): 414 (M^+). NMR ($CDCl_3$) δ: 2.34 (3H, s, N=CMe–N–), 12.30 (1H, d, $J=8.0$ Hz, 1'-NH), 12.60 (1H, bs, NH). *Anal.* Found: C, 45.23; H, 5.39; N, 10.21.

2-Glycosyl-5-substituted 1,2,4-Triazole-3-thione (11a, b, 12a, b, 13a, c, 14a, b)——NBS (265 mg, 0.0015 mol) was added to a stirred solution of *N*-glycosyl-*N'*-amidinothiocarboxamide (**4a**, **b** or **5a**, **b**: 0.001 mol) or glycosylisothiobiuret (**3a**, **c**, **8a**, **b**: 0.001 mol) in $CHCl_3$ (20 ml) under ice-cooling. After 20—40 min, the reaction solution was washed with H_2O and sat. $NaHCO_3$ solution, and dried over $MgSO_4$. Removal of the solvent left a slightly yellow or brownish residue, which was chromatographed on silica gel. The benzene–acetone (19: 1) eluate gave **11a**, **b**, **13a**, **b**, **14a**, **b** as colorless syrups, or **12a**, **b** as colorless needles, respectively.

Acknowledgement This work was supported in part by a Grant-in-Aid for Cancer Research (55-16) from the Ministry of Health and Welfare, Japan.

References and Notes

1) This work was presented at the seventh symposium on Nucleic Acids Chemistry, Oct, 26th—27th, 1979. This series of papers is a continuation of a series entitled "C-nucleoside synthesis." This also constitutes Part XXXIX in a series entitled "St dies on Heterocyclic Compounds:" Previous Paper (Part XIX): H. Ogura, H. Takahashi, and K. Takeda, *Chem. Pharm. Bull.*, **29**, 1832 (1981).
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