Nucleoside Analogs. 5. Synthesis of Carbocyclic Pyrimidine Nucleoside Analogs

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Six carbocyclic analogs of uridine and thymidine in which the pentofuranosyl groups are replaced by a carbocyclic cyclopentane system have been synthsized. Their biological activities were determined against *HeLa* S3 cells.

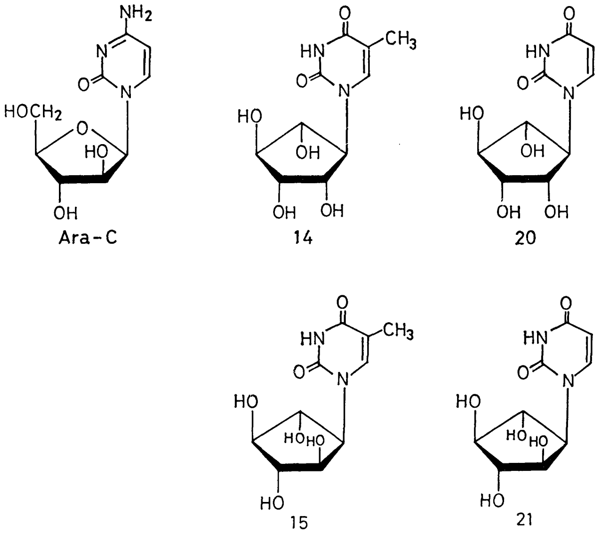
In connection with the preceding papers,[1–4] a report is given on the synthesis of carbocyclic analogs of uridine and thymidine in which the pentofuranosyl groups are replaced by a cyclopentane derivative.

1-β-D-Arabinofuranosylthymine (Ara-T),[5] which has been found in nature, has antiviral activity against 2DNA viruses, herpes virus and vaccinia virus in *HeLa* cell culture.[6]

Since 1-β-D-arabinofuranosylcytosine (Ara-C)[7] is a well known carcinostatic agent,[8] a carbocyclic analog of pyrimidine nucleoside might exhibit antineoplastic activity.

In the present study, three uridine and three thymidine analogs have been prepared and their biological activities are tested against *HeLa* cells.

Three stereoisomers of 5-amino-1,2,3,4-cyclopentanetetrol[3] **1**, **2**, and **3** were treated with nitrourea and subsequently acetylated by the conventional method to give corresponding 1,2,3,4-tetra-*O*-acetyl-5-ureido-1,2,3,4-cyclopentanetetrols **4**, **5**, and **6**, respectively.



Scheme 1.

When **4**, **5**, and **6** were treated with 3-methoxy-2-methylacryloyl chloride[9] in pyridine by an analogous method described by Naito *et al.*,[10] 1,2,3,4-tetra-*O*-acetyl-5-[*N'*-(3-methoxy-2-methylacryloyl)ureido]-1,2,3,4-cyclopentanetetrols **7**, **8**, and **9** were obtained. In their ^{1}H NMR spectra, a doublet at δ 9.21—9.31 (1H, J=8—9 Hz) is attributable to NH linked to the cyclopentane ring, a singlet at δ 8.56—8.86 (1H) being ascribed to NH where the 3-methoxy-2-methylacryloyl group is attached. This indicates that the 3-methoxy-2-methylacryloyl group is attached to the terminal amino group of **4**, **5**, and **6**.

Ring closure of **7**, **8**, and **9** in aqueous ammonia afforded 1-(2,3,4,5-tetrahydroxycyclopentyl)thymines **13** **14**, and **15**. Their successful ring closure was demonstrated by measuring their UV spectra at different pH.[11] Their *O*-acetyl derivatives **16**, **17**, and **18** were prepared by the usual acetylation.

On the other hand, when the ureido derivatives **4**, **5**, and **6** reacted with 3-ethoxyacryloyl chloride [12] by an analogous method described by Bobeck and Farkas,[13] 1,2,3,4-tetra-*O*-acetyl-5-*N'*-(3-ethoxyacryloyl)ureido-1,2,3,4-cyclopentanetetrols **10**, **11**, and **12** were obtained. Their structures were confirmed by means of ^{1}H NMR spectra.

Ring closure of **10**, **11**, and **12** in aqueous ammonia afforded 1-(2,3,4,5-tetrahydroxycyclopentyl)uracils **19**, **20**, and **21**. Their *O*-acetyl derivatives **22**, **23**, and **24** were also prepared.

Compounds **13**, **14**, **15**, **19**, **20**, and **21** showed no biological activity against *HeLa* S3 cells.

Experimental

Melting points were determined in capillary tubes and are uncorrected. Acetylation was carried out in the usual way with acetic anhydride in pyridine. Solutions were concentrated under reduced pressure at 40—50 °C. Silica gel (Wakogel C-300, Wako Pure Chemical Industries Ltd.) was used for column chromatography and TLC was performed on silica gel (Wakogel B-5FM) plates in 5:1 (v/v) benzene-ethanol system. ^{1}H NMR spectra were recorded at 60 MHz with a Varian A-60D spectrometer, peak positions being given in δ values. UV spectra were measured with a Hitachi-Perkin Elmer UV-VIS 139 spectrometer.

1,2,3,4-Tetra-O-acetyl-(1,4/2,3,5)-5-ureido-1,2,3,4-cyclopentanetetrol (4). A mixture of (1,4/2,3,5)-5-amino-1,2,3,4-cyclopentanetetrol[3] (**1**, 536 mg) and nitrourea (455 mg) in water (25 ml) was stirred at room temperature overnight. The solution was concentrated and the residue was acetylated. The solution was poured into ice-cold water (120 ml) and extracted with chloroform repeatedly. After being dried over Na_2SO_4, the chloroform extract was concentrated to dryness,

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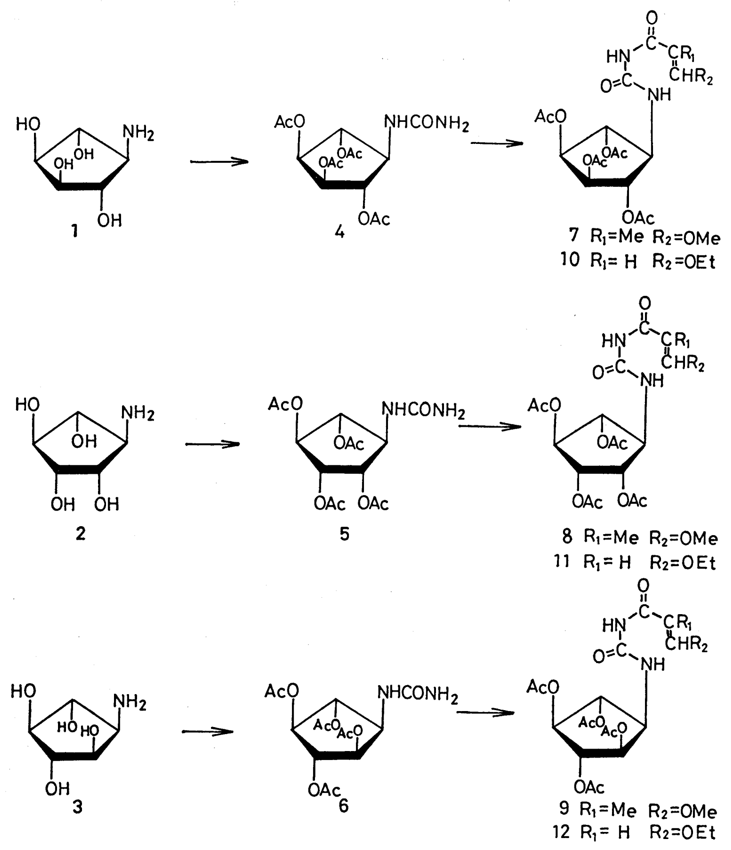
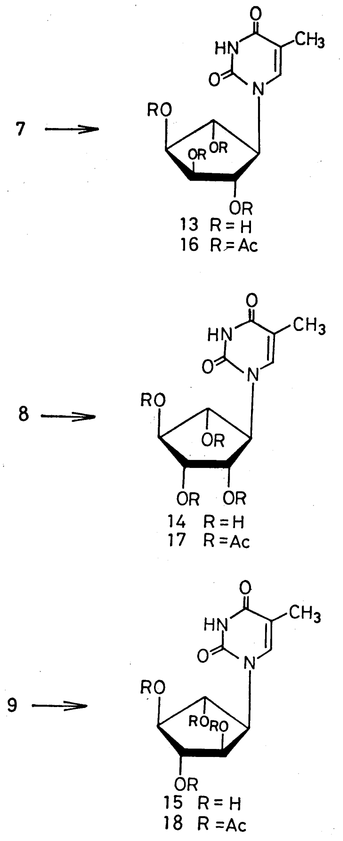
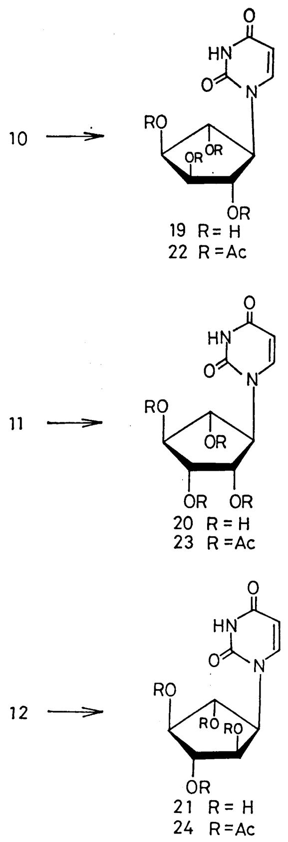


Scheme 2.



Scheme 3.



Scheme 4.

The residue was recrystallized from ethanol to give 823 mg (64%) of **4** as needles, mp 196—197 °C. ^{1}H NMR (DMSO-d_6): δ 2.02 (s, 12, 4×OAc), 3.28 (s, 2, NH_2), 6.42 (d, 1, J=9 Hz, NH).

Found: C, 47.00; H, 5.46; N, 7.77%. Calcd for $C_{14}H_{20}N_2O_9$: C, 46.67; H, 5.60; N, 7.77%.

*1,2,3,4-Tetra-O-acetyl-*DL*-(1,2,4/3,5)-5-ureido-1,2,3,4-cyclopentanetetrol (**5**).* A mixture of DL-(1,2,4/3,5)-5-amino-1,2,3,4-cyclopentanetetrol[3] (**2**, 1.23 g) and nitrourea (1.30 g) in water (60 ml) was heated under reflux for 3 h. Subsequent treatment was analogous to that described in the preparation of **4**. An oily residue was crystallized from ethyl acetate-petroleum ether to give 1.84 g (62%) of **5**, mp 165—166 °C.

Found: C, 46.51; H, 5.52; N, 7.53%. Calcd for $C_{14}H_{20}N_2O_9$: C, 46.67; H, 5.60; N, 7.77%.

*1,2,3,4-Tetra-O-acetyl-*DL*-(1,3,5/2,4)-5-ureido-1,2,3,4-cyclopentanetetrol (**6**).* 1,2,3,4-Tetra-*O*-acetyl-DL-(1,3,5/2,4)-5-acetamido-1,2,3,4-cyclopentaneterol[14] (3.26 g) was heated under reflux in 6 M hydrochloric acid (50 ml) for 1.5 h and the solution was concentrated to dryness. An aqueous solution of the residue was neutralized with Amberlite IRA-400(OH^-) resin and was concentrated. The residue was recrystallized from ethanol to give 1.25 g (93%) of DL-(1,3,5/2,4)-5-amino-1,2,3,4-cyclopentanetetrol (**3**), mp 142—144 °C.

Found: C, 39.97; H, 7.52; N, 8.66%. Calcd for $C_5H_{11}NO_4 \cdot 1/2H_2O$: C, 39.99; H, 7.93; N, 8.48%.

A mixture of **3** (1.00 g) and nitrourea (1.24 g) in water (50 ml) was heated under reflux for 4 h. The mixture was worked up as in the preparation of **4**. The crude product was recrystallized from ethanol to give 2.03 g (84%) of **6** as needles, mp 203—204 °C. ^{1}H NMR ($CDCl_3$–DMSO-d_6, 5 : 1): δ 2.08 (s, 6, 2×OAc), 2.10 (s, 3, OAc), 2.17 (s, 3, OAc), 5.57 (s, 2, NH_2), 6.46 (d, 1, J=9 Hz, NH).

Found: C, 46.64; H, 5.52; N, 7.87%. Calcd for $C_{14}H_{20}N_2O_9$: C, 46.67; H, 5.60; N, 7.77%.

*1,2,3,4-Tetra-O-acetyl-(1,4/2,3,5)-5-[N′-(3-methoxy-2-methylacryloyl)ureido]-1,2,3,4-cyclopentanetetrol (**7**).* A mixture of **4** (1.50 g), 3-methoxy-2-methylacryloyl chloride[9] (0.90 g), pyridine (5 ml) and chloroform (5 ml) was agitated at ambient temperature for 2 days. The solution was concentrated to dryness and the residue was dissolved in water (30 ml). The aqueous solution was extracted 3 times with chloroform (30 ml). After being dried over Na_2SO_4, the combined chloroform extract was concentrated. The residue was recrystallized from ethanol to give 1.31 g (68%) of **7**, mp 138—139 °C. ^{1}H NMR ($CDCl_3$): δ 1.78 (d, 3, J=1 Hz, C–CH_3), 2.07 (s, 6, 2×OAc), 2.08 (s, 6, 2×OAc), 3.86 (s, 3, C–OCH_3), 7.33 (q, 1, J=1 Hz, acryloyl CH), 8.56 (s, 1, N′H), 9.31 (d, 1, J=9 Hz, NH).

Found: C, 49.86; H, 5.68; N, 6.05%. Calcd for $C_{19}H_{26}N_2O_{11}$: C, 49.78; H, 5.72; N, 6.11%.

*1,2,3,4-Tetra-O-acetyl-*DL*-(1,2,4/3,5)-[N′-(3-methoxy-2-methylacryloyl)ureido]-1,2,3,4-cyclopentanetetrol (**8**).* A mixture of **5** (1.00 g), 3-methoxy-2-methylacryloyl choride[9] (1.12 g), pyridine (5 ml) and chloroform (5 ml) was stirred at ambient temperature for 40 h. The solution was worked up as in the preparation of **7**. A product was recrystallized from ether to give 0.59 g (47%) of **8**, mp 167—168 °C. ^{1}H NMR ($CDCl_3$): δ 1.79 (d, 3, J=1 Hz, C–CH_3), 2.04 (s, 3, OAc), 2.06 (s, 3, OAc), 2.08 (s, 6, 2×OAc), 3.87 (s, 3, C–OCH_3), 7.35 (q, 1, J=1 Hz, acryloyl CH), 8.86 (s, 1, N′H), 9.21 (d, 1, J=8 Hz, NH).

Found: C, 49.88; H, 5.74; N, 5.86%. Calcd for $C_{19}H_{26}N_2O_{11}$: C, 49.78; H, 5.72; N, 6.11%.

*1,2,3,4-Tetra-O-acetyl-*DL*-(1,3,5/2,4)-5-[N′-(3-methoxy-2-methylacryloyl)ureido]-1,2,3,4-cyclopentanetetrol (**9**).* A mixture of **6** (1.00 g), 3-methoxy-2-methylacryloyl chloride[9] (0.56 g), pyridine (5 ml) and chloroform (10 ml) was stirred for 38 h. The solution was worked up as in the preparation of **7**. A product was recrystallized from ether-petroleum ether to give 0.43 g (34%) of **9**, mp 130—131 °C. ^{1}H NMR ($CDCl_3$): δ 1.77 (s, 3, J=1 Hz, C–CH_3), 2.07 (s, 3, OAc), 2.08 (s, 3, OAc), 2.10 (s, 3, OAc), 2.16 (s, 3, OAc), 3.87 (s, 3, C–OCH_3), 7.34 (q, 1, J=1 Hz, acryloyl CH), 8.78 (s, 1, N′H), 9.22 (d, 1, J=8 Hz, NH).

Found: C, 49.48; H, 5.66; N, 5.79%. Calcd for $C_{19}H_{26}N_2O_{11}$: C, 49.78; H, 5.72; N, 6.11%.

*1,2,3,4-Tetra-O-acetyl-(1,4/2,3,5)-5-[N′-(3-ethoxyacryloyl)ureido]-*1,2,3,4-*cyclopentanetetrol (**10**).* A mixture of **4** (1.50 g), 3-ethoxyacryloyl chloride[12] (1.05 g), pyridine (7 ml) and chloroform (7 ml) was stirred overnight. The solution was poured into water (50 ml) and extracted with chloroform repeatedly. After being dried over Na_2SO_4, the chloroform extract was concentrated. The residue was purified on a silica gel column (110 g, 30 × 410 mm) using 10:1 (v/v) benzene–ethanol as eluent. Fractions showing a single spot on TLC (R 0.44) were combined and concentrated. The residue was recrystallized from ethyl acetate-petroleum ether to give 677 mg (35%) of **10**, mp 148—149 °C. ^{1}H NMR ($CDCl_3$): δ 1.36 (t, 3, J=7 Hz, C–$OCH_2\underline{CH_3}$), 2.08 (s, 12, 4 × OAc), 4.00 (q, 2, J=7 Hz, C–$O\underline{CH_2}CH_3$), 5.34 (d, 1, J=12 Hz, acryloyl CH), 7.60 (d, 1, J=12 Hz, acryloyl CH), 9.21 (d, 1, J=8 Hz, NH), 9.49 (s, 1, N′H).

Found: C, 49.89; H, 5.86; N, 5.90%. Calcd for $C_{19}H_{26}N_2O_{11}$: C, 49.78; H, 5.72; N, 6.11%.

*1,2,3,4-Tetra-O-acetyl-*DL*-(1,2,4/3,5)-5-[N′-(3-ethoxyacryloyl)ureido]-1,2,3,4-cyclopentanetetrol (**11**).* A mixture of **5** (0.40 g), 3-ethoxyacryloyl chloride[12] (0.50 g) and pyridine (5 ml) in chloroform (5 ml) was stirred for 13 h. The mixture was worked up as in the preparation of **10**. The product was recrystallized from ethanol to give 123 mg (24%) of **11**, mp 147—148 °C. ^{1}H NMR ($CDCl_3$): δ 1.35 (t, 3, J=7 Hz, C–$OCH_2\underline{CH_3}$), 2.06 (s, 3, OAc), 2.08 (s, 3, OAc), 2.09 (s, 3, OAc), 2.10 (s, 3, OAc), 3.98 (q, 2, J=7 Hz, C–$O\underline{CH_2}CH_3$), 5.35 (d, 1, J=12 Hz, acryloyl CH), 7.62 (d, 1, J=12 Hz, acryloyl CH), 9.11 (d, 1, J=8 Hz, NH), 9.78 (s, 1, N′H).

Found: C, 49.83; H, 5.70; N, 5.96%. Calcd for $C_{19}H_{26}N_2O_{11}$: C, 49.78; H, 5.72; N, 6.11%.

*1,2,3,4-Tetra-O-acetyl-*DL*-(1,3,5/2,4)-5-[N′-(3-ethoxyacryloyl)ureido]-1,2,3,4-cyclopentanetetrol (**12**).* A mixture of **6** (1.14 g), 3-ethoxyacryloyl chloride[12] (1.27 g) and pyridine (5 ml) in chloroform (5 ml) was worked up as in the preparation of **10**. A product was recrystallized from ethyl acetate-petroleum ether to give 589 mg (41%) of **12**, mp 132—135 °C. ^{1}H NMR ($CDCl_3$): δ 1.37 (t, 3, J=7 Hz, C–$OCH_2\underline{CH_3}$), 2.06 (s, 3, OAc), 2.09 (s, 6, 2×OAc), 2.15 (s, 3, OAc), 4.00 g (q, 2, J=7 Hz, C–$O\underline{CH_2}CH_3$), 5.33 (d, 1, J=12 Hz, acryloyl CH), 7.61 (d, 1, J=12 Hz, acryloyl CH), 9.11 (d, 1, J=9 Hz, NH), 9.52 (s, 1, N′H).

Found: C, 49.81; H, 5.88; N, 6.20%. Calcd for $C_{19}H_{26}N_2O_{11}$: C, 49.78; H, 5.72; N, 6.11%.

*1-[(1,3,4/2,5)-2,3,4,5-Tetrahydroxycyclopentyl]thymine (**13**).* A solution of **16** (741 mg) in methanol (20 ml) saturated with ammonia was stirred at ambient temperature for 15 h. The solution was concentrated, and the residue was recrystallized from ethanol to give 447 mg (99%) of **13**, mp 241—245 °C. UV: $\lambda_{\max}^{0.1\text{M HCl}}$ 272 nm (ε=1.0×10^4), $\lambda_{\max}^{H_2O}$ 273 nm (ε=0.99×10^4), $\lambda_{\max}^{0.1\text{M NaOH}}$ 272 nm (ε=0.76×10^4).

Found: C, 46.61; H, 5.52; N, 10.64%. Calcd for $C_{10}H_{14}N_2O_6$: C, 46.51; H, 5.46; N, 10.85%.

*1-[*DL*-(1,3/2,4,5)-2,3,4,5-Tetrahydroxycyclopentyl]thymine (**14**).* A solution of **8** (580 mg) in 3.5% aqueous ammonia (12 ml) was heated at 80 °C for 5 h with agitation. The solution was concentrated to dryness and the residue was recrystallized from ethanol to give 298 mg (91%) of **14**, mp 248—252 °C (dec). UV: $\lambda_{\max}^{0.1\text{M HCl}}$ 272 nm (ε=0.94×10^4), $\lambda_{\max}^{\text{H}_2\text{O}}$ 272 nm (ε=0.95×10^4), $\lambda_{\max}^{0.1\text{M NaOH}}$ 272 nm (ε=0.72×10^4).

Found: C, 46.53; H, 5.46; N, 10.96%. Calcd for $C_{10}H_{14}N_2O_6$: C, 46.51; H, 5.46; N, 10.85%.

*1-[*DL*-(1,2,4/3,5)-2,3,4,5-Tetrahydroxycyclopentyl]thymine (**15**).* A solution of **9** (295 mg) in 3.5% aqueous ammonia (10 ml) was heated at 80 °C for 5 h with agitation. The solution was concentrated to *ca.* 1 ml and the residue was stored in a refrigerator overnight to give 129 mg (77%) of **15**, mp 285—288 °C (dec). UV: $\lambda_{\max}^{0.1\text{M HCl}}$ 272 nm (ε=1.0×10^4), $\lambda_{\max}^{\text{H}_2\text{O}}$ 271 nm (ε=1.0×10^4), $\lambda_{\max}^{0.1\text{M HCl}}$ 270 nm (ε=0.8×10^4).

Found: C, 46.64; H, 5.53; N, 10.95%. Calcd for $C_{10}H_{14}N_2O_6$: C, 46.51; H, 5.46; N, 10.85%.

*1-[(1,3,4/2,5)-2,3,4,5-Tetraacetoxycyclopentyl]thymine (**16**).* A solution of **7** (1.20 g) in 3.5% aqueous ammonia (20 ml) was heated at 80 °C for 5 h with agitation. The solution was concentrated to dryness and the residue was acetylated. The product was recrystallized from ethanol to give 961 mg (86%) of **16**, mp 193—194 °C. ^{1}H NMR (CDCl$_3$): δ 1.96 (d, 3, *J*=1 Hz, C-CH$_3$), 2.07 (s, 6, 2×OAc), 2.11 (s, 6, 2×OAc), 7.10 (q, 1, *J*=1 Hz, pyrimidine CH), 9.45 (s, 1, pyrimidine NH).

Found: C, 50.65; H, 5.23; N, 6.42%. Calcd for $C_{18}H_{22}N_2O_{10}$: C, 50.70; H, 5.20; N, 6.57%.

*1-[*DL*-(1,3/2,4,5)-2,3,4,5-Tetraacetoxycyclopentyl]thymine (**17**).* Compound **14** (51 mg) was acetylated and the product was recrystallized from ethanol to give 74 mg (87%) of **17**, mp 207—208 °C. ^{1}H NMR (CDCl$_3$): δ 1.93 (d, 3, J 1 Hz, C-CH$_3$), 2.07 (s, 6, 2×OAc), 2.11 (s, 6, 2×OAc), 6.93 (q, 1, *J*=1 Hz, pyrimidine CH), 9.37 (s, 1, pyrimidine NH).

Found: C, 50.44; H, 5.15; N, 6.50%. Calcd for $C_{18}H_{22}N_2O_{10}$: C, 50.70; H, 5.20; N, 6.57%.

*1-[*DL*-(1,2,4/3,5)-2,3,4,5-Tetraacetoxycyclopentyl]thymine (**18**).* Compound **15** (161 mg) was acetylated and the product was recrystallized from ethanol to give 246 mg (93%) of **18**, mp 177—179 °C. ^{1}H NMR (CDCl$_3$): δ 1.92 (d, 3, *J*=1 Hz, C-CH$_3$), 2.02 (s, 3, OAc), 2.07 (s, 3, OAc), 2.09 (s, 6, 2×OAc), 7.10 (q, 1, *J*=1 Hz, pyrimidine CH), 9.55 (s, 1, pyrimidine NH).

Found: C, 50.89; H, 5.19; N, 6.48%. Calcd for $C_{18}H_{22}N_2O_{10}$: C, 50.70; H, 5.20; N, 6.57%.

*1-[(1,3,4/2,5)-2,3,4,5-Tetrahydroxycyclopentyl]uracil (**19**).* A solution of **22** (101 mg) in methanolic ammonia (5 ml) was stirred overnight at ambient temperature. The solution was concentrated to dryness and the residue was recrystallized from ethanol to give 54 mg (90%) of **19**, mp 237—240 °C. UV: $\lambda_{\max}^{0.1\text{M HCl}}$ 267 nm (ε=1.06×10^4), $\lambda_{\max}^{\text{H}_2\text{O}}$ 267 nm (ε=1.06×10^4), $\lambda_{\max}^{0.1\text{M NaOH}}$ 267 nm (ε=0.78×10^4).

Found: C, 44.66; H, 5.06; N, 11.44%. Calcd for $C_9H_{12}N_2O_6$: C, 44.26; H, 4.96; N, 11.47%.

*1-[*DL*-(1,3/2,4,5)-2,3,4,5-Tetrahydroxycyclopentyl]uracil (**20**).* A solution of **11** (110 mg) in 3.5% aqueous ammonia (5 ml) was heated at 80 °C for 5 h with agitation. The solution was concentrated to *ca.* 1 ml and the residue was stored in a refrigerator overnight to give 36 mg (62%) of **20**, mp 231—234 °C. UV: $\lambda_{\max}^{0.1\text{M HCl}}$ 267 nm (ε=1.0×10^4), $\lambda_{\max}^{\text{H}_2\text{O}}$ 267 nm (ε=1.0×10^4), $\lambda_{\max}^{0.1\text{M NaOH}}$ 266 nm (ε=0.72×10^4).

Found: C, 44.51; H, 5.09; N, 11.81%. Calcd for $C_9H_{12}N_2O_6$: C, 44.26; H, 4.96; N, 11.47%.

*1-[*DL*-(1,2,4/3,5)-Tetrahydroxycyclopentyl]uracil (**21**).* A solution of **24** (100 mg) in methanolic ammonia (5 ml) was stirred at ambient temperature overnight. The solution was concentrated to dryness and the residue was recrystallized from ethanol to give 56 mg (94%) of **21**, mp 255—257 °C. UV: $\lambda_{\max}^{0.1\text{M HCl}}$ 267 nm (ε=1.2×10^4), $\lambda_{\max}^{\text{H}_2\text{O}}$ 266 nm (ε=1.2×10^4), $\lambda_{\max}^{0.1\text{M NaOH}}$ 266 nm (ε=0.81×10^4).

Found: C, 44.38; H, 4.94; N, 11.36%. Calcd for $C_9H_{12}N_2O_6$: C, 44.26; H, 4.96; N, 11.47%.

*1-[(1,3,4/2,5)-2,3,4,5-Tetraacetoxycyclopentyl]uracil (**22**).* A solution of **10** (544 mg) in 3.5% aqueous ammonia (20 ml) was heated at 80 °C for 5 h with agitation. The solution was concentrated to dryness and the residue was acetylated. The product was recrystallized from ethanol to give 460 mg (94%) of **22**, mp 229—231 °C. ^{1}H NMR (DMSO-*d*$_6$): δ 2.10 (s, 6, 2×OAc), 2.15 (s, 6, 2×OAc), 5.84 (d, 1, *J*=8 Hz, pyrimidine CH), 7.97 (d, 1, *J*=8 Hz, pyrimidine CH), 7.34—8.54 (broad, 1, pyrimidine NH).

Found: C, 49.33; H, 4.83; N, 6.63%. Calcd for $C_{17}H_{20}N_2O_{10}$: C, 49.52; H, 4.89; N, 6.79%.

*1-[*DL*-(1,3/2,4,5)-2,3,4,5-Tetraacetoxycyclopentyl]uracil (**23**).* Compound **20** (53 mg) was acetylated and the product was recrystallized from ethanol to give 87 mg (97%) of **23**, mp 219—221 °C. ^{1}H NMR (DMSO-*d*$_6$): δ 2.09 (s, 3, OAc), 2.13 (s, 3, OAc), 2.15 (s, 6, 2×OAc), 5.85 (d, 1, *J*=8 Hz, pyrimidine CH), 8.06 (d, 1, *J*=8 Hz, pyrimidine CH), 8.16 (s, 1, pyrimidine NH).

Found: C, 49.39; H, 4.96; N, 6.56%. Calcd for $C_{17}H_{20}N_2O_{10}$: C, 49.52; H, 4.89; N, 6.79%.

*1-[*DL*-(1,2,4/3,5)-2,3,4,5-Tetraacetoxycyclopentyl]uracil (**24**).* A solution of **12** (582 mg) in 3.5% aqueous ammonia (20 ml) was heated at 80 °C for 5 h with agitation. The solution was concentrated to dryness and the residue was acetylated. The product was purified on a silica gel column (70 g, 30×270 mm) using 5 : 1 (v/v) benzene-ethanol as an eluent. Fractions showing a single spot on TLC (*R*$_f$ 0.66) were combined and concentrated to dryness. The residue was recrystallized from ethyl acetate-ethanol to give 345 mg (73%) of **24**, mp 187—188 °C. ^{1}H NMR (DMSO-*d*$_6$): δ 2.02 (s, 3, OAc), 2.08 (s, 3, OAc), 2.11 (s, 6, 2×OAc), 5.80 (d, 1, *J*=8 Hz, pyrimidine CH), 8.00 (d, 1, *J*=8 Hz, pyrimidine CH), 8.19 (s, 1, Pyrimidine NH).

Found: C, 49.66; H, 4.97; N, 6.67%. Calcd for $C_{17}H_{20}N_2O_{10}$: C, 49.52; H, 4.89; N, 6.79%.

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