

A VERSATILE SYNTHESIS OF DIHYDROPYRIMIDINONE C-NUCLEOSIDES⁺

Ram Chandra Mishra, Diksha Katiyar, Neetu Tewari and Rama Pati Tripathi*

Medicinal Chemistry Division, Central Drug Research Institute, Lucknow-226001, India

Fax:0522-223938,223405, Tel. No. (0522) 212411-18 (4382)

E-mail: rpt_56@yahoo.com

Abstract: A versatile syntheses of N-aryl dihydropyrimidinone C-nucleosides (**20-29**) is described. Glycosyl amino esters (**3-9**), obtained by reductive arylation of glycosyl amino esters **1** and **2**, on condensation with different isocyanates afforded respective ureidyl derivatives (**10-19**) in good to quantitative yields. The latter on cyclative amidation with a combination of DBU/ tetra butyl ammonium bromide/ 4Å MS gave the respective nucleosides (**20-29**) in good yields.

INTRODUCTION

Dihydropyrimidinones have been used as reagents and chiral auxiliaries in asymmetric synthesis of β -amino acids and many other biologically important compounds.¹ C-Nucleosides, having a C-C linkage instead of a C-N linkage between the aglycon and sugar moiety are more stable towards the enzymatic degradation and therefore the half-life of these compounds is far greater than that of nucleosides. Further, these nucleosides are associated with anticancer,² antibacterial,³ antiviral⁴ and antileukemic activities.^{5,6} In spite of so much importance, no serious attempt has been made for the last two decades to synthesize dihydropyrimidinone C-nucleosides. Several reports exist for the synthesis

* Corresponding Author

of C-nucleosides.^{7, 8} Prominent among these are condensations of suitably protected sugar or tetrahydrofuranaldehydes to metalated bases or the development of heterocycles on preformed sugar derivatives by chemical modifications.⁹ Reports on the synthesis of tetrahydropyrimidinone heterocycle by cyclisation of D- or L-asparagine and other β -amino acids with aldehydes also exist.¹⁰ Reported methods for the synthesis of C-nucleosides are difficult to perform and unsuitable for large-scale synthesis because of low yields and high cost.

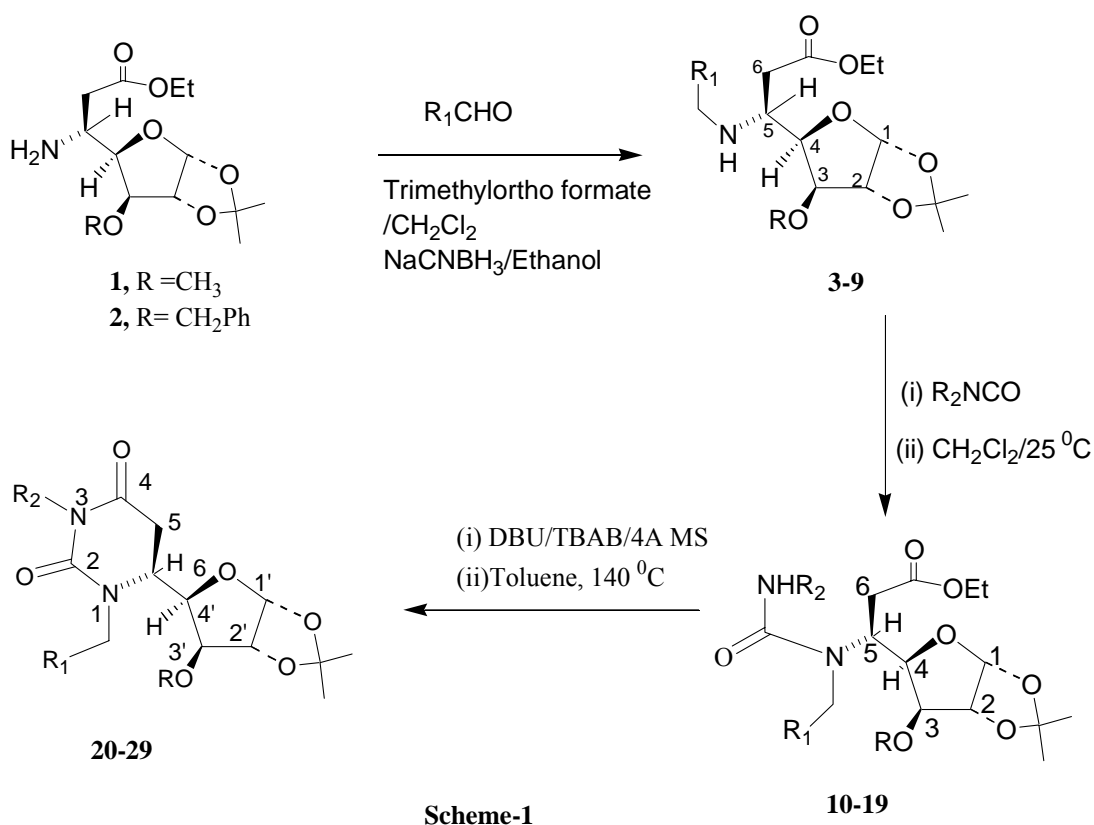
In continuation of our recent work on the development of biologically active nucleosides¹¹⁻¹⁴ the present work describes the synthesis of different dihydropyrimidinone C-nucleosides having N¹ and N³ aryl substituents.

RESULTS AND DISCUSSION

The synthetic strategy (*Scheme-1*) begins with glycosylated amino esters **1** and **2** prepared by our earlier method.^{11a, b} Thus, 5-amino-5-deoxy-3-*O*-methyl-1,2-*O*-isopropylidene- α -D-1,4-heptofuranuronate (**1**) on reaction with benzaldehyde in a mixture of dichloromethane and trimethyl orthoformate followed by *in situ* reduction with sodium cyanoborohydride, gave corresponding N-benzyl derivative **3** in very good yield. Similarly, glycosyl amino esters **4-9** were prepared using a sequence of reductive arylation of **1** and **2** in fair to good yields. Addition of *p*-chloro-phenyl isocyanate on compound **3** gave the corresponding 5-ureidyl heptofuranuronate **10** in 95% yield.

Similarly, ureido glycosyl furanuronates **11-19** were prepared by addition of substituted phenylisocyanates to the glycosyl amino esters **4-9** in almost quantitative yields. The structures of ureidyl derivatives were determined on the basis of their

spectroscopic data and analysis. The ureidyl derivative **10** on heating with a combination of DBU/TBAB / 4Å MS in refluxing toluene afforded 6-glycosyl dihydropyrimidin-2, 4-dione (**20**) in 90 % yield. Similarly dihydropyrimidinone C-nucleosides (**21-29**) were obtained on reaction of ureido glycosyl furanoates (**11-19**) with the above cycloamidative reagent in refluxing toluene in respectable yields.



Configuration at C-5 in the ureido glycosyls and that of C-6 in nucleosides is always that of the starting amino esters used. The relative configuration at C-5 in the furanosylated amino esters **1** and **2** has already been established^{11a, 11b, 15} to be 'S' based on Felkin-Anh transition state models and ¹H NMR spectrum. Since ureidyl formation is simple addition of isocyanates to the amines, the configuration at the carbon linked to nitrogen does not

change in this reaction. Further nucleoside formation does not involve C-5 and therefore configuration at that centre is also unchanged.

In conclusion, we have developed an efficient and stereo-controlled synthesis of dihydropyrimidinone C-nucleosides. The method involves addition of isocyanates to glycosyl amino esters followed by cyclisation of glycosyl ureido derivatives with DBU/4Å MS and TBAB in refluxing toluene. The method is simple and applicable to synthesize a variety of C-nucleosides with well- defined stereochemistry.

EXPERIMENTAL

General Methods. Thin-layer chromatographies were carried out on silica gel (Kiesel 60-F254, Merck), spots were developed in iodine vapours and also by spraying with 5% sulfuric acid in alcohol followed by heating at 100 °C. Column chromatographies were carried out on silica gel (silica gel 60, 70-230 mesh, Merck) using the indicated eluent. IR spectra of liquids were recorded as thin films on KBr plates with a Perkin Elmer 881 spectrophotometer. NMR spectra were recorded on Bruker spectrometers 200 MHz or 300 MHz and reference used was CDCl₃. Chemical shifts were given as δ ppm values and '*J*' values were given in Hertz (Hz). Elemental analyses were performed on a Perkin-Elmer 2400 II elemental analyzer. The optical rotations were measured in a 1.0 dm tube with Jasco dip-140 polarimeter in chloroform, methanol or ethyl acetate. The excess of the reagents or solvents were evaporated under reduced pressure at a bath temperature between the range 45-55 °C.

(5S) Ethyl- [5-benzylamino-5, 6-dideoxy-1, 2-*O*-isopropylidene-3-*O*-methyl- β -L-ido-1,4-heptofuranuronate (3): (5S) Ethyl-5-amino-5, 6-dideoxy-1, 2-*O*-isopropylidene-3-*O*-methyl- β -L-ido-1,4-heptofuranuronate (**1**, 1.5 g, 4.10 mmol) was dissolved in a mixture of trimethyl orthoformate and dichloromethane (2:5) and stirred magnetically at 0 °C. Benzaldehyde (0.7 mL, 6.15 mmol) was added and stirring continued for another 4h at the same temperature. NaCNBH₃ (0.25g, 4.1 mmol) was added to the stirring reaction mixture and stirring continued for 12h at 30 °C. Solvent evaporated under reduced pressure and the residue was dissolved in ethyl acetate and washed with aqueous NH₄Cl (2 x 25 mL) followed by water (2 x 20 mL). The organic layer was separated and dried (Na₂SO₄) and evaporated under reduced pressure to give the crude mass, which was chromatographed over SiO₂ using hexane: ethyl acetate (4:1) to give compound **3**, as colourless oil (2.16g, 85%) R_f 0.38 (hexane / ethyl acetate, 5:1). $[\alpha]_D^{20}$ -41.28 (*c*, 0.014, ethyl acetate). MS (FAB): *m/z* 380 (M+H)⁺. IR(KBr), ν_{\max} cm⁻¹ : 3355, 3048, 2978, 2923, 2845, 1721. ¹H NMR (CDCl₃): δ 7.34 -7.31 (m, 5H, ArH), 5.90 (d, *J*=3.7 Hz, 1H, H-1), 4.57 (d, *J*= 3.7 Hz, 1H, H-2.), 4.23 and 2.18 (dd, *J*=8.6 Hz and 3.1Hz, 1H, H-4), 4.14 (q, *J*=7.1 Hz, 2H, -OCH₂CH₃), 3.90 (d, *J*= 12 Hz, 1H, -NHCH_APh), 3.85 (d, *J*= 12 Hz, 1H, -NHCH_BPh), 3.73 (d, *J*=3.1 Hz, 1H, H-3), 3.42 -3.39 (m, 1H, H-5), 3.36 (s, 3H, -OCH₃), 2.55 (dd, *J* = 15.6 Hz and 4.7 Hz, 1H, H-6_A), 2.43 (dd, *J* = 15.6 Hz and 6.6 Hz, 1H, H-6_B), 2.02 (br s, 1H, -NHCH₂Ph), 1.47 and 1.30 [each s, each 3H, C(CH₃)₂], 1.25 (t, *J*=7.1 Hz, 3H, -OCH₂CH₃). ¹³C NMR (CDCl₃): δ 172.1 (C=O), 140.9, 128.7, 127.2 (Ar-C) 111.9 [C(CH₃)₂] 105.2 (C-1), 84.6 (C-2) 82.8 (C-4), 81.6 (C-3), 60.8 (-OCH₂CH₃), 57.6 (-OCH₃), 54.3 (C-5), 51.9 (-NCH₂), 36.9 (C-6), 27.1 and 26.9 [C(CH₃)₂], 14.62 (CH₃)

Anal. Calcd for C₂₀H₂₉NO₆: C, 63.32 H, 7.65 N, 3.69. Found: C, 64.1, H, 8.01, N, 3.60.

(5S) Ethyl-[5,6-dideoxy -5-(4-methoxy phenylmethyl amino)-1,2-O-isopropylidene-3-O-methyl-β-L-ido-1,4-heptofuranuronate (4): Colourless oil. Yield 2.4 g, Rf 0.60 (hexane /ethyl acetate, 3:2). $[\alpha]_D^{20}$ -25.90 (*c* 0.2625, chloroform). MS (FAB): *m/z* 410 (M+H)⁺. IR(KBr), ν_{\max} cm⁻¹: 3341, 2983, 1730, 1247, 1177, 1028, 757. ¹H NMR (CDCl₃): δ 7.23 and 6.83 (each d, *J*= 8.6 Hz, each 2H, ArH), 5.86 (d, *J*=3.8 Hz 1H, H-1), 4.56 (d, *J*= 3.8 Hz, 1H, H-2), 4.18-4.07 (m, 4H, H-4, NCH_A and -OCH₂), 3.83-3.74 (m, 6H, -NCH_B, H-3, Ar-OCH₃ and H-5), 3.40 (s, 3H, OCH₃), 2.77-2.52 (m, 2 H, H-6) 1.67 (br s, 1H, -NH) 1.47 and 1.31 [each s, each 3H, C(CH₃)₂], 1.24 (t, *J*=7.1 Hz, 3H, -OCH₂CH₃). ¹³C NMR (CDCl₃): δ 172.8 (C=O) 159.0, 133.3, 129.6 114.1, (Ar-C) 111.9 [C(CH₃)₂], 105.1 (C-1), 84.2 (C-2), 82.2 (C-4), 81.8 (C-3), 60.6 (-OCH₂CH₃), 58.0 (Ar-OCH₃), 55.6 (-OCH₃), 52.5 (C-5), 51.3 (-NCH₂), 36.6 (C-6), 27.1 and 26.7 [C(CH₃)₂] and 14.64 (CH₃). Anal. Calcd for C₂₁H₃₁NO₇: C, 61.61, H, 7.58, N, 3.42. Found: C, 62.12, H, 7.98, N, 3.29.

(5S) Ethyl-[5-(2-chlorophenylmethylamino)-5,6-dideoxy-1,2-O-isopropylidene-3-O-methyl-β-L-ido-]-1,4-heptofuranuronate (5): Colourless oil. Yield 3.0 g, Rf 0.70 (hexane /ethyl acetate, 3:2). $[\alpha]_D^{20}$ -40.00 (*c* 0.225, chloroform). MS (FAB): *m/z* 415 (M+H)⁺, IR(KBr), ν_{\max} cm⁻¹ : 3355, 3048, 2978, 2923, 2845, 1721. ¹H NMR (CDCl₃): δ 7.44 (d, *J*= 6.7 Hz, 1H, ArH), 7.33-7.16 (m, 3H, ArH), 5.91 (d, *J*=3.6 Hz, 1H, H-1), 4.58 (d, *J*= 3.6 Hz, 1H, H-2), 4.24 (dd, *J*=8.2 Hz and 2.8 Hz, 1H, H-4), 4.13 (q, *J*=7.1 Hz, 2H, -OCH₂CH₃), 3.96 (s, 2H, -NCH₂), 3.74 (d, *J*=2.8 Hz, 1H, H-3), 3.45-3.43 (m, 1H, H-5), 3.36 (s, 3H, -OCH₃), 2.61-2.50 (m 2H, H-6), 1.86 (br s, 1H, -NH) 1.48 and 1.32 [each s, each 3H, C(CH₃)₂], 1.25 (t, *J*=7.1 Hz, 3H, -OCH₂CH₃). Anal. Calcd for C₂₀H₂₈NO₆Cl: C, 58.04, H, 6.77, N, 3.38, Found: C, 58.46, H, 7.02 N, 3.13.

(5S) Ethyl-[5-(3,4-dimethoxyphenylmethylamino)-5,6-dideoxy-1,2-O-isopropylidene-

3-O-methyl-β-L-ido-1,4-heptofuranuronate (6): Colourless oil, Yield 2.58 g, Rf 0.45

(hexane /ethyl acetate, 3:2). $[\alpha]_D^{20}$ -40.21 (*c* 0.4625, ethyl acetate). MS (FAB): *m/z* 440

(M+H)⁺. IR(KBr), ν_{\max} cm⁻¹: 3343, 2985, 2368, 1731,1514, 1261, 857, 756. ¹H NMR

(CDCl₃): δ 6.89-6.73 (m, 3H, ArH), 5.88 (d, *J*=3.8 Hz, 1H, H-1), 4.56 (d, *J*= 3.8 Hz, 1H,

H-2), 4.23-4.07 (m, 3H, H-4 and -OCH₂), 3.87-3.77 (m, 8H, 2 x ArOCH₃ and NHCH₂),

3.70 (d, *J*=2.7 Hz, 1H, H-3), 3.38-3.36 (m, 1H, H-5), 3.34 (s, 3H, -OCH₃), 2.52 and 2.39

(dd, *J* = 16.8Hz and 5.2 Hz, 1H, H-6_A), 2.39 (dd, *J* = 16.8Hz and 5.6 Hz, 1H, H-6_B), 1.97

(br s, 1H, -NH) 1.45 and 1.29 [each s, each 3H, C(CH₃)₂], 1.23 (t, *J* =7.1 Hz, 3H, -

OCH₂CH₃). ¹³C NMR (CDCl₃): δ 172.1 (C=O), 149, 148.3, 133.0, 120.6, 111.4,

112.7,(Ar-C), 111.9 [C(CH₃)₂], 105.1 (C-1), 84.5 (C-2), 82.8 (C-4), 81.5 (C-3), 60.7 (-

OCH₂CH₃), 57.7 (-OCH₃), 56.3, 56.2 (Ar-OCH₃), 54.2 (C-5), 51.6 (-NCH₂), 36.8 (C-6),

27.1 and 26.6 [C(CH₃)₂], 14.6 (CH₃). Anal. Calcd for C₂₂H₃₃NO₈: C, 60.13, H, 7.51, N,

3.19. Found: C, 60.62, H, 7.8, N, 3.06.

(5S) Ethyl -5,6-dideoxy -5-(4-methoxyphenylmethyl amino)- 1,2-O-isopropylidene-3-

O-benzyl-β-L-ido-1,4-heptofuranuronate (7): Colourless oil. Yield 2.25 g, Rf 0.38

(hexane/ ethyl acetate 5:1). $[\alpha]_D^{20}$ -15.46 (*c* 0.375 chloroform). MS (FAB) = *m/z* 486

(M+H)⁺. IR (KBr), ν_{\max} cm⁻¹: 2339, 2987, 2431, 1729, 1612, 1513, 1378, 1248, 1078,

758. ¹H NMR (CDCl₃): δ 7.31-7.25 (m, 5H, ArH), 7.21 and 6.81 (each d, *J*= 8.4 Hz, each

2H, Ar H), 5.94 (d, *J*=3.8 Hz 1H, H-1), 4.69 and 4.44 (each d, *J*= 11.7 Hz, each 1H, -

OCH_A and OCH_B), 4.63 (d, *J*= 3.8 Hz, 1H, H-2), 4.23 (dd, *J*=9.6 and 3.0 Hz, 1H, H- 4),

4.10 (q, *J* = 7.1 Hz, 2H, OCH₂), 3.99 (d, *J*= 3. Hz, 1H, H-3) 3.80-3.77 (m, 5H, -NHCH₂

and Ar-OCH₃), 3.52-3.48 (m, 1H, H-5), 2.42-2.31 (m, 2H, H-6), 1.95 (br s, 1H, -NH), 1.47 and 1.32 [each s, each 3H, C(CH₃)₂], 1.22 (t, *J*=7.1 Hz, 3H, -OCH₂CH₃). ¹³C NMR (CDCl₃): δ 172.1 (C=O), 137.4, 133.0, 131.9, 131.7, 129.8, 129.0, 128.8, 128.5, 128.4, 128.2, 127.3, 114.1 (Ar-C), 112.0 [C(CH₃)₂], 105.2 (C-1), 82.6 (C-2), 82.2 (C-4), 82.1 (C-3), 71.9 (-OCH₂Ph), 60.8 (-OCH₂CH₃), 55.6 (Ar-OCH₃), 54.1(C-5), 51.4 (-NCH₂), 36.8 (C-6), 27.1 and 26.7 [C(CH₃)₂], 14.6 (CH₃). Anal. Calcd for C₂₇H₃₅NO₇: C, 66.80, H, 7.21, N, 2.88. Found: C, 67.2, H, 7.9, N, 2.81.

(5S) Ethyl- 5-(2-chlorophenylmethyl amino)-5,6-dideoxy-1,2-O-isopropylidene-3-O-benzyl-β-L-ido-1,4-heptofuranuronate (8): Colourless oil. Yield 2.1 g, Rf 0.65 (hexane /ethyl acetate, 3:2). [α]_D²⁰ -20.32 (*c* 0.7625, chloroform). MS (FAB): *m/z* 491 (M+H)⁺. IR (KBr), ν_{\max} cm⁻¹ : 2984, 1731, 1454, 1377, 1216, 1078, 754. ¹H NMR (CDCl₃): δ 7.42-7.22 (m, 7H, ArH), 7.18-7.14 (m, 2H, ArH), 5.95 (d, *J*=3.7 Hz 1H, H-1), 4.68 and 4.44 (each d, *J*= 11.8 Hz, each 1H, -OCH_A and OCH_B), 4.63 (d, *J*= 3.7 Hz, 1H, H-2), 4.25 (dd, *J*=8.6 and 2.7 Hz, 1H, H-4), 4.07 (q, *J*= 7.1 Hz, 2H, OCH₂), 3.94 (s, 3H, NHCH₂ and H-3), 3.54-3.49 (m, 1H, H-5), 2.39 (each dd, *J*= 10.7 Hz and 4.5 Hz, each 1H, H-6), 1.96 (br s, 1H, -NH) 1.48 and 1.31 [each s, each 3H, C(CH₃)₂], 1.20 (t, *J*=7.1 Hz, 3H, -OCH₂CH₃). ¹³C NMR (CDCl₃): δ 172.1 (C=O), 138.5, 137.5, 134.1, 130.5, 129.7, 128.9, 128.4, 127.1 (Ar-C), 112.0 [C(CH₃)₂], 105.3 (C-1), 82.7 (C-2), 82.2 (C-4), 74.9 (C-3), 71.9 (-OCH₂Ph), 60.8 (-OCH₂CH₃), 54.1 (C-5), 49.2 (-NCH₂), 36.8 (C-6), 27.2 and 26.7 [C(CH₃)₂], 14.6 (CH₃). Anal. Calcd for C₂₆H₃₂NO₆Cl: C, 63.73, H, 6.53, N, 2.86. Found: C, 64.2, H, 6.81, N, 2.79.

(5S) Ethyl- 3-O-benzyl -5,6-dideoxy -5-(3,4-dimethoxyphenylmethyl amino)-1,2-O-isopropylidene-β-L-ido-1,4-heptofuranuronate (9): Colourless oil; yield 2.64 g, R_f 0.65 (hexane /ethyl acetate, 3:2), $[\alpha]_D^{20}$ -32.0 (*c* 0.225, chloroform), MS (FAB): *m/z* 517 (M+H)⁺, IR (KBr), ν_{\max} cm⁻¹ 3355, 3048, 2978, 2923, 2845, 1721, 1207, 1078, 752. ¹H NMR (CDCl₃): δ 7.31-7.28 (m, 5H, ArH), 6.81-6.75 (m, 3H, ArH), 5.90 (d, *J*=3.8 Hz 1H, H-1), 4.68 and 4.53 (each d, *J*= 11.7 Hz, each 1H, -OCH_A and OCH_B), 4.60 (d, *J*= 3.8 Hz, 1H, H-2), 4.21-4.07 (m, 4H, -NHCH_A, H-4 and -OCH₂), 3.84 and 3.82 (each s, each 3 H, 2 x ArOCH₃), 3.75-3.64 (m, 2H, -NHCH_B and H-3), 3.64-3.61 (m, 1H, H-5), 2.82 (dd, *J* = 16.8 Hz and 4.2 Hz, 1H, H-6_A), 2.56 (dd, *J* = 16.8Hz and 6.70 Hz, 1H, H-6_B), 1.61 (br s, 1H, -NH) 1.47 and 1.31 [each s, each 3H, C(CH₃)₂], 1.24 (t, *J*=7.1 Hz, 3H, -OCH₂CH₃). ¹³C NMR (CDCl₃): δ 173.0 (C=O), 150.2, 149.2, 138.4, 134.6, 129.8, 129.3, 128.9, 121.6, 113.1 (Ar-C), 112.7 [C(CH₃)₂], 106.2 (C-1), 83.6 (C-2), 83.1 (C-4), 83.0 (C-3), 72.8 (-OCH₂Ph), 61.6 (-OCH₂CH₃), 57.2, 57.1 (Ar-OCH₃), 54.9 (-NCH₂) 52.6 (C-5), 37.7 (C-6), 28.0 and 27.6 [C(CH₃)₂], 15.5 (CH₃). Anal. Calcd for C₂₈H₃₇NO₈: C, 65.24, H, 7.18, N, 2.71. Found: C, 64.89, H, 7.35, N, 2.69.

(1R, 2R, 3S, 4R, 5S) Ethyl-[5-deoxy-3-O-methyl-1,2,-O-isopropylidene -5-{N³-(4-chlorophenyl)-N¹-(phenylmethyl)-1-ureidyl}]-1,4-heptofuranuronate (10)

General Procedure: The above amino ester **3** (1.0 g, 2.64 mmol) and *p*-chlorophenyl isocyanate (0.407g, 2.65 mmol) in anhydrous dichloromethane (15.0 ml) were magnetically stirred at 25 °C temperature for 2 h. Solvent was evaporated and the reaction mixture was chromatographed over a SiO₂ column using a gradient of hexane: ethyl acetate (3:2) as eluent to give compound **10** as colourless foam; yield (1.48g, 95 %).

Rf 0.40 (hexane/ ethyl acetate, 3:2), $[\alpha]_D^{20} - 44.0$ (c 0.2, chloroform). MS (FAB) = m/z 534 (M+H)⁺. IR (Neat) ν_{\max} cm⁻¹: 3370, 3306, 2926, 2372, 1712, 1665, 1602, 1546, 1212, 1078, 717. ¹H NMR (CDCl₃): δ 7.42-7.34 (m, 10H, ArH), 5.97 (d, $J=3.8$ Hz, 1H, H-1), 4.86 and 4.24 (each d, $J=15.3$ Hz, each 1H, NCH_A and -NCH_B), 4.66 (d, $J=3.8$ Hz, 1H, H-2), 4.44-4.40 (m, 2H, H-4, H-5), 4.08 (q, $J= 7.1$ Hz, 2H, -OCH₂), 3.63(d, $J=2.8$ Hz, 1H, H-3), 3.39 (s, 3H, -OCH₃), 2.82-2.76 (m, 1H, H-6_A), 2.47 (dd, $J= 15.7$ and 3.6 Hz, 1H, H-6_B), 1.47, 1.31 [each s, each 3H, 2 x C(CH₃)₂] 1.24 (t, $J=7.1$ Hz, 3H, -OCH₂CH₃). ¹³CNMR (CDCl₃): δ 172.3 (C=O), 157.8 (NHCO), 129.2, 129.1, 122.3 (Ar-C), 112.2 [C(CH₃)₂], 105.0 (C-1), 84.3 (C-2), 81.3 (C-4), 79.7 (C-3), 61.4 (-OCH₂CH₃), 57.1 (-OCH₃), 34.9 (C-6), 27.1 and 26.5 [C(CH₃)₂], 14.4 (CH₃). Anal. Calcd for C₂₇H₃₃N₂O₇Cl: C, 60.84, H, 6.19, N, 5.25 Found: C, 60.12, H, 7.25, N, 5.04.

(1R, 2R, 3S, 4R, 5S) Ethyl -5-deoxy-3-O-methyl-1,2,-O-isopropylidene- 5-[N¹-(2-chlorophenylmethyl)-N³-(phenyl)-1-ureidyl]-1,4-heptofuranuronate (11): Colourless foam; yield 0.48 g. Rf 0.55 (hexane/ ethyl acetate, 3:2), $[\alpha]_D^{20} -92.0$ (c 0.05, chloroform).MS (FAB) $m/z = 436$.IR (Neat) ν_{\max} cm⁻¹: 3342, 1717, 1670, 1543, 1079, 1022, 889, 755. ¹H NMR (CDCl₃): δ 8.41 (bs, 1H, NH), 7.47-76.98 (m, 10H, ArH), 5.85 (d, $J=3.7$ Hz, 1H, H-1), 4.97 and 4.47 (each d, $J= 16.3$ Hz, each 1H, -NCH_APh and -NCH_BPh), 4.73-4.65 (m, 1H, H-5), 4.52 (d, $J=3.7$ Hz, 1H, H-2), 4.24 (dd, $J=6.34$ and 2.8 Hz, 1H, H-4), 4.10 (q, $J= 7.1$ Hz, 2H, -OCH₂), 3.45 (d, $J= 2.8$ Hz, 1H, H-3), 3.31(s, 3H, OCH₃), 2.91 (dd, $J= 17.4$ and 3.2 Hz, 1H, H-6_A), 2.70 (dd, $J= 17.4$ and 11.5 Hz, 1H, H-6_B), 1.44 and 1.29 [each s, each 3H, 2 x C(CH₃)₂], 1.17 (t, $J=7.1$ Hz, 3H, -OCH₂CH₃).

Anal. Calcd for $C_{27}H_{33}N_2O_7Cl$: C, 60.84, H, 6.19, N, 5.25. Found: C, 62.03, H, 7.04, N, 5.39.

(1R, 2R, 3S, 4R, 5S) Ethyl-[5-deoxy-3-O-methyl-1,2,-O-isopropylidene-β-L-ido-5-{N¹-(2-chlorophenylmethyl)-N³-(4-chlorophenyl)-1-ureidyl}]-1,4-heptofuranuronate

(12): Colourless foam; yield 1.04 g, Rf 0.50 (hexane/ ethyl acetate, 3:2), $[\alpha]_D^{20} -50.0$ (c 0.150, chloroform). MS (FAB) = m/z 568 (M+H)⁺. IR (Neat) ν_{max} cm^{-1} : 2996, 2405, 1723, 1668, 1529, 1384, 1222, 1084, 1052, 759, 688. ¹H NMR (CDCl₃): δ 7.80 (br s, 1H, NH), 7.45(d, $J= 6.7$ Hz, 1H, ArH), 7.34-7.13 (m, 7H, ArH), 5.91 (d, $J=3.7$ Hz, 1H, H-1), 4.83-4.62 (m, 3H, -NCH_APh, -NCH_BPh and H-5), 4.61 (d, $J=3.7$ Hz, 1H, H-2), 4.35-4.32 (m, 1H, H-4), 4.11 (q, $J= 7.1$ Hz, 2H, -OCH₂), 3.60 (d, $J= 2.9$ Hz, 1H, H-3), 3.39(s, 3H, OCH₃), 2.67 (dd, $J= 16.4$ and 9.8 Hz, 1H, H-6_A), 2.70 (dd, $J= 16.4$ and 3.7 Hz, 1H, H-6_B), 1.36 and 1.30 [each s, each 3H, 2 x C(CH₃)₂], 1.20 (t, $J=7.1$ Hz, 3H, -OCH₂CH₃).
Anal. Calcd for $C_{27}H_{32}N_2O_7$: C, 57.14 H, 5.64 N, 4.93 Found: C, 58.2 H, 5.69 N, 4.56

(1R, 2R, 3S, 4R, 5S) Ethyl-[5-deoxy-3-O-methyl-1,2,-O-isopropylidene-5-{N¹-(4-methoxyphenylmethyl)-N³-(phenylmethyl)-1-ureidyl}]-1,4-heptofuranuronate (13):

Colourless foam; yield 1.25 g, Rf 0.40 (hexane/ ethyl acetate, 3:2), $[\alpha]_D^{20} -54.66$ (c 0.150, chloroform).MS (FAB) = m/z 543 (M+H)⁺.IR (Neat) ν_{max} cm^{-1} : 3428, 2989, 2386, 1730, 1646, 1517, 1246, 1081, 759. ¹H NMR (CDCl₃): δ 7.29-7.13 (m, 7H, ArH), 6.81(d, $J= 8.56$ Hz, 2H, ArH), 5.88 (d, $J=3.8$ Hz, 1H, H-1), 5.10 (br s, 1H, NH), 4.58 (d, $J=3.8$ Hz, 1H, H-2), 4.52-4.44 (m, 4H, NCH₂, H-5 and H-4), 4.36 (d, $J= 5.28$ Hz, 2H, -NHCH₂), 4.08 (q, $J= 7.1$ Hz, 2H, -OCH₂), 3.77 (s, 3H, Ar-OCH₃), 3.58 (d, $J= 2.2$ Hz, 1H, H-3), 3.34 (s, 3H, OCH₃), 2.80 (m, 1H, H-6_A), 2.42 (dd, $J= 15.5$ and 3.7 Hz, 1H, H-6_B),

1.39 and 1.30 [each s, each 3H, C(CH₃)₂], 1.19 (t, *J*=7.1 Hz, 3H, -OCH₂CH₃). ¹³C NMR (CDCl₃): δ 171.6 (C=O), 159.5 (NHC=O), 159.2, 140.2, 131.3, 128.6, 128.6, 127.6, 127.2, 114.5 (Ar-C), 112.1 [C(CH₃)₂], 105.0 (C-1), 84.2 (C-2), 81.2 (C-4), 80.1 (C-3), 61.2 (-OCH₂CH₃), 57.6 (Ar-OCH₃), 55.6 (-OCH₃), 45.1 (-NCH₂), 36.1 (C-6), 27.1 and 26.8 [C(CH₃)₂], 14.5 (CH₃). Anal. Calcd for C₂₉H₃₈N₂O₈: C, 64.2, H, 7.01, N, 5.16 Found: C, 64.68, H, 7.67, N, 4.96.

(1R, 2R, 3S, 4R, 5S) Ethyl-[5-deoxy-3-O-methyl-1,2,-O-isopropylidene-5-{N¹-(3,4-dimethoxyphenylmethyl)-N³-(phenyl)-1-ureidyl}]-1,4-heptofuranuronate (14):

Colourless foam; yield 1.20 g, Rf 0.35 (hexane/ ethyl acetate, 3:2), [α]_D²⁰ -11.5 (*c* 0.40, chloroform). MS (FAB) = *m/z* 559 (M+H)⁺. IR (Neat) ν_{max} cm⁻¹: 3343, 2938, 2838, 1720, 1667, 1601, 1518, 1450, 1254, 1080, 1023, 756. ¹H NMR (CDCl₃): δ 8.10 (br s, 1H, NH), 7.43-7.39, 7.29-7.21, 6.97-6.87, 6.81-6.78 (each m, each 2H, ArH), 5.86 (d, *J*=3.8 Hz, 1H, H-1), 4.75 and 4.37 (each d, *J*= 15.0 Hz, each 1H, NCH_A and NCH_B), 4.50 (d, *J*=3.8 Hz, 1H, H-2), 4.24 (dd, *J*= 7.9 and 3.1 Hz, 1H, H-4), 4.18-4.04 (m, 3H, -OCH₂ and H-5), 3.84 and 3.83 (each s, each 3H, 2 x Ar-OCH₃), 3.50 (d, *J*= 3.1Hz, 1H, H-3), 3.31 (s, 3H, OCH₃), 2.85 (dd, *J*= 16.8 and 3.2 Hz, 1H, H-6_A), 2.81 (dd, *J*= 16.8 and 10.0 Hz, 1H, H-6_B), 1.43 and 1.29 [each s, each 3H, C(CH₃)₂], 1.19 (t, *J*=7.1 Hz, 3H, -CH₂CH₃). ¹³C NMR (CDCl₃): δ 173.3 (C=O), 157.2 (NHC=O), 149.6, 148.7, 140.3, 132.4, 129.2, 122.6, 120.2, 119.4 (Ar-C), 112.2 [C(CH₃)₂], 111.6, 111.4 (Ar-C), 105.3 (C-1), 84.3 (C-2), 81.5 (C-4), 80.7 (C-3), 61.5 (-OCH₂CH₃), 58.10 (-OCH₃), 56.3, 56.3 (Ar-OCH₃), 53.80 (C-5) , 35.9 (C-6), 27.1 and 26.5 [C(CH₃)₂], 14.6 (CH₃). Anal. Calcd for C₂₉H₃₈N₂O₉: C, 62.36, H, 6.81, N, 5.01. Found: C, 62.38, H, 6.34, N, 4.71.

(1R, 2R, 3S, 4R, 5S) Ethyl-[5-deoxy-3-O-methyl-1,2,-O-isopropylidene -5-{N¹-(3,4-dimethoxyphenylmethyl)-N³-(phenylmethyl)-1-ureidyl}]-1,4-heptofuranuronate (15):

Colourless foam. Yield 1.23 g, Rf 0.40 (hexane/ethyl acetate, 3:2), $[\alpha]_D^{20} - 23.29$ (*c* 0.85, chloroform). MS (FAB) $m/z = 573$. IR (Neat) $\nu_{\max} \text{ cm}^{-1}$: 3404, 2989, 2368, 1730, 1646, 1519, 159, 1259, 856, 755.3, 599.6. ¹H NMR (CDCl₃): δ 7.27-7.16 (m, 3H, ArH), 7.11-7.09 (m, 2H, ArH), 6.77-6.74 (m, 2H, ArH), 5.86 (d, *J*=3.7 Hz, 1H, H-1), 5.13 (br s, 1H, NH), 4.58 (d, *J*=3.7 Hz, 1H, H-2), 4.49-4.28 (m, 5H, -NCH₂, -NHCH₂ and H-5), 4.14-4.04 (m, 3H, H-4, and -OCH₂), 3.83 and 3.81 (each s, each 3H, 2 x ArOCH₃), 3.58 (s, 1H, H-3), 3.35 (s, 3H, OCH₃), 2.94-2.86 (m, 1H, H-6_A), 2.44 (dd, *J*= 15.3 and 3.1 Hz, 1H, H-6_B), 1.35 and 1.29 [each s, each 3H, C(CH₃)₂], 1.24 (t, *J*= 7.3 Hz, 3H, OCH₂CH₃). ¹³C NMR (CDCl₃): δ 171.7 (C=O), 159.3 (NHC=O), 149.9, 148.6, 140.10, 131.8 128.9, 128.7, 127.9, 127.8 127.5, 127.4, 127.1, 118.9, 112.2 (Ar-C), 112.0 [C(CH₃)₂], 111.4, 111.2, 110.8 (Ar-C), 105.1 (C-1), 84.1 (C-2), 81.5 (C-4), 80.1 (C-3), 61.2 (-OCH₂CH₃), 57.7 (-OCH₃), 56.3, 56.2 (Ar-OCH₃), 45.4 (-NCH₂), 36.7 (C-1), 27.1 and 26.8 [C(CH₃)₂] 14.6 (CH₃). Anal. Calcd for C₃₀H₄₀N₂O₉: C, 62.93, H, 6.99, N, 4.89 Found: C, 61.8, H, 7.08, N, 4.63.

(1R, 2R, 3S, 4R, 5S) Ethyl-[3-O-benzyl-5-deoxy-1,2,-O-isopropylidene -5-{N¹-(2-chlorophenylmethyl)-N³-(phenyl)-1-ureidyl}]-1,4-heptofuranuronate (16): Colourless

foam; yield 1.1g, Rf 0.45 (hexane/ethyl acetate, 3:2), $[\alpha]_D^{20} -12.5$ (*c* 0.2, chloroform). MS (FAB) = m/z 610 (M+H)⁺. IR (Neat) $\nu_{\max} \text{ cm}^{-1}$: 3343, 2995, 2934, 2363, 1729, 1834, 1524, 1450, 1378, 1174, 1081, 1023, 853, 758. ¹H NMR (CDCl₃): δ 7.7 (br s, 1H, NH),

7.46-7.43 (m, 2H, ArH), 7.34-7.15 (m, 10H, ArH), 7.00-6.95 (m, 2H, ArH), 5.95 (d, $J=3.6$ Hz, 1H, H-1), 4.86-4.54 (m, 5H, $-\text{OCH}_A\text{Ph}$, H-2, $-\text{NCH}_2$ and H-5), 4.40 (d, $J=11.9$ Hz, 1H, $-\text{OCH}_B$), 4.34-4.30 (m, 1H, H-4), 4.05 (q, $J=7.1$ Hz, 2H, $-\text{OCH}_2$), 3.77 (s, 1H, H-3), 2.56-2.43 (m, 1H, H-6_A), 2.00 (dd, $J=16.5$ and 2.4 Hz, 1H, H-6_B), 1.55 and 1.37 [each s, each 3H, 2 x $\text{C}(\text{CH}_3)_2$], 1.25 (t, $J=7.14$ Hz, 3H, $-\text{OCH}_2\text{CH}_3$). ^{13}C NMR (CDCl_3): δ 171.8 (C=O), 157.7 (NHC=O), 140.1, 137.0, 136.7, 132.6, 129.7, 129.6, 129.3, 129.1, 128.8, 128.6, 127.5, 123.6, 120.2 (Ar-C), 111.9 [$\text{C}(\text{CH}_3)_2$], 105.2 (C-1), 82.2 (C-2), 80.9 (C-4), 79.5 (C-3), 71.8 ($-\text{OCH}_2\text{Ph}$), 61.5 ($-\text{OCH}_2\text{CH}_3$), 52.5 ($-\text{NCH}_2$), 34.8 (C-6), 27.2 and 26.8 [$\text{C}(\text{CH}_3)_2$], 14.5 (CH_3). Anal. Calcd for $\text{C}_{33}\text{H}_{37}\text{N}_2\text{O}_7\text{Cl}$: C, 65.07, H, 6.08, N, 4.60, Found: C, 65.86, H, 6.98, N, 4.34.

(1R, 2R, 3S, 4R, 5S) Ethyl-[3-O-benzyl-5-deoxy-1,2,-O-isopropylidene-5-{N³-(4-chlorophenylmethyl)-N¹-(4-methoxyphenylmethyl)-1-ureidyl}] -1,4-

heptofuranuronate (17): Colourless foam; yield 1.25 g, R_f 0.40 (hexane/ethyl acetate, 3:2) $[\alpha]_D^{20} - 13.81$ (c 0.1375, chloroform). MS (FAB) = m/z 640 (M+H)⁺. IR (Neat) ν_{max} cm^{-1} : 2992, 2312, 1729, 1682, 1597, 1426, 1211, 870, 756. ^1H NMR (CDCl_3): δ 7.59 (bs, 1H, NH), 7.30-7.23 (m, 7H, ArH), 7.16 (s, 3H, ArH), 6.82(d, $J=8.54$ Hz, 2H, ArH), 5.96 (d, $J=3.7$ Hz, 1H, H-1), 4.72 and 4.40 (each d, $J=11.7$ Hz, each 1H, OCH_A and OCH_B), 4.66 (d, $J=3.7$ Hz, 1H, H-2), 4.56-4.37 (m, 3H, N- CH_2 and H-4), 4.08 (q, $J=7.1$ Hz, 2H, $-\text{OCH}_2$), 3.76 (s, 3H, $-\text{OCH}_3$), 2.84-2.77 (m, 1H, H-6_A), 2.03 (dd, $J=16.7$ and 2.2 Hz, 1H, H-6_B), 1.40, 1.31 [each s, each 3H, $\text{C}(\text{CH}_3)_2$], 1.23 (t, $J=7.14$ Hz, 3H, $-\text{OCH}_2\text{CH}_3$). ^{13}C NMR (CDCl_3): δ 171.9 (C=O), 159.2 (NHC=O), 139.1, 137.0, 128.2, 128.8, 128.7, 128.6, 121.1, 114.6 (Ar-C), 112.0 [$\text{C}(\text{CH}_3)_2$], 105.1 (C-1), 82.2 (C-2), 81.0 (C-4), 79.6

(C-3), 71.9 (-OCH₂Ph), 61.4 (-OCH₂CH₃), 55.6 (-NCH₂), 35.1 (C-6), 27.1 and 26.7 [C(CH₃)₂], 14.5 (CH₃). Anal. Calcd for C₃₄H₃₉N₂O₈Cl : C, 63.89, H, 6.10, N, 4.38 Found: C, 64.67, H, 6.85, N, 4.10.

(1R, 2R, 3S, 4R, 5S) Ethyl-[3-O-benzyl-5-deoxy-1,2,-O-isopropylidene -5-{N¹-(3,4-dimethoxyphenylmethyl)-N³-(phenyl)-1-ureidyl}]-1,4-heptofuranuronate (18):

Colourless foam, yield 0.66 g, R_f 0.40 (hexane/ ethyl acetate, 3:2). [α]_D²⁰ – 14.0 (*c* 0.05, chloroform). MS (FAB) = *m/z* 658 (M+Na)⁺. IR (Neat) ν_{max} cm⁻¹: 3408, 1718, 1658, 1516, 1232, 1077, 1025, 857, 756. ¹H NMR (CDCl₃): δ 7.31-6.98 (m, 10H, ArH), 6.84-6.76 (m, 3H, ArH), 5.96 (d, *J*=3.8 Hz, 1H, H-1), 4.72 and 4.41 (each d, *J*= 11.7 Hz, each 1H, OCH_APh and OCH_BPh), 4.68 (d, *J*=3.8 Hz, 1H, H-2), 4.56-4.38 (m, 3H, NCH₂ and H-4), 4.12 (q, *J*= 7.1 Hz, 2H, OCH₂), 3.86 and 3.85 (each s, each 3H, 2 x Ar-OCH₃), 3.78 (d, *J*= 2.3 Hz, 1H, H-3), 3.58-3.42 (m, 1H, H-5), 2.78-2.62 (m, 1H, H-6_A), 2.11 (d, *J*= 14.7 Hz, 1H, H-6_B), 1.39, 1.27 [each s, each 3H, C(CH₃)₂], 1.25 (t, *J*=7.1 Hz, 3H, –OCH₂CH₃). Anal. Calcd for C₃₅H₄₂N₂O₉ : C, 66.24, H, 6.62, N, 4.41 Found: C, 66.85, H, 7.01, N, 4.02.

(1R, 2R, 3S, 4R, 5S) Ethyl-[3-O-benzyl-5-deoxy-1,2,-O-isopropylidene -5-{N³-(3-acetylphenylmethyl)-N¹-(3,4-dimethoxyphenylmethyl)-ureidyl}]-1,4-

heptofuranuronate (19): Colourless foam; yield 0.70 g, R_f 0.35 (hexane/ethyl acetate, 3:2), [α]_D²⁰ – 29.77 (*c* 0.225, chloroform). MS (FAB) = *m/z* 677 (M+H)⁺. IR (Neat) ν_{max} cm⁻¹: 3012, 2369, 1729, 1677, 1594, 1518, 1263, 1077, 898, 755. ¹H NMR (CDCl₃): δ 7.8 (bs, 1H, NH), 7.63-7.57 (m, 1H, ArH), 7.52-7.26 (m, 8H, ArH), 6.83-6.80 (m, 2H, ArH),

5.98 (d, $J=3.8$ Hz, 1H, H-1), 4.74 and 4.40 (each d, $J= 11.9$ Hz, each 1H, -OCH_APh and OCH_BPh), 4.68 (d, $J=3.8$ Hz, 1H, H-2), 4.55 (s, 2H, NCH₂), 4.17-4.06 (m, 4H, H-4, H-5 and -OCH₂), 3.84 (s, 6H, 2 x Ar-OCH₃), 3.77 (d, $J= 2.4$ Hz, 1H, H-3), 2.57-2.55 (m, 5H, ArCOCH₃ and H-6), 1.37, 1.31 [each s, each 3H, C(CH₃)₂], 1.25 (t, $J=7.4$ Hz, 3H, -OCH₂CH₃). Anal. Calcd for C₃₇H₄₄N₂O₁₀: C, 65.68, H, 6.50, N, 4.14. Found: C, 66.12, H, 7.08, N, 3.95.

General procedure for the synthesis of compounds 21-29:

(1'*R*, 2'*R*, 3'*S*, 4'*R*, 6*S*)-N¹-phenylmethyl-N³-(4-chlorophenyl)-5,6-dihydro-6-(1',2'-*O*-isopropylidene)-3'-*O*-methyl-1',2',3',4'-tetrahydrofuranos-4'-yl)-(1H,3H)-

pyrimidine-2,4-dione (20): A mixture of compound **10** (0.3g, 0.564 mmol), 4Å MS (0.03g), TBAB (0.03g, 0.093 mmol) and DBU (0.086 mL, 0.564 mmol) in anhydrous toluene (15 mL) was refluxed for 2 h. Solvent was evaporated and the residue was chromatographed over a SiO₂ column using a gradient of hexane: ethyl acetate (3:1) as eluent to give **20** as colourless foam (0.260 g, 95 %). Similarly, compounds **21-29** were synthesized from the corresponding ureidyl derivatives respectively. R_f 0.45 (Hexane/ethyl acetate, 3:2), $[\alpha]_D^{25} - 17.77$ (*c* 0.1125, chloroform). MS (FAB) = m/z 488. IR (Neat) ν_{\max} cm⁻¹: 3450, 2937, 2376, 1678 1599, 1450, 1372, 1203, 1082, 1018, 704. ¹H NMR (CDCl₃): δ 7.41 (d, $J= 8.4$ Hz, 2 H, ArH), 7.34-7.30 (m, 5H, ArH), 7.11 (d, $J= 8.4$ Hz, 2 H, ArH), 5.98 (d, $J = 3.6$ Hz, 1H, H-1'), 5.40 and 4.28 (each d, $J= 15.3$ Hz, each 1H, NCH_A and NCH_B), 4.61 (d, $J = 3.6$ Hz, 1H, H-2'), 4.44 (d, $J= 9.3$ Hz, 1H, H-4'), 3.87-3.82 (m, 1H, H-6), 3.70 (s, 1H, H-3'), 3.36 (s, 3H, OCH₃), 2.87 (dd, $J= 16.8$ and 6.6 Hz,

1H, H-5_A), 2.56 (d, $J = 16.8$ Hz, 1H, H-5_B), 1.49, 1.34 [each s, each 3H, C(CH₃)₂]. ¹³C NMR (CDCl₃): δ 168.1 (C=O), 157.6 (NC=ON), 157.1, 134.1, 133.8, 129.9, 129.2, 128.7, 128.2, 127.6 (Ar-C), 111.8 [C(CH₃)₂], 105.0 (C-1), 83.6 (C-2), 80.7 (C-4), 80.3 (C-3), 57.3 (-OCH₃), 51.4 (C-6), 49.7 (-NCH₂), 34.6 (C-5), 26.6 and 26.0 [C(CH₃)₂]. Anal. Calcd for C₂₅H₂₇N₂O₆Cl: C, 61.66, H, 5.54, N, 5.75 Found: C, 61.97, H, 5.76, N, 5.62.

(1'R, 2'R, 3'S, 4'R, 6R) N¹-2-chlorohenylmethyl-N³-phenyl-5,6-dihydro-6-(1',2'-O-isopropylidene-3'-O-methyl)-1',4'-(tetrahydrofuranos-4'-yl)-pyrimidin-2,4-dione

(21): Colourless foam; yield 0.24 g, R_f 0.45 (hexane/ethyl acetate, 3:2). $[\alpha]_D^{25} - 39.04$ (c 0.3125, chloroform). MS (FAB) $m/z = 488$ (M+H)⁺. IR (Neat) ν_{\max} cm⁻¹: 3434, 2981, 2244, 1673, 1456, 1374, 1210, 1070, 1012, 858, 758. ¹H NMR (CDCl₃): δ 7.47-7.17 (m, 9H, ArH), 5.88 (d, $J = 3.7$ Hz, 1H, H-1'), 5.13 and 4.52 (each d, $J = 15.07$ Hz, each 1H, NCH_A and NCH_B), 4.59 (d, $J = 3.7$ Hz, 1H, H-2'), 4.37-4.33 (m, 1H, H-4'), 4.00-3.96 (m, 1H, H-6), 3.76 (d, $J = 3.4$ Hz, 1H, H-3'), 3.75 (s, 3H, OCH₃), 3.18 (d, $J = 16.8$ Hz, 1H, H-5_A), 2.85 (dd, $J = 16.9$ and 6.5 Hz, 1H, H-5_B), 1.44, 1.32 [each s, each 3H, C(CH₃)₂]. ¹³C NMR (CDCl₃): δ 169.30 (C=O), 154.0 (NC=ON), 136.1, 134.8, 133.9, 131.2, 130.2, 129.7, 129.4, 129.2, 128.6, 127.8 (Ar-C), 112.4 [C(CH₃)₂], 105.4 (C-1), 84.9 (C-2), 81.2 (C-4), 80.1 (C-3), 57.6 (-OCH₃), 51.1 (C-6), 48.7 (-NCH₂), 34.6 (C-5), 27.3 and [C(CH₃)₂] 26.6. Anal. Calcd for C₂₅H₂₇N₂O₆Cl: C, 61.66, H, 5.55, N, 5.75. Found: C, 61.89, H, 5.84, N, 5.32.

(1'R, 2'R, 3'S, 4'R, 6S) N¹-(2-chlorohenylmethyl)-N³-(4-chlorophenyl)-5,6-dihydro-6-(1',2'-O-isopropylidene-3'-O-methyl)-1',4'-(tetrahydrofuranos-4'-yl)-pyrimidin-

2,4-dione(22): Colourless foam; yield 0.61g, Rf 0.40 (hexane/ethyl acetate, 3:2). $[\alpha]_D^{25}$ - 2.66 (*c* 0.1875, chloroform). MS (FAB) = m/z 522 (M+H)⁺. IR (Neat) ν_{\max} cm⁻¹: 3403, 2986, 2939, 2377, 1688, 1592, 1458, 1368, 1194, 1077, 1023, 853, 754. ¹H NMR (CDCl₃): δ 7.44-7.37 (m, 4H, ArH), 7.25-7.22 (m, 2H, ArH), 7.07 (d, *J* = 8.6 Hz, 2H, ArH), 5.98 (d, *J* = 3.8 Hz, 1H, H-1'), 5.26 and 4.51 (each d, *J* = 14.2 Hz, each 1H, NCH_A and NCH_B), 4.61 (d, *J* = 3.8 Hz, 1H, H-2'), 4.45 (dd, *J* = 9.9 and 2.7 Hz, 1H, H-4'), 4.02-3.97 (m, 1H, H-6), 3.72 (d, *J* = 2.7 Hz, 1H, H-3'), 3.38 (s, 3H, OCH₃), 3.05 (dd, *J* = 16.9 and 6.5 Hz, 1H, H-5_A), 2.59 (d, *J* = 16.8 Hz, 1H, H-5_B), 1.49, 1.34 [each s, each 3H, C(CH₃)₂]. ¹³C NMR (CDCl₃): δ 166.4 (C=O), 150.7 (NC=ON), 132.7, 132.4, 131.9, 129.6, 128.1, 127.9, 127.4, 127.2, 125.0 (Ar-C), 110.1 [C(CH₃)₂], 103.3 (C-1), 81.8 (C-2), 78.9 (C-4), 78.8 (C-3), 55.6 (-OCH₃), 49.2 (C-6), 48.8 (-NCH₂), 35.0 (C-5), 27.2 and 26.5 [C(CH₃)₂]. Anal. Calcd for C₂₅H₂₆N₂O₆Cl₂: C, 57.6, H, 4.99, N, 5.37. Found: C, 57.95, H, 5.03, N, 5.01.

(1'R, 2'R, 3'S, 4'R, 6S)-N¹-(4-methoxyphenylmethyl)-N³-phenylmethyl-5,6-dihydro-6-(1',2'-O-isopropylidene)-3'-O-methyl-1', 4'-(tetrahydrofuranos-4'-yl)-pyrimidin-2,4-dione (23): Colourless foam; yield 0.6g, Rf 0.40 (hexane/ ethyl acetate, 3:2). $[\alpha]_D^{25}$ - 25.0 (*c* 0.2, chloroform), MS (FAB) = m/z 497(M+H)⁺, IR (Neat) ν_{\max} cm⁻¹: 3373, 2936, 2366, 1671, 1611, 1382, 1248, 1080, 850, 756. ¹H NMR (CDCl₃): δ 7.40-7.30(m, 3H, ArH), 7.29-7.20 (m, 3H, ArH), 6.88-6.83 (m, 2H, ArH), 5.90 (d, *J* = 3.8 Hz, 1H, H-1'), 5.35 (d, *J* = 15.02 Hz, 1H, N¹CH_A), 5.02 (s, 2H, N³CH₂Ph) 4.53 (d, *J* = 3.8 Hz, 1H, H-2'), 4.14-4.06 (m, 2H, H-4' and N¹CH_B), 3.79 (s, 3H, Ar-OCH₃), 3.76-3.72 (m, 1H, H-6), 3.61(d, *J* = 3.2 Hz, 1H, H-3'), 3.31 (s, 3H, OCH₃), 2.66 (dd, *J* = 16.8 and 6.78 Hz, 1H,

H-5_A), 2.42(d, J = 16.8 and 1.4Hz, 1H, H-5_B), 1.27 [s, 6H, -C(CH₃)₂]. ¹³C NMR (CDCl₃): 168.6 (C=O), 159.5 (NC=ON), 153.2, 138.2, 130.1, 129.9, 128.9, 128.9, 127.7, 114.5 (Ar-C), 112.4 [C(CH₃)₂], 105.5 (C-1), 84.2 (C-2), 81.4 (C-4), 80.9 (C-3), 57.8 (-OCH₃), 55.7 (Ar-OCH₃), 51.0 (C-6), 49.8, 44.2 (-NCH₂) 34.7 (C-5), 27.1 and 26.6 [C(CH₃)₂].

Anal. Calcd for C₂₇H₃₂N₂O₇ : C, 65.32, H, 6.45, N, 5.64 Found: C, 66.10, H, 7.01, N, 5.50.

(1'*R*, 2'*R*, 3'*S*, 4'*R*, 6*S*)-N¹-(3,4-dimethoxyphenylmethyl)-N³-phenyl-5,6-dihydro-6-(1',2'-*O*-isopropylidene-3'-*O*-methyl)-1',4'-(tetrahydrofuranos-4'-yl)-pyrimidin-2,4-dione (24): Colourless foam; yield 0.57 g, R_f 0.35 (hexane/ethyl acetate, 3:2). $[\alpha]_D^{25}$ –14.6 (*c* 0.20, ethyl acetate). MS (FAB) = m/z 513 (M+H)⁺. IR (Neat) ν_{\max} cm⁻¹: 3455, 2939, 2370, 1679, 1597, 1454, 1202, 1078, 1019, 755. ¹H NMR (CDCl₃): δ 7.49-7.41 (m, 3H, ArH), 7.18-7.15 (d, J = 6.5 Hz, 2 H, ArH), 6.93-6.85 (m, 3H, ArH), 5.98 (d, J = 3.8 Hz, 1H, H-1'), 5.37 and 4.21 (each d, J = 14.8 Hz, each 1H, N¹CH_A and N¹CH_B), 4.61 (d, J = 3.8 Hz, 1H, H-2'), 4.52 (dd, J = 9.9 and 3.1 Hz, 1H, H-4'), 3.92-3.89 (m, 1H, H-6), 3.87 (s, 6H, 2 x Ar-OCH₃), 3.71 (d, J = 3.1 Hz, 1H, H-3'), 3.38 (s, 3H, OCH₃), 2.85 (dd, J = 16.8 and 6.5 Hz, 1H, H-5_A), 2.55 (d, J = 16.8 Hz, 1H, H-5_B), 1.52 and 1.35 [s, 6H, -C(CH₃)₂]. ¹³C NMR (CDCl₃): 168.7 (C=O), 153.3 (NC=ON), 149.7, 149.2, 135.9, 130.3, 129.6, 129.0, 128.8, 121.4, 112.4, 112.4 (Ar-C), 111.7 [C(CH₃)₂], 105.5 (C-1), 84.2 (C-2), 81.3 (C-4), 80.9 (C-3), 57.9 (-OCH₃), 56.5, 56.3 (Ar-OCH₃), 51.6 (C-6), 49.9 (-NCH₂), 35.2 (C-5), 27.2, 26.6. Anal. Calcd for C₂₇H₃₂N₂O₈ : C, 63.28, H, 6.25, N, 5.46. Found: C, 64.33, H, 6.98, N, 5.31.

(1'R, 2'R, 3'S, 4'R 6S)-N¹-(3,4-dimethoxyphenylmethyl)-N³-benzyl-5,6-dihydro-6-(1',2'-O-isopropylidene-3'-O-methyl)-1',4'-(tetrahydrofuranos-4'-yl)-pyrimidin-2,4-dione (25): Colourless foam; yield 0.61 g, Rf 0.45 (hexane/ ethyl acetate, 3:2). $[\alpha]_D^{25} - 22.4$ (*c* 0.2, ethyl acetate). MS (FAB) = *m/z* 527 (M+H)⁺. IR (Neat) ν_{\max} cm⁻¹: 3431, 2939, 2377.9, 2148, 1597, 1520.71455.5, 1366.9, 1260.2, 1162.2, 1076.8, 1022.6, 700.5, 631.6, 556.2. ¹H NMR (CDCl₃): δ 7.39-7.33 (m, 2H, ArH), 7.30-7.24 (m, 4H, ArH), 6.82 (s, 2H, ArH), 5.90 (d, *J* = 3.8 Hz, 1H, H-1'), 5.34 and 4.13 (each d, *J* = 14.9 Hz, each 1H, N¹CH_A and N¹CH_B), 4.54 (s, 2H, -N³CH₂), 4.53 (d, *J* = 3.8 Hz, 1H, H-2'), 4.14 (dd, *J* = 9.7 and 3.0 Hz, 1H, H-4'), 3.85 and 3.83 (each s, each 3H, 2 x Ar-OCH₃), 3.74-3.70 (m, 1H, H-6), 3.61 (d, *J* = 3.0 Hz, 1H, H-3'), 3.31 (s, 3H, OCH₃), 2.65 (dd, *J* = 16.8 and 6.7 Hz, 1H, H-5_A), 2.43 (d, *J* = 16.8 Hz, 1H, H-5_B), 1.27 [s, 6H, -C(CH₃)₂]. ¹³C NMR (CDCl₃): δ 168.6(C=O), 158.5 (NC=ON), 149.6, 149.0, 139.7, 130.5, 129.09, 128.9, 128.8, 127.8, 127.6, 127.5, 121.0 (Ar-C), 112.00 [C(CH₃)₂], 111.7, 111.4 (Ar-C), 105.5 (C-1), 84.1 (C-2), 81.4 (C-4), 80.9 (C-3), 57.7 (-OCH₃), 56.3, 56.2 (Ar-OCH₃), 51.6 (C-6), 49.7, 44.2 (-NCH₂), 34.6 (C-5), 27.1 and 26.5 [C(CH₃)₂]. Anal. Calcd for C₂₈H₃₄N₂O₈: C, 63.87, H, 6.46, N, 5.32. Found: C, 64.26, H, 7.01, N, 5.09.

(1'R,2'R,3'S,4'R,6S)-N¹-(2-chlorophenylmethyl)-N³-phenyl-5,6-dihydro-6-(1',2'-O-isopropylidene-3'-O-benzyl)-1',4'-(tetrahydrofuranos-4'-yl)-pyrimidin-2,4-dione (26): Colourless foam; yield 0.55 g, Rf 0.35 (hexane/ethyl acetate, 3:2). $[\alpha]_D^{20} - 25.6$ (*c* 0.1875, chloroform). MS (FAB) = *m/z* 564 (M+H)⁺. IR (Neat) ν_{\max} cm⁻¹: 2927, 2371, 1682, 1597. ¹H NMR (CDCl₃): δ 7.42-7.32 (m, 8H, ArH), 7.25-7.19 (m, 4H, ArH), 7.14-7.10 (m, 2H, ArH), 6.01 (d, *J* = 3.7 Hz, 1H, H-1'), 5.26 (d, *J* = 14.9 Hz, 1H, NCH_APh), 4.70 and 4.58 (each d, *J* = 11.9 Hz, each 1H, -OCH_APh and -OCH_BPh), 4.65 (d, *J* = 3.7

Hz, 1H, H-2'), 4.51-4.43 (m, 2H, H-4' and -NCH_BPh), 4.21-4.15 (m, 1H, H-6), 3.95 (d, *J* = 3.1 Hz, 1H, H-3'), 2.92 (dd, *J* = 16.9 and 5.6 Hz, 1H, H-5_A), 2.32 (d, *J* = 16.9 Hz, 1H, H-5_B), 1.51, 1.33 [each s, each 3H, C(CH₃)₂]. ¹³C NMR (CDCl₃): δ 168.7 (C=O), 153.3 (NC=ON), 137.1, 135.8, 135.2, 134.3, 132.2, 130.1, 129.5, 129.5, 129.1, 129.0, 128.7, 128.0, 127.3 (Ar-C), 112.5 [C(CH₃)₂], 105.7 (C-1), 81.9 (C-2), 81.1 (C-4), 81.3 (C-3), 72.2 (-OCH₂Ph), 51.3 (C-6), 51.2 (-NCH₂), 34.7 (C-5), 27.2 and 26.6 [C(CH₃)₂]. Anal. Calcd for C₃₁H₃₁N₂O₆Cl: C, 66.13, H, 5.51, N, 4.97. Found: C, 66.46, H, 5.72, N, 4.83.

(1'*R*,2'*R*,3'*S*,4'*R*,6*S*)-N¹-(4-methoxyphenylmethyl)-N³-(4-chlorophenyl)-5,6-dihydro-6-(1',2'-*O*-isopropylidene-3'-*O*-benzyl)-1',4'-(tetrahydrofuranos-4'-yl)-pyrimidin-2,4-dione (27): Colourless foam; yield 0.58 g, R_f 0.35 (hexane/ethylacetate, 3:2). [α]_D²⁵ - 4.36 (*c* 0.1375, chloroform). MS (FAB) *m/z* = 593 (M+H)⁺. IR (Neat) ν_{max} cm⁻¹: 3450, 2931, 2374, 1678, 1603, 1509. ¹H NMR (CDCl₃): δ 7.39 (d, *J* = 8.6 Hz, 2H, ArH), 7.34-7.18 (m, 7H, ArH), 7.07 and 6.87 (each d, *J* = 8.6 Hz, each 2H, ArH), 6.0 (d, *J* = 3.7 Hz, 1H, H-1'), 5.33 and 4.20 (each d, *J* = 14.8 Hz, each 1H, NCH_A and NCH_B), 4.68 (d, *J* = 11.9 Hz, 1H, OCH_A), 4.64 (d, *J* = 3.7 Hz, 1H, H-2'), 4.45-4.39 (m, 2H, OCH_B and H-4'), 3.93-3.89 (m, 2H, H-6 and H-3'), 3.80 (s, 3H, ArOCH₃), 2.65 (dd, *J* = 16.9 and 6.5 Hz, 1H, H-5_A), 2.26 (d, *J* = 16.9 Hz, 1H, H-5_B), 1.49, 1.33 [each s, each 3H, C(CH₃)₂]. ¹³C NMR (CDCl₃): δ 168.5 (C=O), 159.7 (NC=ON), 153.0, 136.9, 134.6, 134.4, 130.4, 130.4, 129.7, 129.6, 129.1, 128.8, 128.1, 114.6 (Ar-C), 112.5 [C(CH₃)₂], 105.6 (C-1), 81.8 (C-1), 81.7 (C-1), 81.3 (C-1), 72.2 (-OCH₂Ph), 55.7 (Ar-OCH₃), 51.4 (C-6), 49.5 (-NCH₂), 34.9 (C-5), 27.2 and 26.6 [C(CH₃)₂]. Anal. Calcd for C₃₂H₃₃N₂O₇Cl: C, 64.81, H, 5.57, N, 4.72. Found: C, 65.19, H, 5.94, N, 4.68.

(1'R,2'R,3'S,4'R,6S)-N¹-(3,4-dimethoxyphenylmethyl)-N³-phenyl-5,6-dihydro-6-(1',2'-O-isopropylidene-3'-O-benzyl)-1',4'-(tetrahydrofuranos-4'-yl)-pyrimidin-2,4-dione (28): Colourless foam; yield 0.41 g, Rf 0.35 (hexane/ethyl acetate 3:2). MS (FAB) = m/z 589 (M+H)⁺. IR (Neat) ν_{\max} cm⁻¹: 3433, 2263, 1670, 1594, 1503, 1425, 1387, 1248, 1155, 1062, 1003, 875, 821. ¹H NMR (CDCl₃): δ 7.44-7.31 (m, 5H, ArH), 7.21-7.12 (m, 5H, ArH), 6.87-6.84 (m, 3H, ArH), 6.01 (d, J = 3.7 Hz, 1H, H-1'), 5.30 and 4.22 (each d, J = 14.7 Hz, each 1H, NCH_A and NCH_B), 4.67 and 4.43 (each d, J = 11.7 Hz, each 1H, OCH_A and OCH_B), 4.65 (d, J = 3.7 Hz, 1H, H-2'), 4.49 (dd, J = 9.9 and 3.0 Hz, 1H, H-4'), 3.95 (m, 1H, H-6), 3.96-3.92 (m, 2H, H-6 and H-3'), 3.87 and 3.83 (each s, each 3H, 2 x ArOCH₃), 2.69 (dd, J = 16.9 and 6.5 Hz, 1H, H-5_A), 2.30 (d, J = 16.9 Hz, 1H, H-5_B), 1.51, 1.33 [each s, each 3H, C(CH₃)₂]. ¹³C NMR (CDCl₃): δ 168.5 (C=O), 153.0 (NC=ON), 149.7, 149.2, 135.9, 137.0, 130.3, 129.5, 129.1, 129.0, 128.9, 128.8, 128.7, 128.5, 128.3, 128.1, 121.6, 112.5, 112.5 (Ar-C), 111.8 [C(CH₃)₂], 105.6 (C-1), 81.9 (C-2), 81.7 (C-4), 81.4 (C-3), 72.2 (-OCH₂Ph), 56.4, 56.3 (Ar-OCH₃), 51.7 (C-6), 49.4 (-NCH₂), 34.9 (C-5), 27.2, 26.6. Anal. Calcd for C₃₃H₃₆N₂O₈: C, 67.34, H, 6.12, N, 4.76. Found: C, 67.67, H, 6.35, N, 4.62.

(1'R,2'R,3'S,4'R,6S)-N¹-(3,4-dimethoxyphenylmethyl)-N³-(3-acetylphenyl)-5,6-dihydro-6-(1',2'-O-isopropylidene-3'-O-benzyl)-1',4'-(tetrahydrofuranos-4'-yl)-pyrimidin-2,4-dione (29): Colourless foam; yield 0.42 g, Rf 0.3 (hexane/ethyl acetate, 3:2). $[\alpha]_D^{25}$ +33 (c 0.1, chloroform). MS (FAB) = m/z 631 (M+H)⁺. IR (Neat) ν_{\max} cm⁻¹: 3018, 2438, 1681, 1597, 1513. ¹H NMR (CDCl₃): δ 7.97 (d, J = 7.8 Hz, 1H, ArH), 7.73 (s,

1H, ArH), 7.51 (dd, $J = 7.8$ and 7.31 Hz, 1H, ArH), 7.37-7.21 (m, 4H, ArH), 7.23-7.19 (m, 2H, ArH), 6.88-6.85 (m, 3H, ArH), 6.03 (d, $J = 3.6$ Hz, 1H, H-1'), 5.34 and 4.21 (each d, $J = 14.7$ Hz, each 1H, NCH_A and NCH_B), 4.70 and 4.42 (each d, $J = 11.7$ Hz, each 1H, OCH_A and OCH_B), 4.67 (d, $J = 3.6$ Hz, 1H, H-2'), 4.47 (dd, $J = 9.1$ and 2.8 Hz, 1H, H-4'), 4.03-3.97 (m, 1H, H-6), 3.95 (d, $J = 2.8$ Hz, 1H, H-3'), 3.88 and 3.84 (each s, each 3H, 2 x ArOCH₃), 2.70 (dd, $J = 16.9$ and 6.5 Hz, 1H, H-5_A), 2.58 (s, 3H, ArCOCH₃), 2.30 (d, $J = 16.9$ Hz, 1H, H-5_B), 1.53, 1.35 [each s, each 3H, C(CH₃)₂]. ¹³C NMR (CDCl₃): δ 197.1 (C=OCH₃), 168.5 (C=O), 153.0 (NC=ON), 149.6, 149.2, 138.5, 136.9, 136.3, 133.8, 129.8, 129.2, 129.1, 128.8, 128.6, 128.1, 121.6 (Ar-C), 112.4 [C(CH₃)₂], 111.7, 112.6 (Ar-C), 105.7 (C-1), 81.3 (C-2), 81.7 (C-4), 81.3 (C-3), 72.2 (-OCH₂Ph), 56.3, 56.4 (Ar-OCH₃), 51.8 (C-6), 49.4, 34.9 (C-5), 27.2, 27.0, 26.6. Anal. Calcd for C₃₅H₃₈N₂O₉ : C, 66.66, H, 6.03, N, 4.44. Found: C, 67.0, H, 6.35, N, 4.39.

ACKNOWLEDGEMENTS

Authors thank Director, CDRI for his keen interest in the programme, and to ICMR, New Delhi & V.W. Foundation Germany for financial support. We thank RSIC Division for giving spectral data and analysis. This paper bears CDRI communication No. 6338.

REFERENCES

1. Juaristi, E, Quintana, D.; Balderas, M.; Garcia-Perez E. Enantioselective synthesis of β -amino acids 7. Preparation of enantiopure β -amino acids from 1-benzoyl-2 (S)-tert-butyl-3-methylperhydropyrimidine-4-one. *Tetrahedron Assym.* **1996**, 7, 2233-2241 and references cited therein. (b) Chu, K. S.; Negrete, G. R.;

- Konopleski, J.P.; Lakner, F. J.; Woo, N.T.; Olmstead, M. M. Enantiomerically pure dihydropyrimidinones as reagents and auxiliaries for asymmetric synthesis. *J. Am. Chem. Soc.* **1992**, *114*, 1800-1802.
2. Burchenal, J.H. K.; Ciovacco, K.; Kalhar, K.; Toole, T.O.; Kiefner, R.; Dowing, M.D.; Chu, C.K.; Watanabe K.A.; Wempen, I.; Fox, J. J. *Cancer Research.* **1976**, *36*, 1520.
 3. (a) Shudolink, R.J.; “*Nucleoside Antibiotics*” Willey Inter Science, New York, N.Y. 1970. (b) Postema, M.H.D. *C-Glycoside Synthesis*, CRC, London, 1995. Levy, D.E.; Tang, C. *The chemistry of C-Glycosides*, Elsevier, Oxford, 1995.
 4. Schaeffer, H. J.; Beauchamp, L.; Miranda, P. D.; Ellion, G.B.; Bauer, D. J.; Collins, P. *Nature* **1978**, *272*, 583-585.
 5. (a) Skaric, V.; Matulic-adamic, J. J. *Chem. Soc. Perkin Trans. 1.* **1985**, 779-781 (b) Skaric, V.; Gaspert, B.; HohnJee, M.; and Lacan, G. *J. Chem. Soc. Perkin Trans. 1.* **1974**, 267-271
 6. Robins, R.K.; Srivastava, P.C.; Narayana, V.L.; Plowman, J. and Paul, K.D. *J. Med. Chem.* **1982**, *25*, 107-108.
 7. (a) Postema, M.H.D. *Tetrahedron* **1992**, *40*, 8545-8552 (b) Watanabe, K.A. *Chemistry of Nucleosides and Nucleotides* Townsend, L.B. Ed.; Plenum Press: New York, **1994**, *3*, 421-535.
 8. Lankner, F. J.; Chu, K.S.; Negrete, G.R.; Konopelski, J.P.; *Org. Synthesis* **1996**, *73*, 201.
 9. (a) Jaramillo, C.; Knapp, S. *Synthesis* **1994**, 1-20. (b) Chu, C.K.; Wempen, I.; Watanabe, K.A.; and Fox, J.J. *J. Org. Chem.* **1976**, *41*, 2793-2801 and references

- cited therein. (c) Guianvarc'h, D.; Fourrey, J. L.; Dau, M. E. T. H.; Guerineau, V. *J. Org. Chem.* **2002**, *67*, 3724-3729 (d) Fuentes, J.; Angulo, M.; Pradera, M. A. *J. Org. Chem.* **2002**, *67*, 2577-2583.
10. Lankner, F. J.; Negrette, G. R. *Synlett.* **2002**, 643-644.
11. (a) Tripathi, R. P.; Tripathi, R.; Tiwari, V. K.; Bala, L.; Sinha, S.; Srivastava, R.; and Srivastava, B. S. *Eur. J. Med. Chem.* **2002**, *37*, 773 (b) Khan, A.R.; Tripathi, R.P.; Tiwari, V.K.; Mishra, R.C.; Reddy, V.J.M.; and Saxena, J.K. *J. Carbohydr. Chem.* **2002**, *21(6)*, 587-600 and references cited in.
12. Mishra, R. C.; Tewari N.; Arora, K.; Tripathi R.P.; Tiwari, V.K.; Walter R.D.; Srivastava A. K. *Comb. Chem. & High. Through. Screen.* **2003**, *6*, 37-50.
13. Tewari N.; Tiwari, V.K.; Mishra, R. C.; Tripathi R.P.; Ahmed R.; Srivastava A. Srivastava R.; Srivastava B.S. *Bioorganic Med Chem.* **2003**, *11*, 2911-2922.
14. Tewari N.; Mishra, R. C.; Tiwari, V.K.; Tripathi R.P. *Synlett*, **2002**, *11*, 1779-1781
15. Patil, N.T.; Tilekar, J. N.; Dhavale, D. D. *J. Org. Chem.* **2001**, *66*, 1065-1071 and references cited therein.