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SYNTHESIS OF 1-(3'-DEOXY-β-D-GLYCERO-PENTOFURAN-2'-ULOSYL)URACIL BY SELECTIVE ELIMINATION REACTIONS

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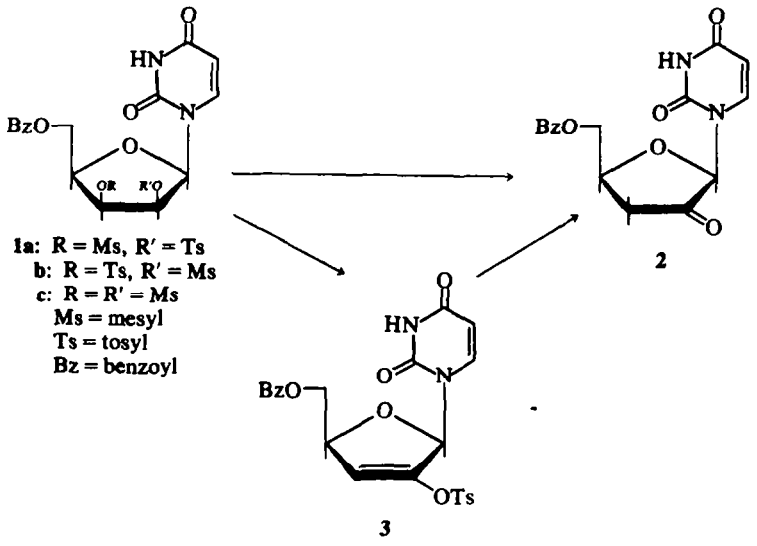
Abstract—For the synthesis of 1-(3'-deoxy-β-D-*glycero*-pentofuran-2'-ulosyl)uracil (**16**), the precursor, 5'-O-benzoyl derivative (**2**),[2] was elaborated in a variety of ways. 1-(5'-O-Benzoyl-3'-O-tosyl-β-D-lyxofuranosyl)uracil (**4**)[2] was benzoylated to N³-benzoyl-1-(2',5'-di-O-benzoyl-3'-O-tosyl-β-D-lyxofuranosyl)uracil (**5**), which directly yielded **2** on treatment with sodium benzoate. 1-(3',5'-Di-O-benzoyl-2'-O-tosyl-β-D-lyxofuranosyl)uracil (**8**) and its 3',5'-O-isopropylidene analog (**10**) resisted elimination reactions, thus proving *absolute* selectivity in the elimination of the derivatives of 1-β-D-lyxofuranosyl-uracil. Seeking a more economical path to **2**, 1-(5'-O-benzoyl-β-D-lyxofuranosyl)uracil (**11**) was first benzoylated to give 2',5'-di-O-benzoate (**12**), accompanied by 3',5'-di- and 2',3',5'-tri-O-benzoate. Mesylation of the major product (**12**) gave 1-(2',5'-di-O-benzoyl-3'-O-mesyl-β-D-lyxofuranosyl)uracil (**15**), which, on treatment with sodium benzoate, gave **2** in an highly improved yield. Basic hydrolysis on **2** gave compound **16**.

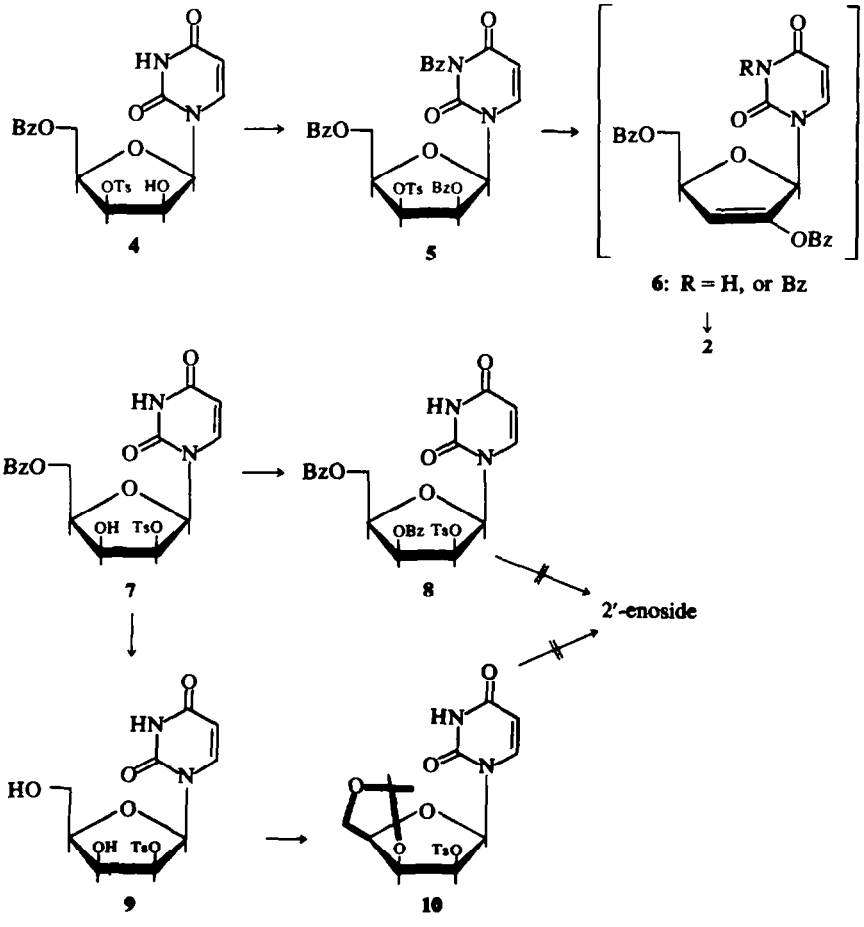
Recent reports have described the base-catalysed, selective elimination reactions of some uracil[1,2] and purine[3] ribonucleoside derivatives appropriately substituted with leaving groups at the 2'- and 3'-positions. Of interest is the behavior of the derivatives **1a–c** of 1 - (5' - O - benzoyl - β - D - lyxofuranosyl)uracil (**11**)[11] under the basic conditions used, in which 1 - (5' - O - benzoyl - 3' - deoxy - β - D - *glycero* - pentofuran - 2' - ulosyl)uracil (**2**) was obtained more readily than the intermediate 2'-enonucleoside (**3**) or its 2'-O-mesyl analog.[2] Compound **2** represents a new type of synthetic nucleoside and should have considerable importance not only as a synthetic intermediate but also from a biological point of view after deprotection. A biosynthetic implication with an analogous 3'-deoxy-2'-ketoadenosine, a hypothetical intermediate, has been reviewed.[4] However, our previous attempts to obtain intact 1 - (3' - deoxy - β - D - *glycero* - pentofuran - 2' - ulosyl)uracil, i.e. 3' - deoxy - 2' - ketouridine (**16** in Scheme 3), from **2** failed principally due to the lower yield of **2** (10–20%). There was normally a considerable degree of resinification. Hence, it is possible that **2** may have formed selectively and extensively degraded, or another product, possibly 3'-keto analog, also formed and completely degraded under the reaction conditions, leaving some part of **2**. An earlier observation revealed the rapid and complete degradation of 3'-ketonucleosides by the β-elimination of the heterocyclic base under the oxidation reaction conditions used.[5] On the basis of these considerations, this paper describes the results of our further synthetic work to obtain the elusive substance **16** and additional evidence supporting absolute selectivity in the elimination reactions.

Previously, we noted that the elimination reaction of 2',3'-di-O-tosyladenosine needed far more vigorous conditions[3] than that of 3'-O-tosyl-2'-deoxyadenosine.[6] Since one of the reasons for this appeared to lie in the different electrostatic nature surrounding C_2, the 2'-hydroxyl group was protected. Our earlier experiments showed that the 2' - hydroxyl in 1 - (5' - O - benzoyl - 3' - O - tosyl - β - D - lyxofuranosyl)uracil (**4**)[2] and 3' - hydroxyl in its 5' - O - benzoyl - 2' - O - tosyl analog (**7**)[2] are sufficiently hindered to exclude the introduction of another tosyl group under mild conditions. Hence, compound **4** was benzoylated using excess benzoyl chloride to afford N³ - benzoyl - 1 - (2',5' - di - O - benzoyl - 3' - O - tosyl - β - D - lyxofuranosyl)uracil (**5**). Reaction of **5** with excess sodium benzoate directly gave 2'-ketouridine **2** in a slightly improved yield (25%). Although an elaboration of the reaction conditions was abandoned for the sake of material salvation, 2'-enonucleoside **6** (R = H or Bz) must have intervened and transformed to **2** as previously observed.[2] On the other hand, 1 - (3',5' - di - O - benzoyl - 2' - O - tosyl - β - D - lyxofuranosyl)uracil (**8**) as well as the 3',5'-O-isopropylidene analog (**10**) resisted similar elimination reactions to be recovered unchanged, even when a more efficient system, e.g. t-BuOK-DMSO† and t-BuOK-THF, respectively, was used. These negative results support the full selectivity of the elimination reactions of the derivatives of ribo- and lyxonucleosides,[1-3] and led us to attempt a more efficient elimination

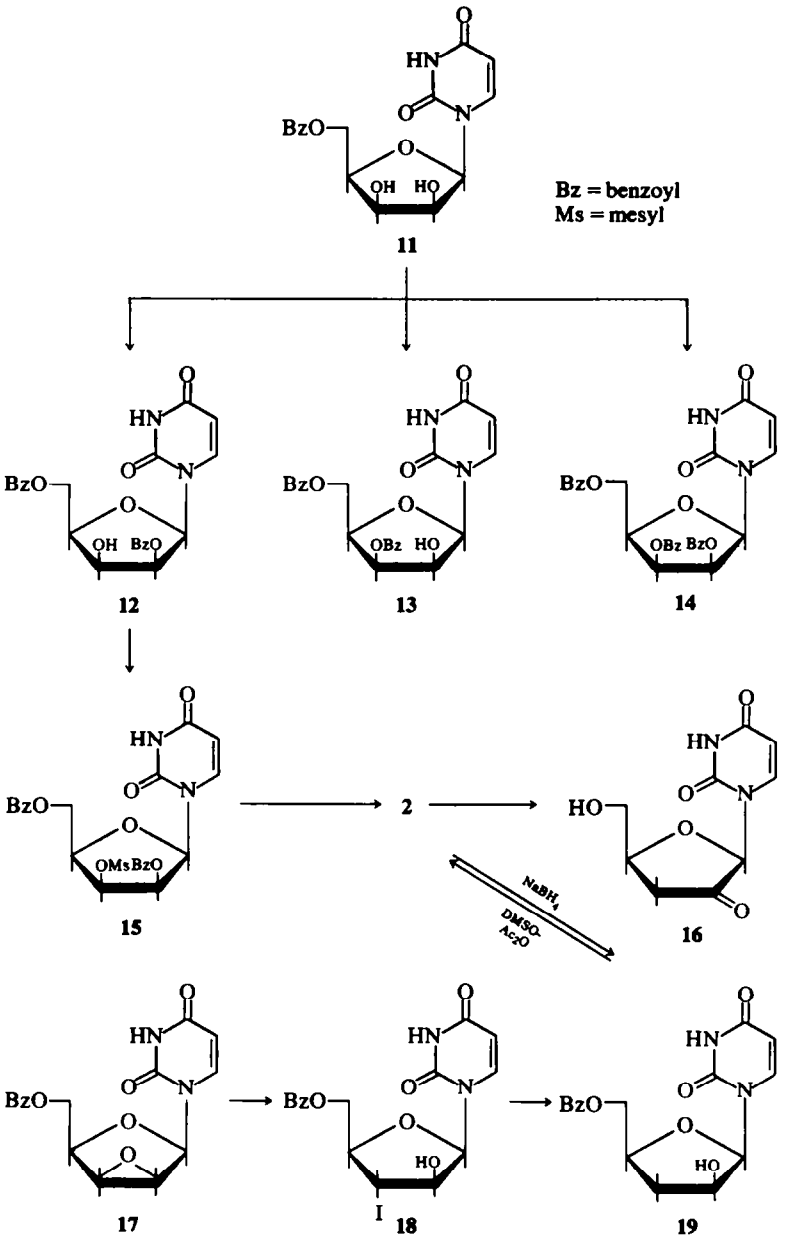
†In this case some degree of debenzoylation of the starting material was inevitable.



SCHEME 1.



SCHEME 2.



SCHEME 3.

reaction followed by debenzoylation as visualized in Scheme 3, since compound **4** was a minor product in the tosylation of **11**. The initial benzoylation experiment on **11** gave three products, **12**, **13** and **14**. The structure of **12** was easily established to be 2',5'-di-O-benzoate on the basis of the NMR spectrum, in which the signal of H_3, merged with those of $H_{4'}$ and 5'–CH_2 as a complex multiplet at 4·20–4·80 ppm (Experimental). The more deshielded doublet of doublets at 5·50 ppm is attributable to a proton attached to a C atom having the benzoyloxy group and must be the signal of $H_{2'}$ which coupled with the anomeric proton at 6·45 ppm ($J_{1',2'}$ = 6·9 Hz). The structure of **13** should be 3',5'-di-O-benzoate: in its NMR spectrum, the signal of $H_{2'}$ overlapped with those of $H_{4'}$, 5'–CH_2 and of the OH as a broad multiplet at 4·5–5·1 ppm; the 1H-multiplet at 5·75 ppm did not interact with the anomeric proton and hence was the signal of $H_{3'}$. The appearance of the D_2O-exchangeable NH-signal at 10·20 ppm was additional evidence for structure **13**. Compound **14** was 2',3',5'-tri-O-

benzoate, in the NMR spectrum of which the signals of $H_{2'}$ and $H_{3'}$ appeared at around 6·0 ppm and were clearly separated from the resonance envelope of $H_{4'}$ and 5′–CH_2. The occurrence of an NH-signal at 9·30 ppm was additional structural evidence. Another well-controlled benzoylation on **11** gave compound **12** in 92% yield after simple extraction and crystallization. Mesylation of **12** gave non-crystalline 1 - (2′,5′ - di - O - benzoyl - 3′ - O - mesyl - β - D - lyxofuranosyl)uracil (**15**) in high yield, which then successfully yielded compound **2** (60%) on treatment with sodium benzoate. An overall yield of 50% of **2** from **11** (*via* procedure *B* for **12**) was realized, while the corresponding yield through the route, **11**→**4**→**5**→**2**, was 8·6% (Scheme 2).

A conventional synthetic route was then examined. 1 - (5′ - O - Benzoyl - 3′ - deoxy - 3′ - iodo - β - D - arabinofuranosyl)uracil (**18**)[7] was obtained from 1 - (5′ - O - benzoyl - 2′,3′ - anhydro - β - D - lyxofuranosyl)uracil (**17**)[8] and pyridine hydroiodide in an improved yield (71%). Reduction of **18** by the reported procedure[7] gave 1 - (5′ - O - benzoyl - 3′ - deoxy - β - D - *threo* - pentofuranosyl)uracil (**19**),[7] which was oxidized with a DMSO-acetic anhydride mixture to afford **2** in 38% yield, an overall yield of 19·4% from **17**. It might be noted that the synthesis of **17** requires four steps[8,9] from uridine though each step proceeds in excellent yield, while the synthesis of **11** is in three steps, each yield being also excellent.[10,11] Borohydride reduction of **2** regenerated **19**. Deprotection of **2** to **16** was not so facile due to its base-sensitivity but was eventually achieved in 36% yield by the use of a triethylamine-methanol mixture. Compound **16** resisted crystallization but gave a satisfactory elemental analysis and spectral properties as shown in the Experimental.

The 2′-ketouridine **16** gives ill-defined ORD and CD curves possibly due to perturbation by the sugar ketone (Fig 1); however, the strong negative Cotton effect at 260–280 nm region clearly indicates the *syn*-conformation, obeying Ulbricht's rule.[12] This would simply result from the repercussion between the 2- and 2′-carbonyl groups. The negative Cotton effects observed on 2′,3′-dideoxy-2′,3′-didehydrouridine and 2′,3′-thionocarbonate of uridine might be also interpreted in a similar sence.[12]

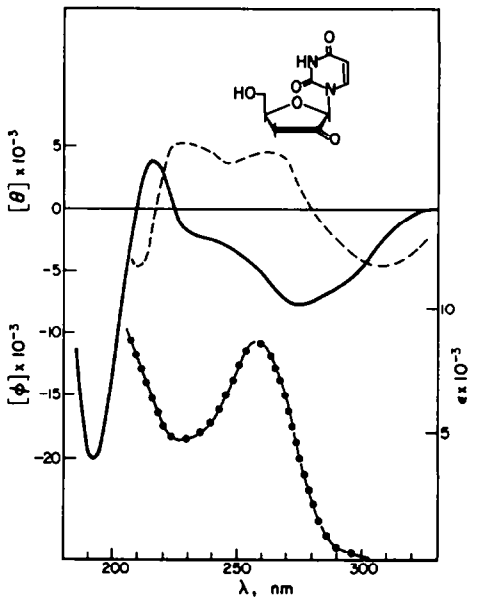


Fig 1. ORD- (----), CD- (———) and UV- (·-·-·-·) Spectra of 1-(3′-Deoxy-β-D-*glycero*-pentofuran-2′-ulosyl)uracil (**16**) in Methanol.

EXPERIMENTAL

All the m.ps are uncorrected. The electronic and ORD spectra were measured on a JASCO Model ORD/UV-5 spectrophotometer. The CD curve was recorded with a JASCO Model J-20 recording spectropolarimeter. The specific rotations were measured with a YANAGIMOTO Model OR-50D digital automatic polarimeter in DMF. The NMR spectra were measured with a JNM C-60 HL spectrometer, TMS being used as an internal standard. In the case of the OH containing compounds, measurements after D_2O exchanges were also carried out. Wakogel B-5 silica gel, supplied by the Wako Pure Chemical Industries, was used for TLC, while column chromatography was carried out using Mallinkrodt silicic acid (100 mesh) after washing with ethyl acetate.

N³ - Benzoyl - 1 - (2′,5′ - di - O - benzoyl - 3′ - O - tosyl - β - D - lyxofuranosyl)uracil (**5**)

Benzoyl chloride (0·29 ml, *ca* 2·5 mmol) was added to an ice-cold stirred soln of **4**[2] (502 mg, 1 mmol) in pyridine (4 ml). The mixture was held at room temp overnight, then treated with MeOH (2 ml) for 30 min and evaporated to a gum, which was repeatedly digested with water. After removing the water by decantation, the residue was triturated with a small volume of EtOH to effect crystallization. Recrystallization from EtOH gave 600 mg (84·4%) of colorless needles (**5**), m.p. 214–216°: $[\alpha]_D^{17}$ + 115° (c, 0·013, DMF); λ_{max}^{MeOH} nm (ε) 230 (36200) and 250 (23200, inflection); NMR ($CDCl_3$) δ 2·13 (3H, s, Me of the tosyl group), 4·57 (2H, m, 5′–CH_2), 5·40 (1H, m, $H_{3'}$), 5·61 (1H, d, $J_{1',2'}$ = 6·6 Hz, $H_{2'}$), 5·68 (1H, d, $J_{5,6}$ = 8·0 Hz, H_5), 6·30 (1H, d, $J_{1',2'}$ = 6·6 Hz, $H_{1'}$), 6·80–7·95 (20H, m, aryl protons and H_6). (Found: C, 62·47; H, 4·35; N, 3·90. $C_{37}H_{30}N_2O_{11}S$ requires: C, 62·53; H, 4·25; N, 3·94%).

Reaction of N³ - benzoyl - 1 - (2′,5′ - di - O - benzoyl - 3′ - O - tosyl - β - D - lyxofuranosyl)uracil (**5**) *with sodium benzoate*

A mixture of **5** (600 mg, 0·85 mmol) and sodium benzoate (580 mg, 4·0 mmol) in DMF (15 ml) was stirred at 120° for 3 h. TLC with an aliquot of the mixture indicated the presence of one main product with no starting material. The brown mixture was evaporated *in vacuo* to a pasty residue, which was taken into chloroform (60 ml), washed with water (20 ml) and dried over Na_2SO_4. The chloroform soln was concentrated and directly applied on a silica gel column (1·2 × 20 cm). Elution with a solvent system, $CHCl_3$ (3)/EtOH (1), gave first an unspecified amount of benzoic acid and then a homogeneous crystal-

line product, which was identified with an authentic sample of **2** by IR spectroscopy and mixture m.p.d. (m.p. and mixed m.p. 193–195°). The yield after one crystallization from MeOH was 70 mg (25%). An overall yield of 8·6% was calculated on the basis of **11**.[11]

1 - (3',5' - *Di* - O - *benzoyl* - 2' - O - *tosyl* - β - D - *lyxofuranosyl)uracil* (**8**)

To an ice-cold stirred soln of the methanolate of **7**[2] (330 mg, 0·63 mmol) in dry pyridine (3 ml) was added benzoyl chloride (0·18 ml, 1·6 mmol). The mixture was left at room temp overnight, then treated with EtOH (1 ml) at room temp for 20 min and evaporated to a gum, which was dissolved in EtOAc (50 ml). The soln was washed with water (20 ml), dried over $NaSO_4$ and evaporated. The residual paste was submitted to preparative TLC with the use of a silica gel plate (20 × 20 cm) and a mixed solvent, $CHCl_3$ (1)/EtOAc (1). Elution of the faster-moving band with acetone and evaporation of the solvent gave a paste, which crystallized from MeOH to give 220 mg (50·3%) of colourless crystals, m.p. 201–203°: $[\alpha]_D^{17} + 88°$ (c, 0·01, DMF); λ_{max}^{MeOH} nm (ε) 228 (38300) and 259 (10900); NMR ($CDCl_3$) δ 2·30 (3H, s, Me), 4·75 (3H, br. s, $H_{4'}$ and 5'–CH_2), 5·48 (1H, t, $J_{1',2'} = J_{2',3'} = 4·0$ Hz, $H_{2'}$), 5·66 (1H, dd, $J_{5,6} = 8·0$ Hz, $J_{5,NH} = 1·5$ Hz, H_5), 5·97 (1H, m, $H_{3'}$), 6·30 (1H, d, $J_{1',2'} = 4·0$ Hz, $H_{1'}$), 7·10–8·25 (15H, m, H_6 and aryl protons) and 9·82 (1H, br. s, NH, lost on D_2O-addition). (Found: C, 59·12; H, 4·39; N, 4·51. $C_{30}H_{26}N_2O_{10}S$ requires: C, 59·40; H, 4·32; N, 4·62%). The slower band of the chromatogram gave 80 mg (24·2%) of the starting material.

1 - (2' - O - *Tosyl* - β - D - *lyxofuranosyl)uracil* (**9**)

Conc NH_4OH (3 ml) was added to a soln of the methanolate of **7**[2] (330 mg, 0·63 mmol) in a mixture of MeOH (9 ml) and acetone (2 ml), and the mixture was left at room temp for 30 h. The solvent and excess ammonia were removed under reduced pressure and the residual water was removed by repeated evaporation with EtOH. The residue was then thoroughly digested with dry benzene to afford crystalline solid, which was collected by filtration and recrystallized from MeOH to give 170 mg (68%) of colourless needles (**9**), m.p. 259–260° (dec.): $[\alpha]_D^{17} + 18°$ (c, 0·011, DMF); λ_{max}^{MeOH} nm (ε) 225 (14500) and 259 (9800). (Found: C, 48·00; H, 4·63; N, 7·18. $C_{16}H_{18}N_2O_8S$ requires: C, 48·24; H, 4·56; N, 7·03%).

1 - (3',5' - O - *Isopropylidene* - 2' - O - *tosyl* - β - D - *lyxofuranosyl)uracil* (**10**)

To a mixture of **9** (130 mg, 0·33 mmol), DMF (1 ml), ethyl orthoformate (0·1 ml) and acetone (0·1 ml) was added a few drops of saturated dioxane soln of HCl. After standing in a refrigerator (0–3°) overnight, the mixture was neutralized, under stirring, by addition of solid $NaHCO_3$ in small portions. The mixture was then diluted with acetone (5 ml) and inorganic material was filtered off. The filtrate was evaporated *in vacuo* and the residue was triturated with ice-water (10 ml) to give a ppt, which was filtered, dissolved in EtOAc and dried over $NaSO_4$. The EtOAc soln was filtered with Norit and evaporated *in vacuo* to a foam (**10**) which resisted crystallization. Its homogeneity was confirmed by TLC using silica gel and 20% EtOH in benzene. The yield after drying at 50° *in vacuo* for 2 days was 100 mg (71%). λ_{max}^{MeOH} nm (ε) 225 (16800) and 259 (11200). (Found: C, 51·98; H, 5·15; N, 6·65. $C_{19}H_{22}N_2O_8S$ requires: C, 52·05; H, 5·05; N, 6·39%).

Benzoylation of 1 - (5' - O - *benzoyl* - β - D - *lyxofuranosyl)uracil* (**11**)[11]

Method A. To a stirred soln of **11** (1·04 g, 3·0 mmol) in dry pyridine (16 ml) at −20° was added dropwise benzoyl chloride (0·38 ml, 3·3 mmol). The mixture was held at −20° overnight, then treated with MeOH for 20 min and evaporated *in vacuo* at below 40°. The residual paste was dissolved in MeOH (15 ml) and precipitated into ice-water (200 ml). The collected ppt was semi-dried by pressing on a porous plate, dissolved in $CHCl_3$ (100 ml) and dried over Na_2SO_4. Concentration of the soln to *ca* 30 ml gave homogeneous crystals of **12** (0·97 g). The filtrate was concentrated and chromatographed on a silica gel column (1·5 × 16 cm) using $CHCl_3$ (3)/EtOAc (1). The first fraction gave practically pure, crystalline **14** (100 mg, 6·0%). The second fraction gave another crop of **12** (100 mg, homogeneous). The total yield of **12** was 71%. Subsequent fractions gave 170 mg (13·3%) of the third product, **13**.

The combined crops of **13** was once recrystallized from $CHCl_3$ to give colourless fine needles which shrank at 104° and melted at 108–110°, λ_{max}^{MeOH} nm (ε) 227 (25800) and 259 (11000); NMR [$CDCl_3$ (5)/DMSO (1), and one drop of D_2O] δ 4·20 (4H, complex multiplet, $H_{3'}$, $H_{4'}$ and 5'–CH_2), 5·50 (1H, dd, $J_{1',2'} = 6·9$ Hz, $J_{2',3'} = 4·4$ Hz, $H_{2'}$), 5·67 (1H, d, $J_{5,6} = 7·5$ Hz, H_5), 6·45 (1H, d, $J_{1',2'} = 6·9$ Hz, $H_{1'}$), 7·25–8·10 (11H, m, aryl protons and H_6). (Found: C, 61·05; H, 4·50; N, 6·10. $C_{23}H_{20}N_2O_8$ requires: C, 61·06; H, 4·46; N, 6·19%).

Compound **13** was also crystallized from $CHCl_3$ to give fine needles, which shrank at 99° and melted at 104–106°: $[\alpha]_D^{17} + 140°$ (c, 0·010, DMF); λ_{max}^{MeOH} nm (ε) 227 (27400) and 259 (10000); NMR ($CDCl_3$) δ 4·50–5·10 (5H, m, $H_{2'}$, $H_{4'}$, 5'–CH_2 and OH), 5·47 (1H, dd, $J_{5,6} = 8·0$ Hz, $J_{5,NH} = 2·0$ Hz, H_5), 5·75 (1H, m, $H_{3'}$), 6·17 (1H, d, $J_{1',2'} = 5·5$ Hz, $H_{1'}$), 7·20–8·15 (11H, m, aryl protons and H_6), and 10·20 (1H, br. s, NH, lost on D_2O addition). (Found: C, 60·77; H, 4·74; N, 6·24. $C_{23}H_{20}N_2O_8$ requires: C, 61·06; H, 4·46; N, 6·19%).

Compound **15** was recrystallized from EtOH to give colourless needles of m.p. 142–144°; λ_{max}^{MeOH} nm (ε) 227 (41200) and 260 (11000); NMR ($CDCl_3$) δ 4·75 (3H, s, $H_{4'}$ and 5'–CH_2), 5·60 (1H, br. d, $J_{5,6} = 7·5$ Hz, H_5), 6·00 (1H, d, $J_{1',2'} = 6·0$ Hz, $H_{2'}$), 6·02 (1H, s, $H_{3'}$), 6·46 (1H, d, $J_{1',2'} = 6·0$ Hz, $H_{1'}$), 7·15–7·97 (16H, m, aryl protons and H_6) and 9·30 (1H, br. s, NH, D_2O-exchangeable). (Found: C, 64·68; H, 4·63; N, 5·11. $C_{30}H_{24}N_2O_9$ requires: C, 64·74; H, 4·35; N, 5·03%).

Method B. Benzoyl chloride (0·35 ml, 3·0 mmol) was gradually added (in 10 min) to a stirred pre-cooled solution of **11** (1·04 g, 3·0 mmol) in pyridine (14 ml). During the addition, the temp of the soln was rigorously maintained at below −20°. After standing at −20° overnight, the mixture was worked up as in *Method A* except chromatography. The finally obtained $CHCl_3$ soln was concentrated to give, in one batch, 1·25 g (92%) of practically pure crystals, which was identified with **12** in procedure *A* by IR spectroscopy and mixture m.p. (m.m.p.) determination.

1 - (2',5' - *Di* - O - *benzoyl* - 3' - O - *mesyl* - β - D - *lyxofuranosyl)uracil* (**15**)

To a stirred ice-cold soln of **12** (904 mg, 2·0 mmol) obtained above in dry pyridine (4 ml) was added methanesulfonyl chloride (0·2 ml, 2·6 mmol). After 20 h at 0° the mixture was treated with MeOH (2 ml) at room temp for 20 min and evaporated *in vacuo* to a gum, which was dissolved in MeOH (4 ml) and precipitated into ice-water (40 ml) under vigorous stirring. The ppt was filtered off, air-dried

on a porous plate and dissolved in $CHCl_3$ (50 ml). The $CHCl_3$ soln was filtered with Norit and evaporated under reduced pressure to give a homogeneous foam, which was thoroughly dried under high vacuum in a desiccator, yield: 970 mg (91%); IR (KBr): ν S=O 1370 and 1185 cm^{-1}; NMR ($CDCl_3$) δ 2·94 (3H, s, mesyl), 4·70 (3H, br. s, $H_{4'}$ and 5'–CH_2), 5·50–6·05 (3H, m, $H_{2'}$, $H_{3'}$ and H_5), 6·47 (1H, d, $J_{1',2'} = 6·0$ Hz, $H_{1'}$), 7·15–8·10 (11H, m, aryl protons and H_6) and 9·43 (1H, br. s, NH, D_2O-exchangeable).

Reaction of 1 - (2',5' - *di* - O - *benzoyl* - 3' - O - *mesyl* - β - D - *lyxofuranosyl*)*uracil* (**15**) *with sodium benzoate*

A mixture of **15** (424 mg, 0·8 mmol) and sodium benzoate (450 mg, 3·1 mmol) in DMF (8 ml) was stirred at 115° for 1 h. TLC with an aliquot of the mixture showed the presence of one main product and no starting material. The mixture was evaporated *in vacuo* to a tar, which was twice digested with a small amount of ice-water. The residue separated from the water was dissolved in warm acetone (30 ml) and insoluble solid was filtered off. The filtrate was evaporated to a gum, which was applied on a silica gel column (1·6 × 14 cm) and developed with a solvent system, $CHCl_3$ (3)/EtOH (1). The main fraction gave a practically homogeneous solid, which was recrystallized from methylene chloride to colourless crystals of m.p. 192–194° (150 mg, 60%), identical with **2** in all respects. The overall yield from **11** was 50% (through procedure *B* for **12**).

1 - (3' - *Deoxy* - β - D - *glycero* - *pentofuran* - 2' - *ulosyl*)*uracil* (**16**)

2[2] (100 mg, 0·3 mmol) was dissolved in a mixture of MeOH (10 ml) and triethylamine (1 ml). The soln was gently refluxed for 1 h and, after adding further triethylamine (1 ml), left at room temp overnight. The concentrated mixture was repeatedly evaporated with EtOH to give a gum, an aliquot of which was examined by TLC to show one main product with a small amount of the starting material and a faster-moving spot, which seemed to be due to a mixture of deglycosidation products. The mixture was then submitted to preparative TLC using silica gel and 30% EtOH in benzene. Elution of the main band with acetone, followed by evaporation, gave a homogeneous paste, which resisted crystallization. The paste was then dissolved in acetone (10 ml) and the soln was filtered with Norit. After careful concentration to *ca* 2 ml, the soln was dropped into dry ether (15 ml) under stirring. The fluffy ppt was collected by centrifugation and dried under high vacuum to give 20 mg (36·5%) of colourless powder (**16**). IR (KBr): ν C=O 1770 cm^{-1}; λ_{max}^{MeOH} 258 nm (ϵ 8600). (Found: C, 35·82; H, 4·02; N, 8·15. $C_9H_{10}N_2O_5$ requires: C, 35·62; H, 3·89; N, 8·31%).

1 - (5' - O - *Benzoyl* - 3' - *deoxy* - 3' - *iodo* - β - D - *arabinofuranosyl*)*uracil* (**18**)

A soln of **17**[6] (0·5 g, 1·5 mmol) and pyridine hydroiodide (1·24 g, 6·0 mmol) in dry pyridine (25 ml) was refluxed for 3 h. After cooling, the mixture was evaporated *in vacuo* to a paste, which was dissolved in $CHCl_3$, washed with saturated sodium thiosulfate soln (15 ml) and water (10 ml), and then dried over $NaSO_4$. Evaporation of the solvent gave a solid, which was recrystallized from EtOH to give 491 mg (71%) of colourless needles of m.p. 199–201° (lit[7] 200–202°). Identity with an authentic specimen was confirmed by IR spectra and m.m.p.

Oxidation of 1 - (5' - O - *benzoyl* - 3' - *deoxy* - β - D - *arabinofuranosyl*)*uracil* (**19**) *with DMSO-acetic anhydride*

Ac_2O (0·9 ml) was added to a soln of **19** (290 mg, 0·87 mmol) in a mixture of DMSO (9 ml) and dry benzene (2 ml), and the total was heated at 60° for 4 h. After cooling, EtOAc (50 ml) was added and the mixture was neutralized by shaking with 5% $NaHCO_3$. The organic layer was then washed with water (3 × 10 ml), dried over $NaSO_4$ and evaporated *in vacuo* to a paste, which was applied on a silica gel column (1 × 20 cm) and eluted with $CHCl_3$ (4)/EtOAc (1). Crystallization of the main fraction from MeOH gave 110 mg (38%) of **2**, identical with an authentic specimen[2] (IR spectra and m.m.p.). The overall yield was 19·4% from **17**.

Borohydride reduction of 1 - (5' - *benzoyl* - 3' - *deoxy* - β - D - *glycero* - *pentofuran* - 2' - *ulosyl*)*uracil* (**2**)[2]

Compound **2** (100 mg, 0·33 mmol) was dissolved in EtOH (3 ml) and $NaBH_4$ (100 mg, 2·6 mmol) was added. After stirring at room temp for 1·5 h, the solvent was evaporated at room temp and the residue was partitioned between $CHCl_3$ (40 ml) and water (10 ml). The $CHCl_3$ layer was dried over Na_2SO_4, concentrated and submitted to preparative TLC using a silica gel plate (5 × 20 cm) and $CHCl_3$ (1)/EtOAc (1). Elution of the main band with acetone and crystallization of the solid from a small amount of acetone gave 35 mg (35%) of fine needles, m.p. 162–164° (lit[7] 163–165°), identified with an authentic sample (**19**)[7] by IR spectra and m.m.p.

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