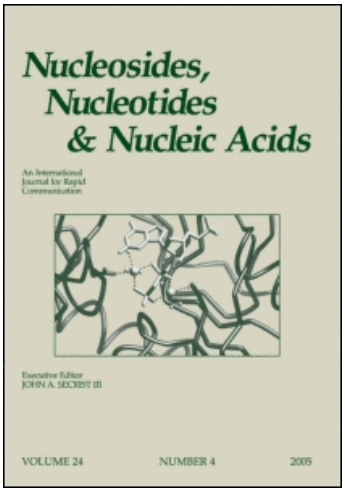

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CONDENSATION REACTION BETWEEN 2,2-DIPHENYLTHIO-2,3-DIDEOXYRIBOSE AND SILYLATED PYRIMIDINE BASES

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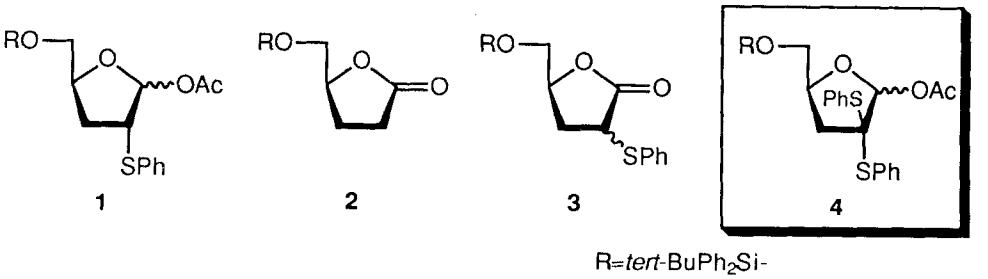
ABSTRACT

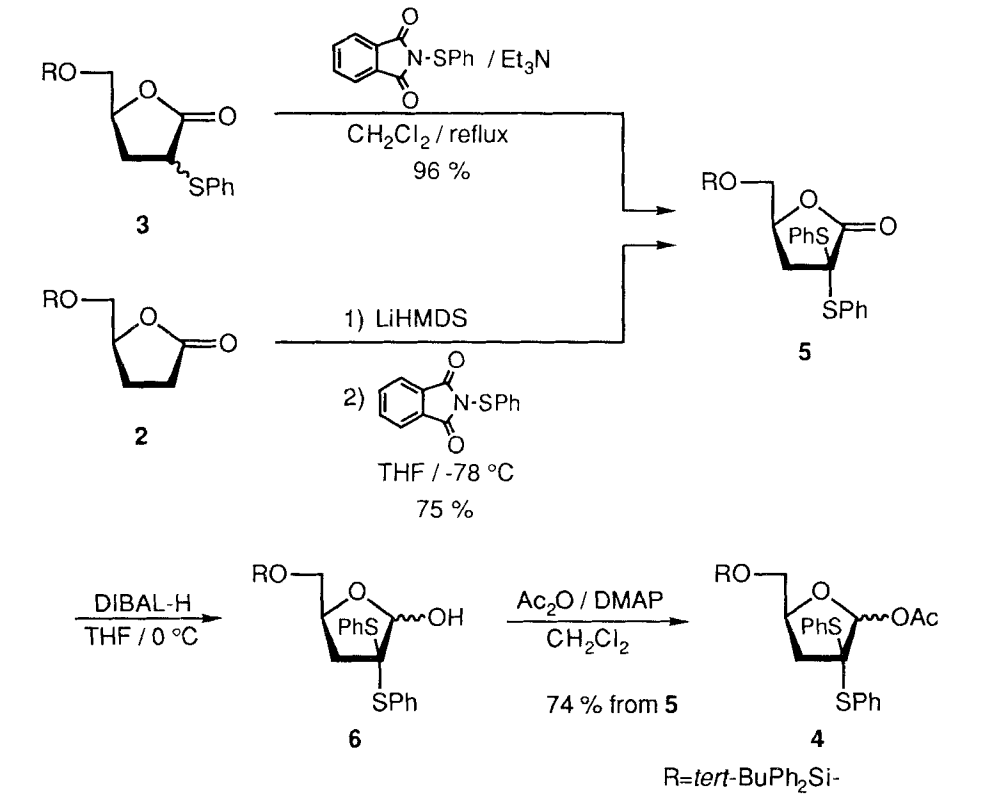
The condensation reaction between 2,2-diphenylthio-2,3-dideoxyribose and silylated pyrimidine bases was examined. In the presence of TMSOTf as a catalyst, this reaction proceeded to give the nucleosides in the ratio of $\alpha : \beta = 2 : 8$. Each β-anomer was converted to protected 2',3'-dideoxynucleosides.

Recent researches for antivirus or antitumor compounds have revealed an importance of nucleoside analogues.[1] A typical example is that the only two drugs allowed to be used against AIDS caused by HIV were nucleoside analogues. Other series of nucleoside analogues, such as 2',3'-didehydro-2',3'-dideoxynucleosides, are now under consideration for AIDS. These nucleoside analogues have no substituents at the 2'-position. We studied the stereoselectivities in the condensation reaction between 2-deoxysugars and nucleic bases,[2] since this reaction can be applicable for the synthesis of a wide variety of nucleoside analogues. In the course, it became clear that the phenylthio group on C-2 of the sugar strictly affects the stereochemistry of this reaction.[2d,f,3] For instance, the condensation reaction between 2-α-phenylthio-2,3-dideoxyribose (**1**) and silylated pyrimidine bases in the presence of $SnCl_4$ as a catalyst proceeded in the ratio of $\alpha : \beta = 1 : 9$. This reaction was applied for the synthesis of 2',3'-didehydro-2',3'-dideoxynucleosides. This method, however, has a serious disadvantage. In the preparation of **1**, the stereoselectivity of the phenylsulfenylation reaction of γ-lactone (**2**)[4] to **3** was the ratio of *trans* : *cis* = 2 : 1.[2d,f,3,5] From a practical viewpoint, it makes the isolation of product troublesome. A simple solution to this problem is that two phenylthio groups are introduced on C-2 of a sugar to collapse the stereocenter. It was also of interest which phenylthio group was more effective in controlling the stereochemistry in the condensation



reaction. In this paper, we report the results of the condensation reaction between 2,2-diphenylthio-2,3-dideoxyribose (**4**) and silylated pyrimidine bases.

2,2-Diphenylthio-2,3-dideoxyribose (**4**) was prepared from the corresponding γ-lactone (**5**). (SCHEME 1) Introduction of a *gem*-diphenylthio group was achieved, at first, by phenylsulfenylation of 2-phenylthio lactone (**3**). Thus, **3** was treated with *N*-phenylthiophthalimide and triethylamine in refluxing CH_2Cl_2 overnight to give **5** in 96%



SCHEME 1

TABLE 1 Condensation reaction between sugar (**4**) and silylated uracil (**7**).[a]

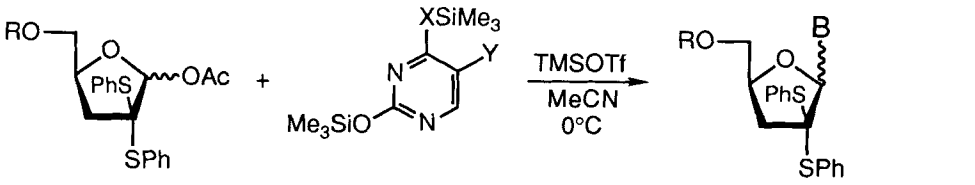
Entry	Lewis Acid	Solvent	Reaction Time	Yield(%)[b] ($\alpha + \beta$)	Stereoselectivity[b] ($\alpha : \beta$)
1[c]	$SnCl_4$	CH_2Cl_2	15 min	25	23 : 77
2[c]	$SnCl_4$	CH_3CN	30 min	64	23 : 77
3	TMSOTf	$ClCH_2CH_2Cl$	4 h	78	24 : 76
4	TMSOTf	$ClCH_2CH_2Cl$	overnight	63	19 : 81
5[d]	TMSOTf	$ClCH_2CH_2Cl$	1 h	53	20 : 80
6	TMSOTf	CH_3CN	30 min	72	21 : 79
7[d,e]	TMSOTf	CH_3CN	4 h	83	19 : 81

a) 0.10 mmol scale, **4** : **7** =1 : 1.5, 0.3-0.6 equivalent of catalyst, 2 ml of solvent.
b) Determined by HPLC.
c) 3.0 equivalent of $SnCl_4$ was used.
d) Condensation reaction was carried out at 0°C.
e) Condensation reaction was carried out under the following conditions: 3.42 mmol scale, **4** : **7** =1 : 2, 0.5 equivalent of catalyst, 22 ml of solvent. Yield was the isolation yield.

yield.[6] **5** was also prepared more conveniently by double phenylsulfenylation of γ-lactone (**2**) with *N*-phenylthiophthalimide and lithium hexamethyldisilazide (LiHMDS) as a base in 75% yield. In this case, an excess amount of LiHMDS caused the decrease of yield of **5**. Lactone (**5**) was reduced to lactol (**6**) with di(*iso*-butyl)aluminum hydride (DIBAL-H). **4** was obtained after acetylation.

The condensation reaction between **4** and silylated uracil (**7**) was performed under various conditions. The results are summarized in TABLE 1. Stereochemistries of products were determined by ^{1}H-NMR[2e] and also by comparison to the authentic sample[2e] after conversion of the isolated β-anomer (**8**β) to protected 2',3'-dideoxyuridine (*vide infra*). The nucleosides (**8**) were obtained at the early stage of the reaction in the presence of $SnCl_4$,[7] which was the best catalyst in the case of the condensation reaction with **1**. The yield of **8** was, however, observed to decrease after a prolonged reaction time. Using trimethylsilyl trifluoromethanesulfonate (TMSOTf) as a catalyst[8] afforded **8** in good yield, and no significant decomposition of the products was recorded. In the point of stereoselectivities, good β-selectivities were achieved, although not as high as those with **1**. As both catalysts afforded similar selectivities, TMSOTf was thought to be advantageous because it did not affect the condensation products.

These reaction conditions were also applied to the condensation reaction with silylated thymine (**9**) and N^4-acetylcytosine (**10**). The results are summarized in



4

7 : X=O ; Y=H
9 : X=O ; Y=Me
10 : X=NAc ; Y=H

8 : B=U ; 83 %, α : β =19 : 81
11 : B=T ; 60 %, α : β = 19 : 81
12 : B=C^{Ac} ; 79 %, α : β= 20 : 80

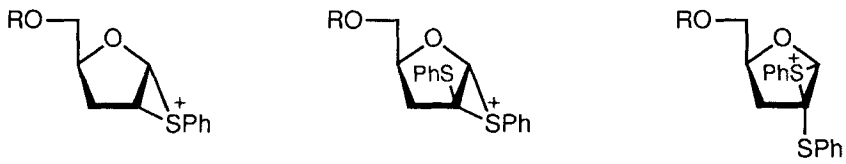
R=*tert*-$BuPh_2Si$-

SCHEME 2

SCHEME 2. Both yields and stereoselectivities of the reactions with these nucleic bases were similar to those with silylated uracil (**7**).

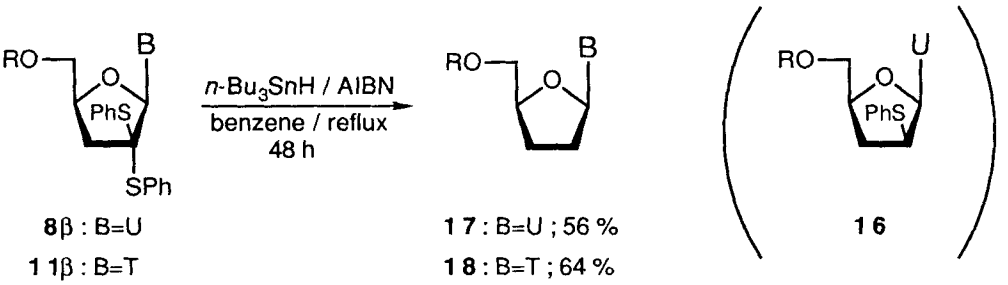
These selectivities could be explained as follows. We reported previously that the condensation reaction with **1** in the presence of TMSOTf gave the anomeric mixture of α : β = 2 : 8.[2d,f] In that case, we assumed an episulfonium ion intermediate (**13**).[9] In the case of **4** in the presence of Lewis acid, two intermediates similar to **13** could be assumed, **14** and **15**. As the steric repulsion between the β-phenylthio group and the side chain at C-4, the α-phenylthio group is thought to take a position of *quasi*-axial and the attribution of **14** overwhelmed that of **15** to give the β-nucleosides as the main products.

The β-anomers (**8β**, **11β**, **12β**) were subjected to reductive desulfenylation after the separation with HPLC. **8β** was completely consumed in 1 h when the reduction was



13 14 15

carried out with *n*-Bu_3SnH and catalytic amount of AIBN in benzene at reflux. Analysis of crude reaction mixture with ^{1}H-NMR revealed that the main product was nucleoside (**16**), which has a relationship of *cis* to each other between uracil and the remaining phenylthio group. It took more time to reduce the phenylthio group *cis* to uracil. After 48 h, protected 2',3'-dideoxyuridine (**17**) could be isolated in 56% yield, although a small quantity of half-reduced nucleoside (**16**) still remained. Thymidine derivative (**11β**) and cytidine derivative (**12β**) were also subjected to the same reaction conditions as those for uridine derivative (**8β**). After 48 h, each 2',3'-dideoxynucleoside (**18**) and (**19**) was



8β : B=U
11β : B=T
12β : B=C^{Ac}

17 : B=U ; 56 %
18 : B=T ; 64 %
19 : B=C^{Ac} ; 4 %

16

R=*tert*-BuPh$_2$Si-

SCHEME 3

obtained in 64% and 4%[10] yields respectively. (SCHEME 3) In both cases, starting materials (**11**β) and (**12**β) could not be detected on TLC after 1 h. The longer reaction time for second reductions seemed to be attributed to the steric hindrance.

In conclusion, the condensation reaction between 2,2-diphenylthio-2,3-dideoxyribose and silylated pyrimidine bases in the presence of Lewis acid proceeded in stereoselectivity of α : β = 2 : 8. These nucleosides were converted to 2',3'-dideoxynucleosides by radical reduction of two phenylthio groups with *n*-Bu$_3$SnH.

EXPERIMENTAL

Spectral Measurements. Optical rotation was measured on a Jasco DIP-370 polarimeter. ^{1}H-NMR spectra were recorded at 300 MHz and ^{13}C-NMR spectra at 75 MHz, on a Brucker AC-300P spectrometer. Chemical shifts are given in ppm (δ) relative to tetramethylsilane for ^{1}H-NMR and relative to $CDCl_3$ (77.0 ppm) for ^{13}C-NMR. IR spectra were measured on a Jasco FT/IR-5000 spectrophotometer. UV spectra were measured on a Beckman DU-65 spectrophotometer.

(4*S*)-5-(*tert*-Butyldiphenylsilyloxy)-2,2-di(phenylthio)pentan-4-olide (5). From monophenylthiolactone (3).[5] Under an argon atmosphere, a mixture of (4*S*)-5-(*tert*-butyldiphenylsilyloxy)-2-phenylthiopentan-4-olide (**3**, 2*S* / 2*R* mixture, 3.41 g, 7.37 mmol), *N*-phenylthiophthalimide (2.26 g, 8.85 mmol), and triethylamine (1.30 ml, 8.85 mmol) in dry dichloromethane (40 ml) was heated under reflux overnight. The precipitate was filtered off with a Celite pad, and the solvent was distilled away under reduced pressure. The residue was purified by silica gel column chromatography (*n*-hexane : diethyl ether = 8 : 1) to give 4.08 g of **5** (96% yield); ^{1}H-NMR ($CDCl_3$) :δ 7.69-7.56 (8H, m, aromatic H), 7.48-7.25 (12H, m, aromatic H), 4.50-4.39 (1H, m, H-4), 3.71 (1H, dd, *J*=11.6, 3.6 Hz, H-5), 3.54 (1H, dd, *J*=11.6, 4.3 Hz, H-5), 2.63 (1H, dd, *J*=14.0, 9.5 Hz, H-3), 2.21 (1H, dd, *J*=14.0, 6.0 Hz, H-3), 0.98 (9H, s, *tert*-Bu).

From γ-lactone (2). Under an argon atmosphere, (4*S*)-5-(*tert*-butyldiphenylsilyloxy)-pentan-4-olide (**2**, 363 mg, 1.02 mmol) and *N*-phenylthiophthalimide (570 mg, 2.23 mmol) were dissolved in dry tetrahydrofuran (3 ml), and cooled to -78°C. To this suspension, 2.3 ml of 1.0 *M* solution of lithium hexamethyldisilazide in tetrahydrofuran[11] was added dropwise at -78°C, and the mixture was stirred at room temperature for 1.5 h. The reaction mixture was poured into a saturated aqueous solution of ammonium sulfate and extracted with diethyl ether three times. The organic layer was dried over anhydrous magnesium sulfate, and the solvent was distilled away under reduced pressure. The residue was purified as above to give 438 mg of **5** (75% yield).

1-*O*-Acetyl-5-*O*-(*tert*-butyldiphenylsilyl)-2,3-dideoxy-2,2-di(phenylthio)-D-*glycero*-pentofuranose (4). To a solution of (4*S*)-5-(*tert*-butyldiphenylsilyloxy)-2,2-di(phenylthio)pentan-4-olide (**5**, 4.00 g, 7.00 mmol) in dry tetrahydrofuran (45 ml), 15 ml of 1.0 *M* solution of di(*iso*-butyl)aluminum hydride in toluene[12] was added dropwise at 0°C under an argon atmosphere, and the mixture was stirred at the same temperature for 1.5 h. To this reaction mixture, a small quantity of water was added, and after standing at room temperature for a while anhydrous magnesium sulfate was added. The precipitate was filtered off with a Celite pad, and the solvent was distilled away under reduced pressure. The residue was dissolved in dry dichloromethane (30 ml), and to this solution, acetic anhydride (1.0 ml, 11 mmol) and 4-(*N*,*N*-dimethylamino)pyridine (50 mg) were added and stirred at room temperature overnight. The reaction mixture was poured into a saturated aqueous solution of sodium bicarbonate and extracted with chloroform three times. The organic layer was dried over anhydrous magnesium sulfate, and the solvent was distilled away under reduced pressure. The residue was purified by silica gel column chromatography (*n*-hexane : ethyl acetate = 85 : 15) to give 3.17 g of an anomeric mixture of **4** (73% yield); ^{1}H-NMR ($CDCl_3$) :δ 7.73-7.53 (8H, m, aromatic H), 7.45-7.30 (12H, m, aromatic H), 6.40 (0.4H, s, H-1), 6.20 (0.6H, s, H-1), 4.55-4.41 (1H, m, H-4), 3.77-3.64 (2H, m, H-5), 2.42 (0.6H, dd, *J*=13.4, 9.6 Hz, H-3), 2.29 (0.4H, dd, *J*=14.5, 6.9 Hz, H-3), 2.21 (0.4H, dd, *J*=14.5, 7.6 Hz, H-3), 2.07-2.01 (1.8H, m, H-3, Ac), 1.88 (1.8H, s, Ac), 1.00 (9H, s, *tert*-Bu).

1-[5-*O*-(*tert*-Butyldiphenylsilyl)-2,3-dideoxy-2,2-di(phenylthio)-β-D-*glycero*-pentofuranosyl]uracil (8β). Under an argon atmosphere, silylated uracil (**7**, 6.84 mmol)[2d] and 1-*O*-acetyl-5-*O*-(*tert*-butyldiphenylsilyl)-2,3-dideoxy-2,2-di-(phenylthio)-D-*glycero*-pentofuranose (**4**, 2.11 g, 3.42 mmol) were dissolved in dry acetonitrile (20 ml). To this solution, a solution of 340 μl of trimethylsilyl trifluoro-methanesulfonate in 2 ml of acetonitrile was added dropwise at 0°C, and the mixture was

stirred under an argon atmosphere at 0°C for 4 h. The reaction mixture was poured into a saturated aqueous solution of sodium bicarbonate and extracted with chloroform three times. The organic layer was dried over anhydrous magnesium sulfate, and the solvent was distilled away under reduced pressure. The residue was purified by silica gel column chromatography (*n*-hexane : ethyl acetate = 3 : 2) to give 1.89 g of an anomeric mixture of 1-[5-*O*-(*tert*-butyldiphenylsilyl)-2,3-dideoxy-2,2-di(phenylthio)-D-*glycero*-pento-furanosyl]uracil (**8**) (yield 83%, α : β = 19 : 81). These nucleosides were separated by HPLC (ODS; 30 mmϕ X 250 mm; acetonitrile : water= 85 : 15; 10 ml/min.) to give pure **8**β; $[\alpha]_D$ -8.4 ° (*c* 1.03, 24 °C, $CHCl_3$); ^{1}H-NMR ($CDCl_3$) :δ 8.03-7.96 (2H, m, H-6, NH),7.82-7.77 (2H, m, aromatic H), 7.58-7.25 (18H, m, aromatic H), 6.35 (1H, s, H-1'), 5.26 (1H, dd, *J*=8.2, 1.9 Hz, H-5), 4.53-4.45 (1H, m, H-4'), 4.14 (1H, dd, *J*=12.2, 2.0 Hz, H-5'), 3.62 (1H, dd, *J*=12.2, 2.1 Hz, H-5'), 2.53 (1H, dd, *J*=13.7, 11.1 Hz, H-3'), 1.82 (1H, dd, *J*=13.7, 4.8 Hz, H-3'), 1.03 (9H, s, *tert*-Bu); ^{13}C-NMR ($CDCl_3$) :δ 162.62 (C-4), 149.89 (C-2), 140.82 (C-6), 137.20 (aromatic C), 135.52 (aromatic C), 135.33 (aromatic C), 132.53 (aromatic C), 132.03 (aromatic C), 131.01 (aromatic C), 130.15 (aromatic C), 130.09, (aromatic C), 130.01 (aromatic C), 129.40 (aromatic C), 129.05 (aromatic C), 129.01 (aromatic C), 127.95 (aromatic C), 101.76 (C-5), 90.37 (C-1'), 80.15 (C-4'), 72.96 (C-2'), 62.85 (C-5'), 38.87 (C-3'), 26.89 (quaternary C of *tert*-Bu), 19.28 (Me of *tert*-Bu); IR (KBr) :ν 1690 (s), 1265 (m), 1114 (m), 748 (m), 702 (m), 505 (m) cm^{-1}; UV ($CHCl_3$) :λ 265 nm (log ε 4.11); HRMS (FAB): m/e $(M+H)^+$ 667.2125 (calcd. for $C_{37}H_{39}N_2O_4SiS_2$, 667.2121).

1-[5-*O*-(*tert*-Butyldiphenylsilyl)-2,3-dideoxy-2,2-di(phenylthio)-β-D-*glycero*-pentofuranosyl]thymine (11β). Reaction of 1.61 g (2.61 mmol) of **4** and 5.22 mmol of **9** in a similar way as described for the preparation of **8**β gave 1.07 g of **11**, 60% yield (α : β= 19 : 81). HPLC separation (acetonitrile : water= 85 : 15) gave **11**β; $[\alpha]_D$ -18.7 ° (*c* 1.01, 25 °C, $CHCl_3$); ^{1}H-NMR ($CDCl_3$) :δ 8.44 (1H, br, NH), 7.79-7.74 (2H, m, aromatic H), 7.66-7.55 (4H, m, aromatic H), 7.52-7.23 (15H, m, aromatic H, H-6), 6.41 (1H, s, H-1'), 4.43-4.34 (1H, m, H-4'), 4.06 (1H, dd, *J*=11.9, 2.6 Hz, H-5'), 3.72 (1H, dd, *J*=11.9, 3.3 Hz, H-5'), 2.40 (1H, dd, *J*=13.6, 10.8 Hz, H-3'), 1.97 (1H, dd, *J*=13.6, 4.8 Hz, H-3'), 1.57 (3H, s, Me), 1.06 (9H, s, *tert*-Bu); ^{13}C-NMR ($CDCl_3$) :δ 163.44 (C-4), 150.05 (C-2), 137.12 (aromatic C), 136.30 (C-6), 135.45 (aromatic C), 135.28 (aromatic C), 134.33 (aromatic C), 132.98 (aromatic C), 132.57 (aromatic C), 131.42 (aromatic C), 130.35 (aromatic C), 130.05 (aromatic C), 130.00 (aromatic C), 129.94, (aromatic C), 129.02 (aromatic C), 128.83 (aromatic C), 127.84 (aromatic C), 109.95 (C-5), 90.48 (C-1'), 79.17 (C-4'), 72.37 (C-2'), 63.40 (C-5'), 40.20 (C-3'), 26.97 (quaternary C of *tert*-Bu), 19.39 (Me of *tert*-Bu), 12.03 (Me); IR

(KBr) :ν 1690 (s), 1473 (m), 1263 (m), 1114 (m), 1077 (m), 745 (m), 702 (m), 505 (m) cm^{-1} ; UV ($CHCl_3$) :λ 266 nm (log ε 4.13); HRMS (FAB): m/e $(M+H)^+$ 681.2296 (calcd. for $C_{38}H_{41}N_2O_4SiS_2$, 681.2277).

N^4-Acetyl-1-[5-*O*-(*tert*-butyldiphenylsilyl)-2,3-dideoxy-2,2-di(phenylthio)-β-D-*glycero*-pentofuranosyl]cytosine (12β). Reaction of 1.60 g (2.60 mmol) of **4** and 5.19 mmol of **12** in a similar way as described for the preparation of **8β** gave 1.45 g of **12**, 79% yield (α : β= 20 : 80). HPLC separation (acetonitrile : water= 85 : 15) gave **12β**; $[\alpha]_D$ -13.0 ° (*c* 1.03, 26 °C, $CHCl_3$); ^{1}H-NMR ($CDCl_3$) :δ 10.67 (1H, br, NH), 8.42 (1H, d, *J*=7.6 Hz, H-6), 7.83-7.76 (2H, m, aromatic H), 7.62-7.17 (19H, m, aromatic H, H-5), 6.52 (1H, s, H-1'), 4.53-4.43 (1H, m, H-4'), 4.14 (1H, dd, *J*=12.2, 1.9 Hz, H-5'), 3.58 (1H, dd, *J*=12.2, 2.0 Hz, H-5'), 2.43 (1H, dd, *J*=13.7, 11.1 Hz, H-3'), 2.28 (3H, s, Ac), 1.70 (1H, dd, *J*=13.7, 4.6 Hz, H-3'), 1.05 (9H, s, *tert*-Bu); ^{13}C-NMR ($CDCl_3$) :δ 171.60 (C=O of Ac), 163.11 (C-4), 155.19 (C-2), 145.07 (C-6), 137.20 (aromatic C), 136.02 (aromatic C), 135.53 (aromatic C), 135.36 (aromatic C), 132.30 (aromatic C), 132.14 (aromatic C), 130.98 (aromatic C), 130.30 (aromatic C), 130.07 (aromatic C), 129.98 (aromatic C), 129.35 (aromatic C), 128.90 (aromatic C), 128.85 (aromatic C), 127.93 (aromatic C), 127.88 (aromatic C), 96.81 (C-5), 91.48 (C-1'), 80.19 (C-4'), 73.03 (C-2'), 62.88 (C-5'), 38.18 (C-3'), 26.81 (quaternary C of *tert*-Bu), 25.05 (Me of Ac), 19.19 (Me of *tert*-Bu); IR (KBr) :ν 1673 (s), 1626 (m), 1495 (m), 1317 (m), 1238 (m), 1112 (m), 702 (m) cm^{-1} ; UV ($CHCl_3$) :λ 253 nm (log ε 4.15), 310 nm (log ε 3.83); HRMS (FAB): m/e $(M+H)^+$ 708.2402 (calcd. for $C_{39}H_{42}N_3O_4SiS_2$, 708.2386).

1-[5-*O*-(*tert*-Butyldiphenylsilyl)-2,3-dideoxy-β-D-*glycero*-pentofuranosyl]-uracil (17). Under an argon atmosphere, a mixture of 1-[5-*O*-(*tert*-butyldiphenylsilyl)-2,3-dideoxy-2,2-di(phenylthio)-β-D-*glycero*-pentofuranosyl]uracil (**8β**, 67 mg, 0.10 mmol), tri(*n*-butyl)tin hydride (150 μl, 0.57 mmol), and AIBN (10 mg) in benzene (10 ml) was heated under reflux for 48 h. The solvent was removed under reduced pressure. The residue was purified by TLC (silica gel, *n*-hexane : ethyl acetate = 1 : 1) to give 25 mg of **17** (56% yield); ^{1}H-NMR ($CDCl_3$) :δ 8.87 (1H, br, NH), 7.99 (1H, *J*=8.1 Hz, H-6), 7.70-7.62 (4H, m, aromatic H), 7.48-7.36 (6H, m, aromatic H), 6.11 (1H, dd, *J*=6.6, 2.8 Hz, H-1'), 5.41 (1H, dd, *J*=8.1, 2.1 Hz, H-5), 4.17-4.09 (2H, m, H-4', H-5'), 3.73 (1H, dd, *J*=11.5, 2.6 Hz, H-5'), 2.51-2.35 (1H, m, H-2'), 2.18-2.04 (2H, m, H-2',H-3'), 1.98-1.88 (1H, m, H-3'), 1.09 (9H, s, *tert*-Bu).

1-[5-*O*-(*tert*-Butyldiphenylsilyl)-2,3-dideoxy-β-D-*glycero*-pentofuranosyl]-thymine (18). Reaction of 68 mg (0.10 mmol) of **11β** in a similar way as described for

the preparation of **17** gave 30 mg of **18** (64% yield); ^{1}H-NMR ($CDCl_3$) :δ 8.83 (1H, br, NH), 7.71-7.65 (4H, m, aromatic H), 7.48-7.35 (7H, m, aromatic H, H-6), 6.12 (1H, dd, *J*=6.3, 4.7 Hz, H-1'), 4.20-4.17 (1H, m, H-4'), 4.03 (1H, dd, *J*=11.4, 2.8 Hz, H-5'), 3.75 (1H, dd, *J*=11.4, 3.4 Hz, H-5'), 2.46-2.34 (1H, m, H-2'), 2.12-1.94 (3H, m, H-2',H-3'), 1.64 (3H, d, *J*=1.2 Hz, Me), 1.10 (9H, s, *tert*-Bu).

N^4-Acetyl-1-[5-*O*-(*tert*-butyldiphenylsilyl)-2,3-dideoxy-β-D-*glycero*-pentofuranosyl]cytosine (19). Reaction of 72 mg (0.10 mmol) of **12β** in a similar way as described for the preparation of **17** gave 2 mg of **19** (4% yield); ^{1}H-NMR ($CDCl_3$) :δ 8.72 (1H, br, NH), 8.46 (1H, d, *J*=7.4 Hz, H-6), 7.74-7.66 (4H, m, aromatic H), 7.50-7.38 (6H, m, aromatic H), 6.11 (1H, dd, *J*=6.6, 1.9 Hz, H-1'), 4.24-4.13 (2H, m, H-4',H-5'), 3.76 (1H, dd, *J*=11.3, 2.7 Hz, H-5'), 2.62-2.45 (1H, m, H-2'), 2.27-2.13 (4H, m, H-2',Ac), 2.08-1.85 (2H, m, H-3'), 1.12 (9H, s, *tert*-Bu).

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