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SUPPORTING INFORMATION

Structure and Base Pairing Properties of a Replicable Nonpolar Isostere for Deoxyadenosine

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Supporting x-ray data for compound 1. (pages 8-12)

Mass spectral data for strand containing Z. (page 13)

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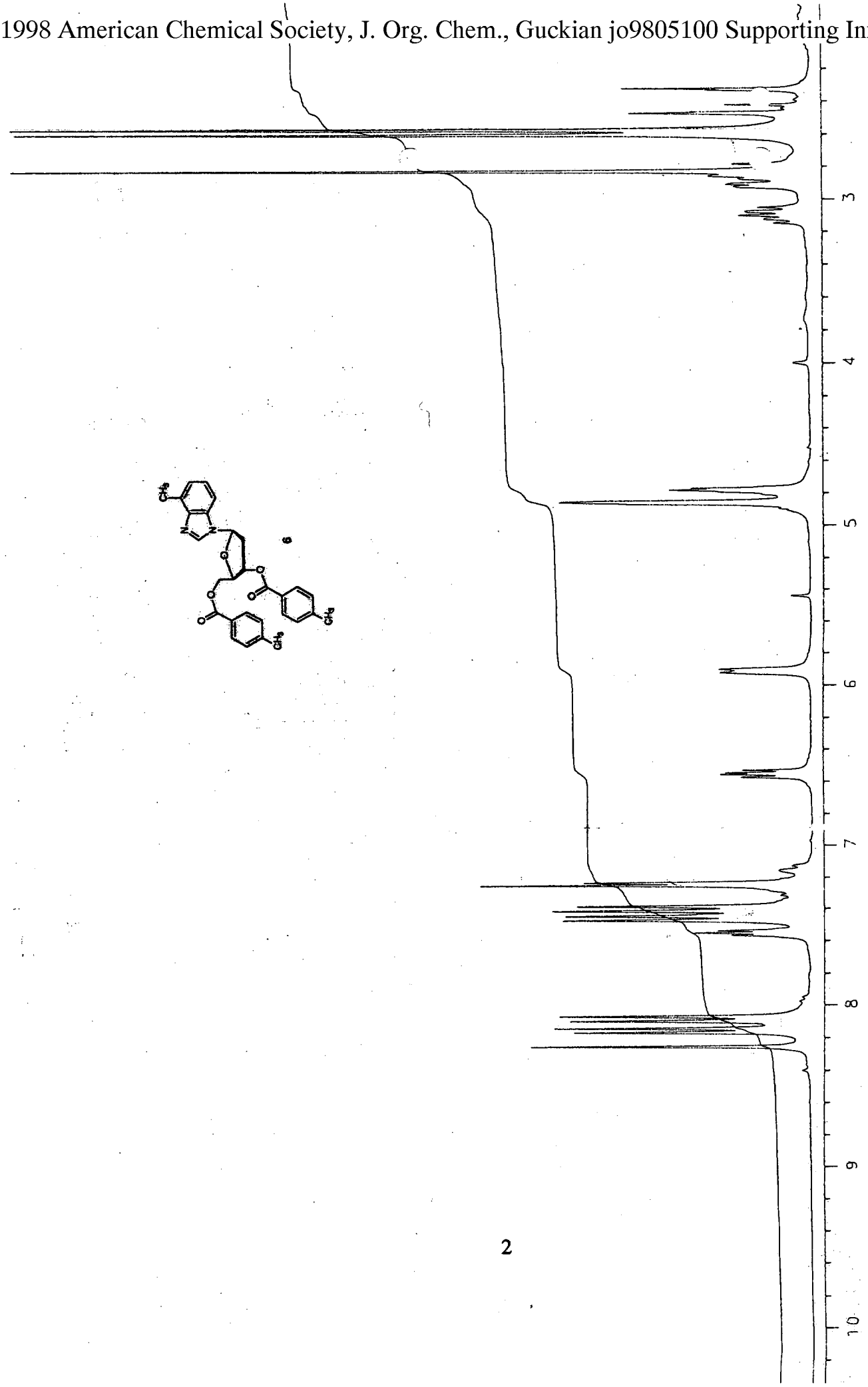
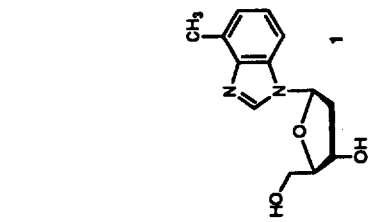
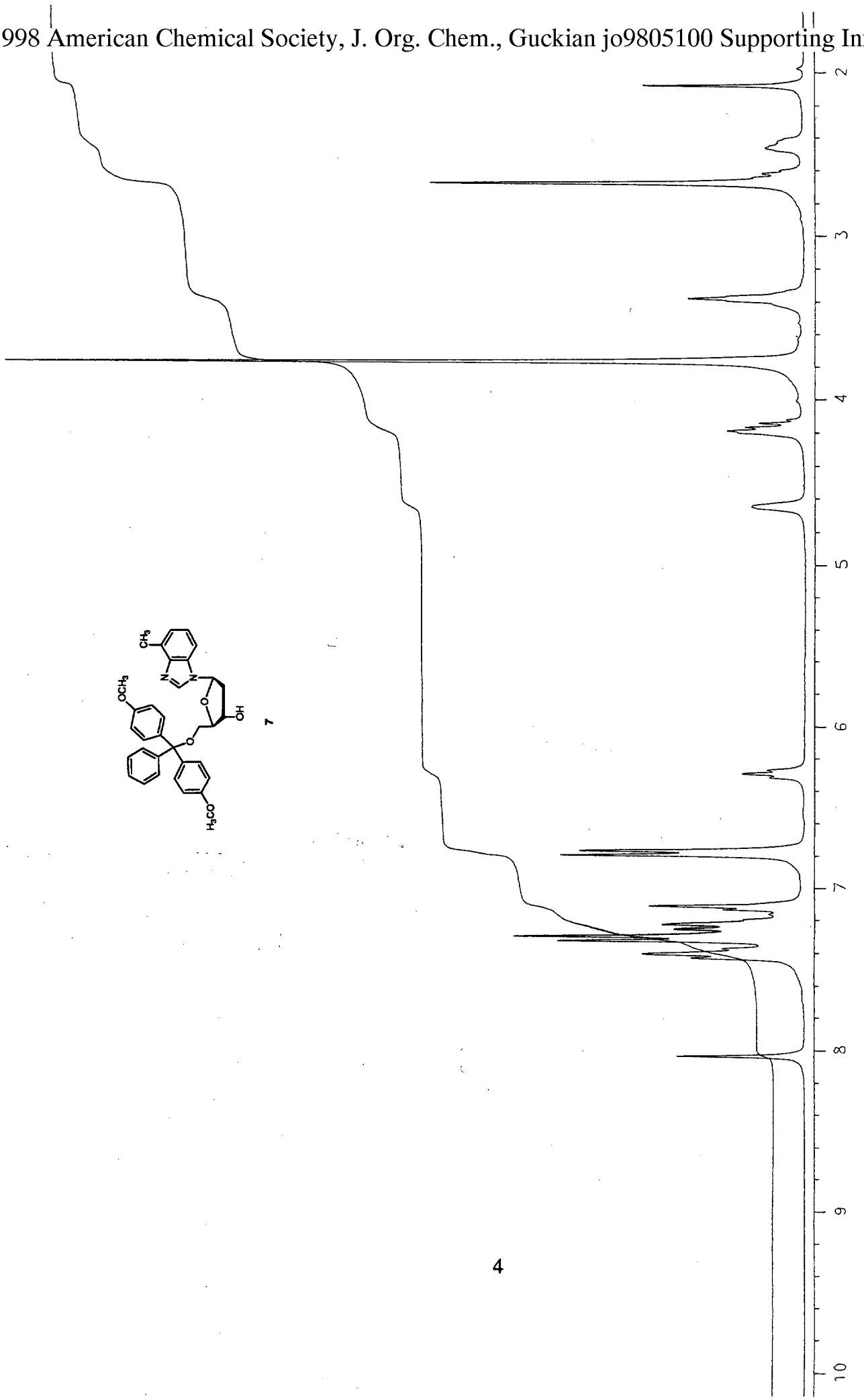
Synthesis of 4-methyl-1*H*-benzimidazole derivatives. (page 15-16)





1



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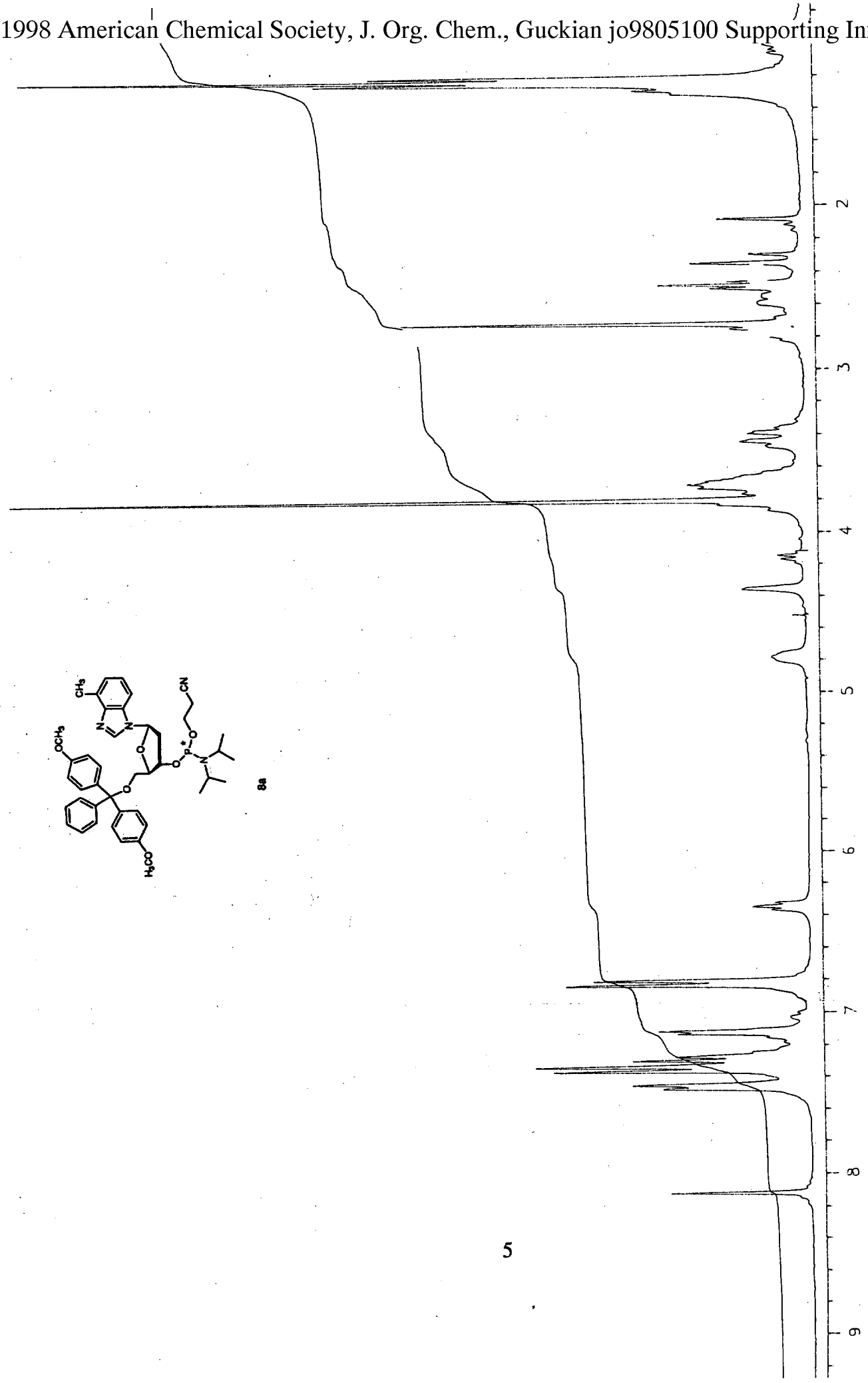
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3
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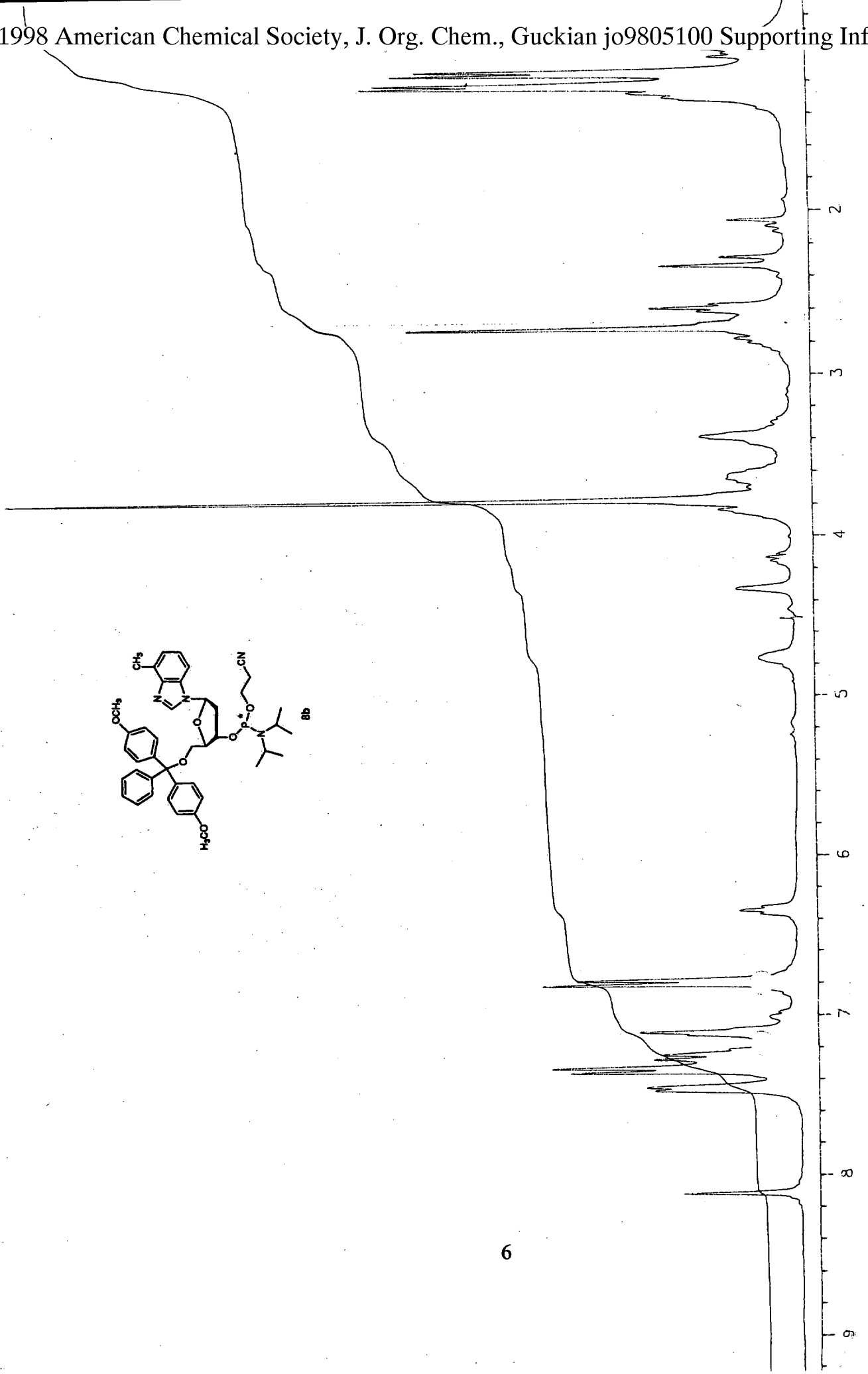
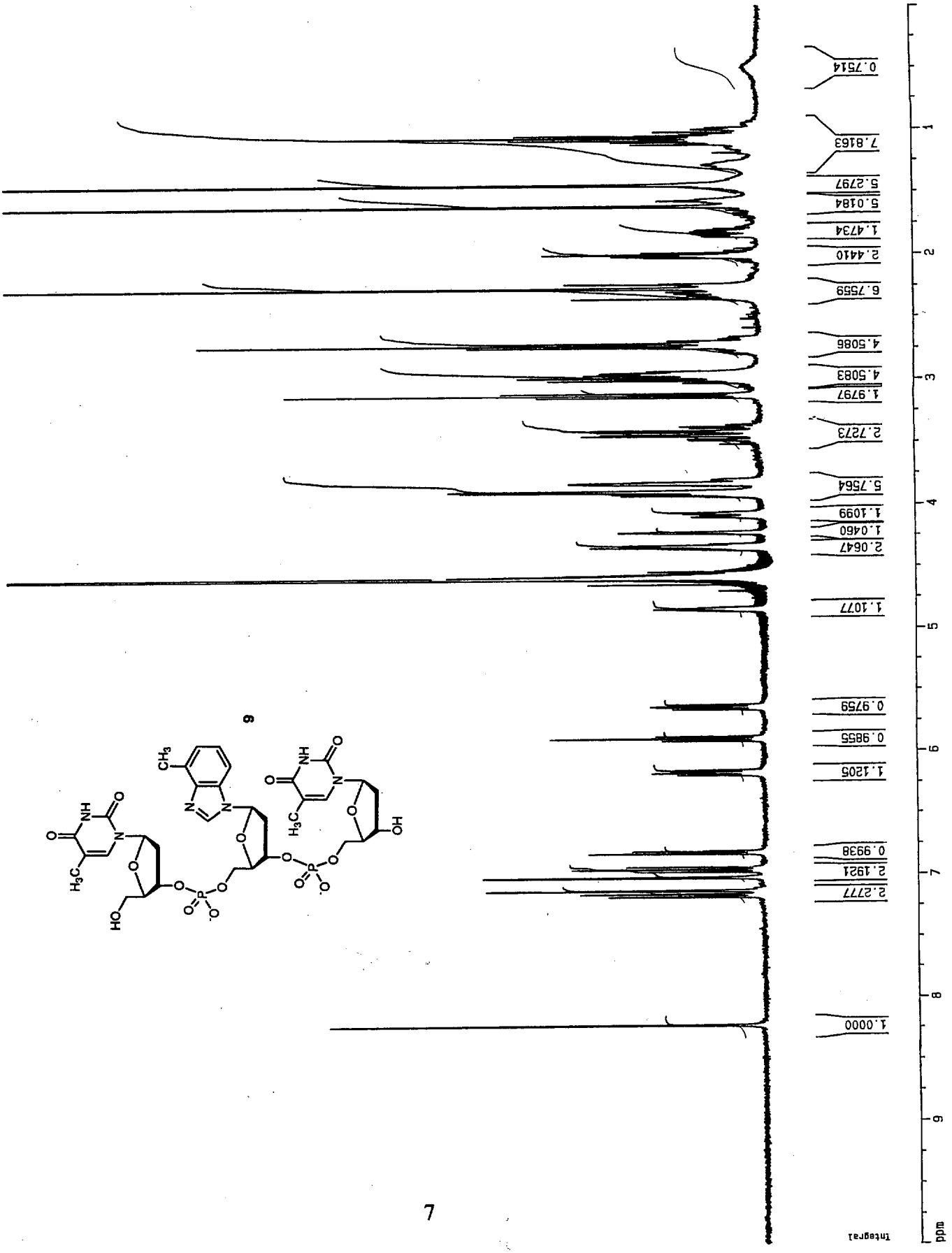
CH3
CN
OCH3
H3CO
8a





Empirical formula	$C_{13}H_{19}N_2O_4$
Formula weight	267.30
Temperature	223(2) K
Wavelength	0.71073 Å
Crystal system	Orthorhombic
Space group	$P2_12_12_1$
unit cell dimensions	a = 7.104(6) Å alpha = 90°
	b = 8.716(8) Å beta = 90°
	c = 21.67(2) Å gamma = 90°
Volume, Z	1342 (2) $Å^3$, 4
Density (calculated)	1.323 Mg/m^3
Absorption coeficient	0.099 mm^{-1}
F(000)	572
Crystal size	.4 X .08 X .08 mm^3
θ range for data collection	1.88 to 28.27°
Limiting indices	$-9 \le h \le 9$, $-10 \le k \le 11$, $-22 \le l \le 28$
Reflections collected	8410
Independent reflections	3155 (R_{int}=0.0755)
Absorption correction	SADABS
Refinement method	full matrix least-squares on F^2
Data / restraints / parameters	3155 / 0 /184
Goodness-of-fit on F^2	0.926
Final R indices [$I>2\sigma(I)$]	R1 = 0.0683, wR2 = 0.1618
R indicies (all data)	R1 = 0.0995, wR2 = 0.1756
Absolute structure parameter	0 (2)
Largest diff. peak and hole	0.235 and -0.568 $eÅ^{-3}$

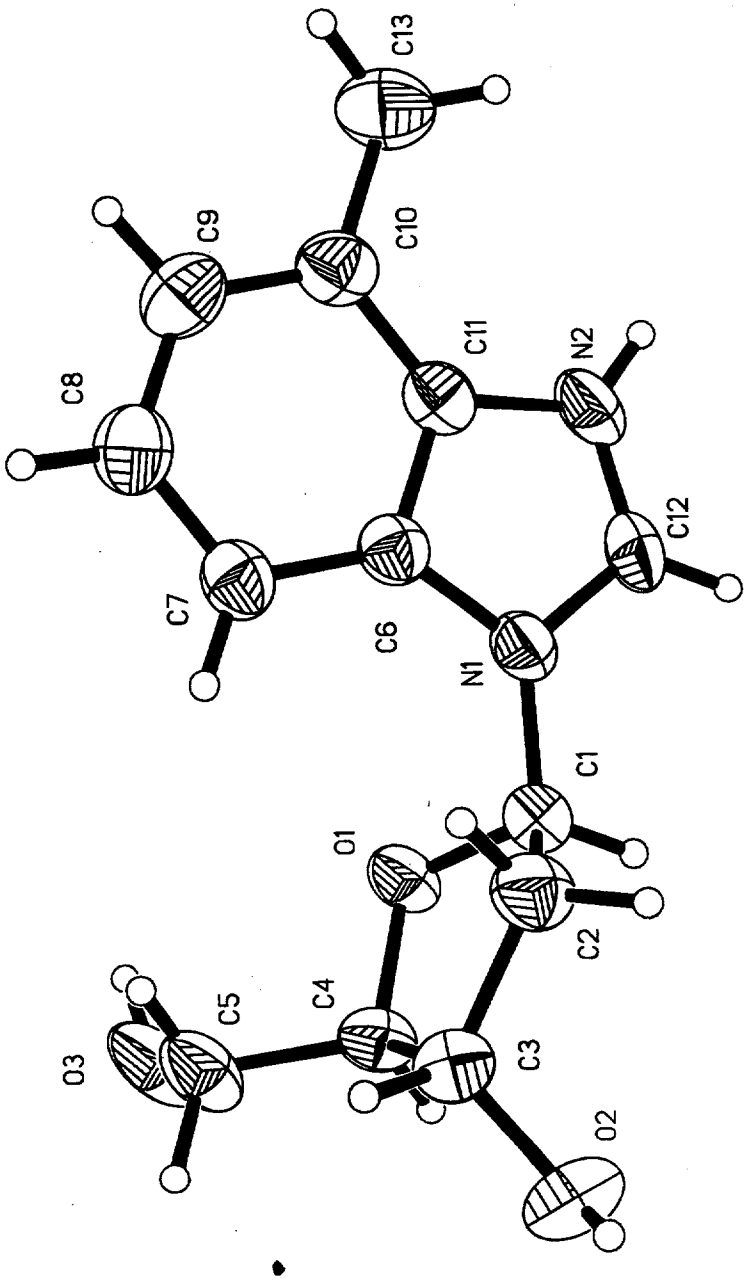


Table 2. Atomic coordinates [x 10^4] and equivalent isotropic displacement parameters [$Å^2$ x 10^3] for 1. U(eq) is defined as one third of the trace of the orthogonalized U_{ij} tensor.

	x	y	z	U(eq)
O(1)	9124(3)	9106(2)	1407(1)	38(1)
O(2)	7712(3)	11671(3)	336(1)	50(1)
O(3)	8723(5)	6545(3)	571(1)	67(1)
N(1)	10447(3)	10425(3)	2216(1)	38(1)
N(2)	11227(4)	10553(3)	3212(1)	45(1)
C(1)	9299(5)	10593(3)	1665(1)	39(1)
C(2)	10120(5)	11577(4)	1157(2)	43(1)
C(3)	9299(4)	10878(3)	565(2)	36(1)
C(4)	8643(4)	9277(3)	766(1)	37(1)
C(5)	9532(6)	7990(4)	417(2)	50(1)
C(6)	12201(4)	9748(3)	2263(1)	36(1)
C(7)	13398(4)	9068(4)	1831(2)	41(1)
C(8)	15047(5)	8488(4)	2048(2)	48(1)
C(9)	15532(5)	8574(4)	2673(2)	50(1)
C(10)	14390(5)	9264(4)	3107(2)	44(1)
C(11)	12676(4)	9827(4)	2893(2)	39(1)
C(12)	9935(5)	10877(4)	2802(2)	42(1)
C(13)	14964(6)	9388(5)	3777(2)	64(1)
O(4)	4001(4)	10816(3)	237(1)	42(1)

Table 4. Bond lengths [Å] and angles [°] for 1.

O(1)-C(1)	1.418(4)	O(1)-C(4)	1.438(4)
O(2)-C(3)	1.413(4)	O(3)-C(5)	1.424(4)
N(1)-C(12)	1.378(4)	N(1)-C(6)	1.383(4)
N(1)-C(1)	1.453(4)	N(2)-C(12)	1.309(4)
N(2)-C(11)	1.392(4)	C(1)-C(2)	1.514(5)
C(2)-C(3)	1.534(5)	C(3)-C(4)	1.534(4)
C(4)-C(5)	1.493(4)	C(6)-C(7)	1.398(4)
C(6)-C(11)	1.408(5)	C(7)-C(8)	1.361(5)
C(8)-C(9)	1.399(5)	C(9)-C(10)	1.381(5)
C(10)-C(11)	1.392(5)	C(10)-C(13)	1.511(5)

C(1)-O(1)-C(4)	107.9(2)	C(12)-N(1)-C(6)	107.0(3)
C(12)-N(1)-C(1)	125.4(3)	C(6)-N(1)-C(1)	127.6(3)
C(12)-N(2)-C(11)	106.2(3)	O(1)-C(1)-N(1)	106.4(2)
O(1)-C(1)-C(2)	105.3(2)	N(1)-C(1)-C(2)	116.0(3)
C(1)-C(2)-C(3)	103.7(3)	O(2)-C(3)-C(2)	113.7(3)
O(2)-C(3)-C(4)	107.6(2)	C(2)-C(3)-C(4)	103.9(2)
O(1)-C(4)-C(5)	108.1(3)	O(1)-C(4)-C(3)	107.2(2)
C(5)-C(4)-C(3)	114.3(3)	O(3)-C(5)-C(4)	112.1(3)
N(1)-C(6)-C(7)	132.8(3)	N(1)-C(6)-C(11)	105.5(3)
C(7)-C(6)-C(11)	121.7(3)	C(8)-C(7)-C(6)	116.7(3)
C(7)-C(8)-C(9)	121.9(3)	C(10)-C(9)-C(8)	122.6(3)
C(9)-C(10)-C(11)	116.1(3)	C(9)-C(10)-C(13)	121.8(3)
C(11)-C(10)-C(13)	122.1(3)	N(2)-C(11)-C(10)	129.9(3)
N(2)-C(11)-C(6)	109.1(3)	C(10)-C(11)-C(6)	121.0(3)
N(2)-C(12)-N(1)	112.3(3)		

Symmetry transformations used to generate equivalent atoms:

Table 5. Anisotropic displacement parameters [$Å^2 \times 10^3$] for 1.

The anisotropic displacement factor exponent takes the form:

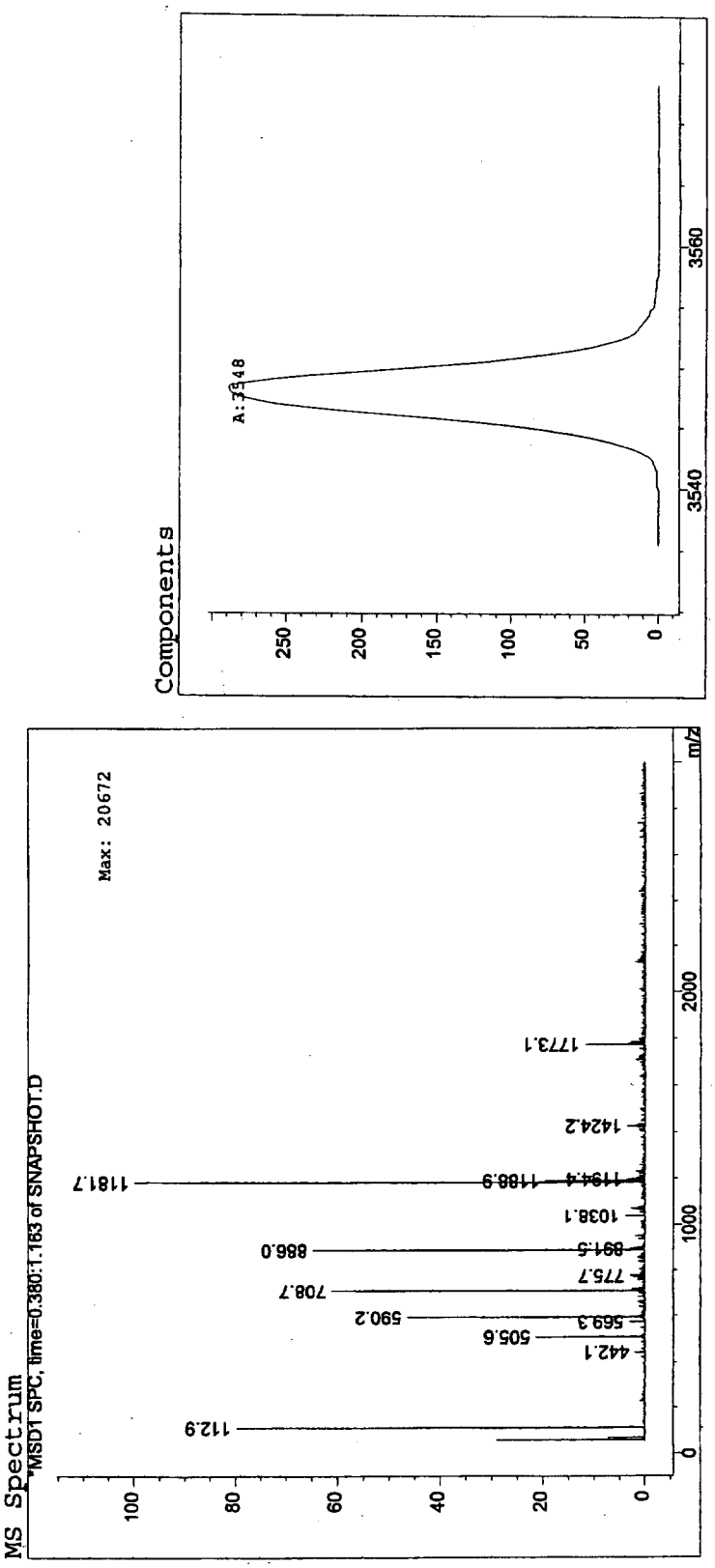
$-2\pi^2 [(ha^*)^2 U_{11} + ... + 2hka^* b^* U_{12}]$

	U11	U22	U33	U23	U13	U12
O(1)	52(1)	35(1)	27(1)	-1(1)	2(1)	-4(1)
O(2)	39(1)	47(1)	64(2)	19(1)	-12(1)	-6(1)
O(3)	134(3)	35(1)	30(1)	-1(1)	1(2)	-4(2)
N(1)	37(2)	44(2)	34(1)	-10(1)	1(1)	2(1)
N(2)	63(2)	43(2)	28(1)	-10(1)	4(1)	1(1)
C(1)	41(2)	39(2)	36(2)	-5(1)	-2(1)	2(1)
C(2)	51(2)	35(2)	44(2)	-1(2)	-6(2)	-4(2)
C(3)	32(2)	39(2)	38(2)	4(1)	-1(1)	-5(1)
C(4)	43(2)	39(2)	30(2)	3(1)	-3(1)	-4(1)
C(5)	86(3)	35(2)	29(2)	1(1)	5(2)	-1(2)
C(6)	36(2)	34(2)	38(2)	-2(1)	0(1)	-4(1)
C(7)	42(2)	44(2)	38(2)	-3(2)	6(1)	-1(2)
C(8)	45(2)	49(2)	51(2)	1(2)	9(2)	1(2)
C(9)	45(2)	50(2)	54(2)	11(2)	-1(2)	4(2)
C(10)	53(2)	41(2)	39(2)	5(2)	-4(2)	-1(2)
C(11)	45(2)	36(2)	36(2)	-2(1)	1(1)	-3(1)
C(12)	46(2)	41(2)	40(2)	-12(2)	10(2)	5(2)
C(13)	76(3)	76(3)	41(2)	7(2)	-12(2)	5(2)
O(4)	39(2)	43(1)	45(1)	-4(1)	-1(1)	1(1)

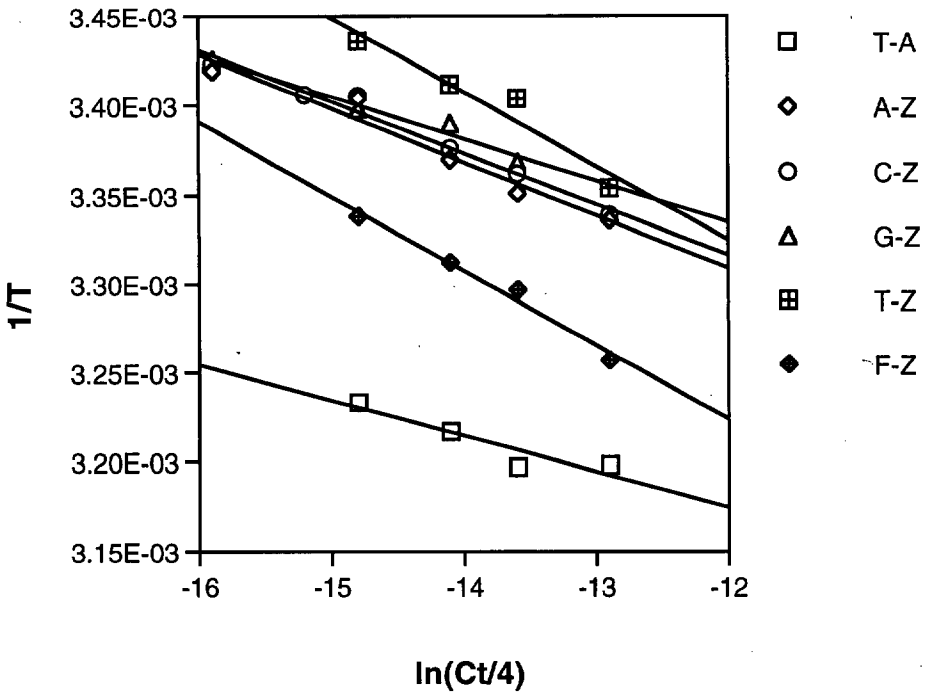
ES-MS spectrum of DNA 12mer:

5'-CTT TTC ZTT CTT (10)

Calculated mass: 3550
Found mass: 3548



Van't Hoff plots for melting measurements on DNA duplexes (Table 2 in text)



Supplementary Material

1-[2-Deoxy-3,5,-bis-O-(4-toluoyl)-β-D-*erythro*-pentofuranosyl]-4-methyl-1*H*-benzimidazole (6). 4-Methyl-1*H*-benzimidazole[17] (1.5 g, 11.3 mmol) was dissolved in dry acetonitrile (180 mL) in an oven- dried flask under argon. The solution was cooled to 0 °C and sodium hydride 60% oil suspension (0.50 g, 12.5 mmol) was added in one portion to the solution and stirred for 30 min. The solution was cooled to -5 °C with a brine-ice bath and 1-chloro-2-deoxy-3,5-di-*O*-*p*-toluoyl-α-D-*erythro*-pentofuranose[18] (4.41 g, 11.3 mmol) was added portionwise as a solid over 1 h. After 2 h the reaction was quenched by addition of saturated sodium bicarbonate solution and the aqueous layer was washed with ethyl acetate. The organic layers were washed with brine and dried over anhydrous magnesium sulfate. The solution was filtered, concentrated, and purified by silica chromatography, eluting with hexanes-acetone (1:2). The fractions containing β-isomers were concentrated to yield 4.23 g (77%). Further chromatographic purification yielded 3.283 g (60%) of a mixture of the toluoyl-protected isomers **5** and **6** and 885 mg (16%) of pure **6**: ^{1}H-NMR ($CDCl_3$, ppm) δ 8.00 (1H, s), 7.90 (2H, d, J=7.8 Hz), 7.82 (2H, d, J=7.8 Hz), 7.32 (1H, t, J=7.0 Hz), 7.20 (2H, d, J=7.8 Hz), 7.14 (2H, d, J=7.8 Hz), 7.10-6.85 (2H, m), 6.30 (1H, dd, J=6.0, 10.8 Hz), 5.62 (1H, m), 4.60 (1H, m), 4.52 (1H, m), 2.90-2.51 (2H, m), 2.55 (3H, s), 2.33 (3H, s), 2.30 (3H, s); ^{13}C-NMR ($CDCl_3$, ppm) δ 165.88, 165.66, 144.23, 143.80, 143.39, 139.46, 132.10, 132.27, 129.54, 129.41, 129.04, 126.54, 126.29, 125.78, 123.04, 122.86, 107.98, 85.29, 82.14, 63.75, 60.05, 37.72, 21.43, 21.38, 16.45, 16.39; HRMS (DCI) calcd. for $C_{29}H_{28}O_5N_2$ (M+1) 485.2076, found 485.2065.

1-[2-Deoxy-β-D-*erythro*-pentofuranosyl]-4-methyl-1*H*-benzimidazole (1). 1-[2-Deoxy-3,5,-bis-O-(4-toluoyl)-β-D-*erythro*-pentofuranosyl]-4-methyl-1*H*-benzimidazole (6) (885 mg, 1.82 mmol) was suspended in dry methanol (15 mL) and a 0.5 M solution of sodium methoxide in methanol (1.2 mL) was added. The reaction mixture was stirred at room temperature for 2 h. Solid ammonium chloride (2.5 g) was added and stirring was continued for 10 more min. The mixture was filtered, washed with methanol and concentrated. The crude product was purified by silica column chromatography (dichloromethane-methanol, 10:1) to obtain 402 mg (89%) of

nucleoside **1**: ^{1}H-NMR (CD_3OD, ppm) δ 8.42 (1H, s), 7.46 (1H, d, J=8.5 Hz), 7.20 (1H, t, J=8.0 Hz), 7.08 (1H, d, J=8.0 Hz), 6.37 (1H, t, J=6.7 Hz), 4.65 (1H, br s), 4.52 (1H, m), 4.00 (1H, m), 3.82-3.69 (2H, m), 2.73-2.41 (2H, m), 2.60 (3H, s); ^{13}C-NMR ($CDCl_3$, ppm) δ 143.5, 142.0, 137.0, 134.5, 130.5, 124.7, 124.6, 109.7, 88.8, 86.4, 72.5, 63.1, 41.8, 17.0; HRMS (DCI) calcd. for $C_{13}H_{16}O_3N_2$ (M+1) 249.1239, found 249.1233.