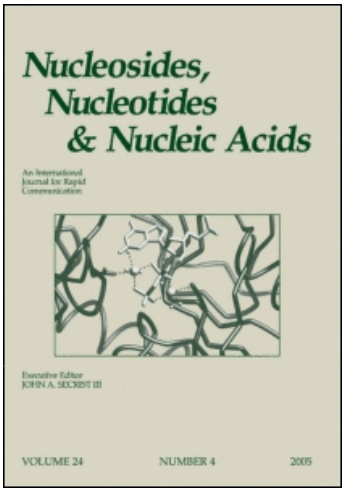



**Nucleosides, Nucleotides and Nucleic Acids**
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713597286

# 3-Substituted Pyrazinone Nucleosides—A New Family of D4T Analogues

Nathalie Batoux[a]; Robert Granet[a]; Rachida Zerrouki[a]; Pierre Krausz[a]
[a] Laboratoire de Chimie des Substances Naturelles, Faculté des Sciences et Techniques, Université de Limoges, Limoges, France

**To cite this Article** Batoux, Nathalie , Granet, Robert , Zerrouki, Rachida and Krausz, Pierre(2009) '3-Substituted Pyrazinone Nucleosides—A New Family of D4T Analogues', Nucleosides, Nucleotides and Nucleic Acids, 28: 9, 866 — 873
**To link to this Article: DOI:** 10.1080/15257770903169999
**URL:** http://dx.doi.org/10.1080/15257770903169999

*Nucleosides, Nucleotides and Nucleic Acids*, 28:866–873, 2009

ISSN: 1525-7770 print / 1532-2335 online
DOI: 10.1080/15257770903169999

Taylor & Francis
Taylor & Francis Group

# 3-SUBSTITUTED PYRAZINONE NUCLEOSIDES—A NEW FAMILY OF D4T ANALOGUES

**Nathalie Batoux, Robert Granet, Rachida Zerrouki, and Pierre Krausz**

*Université de Limoges, Laboratoire de Chimie des Substances Naturelles, Faculté des Sciences et Techniques, Limoges, France*

□ *The synthesis of a new family of D4T analogues is described to study the influence of pyrazinone base on antiretroviral power. Substitution of 3H by methyl or n-decyl increases the lipophilic character and may facilitate diffusion across cell membranes. The compounds were characterized by $^1H$ NMR and infrared spectroscopy. Antiviral (HIV-1) properties of these compounds were examined.*

**Keywords** Pyrazinone; d4t; nucleosides; HIV

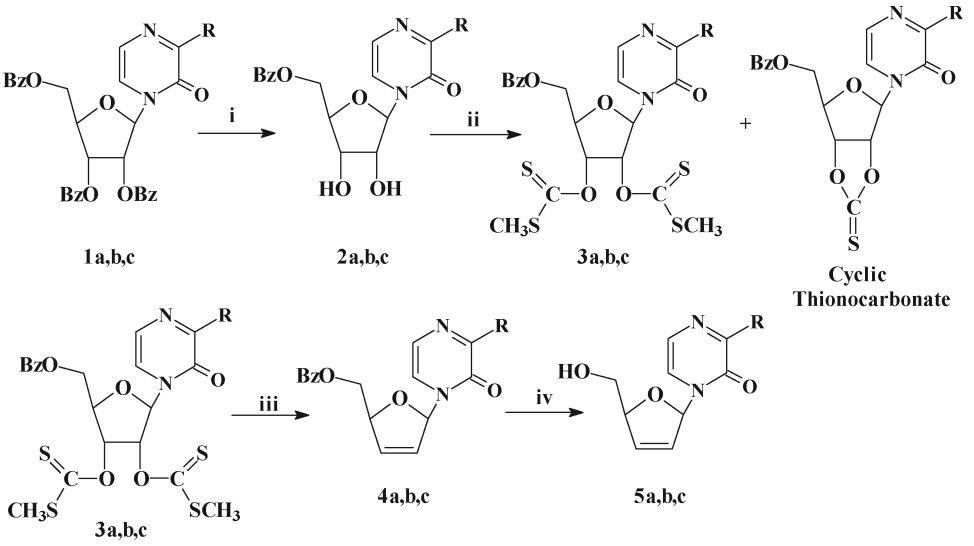


The nucleoside analogue 2′,3′-didehydro-2′,3′-dideoxythymidine (d4T) is used in combination with other drugs to treat human immunodeficiency virus (HIV) infection. As part of our program to search for new anti-HIV nucleosides, we were interested in the preparation of a new family of d4t analogues **5a**,**b**,**c** and to study the influence of the pyrazinone base on their antiretroviral power. Substitution of H-3 by methyl or n-decyl increases the lipophilic character and may facilitate diffusion across cellular membranes. The strategy of synthesis of d4t analogues **5a**,**b**,**c** is presented in Scheme 1.

## RESULTS AND DISCUSSION

Pyrazinone nucleosides (**1a**,**b**,**c**) were synthesized according to a method described in a previous article;[1] the preparation of 2′,3′-unprotected compounds **2a**,**b**,**c**[2] was eased because secondary hydroxyl groups can be efficiently and selectively deprotected by methanolic $NH_3$, provided that the amount of $NH_3$ be 25 equivalents per protecting benzoyl group. In each case, the reaction was checked by thin layer chromatography (TLC)

Received 1 July 2009; accepted 7 July 2009.
Address correspondence to Rachinda Zerrouki, Université de Limoges, Laboratoire de Chimie des Substances Naturelles, EA1069, Faculté des Sciences et Techniques, 123, Av. Albert Thomas, 87060, Limoges, France. E-mail: Rachida.zerrouki@unilim.fr




**SCHEME 1** Strategy of synthesis of d4t analogues.



and was stopped as soon as the trihydroxyl derivatives appeared. A reaction time of 6 hours at room temperature led to the unprotected products. After evaporation and purification, deprotected compounds **2a**,**b**,**c** were obtained in reasonable yields (60%, 64%, and 65%). Infrared (IR) spectra display a hydroxyl band at 3410 $cm^{-1}$ and $^1H$ NMR indicates the presence of only one benzoyl group.

Many methods have been described for obtaining double bonds from diols. We used the Barton's method[3] in order to synthesize unsaturated compounds **4a**,**b**,**c**. The reaction proceeds in two steps The first step is in the formation of a bisxanthate intermediate by reaction of the diol with carbon disulfide, sodium hydride, and methyl iodide in anhydrous tetrahydrofuran (THF). In these conditions, reaction of **2a** gives two products. Structural elucidation of these compounds indicated that one was the expected bisxantate product **3a** obtained in low yield (31%) and the second (53%) was a cyclic thionocarbonate. After numerous attempts, the reaction was finally conducted in anhydrous N,N-dimethylformamide (DMF), and compound **2a** led to the desired bisxantate **3a** in 82% yield along with 15% of cyclic thionocarbonate. Compounds **3b** and **3c** were obtained in 65% and 70% yields, respectively, with 15% of cyclic thionocarbonate.

The second step, which allows the formation of the double bond, is a radical reaction that takes place in anhydrous dioxane in the presence of tributylphosphine-borane and 2,2-azobisisobutyronitrile as initiator. The olefin compound **4c** was obtained in good yield (95%), compound **4b** in acceptable yield (60%), and compound **4a** in low yield 36%. We have

tried several methods[4] for obtaining **4a** in acceptable yield but without improvement.

Deprotection of the primary hydroxyl group was achieved using 7 M ammonia in methanol. The expected compounds were obtained in good yields.

The biological properties of compounds **5a,b,c** were evaluated on CEM-SS cells infected by HIV-1 LAI virus and on MT4 cells infected by HIV-1 IIIB according to standardized protocols.[5] These compounds do not show any activity against these viruses and were found non-cytotoxic.

## EXPERIMENTAL

All the solvents and chemicals were commercially available and, unless otherwise stated, were used as received. Reactions were monitored by TLC on precoated 0.2 mm silica gel 60 $F_{254}$ (Merck, Germany) plates and visualized in several ways: with an ultraviolet light source at 254 nm, by spraying with sulfuric acid (6N), and heating to 200°C. Silica gel (Merck Kieselgel 60, 15–40 $\mu$m) was used for flash chromatography. $^1$H NMR spectra were recorded at 400.13 MHz with a Bruker (Germany) DPX spectrometer. Chemical shifts ($\delta$) are expressed in ppm with $Me_4Si$ as internal standard ($\delta = 0$). Data are reported as follows: chemical shift, multiplicity (s, singlet; d, doublet; t, triplet; q, quartet; quint, quintet; m, multiplet and br, broad), coupling constants (Hz), and assignment. Melting points (m.p.) were determined with a Kofler block and are uncorrected. IR spectra were recorded on a Perkin Elmer (France) 1310 grating spectrophotometer and are reported in wave number ($cm^{-1}$).



***1-(5′-O-benzoyl-β-D-ribofuranosyl)pyrazin-2-one (2a).*** 1-(2′,3′,5′-*O*-benzoyl-β-D-ribo furanosyl)pyrazin-2-one **1a** (1.62 g, 3 mmol) was stirred with methanolic ammonia (7 N) (50 equiv.) in methanol (21.50 mL) at room temperature during 6 hours. The solvent was removed under reduced pressure and the crude residue was purified by recrystallization in ethyl acetate to yield compound **2a** as crystal in 60% (600 mg). $R_f$ = 0.46 ($CHCl_3$/EtOH, 9/1, v/v); Tf = 155–158°C; IR: 3400–3250 (OH), 3050–2860 (CH), 1720 (C=O benzoyl), 1651 (C=O), 1585 (C=C). $^1$H NMR (400.13 MHz, $CDCl_3-CD_3OD$): $\delta$ 4.18 (m, 2H, H-2′, H-3′); 4.48 (m, 1H, H-4′); 4.67 (dd, 1H, J = 12.7, 3.0 Hz, H-5′a); 4.81 (dd, 1H, J = 12.7, 2.2 Hz, H-5′b); 5.92 (brs, 1H, H-1′); 7.24 (d, 1H, J = 3.9 Hz, H-5); 8.10 (brs, 1H, H-3), 7.49–8.01 (m, Har, H-6). $^{13}$C NMR:$\delta$ 63.26 (C-5′); 69.43 (C-3′); 75.13 (C-2′); 82.20 (C-4′); 91.84 (C-1′); 123.38 (C-5); 124.65 (C-6); 128.83, 129.51, 129.68, 133.85 (C–Ar); 148.60 (C-3); 156.15 (C-2), 166.61 (C=O). SM (DCI/$NH_3$): m/z 333 $(M+H)^+$; m/z 350 $(M+NH_4)^+$.

***1-(5′-O-benzoyl-β-D-ribofuranosyl)-3-methylpyrazin-2-one (2b).*** Compound **2b** was prepared according to the procedure described for **2a** starting from

1-(2′,3′,5′-*O*-benzoyl-β-D-ribo furanosyl)-3-methylpyrazin-2-one **1b** (1.11 g, 2 mmol) and stirred with methanolic ammonia (7 N) (50 equiv.). Yield: 64% (444 mg). $R_f$ = 0.50 ($CHCl_3$/EtOH, 9/1, v/v); IR: 3390 (OH), 3000–2860 (CH), 1720 (C=O benzoyl), 1645 (C=O), 1580 (C=C). $^1$H NMR (400.13 MHz, $CDCl_3$): δ 2.45 (s, 3H, $CH_3$); 4.20 (m, 2H, H-2′, H-3′); 4.48 (m, 1H, H-4′); 4.67 (dt, 1H, J = 12.7, 3.0 Hz, H-5′a); 4.81 (dt, 1H, J = 12.7, 2.2 Hz, H-5′b); 5.93 (d, 1H, J = 3.2 Hz, H-1′); 7.24 (d, 1H, J = 3.9 Hz, H-5); 7.50–8.01 (m, Har, H-6). $^{13}$C NMR:δ 20.38 ($CH_3$); 63.67 (C-5′); 71.16 (C-3′); 76.43 (C-2′); 83.99 (C-4′); 93.01 (C-1′); 121.04 (C-5); 124.07 (C-6); 128.66, 128.79, 129.67, 130.30 (C−Ar); 156.62 (C-3); 157.38 (C-2), 166.29 (C=O). SM (DCI/$NH_3$): m/z 347 $(M+H)^+$; m/z 364 $(M+ NH_4)^+$.

***1-(5′-O-benzoyl-β-D-ribofuranosyl)-3-decylpyrazin-2-one (2c).*** Compound **2c** was prepared according to the procedure described for **2a** starting from 1-(2′,3′,5′-*O*-benzoyl-β-D-ribo furanosyl)-3-decylpyrazin-2-one **1c** (1.36 g, 2 mmol) and stirred with methanolic ammonia (7 N) (50 equiv.). Yield: 65% (615 mg). $R_f$ = 0.39 ($CHCl_3$/EtOH, 95/5, v/v); IR: 3400 (OH), 3000–2850 (CH), 1719 (C=O benzoyl), 1650 (C=O), 1585 (C=C). $^1$H NMR (400.13 MHz, $CDCl_3$): δ 0.88 (t, 3H, J = 6.7 Hz, $CH_3$); 1.25 (brs, 14H, $(CH_2)_7$); 1.68 (quint, 2H, J = 7.5 Hz, $CH_2$); 2.80 (brq, 2H, J = 7.3 Hz, $CH_2$); 4.26 (dd, 1H, J = 5.2, 4.2 Hz, H-2′); 4.33 (dd, 1H, J = 3.7, 5.2 Hz, H-3′); 4.55 (dd, 1H, J = 12.4, 3.5 Hz, H-5′a); 4.64 (ddt, 1H, J = 3.5, 2.9 Hz, H-4′); 4.72 (dd, 1H, J = 12.4, 2.9 Hz, H-5′b);5.91 (d, 1H, J = 4.2 Hz, H-1′), 7.28 (d, 1H, J = 4.6 Hz, H-5); 7.52 (d, 1H, J = 4.6, H-6); 7.40–7.88 (m, Har). $^{13}$C NMR: δ 14.11 ($CH_3$); 22.68, 26.58, 29.33, 29.47, 29.52, 29.56, 29.61(C-alkyl); 63.72 (C-5′); 71.73 (C-3′); 76.84 (C-2′); 84.56 (C-4′); 93.26 (C-1′); 120.34 (C-5); 124.08 (C-6); 128.47, 128.61, 129.46, 130.17, 133.59, 133.62 (C−Ar); 156.47 (C-3); 160.31 (C-2), 166.04 (C=O). SM (DCI/$NH_3$): m/z 473 $(M+H)^+$.

***1-(5-O-benzoyl-2,3-bis-O-((methylthio)thiocarbonyl)-β-D-ribofuranosyl)pyrazin-2-one (3a).*** Compound **2a** (300 mg, 0.903 mmol) was solubilized in 7.5 mL of anhydrous DMF with 0.183 mL (3.24 mmol, 3.35 equiv.) of $CS_2$ and 120 mg (3.24 mmol) of sodium hydride. This solution was placed under argon; iodomethane was then added (126 μL, 2.031 mmol). The mixture was stirred until completion of reaction as monitored by TLC (30 minutes) and stopped with the addition of ethanol. After work up, the crude residue purified by thin layer preparative chromatography on silica gel ($CHCl_3$/EtOH, 93/7) yielded compound **3a** in 82% (381 mg). $R_f$ = 0.49 ($CHCl_3$/EtOH, 95/5, v/v); IR: 2900 (CH), 1722 (C=O benzoyl), 1652 (C=O), 1600 (C=C), 1020 (C=S). $^1$H NMR (400.13 MHz, $CDCl_3$): δ 2.58 (s, 3H, S-$CH_3$); 2.60 (s, 3H, S-$CH_3$); 4.67 (dd, 1H, J = 4.6, 13.0 Hz, H-5′a); 4.80 (dd, 1H, J = 2.8, 13.0 Hz, H-5′b); 4.82 (m, 2H, H-4′); 6.25 (t, 1H, J = 4.7 Hz, H-2′); 6.40 (dd, 1H, J = 4.9, 5.7 Hz, H-3′); 6.49 (t, 1H, J = 5.5 Hz, H-1′), 7.17–7.61 (m, Har, H-5, H-6); 8.09 (d, 1H, J = 1.2, H-3). $^{13}$C NMR: δ

19.39 (S-$CH_3$); 19.59 (S-$CH_3$); 63.59 (C-5′); 77.35 (C-4′); 80.02 (C-3′); 80.80 (C-2′); 89.28 (C-1′); 123.90 (C-5); 128.68, 128.85, 129.17, 129.77, 133.65, (C−Ar, C-6); 150.47 (C-3); 155.15 (C-2), 166.00 (C=O). SM (DCI/$NH_3$): m/z 513 $(M+H)^+$, 530 $(M+NH_4)^+$.

***1-(5-O-benzoyl-2,3-bis-O-((methylthio)thiocarbonyl)-β-D-ribofuranosyl)-3-methylpyrazin-2-one (3b).*** Compound **3b** was prepared according to the procedure described for **3a** starting from **2b** (350 mg, 1.01 mmol). Yield: 65% (342 mg). $R_f$ = 0.57 ($CHCl_3$/EtOH, 95/5, v/v); IR: 2850 (CH), 1720 (C=O benzoyl), 1650 (C=O), 1605 (C=C), 1020 (C=S). $^1$H NMR (400.13 MHz, $CDCl_3$): δ 2.44 (s, 3H, $CH_3$); 2.58 (s, 3H, S-$CH_3$); 2.59 (s, 3H, S-$CH_3$); 4.65 (dd, 1H, J = 3.2, 11.9 Hz, H-5′a); 4.80 (m, 2H, H-4′, H-5′b); 6.20 (t, 1H, J = 4.4 Hz, H-3′); 6.40 (dd, 1H, J = 4.4, 5.8 Hz, H-2′); 6.49 (t, 1H, J = 5.8 Hz, H-1′), 7.07–8.10 (m, Har, H-5, H-6).$^{13}$C NMR: δ 19.42 (S-$CH_3$); 19.57 (S-$CH_3$); 20.52 ($CH_3$); 64.02 (C-5′); 81.02 (C-3′); 81.43 (C-2′); 87.99 (C-4′); 92.00 (C-1′); 120.84 (C-5); 124.15; 128.62, 129.00, 129.65, 130.80 (C−Ar, C-6); 155.62 (C-3); 157.88 (C-2), 166.00 (C=O). SM (DCI/$NH_3$): m/z 527 $(M+H)^+$, 544 $(M+NH_4)^+$.

***1-(5-O-benzoyl-2,3-bis-O-((methylthio)thiocarbonyl)-β-D-ribofuranosyl)-3-decylpyrazin-2-one (3c).*** Compound **3c** was prepared according to the procedure described for **3a** starting from **2c** (200 mg, 0.42 mmol). Yield: 70% (185 mg). $R_f$ = 0.60 ($CHCl_3$/EtOH, 98/2, v/v); IR: 2900 (CH), 1725 (C=O benzoyl), 1665 (C=O), 1610 (C=C), 1022 (C=S). $^1$H NMR (400.13 MHz, $CDCl_3$): δ 0.90 (t, 3H, J = 7.0 Hz, $CH_3$); 1.28 (brs, 14H, $(CH_2)_7$); 1.66 (quint, 2H, J = 7.5 Hz, $CH_2$); 2.59 (s, 3H, S-$CH_3$); 2.60 (s, 3H, S-$CH_3$); 2.84 (brq, 2H, J = 7.0 Hz, $CH_2$); 6.35 (dd, 1H, J = 5.2, 6.0 Hz, H-2′); 6.15 (dd, 1H, J = 3.7, 5.2 Hz, H-3′); 4.62 (dd, 1H, J = 12.0, 3.8 Hz, H-5′a); 4.82 (m, 2H, H-4′, H-5′b); 6.48 (d, 1H, J = 6.0 Hz, H-1′), 7.20 (d, 1H, J = 4.6 Hz, H-5); 7.17–8.07 (m, Har, H-6).$^{13}$C NMR: δ 14.16 ($CH_3$); 19.40 (S-$CH_3$); 19.55 (S-$CH_3$); 22.66, 26.08, 29.00, 29.32, 29.44, 29.56, 29.71(C-alkyl); 64.12 (C-5′); 84.51 (C-3′); 81.73 (C-2′); 87.00 (C-4′); 92.12 (C-1′); 122.80 (C-5); 127.11 (C-6); 128.70, 129.20, 129.86, 132.73, 133.21, 133.52 (C−Ar); 154.12 (C-3); 157.43 (C-2), 166.11 (C=O). SM (DCI/$NH_3$): m/z 653 $(M+H)^+$, 670 $(M+NH_4)^+$.

***1-(5-benzoyl-2,3-dideoxy-β-D-glyceropent-2-enofuranosyl) pyrazin-2-one (4a).*** An amount of 254 mg (0.494 mmol) of compound **3a** were dissolved in anhydrous dioxane (6 mL) and tributylphosphine borane (0.40 mL, 1.486 mmol). This system was stirred under argon and immersed in an oil bath at 105°C. A solution of AIBN (0.6 equiv.) in dioxane was added dropwise and let to react during 5 houra. The reaction was evaporated and the crude product was purified using preparative TLC ($CHCl_3$/EtOH, 95/5, v/v). Pure **4a** (54 mg) was recovered in 36% yield. $R_f$ = 0.30 ($CHCl_3$/EtOH, 95/5, v/v); IR: 2900 (CH), 1720 (C=O benzoyl), 1650 (C=O), 1610 (C=C). $^1$H NMR (400.13 MHz, $CDCl_3$): δ 4.57 (dd, 1H, J = 2.7, 12.5 Hz, H-5′a);

4.73 (dd, 1H, J = 3.7, 12.5 Hz, H-5′b); 5.28 (m, 1H, H-4′); 6.10 (brt, 1H, J = 5.8 Hz, H-3′); 6.34 (dt, 1H, J = 1.3, 6.0 Hz, H-2′); 7.06 (m, 1H, H-1′); 7.08 (d, 1H, J = 4.6 Hz, H-6); 7.41 (brd, 1H, J = 4.5 Hz, H-5); 8.09 (brs, 1H, H-3); 7.44–7.97 (m, Har). $^{13}$C NMR: $\delta$ 64.75 (C-5′); 85.58 (C-4′); 90.81 (C-1′); 121.46 (C-5); 122.35 (C-6); 155.64 (C-3); 158.10 (C-2); 127.74, 128.62, 129.40, 129.73, 132.34, 133.71 (C−Ar, C-2′, C-3′); 166.28 (C-6). SM (DCI/$NH_3$): m/z 299 $(M+H)^+$, 316 $(M+NH_4)^+$.

***1-(5-benzoyl-2,3-dideoxy-β-D-glyceropent-2-enofuranosyl)-3-methylpyrazin-2-one (4b).*** Compound **4b** was prepared according to the procedure described for **4a** starting from **3b** (240 mg, 0.456 mmol). Yield: 65% (93 mg); $R_f$ = 0.40 ($CHCl_3$/EtOH, 95/5, v/v); IR: 3090 (CH), 1720 (C=O benzoyl), 1654 (C=O), 1600 (C=C). $^1$H NMR (400.13 MHz, $CDCl_3$): $\delta$ 2.45 (s, 3H, $CH_3$); 4.55 (dd, 1H, J = 2.9, 12.5 Hz, H-5′a); 4.75 (dd, 1H, J = 3.9, 12.5 Hz, H-5′b); 5.27 (m, 1H, H-4′); 6.07 (dt, 1H, J = 5.8, 1.4 Hz, H-3′); 6.34 (dt, 1H, J = 1.5, 6.0 Hz, H-2′); 6.97 (d, 1H, J = 4.7 Hz, H-6); 7.11 (m, 1H, H-1′); 7.28 (d, 1H, J = 4.7 Hz, H-5); 7.45–7.97 (m, Har). $^{13}$C NMR: $\delta$ 20.70 ($CH_3$); 64.85 (C-5′); 85.52 (C-4′); 90.61 (C-1′); 121.42 (C-5); 122.18 (C-6); 155.67 (C-3); 158.19 (C-2); 127.73, 128.56, 129.40, 129.68, 132.22, 133.55 (C−Ar, C-2′, C-3′); 166.16 (C-6). SM (DCI/$NH_3$): m/z 313 $(M+H)^+$, 330 $(M+NH_4)^+$.

***1-(5-benzoyl-2,3-dideoxy-β-D-glyceropent-2-enofuranosyl)-3-decylpyrazin-2-one (4c).*** Compound **4c** was prepared according to the procedure described for **4a** starting from **3c** (150 mg, 0.228 mmol). Yield: 95% (96 mg); $R_f$ = 0.57 ($CHCl_3$/EtOH, 98/2, v/v); IR: 2920 (CH), 1720 (C=O benzoyl), 1650 (C=O), 1595 (C=C). $^1$H NMR (400.13 MHz, $CDCl_3$): $\delta$ 0.87 (t, 3H, J = 6.7 Hz, $CH_3$); 1.25 (brs, 14H, $CH_2$); 1.68 (quint, 2H, J = 7.5 Hz, $CH_2$); 2.78 (dt, 2H, J = 1.9, 7.1 Hz, $CH_2$) 4.57 (dd, 1H, J = 2.9, 12.5 Hz, H-5′a); 4.71 (dd, 1H, J = 4.8, 12.5 Hz, H-5′b); 5.28 (m, 1H, H-4′); 6.07 (dt, 1H, J = 5.9, 1.7 Hz, H-3′); 6.36 (dt, 1H, J = 1.5, 6.0 Hz, H-2′); 6.99 (d, 1H, J = 4.6 Hz, H-6); 7.10 (m, 1H, H-1′); 7.31 (d, 1H, J = 4.7 Hz, H-5); 7.45–7.97 (m, Har). $^{13}$C NMR: $\delta$ 14.14 ($CH_3$); 22.75, 26.68, 29.40, 29.54, 29.60, 29.63, 29.67, 31.99, 33.45 ($CH_2$); 64.98 (C-5′); 85.64 (C-4′); 90.78 (C-1′); 121.52 (C-5); 122.71 (C-6); 155.60 (C-3); 161.31 (C-2); 127.73, 128.68, 129.41, 129.73, 132.44, 133.72 (C−Ar, C-2′, C-3′); 166.45 (C-6). SM (DCI/$NH_3$): m/z 453 $(M+H)^+$, 471 $(M+NH_4)^+$.

***1-(2,3-dideoxy-β-D-glyceropent-2-enofuranosyl)pyrazin-2-one (5a).*** Compound **4a** (71 mg, 0.235 mmol) was dissolved in methanolic ammonia (7 N) (10 mL) and stirred during 3 days at room temperature. Solvent was removed under reduced pressure and the crude residue was purified by thin layer preparative chromatography on silica gel ($CHCl_3$/ EtOH, 9/1, v/v) to yield compound **5a** in 95% (44 mg). $R_f$ = 0.40 ($CHCl_3$/EtOH, 9/1, v/v); IR: 3400 (OH), 2900 (CH), 1650 (C=O), 1600 (C=C). $^1$H NMR (400.13 MHz, $CD_3OD$): $\delta$ 3.76 (dd, 1H, J = 3.5, 12.4 Hz, H-5′a); 3.81 (dd, 1H, J = 3.2, 12.4 Hz, H-5′b); 4.99 (m, 1H, H-4′); 6.02 (ddd, 1H, J = 1.5, 1.8, 6.1 Hz,

H-3′); 6.41 (dt, 1H, J = 1.6, 6.1 Hz, H-2′); 7.06 (m, 1H, H-1′); 7.39 (d, 1H, J = 4.6 Hz, H-6); 7.95 (dd, 1H, J = 1.0, 4.6 Hz, H-5); 8.02 (brs, 1H, H-3). SM (DCI/$NH_3$): m/z 195 $(M+H)^+$, 212 $(M+NH_4)^+$.

***1-(2,3-dideoxy-β-D-glyceropent-2-enofuranosyl)-3-methylpyrazin-2-one (5b).*** **5b** was prepared according to the procedure described for **5a** starting from **4b** (50 mg, 0.16 mmol). Yield: 96% (32 mg); $R_f$ = 0.43 ($CHCl_3$/EtOH, 9/1, v/v); IR: 3395 (OH), 2915 (CH), 1651 (C=O), 1591 (C=C), 1020. $^1$H NMR (400.13 MHz, $CD_3OD$): δ 2.39 (brs, 3H, $CH_3$); 3.74 (dd, 1H, J = 3.7, 12.4 Hz, H-5′a); 3.80 (dd, 1H, J = 3.2, 12.4 Hz, H-5′b); 4.98 (m, 1H, H-4′); 6.00 (ddd, 1H, J = 1.5, 1.8, 6.0 Hz, H-3′); 6.39 (dt, 1H, J = 1.6, 6.0 Hz, H-2′); 7.08 (m, 1H, H-1′); 7.21 (d, 1H, J = 4.6, H-6); 7.79 (d, 1H, J = 4.6 Hz, H-5). SM (ESI): m/z 230.97 $(M+Na)^+$.

***1-(2,3-dideoxy-β-D-glyceropent-2-enofuranosyl)-3-methylpyrazin-2-one (5c).*** Compound **5c** was prepared according to the procedure described for **5a** starting from **4c** (50 mg, 0.115 mmol). Yield: 99% (39 mg); $R_f$ = 0.32 ($CHCl_3$/EtOH, 95/5, v/v); IR: 3360 (OH), 2900 (CH), 1650 (C=O), 1591 (C=C). $^1$H NMR (400.13 MHz, $CD_3OD$): δ 0.89 (brt, 3H, J = 6.8 Hz, $CH_3$); 1.29 (brs, 14H, $CH_2$); 1.68 (br quint, 2H, J = 7.4 Hz, $CH_2$); 2.76 (dd, 2H, J = 6.6, 8.5 Hz, $CH_2$); 3.74 (dd, 1H, J = 3.7, 12.3 Hz, H-5′a); 3.80 (dd, 1H, J = 3.2, 12.3 Hz, H-5′b); 4.98 (m, 1H, H-4′); 6.00 (ddd, 1H, J = 1.5, 1.9, 6.0 Hz, H-3′); 6.39 (dt, 1H, J = 1.6, 6.0 Hz, H-2′); 7.08 (m, 1H, H-1′); 7.25 (d, 1H, J = 4.6 Hz, H-6); 7.78 (d, 1H, J = 4.6 Hz, H-5). SM (ESI): m/z 357.20 $(M+Na)^+$.



## REFERENCES


1. Davis, J.; Benhaddou, R.; Granet, R.; Krausz, P.; De Monte, M.; Aubertin, A. M. Synthesis and antiviral evaluation of pyrazinones substituted with acyclic chains. *Nucleosides Nucleotides* **1998**, 17, 875–893.
2. Zerrouki, R.; Roy, V.; Hadj-Bouazza, A.; Krausz, P. Selective deprotection of fully benzoylated nucleoside derivatives. *J. Carbohydr. Chem.* **2004**, 23, 299–303.
3. a) Barton, D.H.R.; McCombie, S.W. A new method for the deoxygenation of secondary alcohols. *Perkin Trans I* **1975**, 16, 1574–1585. b) Barett, A.G.M.; Barton, D.H.R.; Bielski, R. Reactions of relevance to the chemistry of aminoglycoside antibiotics. Part 11. Preparation of olefins from vicinal diols. *Perkin Trans I* **1979**, 2378–2381. c) Barton, D.H.R.; Ok Jang, D.; Jaszberenyi, J.Cs. On the mechanism of deoxygenation of secondary alcohols by tin hydride reduction of methyl xanthates and other thiocarbonyl derivatives. *Tetrahedron Lett.* **1990**, 31, 3991–3994.
4. a) Eastwood, F.W.; Harrington, K.J.; Josan, J.S.; Pura, J.L. Conversion of 2-dimethylamino-1,3-dioxolanes into alkenes. *Tetrahedron Lett.* **1970**, 60, 5223–5224. b) Hanessian, S.; Moralioglu, E. Preparative and explorative carbohydrate chemistry. Chemistry and synthetic utility of a -(dimethylamino)benzylidene and 1-(dimethylamino)ethylidene acetals. *Can. J. Chem.* **1972**, 50, 233–245. c) Samuelsson, B.; Garreg, P.J. One-step conversion of vicinal diols into olefins, using a novel reagent system. *Synthesis* **1979**, 469–470. d) Liu, Z.; Classon, B.; Samuelson, B. A novel route to olefins from vicinal diols. *J. Org. Chem.* **1990**, 55, 4273–4275. e) Corey, E.J.; Carey, F.A.; Winter, R.A.E. Stereospecific syntheses of olefins from 1,2-thionocarbonates and 1,2-trithiocarbonates. trans-cycloheptene. *J. Am. Chem. Soc.* **1965**, 87, 934–935. f) Corey, E.J.; Winter, R.A.E. New stereospecific

olefin synthesis from 1,2-diols. *J. Am. Chem. Soc.* **1963**, 85, 2677–2678. g) Corey, E.J.; Hopkins, P.B. A mild procedure for the conversion of 1,2-diols to olefins. *Tetrahedron Lett.* **1982**, 23, 1979–1982.

5. Moog, C.; Wick, A.; Le Ber, P.; Kirn, A.; Aubertin, A.M. Bicyclic imidazo derivatives, a new class of highly selective inhibitors for the human immunodeficiency virus type 1. *Antivir. Res.* **1994**, 24, 275–288.