Synthetic Nucleosides. LXI.[1,2] Studies on the Synthesis of *cis*-2,3-Diamino Sugars. IV. The Guanidine Neighboring Group

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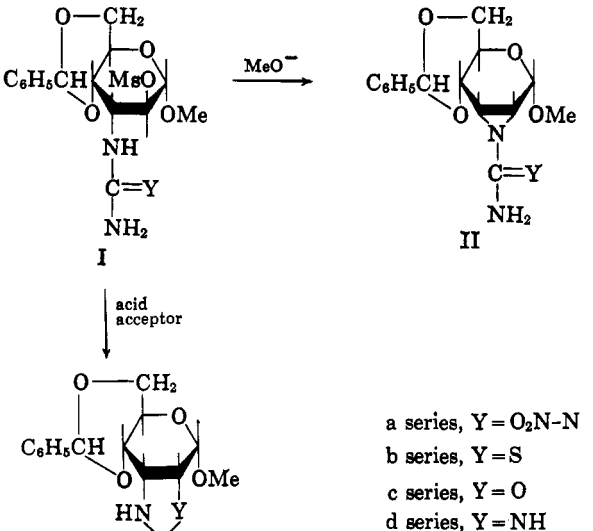
The cyanamido group of methyl 4,6-*O*-benzylidene-3-cyanamido-3-deoxy-2-*O*-mesyl-α,D-altropyranoside (IV) was a sufficiently strong acid to be converted to an anion with ammonia which rapidly cyclized to the cyanoimino alloside (VI) rather than adding ammonia to form a guanidino derivative (V). However, aniline was not sufficiently basic to cause anionic ring closure; instead aniline slowly added to the cyanamido group of IV to give a phenylguanidine derivative that cyclized to a 1-phenyl-2-imino imidazoline (XXIII) faster than addition occurred. Vigorous basic hydrolysis of XXIII afforded methyl 3-amino-2-anilino-4,6-*O*-benzylidene-2,3-dideoxy-α,D-allopyranoside (XXV), a derivative of a *cis*-2,3-diamino sugar. Similarly, reaction of IV with *N*-methylaniline gave methyl 3-amino-4,6-*O*-benzylidene-2,3-dideoxy-2-(*N*-methylanilino)-α,D-allopyranoside (XXIX).

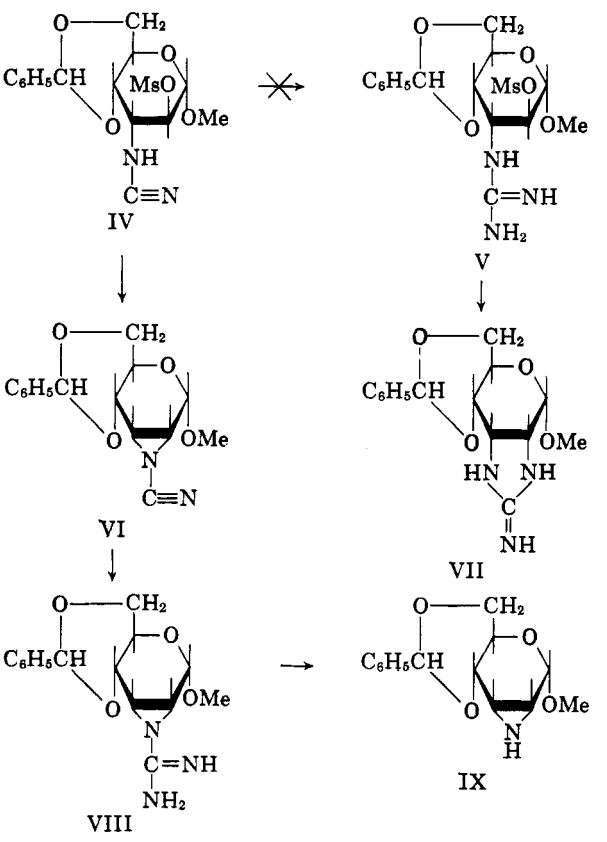
The rationale for synthesis of nucleosides derived from 2,3-diamino-2,3-dideoxy-D-ribofuranose has been presented in a previous paper.[3] The availability of methyl 3-amino-4,6-*O*-benzylidene-3-deoxy-α,D-altropyranoside (X)[4,5] makes this compound useful for study of neighboring group reactions that have the potential of introducing a second amino in the 2-position *cis* to the 3-amino group. Study of "complex" neighboring groups[6] such as nitroguanidino (Ia),[3] thioureido (Ib),[7] and ureido (Ic)[2] has been reported in the accompanying papers. In all three cases, when I was converted to an anion with sodium methoxide,

SCHEME I



ring closure to an aziridine derivative (II) took place (Scheme I). In the presence of an acid acceptor such as sodium acetate or pyridine ring closure to IIIb and IIIc took place, but Ia failed to cyclize under these conditions; thus oxygen or sulfur could be introduced,

SCHEME II



but not a usable nitrogen function. Blocking of the secondary nitrogen of Ic was one solution to the problem.[2] Another possible solution to this enigma would be the use of a guanidine neighboring group (Id) so that ring closure under acid acceptor (nonanionic) conditions which usually forms a five-membered ring (IIId) could only proceed by nitrogen attack; studies on the preparation of Id, derivatives, and their mode of ring closure is the subject of this paper.

Methyl 4,6-*O*-benzylidene-3-cyanamido-3-deoxy-2-*O*-mesyl-α,D-altropyranoside (IV)[7] appeared to be an attractive starting material for preparation of V and VII. Attempts to add ammonia to the C≡N of IV with ammonium chloride or ammonium mesylate in alcohol led to the partial loss of the benzylidene group and no detectable addition to the triple bond took place; if the reaction was run in dry pyridine to avoid loss of the benzylidene group, decomposition occurred.

(1) This work was generously supported by Grant CY-5845 from the National Cancer Institute, U. S. Public Health Service.

(2) For the previous paper of this series, see B. R. Baker and T. Neilson, *J. Org. Chem.*, **29**, 1057 (1964).

(3) B. R. Baker and T. Neilson, *ibid.*, **29**, 1047 (1964), paper LVIII of this series.

(4) B. R. Baker and R. E. Schaub, *ibid.*, **19**, 646 (1954).

(5) W. H. Myers and G. J. Robertson, *J. Am. Chem. Soc.*, **65**, 8 (1943).

(6) S. Winstein and R. Boschan, *ibid.*, **72**, 4669 (1950).

(7) See ref. 2, LX paper of this series.

The use of the relatively neutral ammonium acetate in alcohol gave the same results as ammonium hydroxide described subsequently.

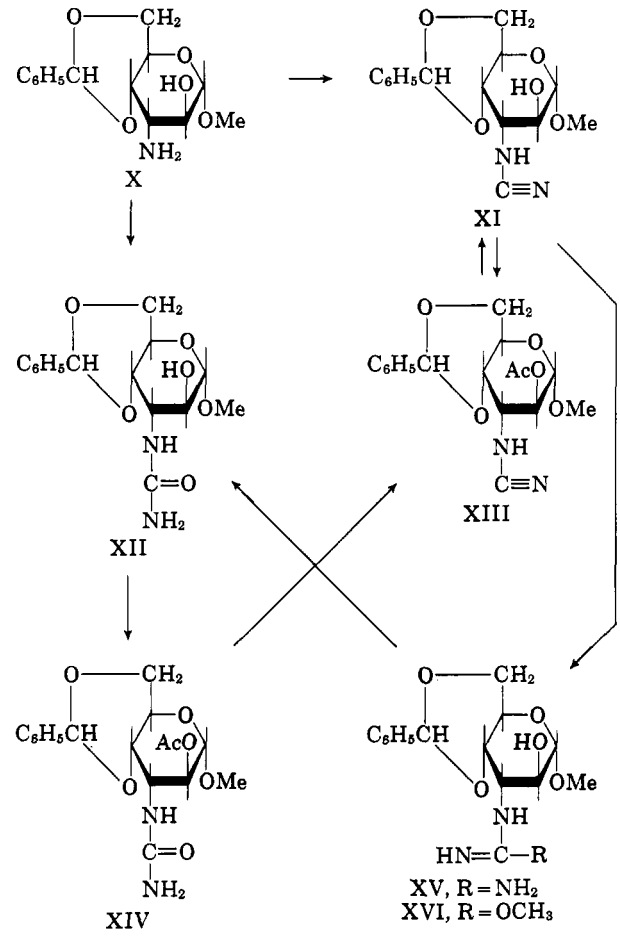
When IV was allowed to react with ammonia in dilute alcohol at ambient temperature after 5-min. warming at 50°, a crystalline amidine base separated in 19% yield (presumed to be VII) which was insoluble in all solvents except hot dimethylformamide; when the filtrate was processed through water and chloroform, an oil was obtained which was soluble in ethyl acetate and could be crystallized in 58% yield (m.p. 201°) by addition of petroleum ether (b.p. 30–60°) and which showed combustion values in agreement with the amidine containing a covalent mesylate (V). The solubility properties were certainly compatible with a covalent mesylate. However, the C=N absorption of V at 6.00 μ was more characteristic of C=NH$^+$, than C=N which usually appears at 6.1–6.3 μ; in addition the covalent sulfonate band was not near 8.55 μ as usual, but was at 8.18 μ which is more typical of an ionic sulfonate. That the compound was actually ionic rather than a covalent compound was shown by treatment with cold methanolic sodium hydroxide; the free base obtained was identical with the free base obtained directly from the reaction mixture in 19% yield. Basic hydrolysis of the presumed imidazoline (VII) did not afford a 2,3-diamino allose derivative, but instead formed the imino alloside (IX),[3] showing the amidine and its methanesulfonate salt did not have structure VII, but structure VIII.

The mode of formation of VIII from IV (Scheme II) was shown to be as follows. Treatment of a suspension of the cyanamido mesylate (IV) in ethanol with aqueous ammonia at 25° gave a yellow color; the cyanamido mesylate (IV) rapidly dissolved, the color bleached, and another compound rapidly separated. This compound proved to be the cyano imine (VI), identical with a sample prepared from IV with methanolic sodium methoxide.[7] When VI was warmed briefly with ammonia in dilute alcohol, then allowed to stand, a 69% yield of the crystalline amidinyl imine (VIII) separated from solution; this compound was identical with that prepared directly from IV with ammonia in dilute alcohol that was earlier presumed to be VII. Apparently the cyanamide (IV) is a sufficiently strong acid to be converted to the anion with dilute ammonia, said anion then rapidly ring closing to the cyano imine (VI).

Two approaches were then envisioned to overcome the difficulty of the rapid anionic ring closure of IV to VI. The first was to put the guanidine residue in place before introduction of the mesylate into V, and the second was to add an amine to the nitrile of IV that was a sufficiently weak base not to convert IV to an anion.

The ureido altroside (XII), prepared earlier[7] from the amino altroside (X) and potassium cyanate, was acetylated with acetic anhydride in pyridine to give XIV as a glass. When XIV was dehydrated with mesyl chloride in pyridine, the crystalline cyanamido acetate (XIII) was obtained in 60% yield. Short treatment with warm aqueous ammonia gave the desired XI in 72% yield (Scheme III). A shorter route also was formed for XI which involved treating the amino altroside (X) with one-half equivalent of

SCHEME III



cyanogen bromide, the excess X being used as an acid acceptor and being recovered.[8]

When XI reacted with ammonia in dilute methanol at 100° under pressure for 18 hr., the resultant oil had lost the C≡N bond near 4.5 μ and now showed C=N absorption at 6.12 μ. However, the low nitrogen analysis indicated that ammonia did not add to the triple bond to give XV, but, most likely, methanol had added to give the *O*-methylurea (XVI); when the crude oil was allowed to stand several days in water, crystals of the urea derivative (XII) gradually separated.

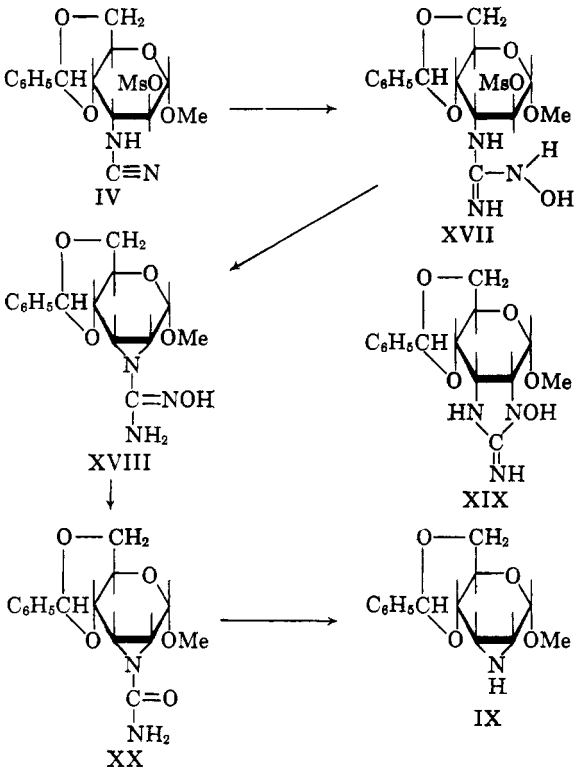
It is notable that the cyano imine (VI) adds ammonia very rapidly to give the amidine (VIII), whereas the cyanamido altrose (XI) was recovered unchanged under the same conditions. Apparently the imine activates the C≡N in the same way that the C=O of an acylated aziridine is activated.[9] Although it may have been possible to form XV in an aprotic solvent, these studies were discontinued when concurrent studies to be described on the addition of aniline to the cyanamide (IV) were successful.

Attention was then turned to the addition of amines to the cyanamide (IV) that were sufficiently weak not to convert IV to an anion in order to avoid cyclization to the cyano imine (VI). Hydroxylamine and

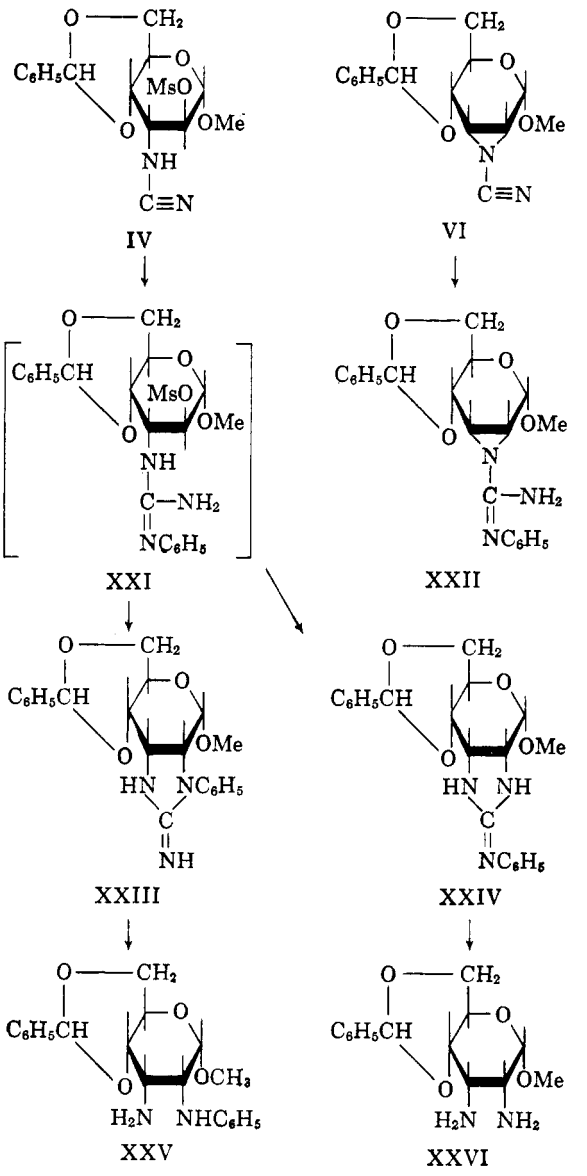
(8) The amino altroside (X) failed to condense with cyanamide in dilute alcohol to give the corresponding guanidine altroside (XV).

(9) The higher reactivity of the carbonyl of an acylaziridine compared to an ordinary *t*-amide has been noted previously: H. C. Brown and A. Tsukamoto, *J. Am. Chem. Soc.*, **83**, 4549 (1961); and H. W. Heine, M. A. Fetter, and E. M. Nicholson, *ibid.*, **81**, 2202 (1959).

SCHEME IV



SCHEME V



aniline were investigated. When IV reacted with hydroxylamine hydrochloride in boiling pyridine[10] for 10 min., the hydroxyguanidine mesylate (XVII) was obtained as a glass in 92% yield with no C≡N absorption; that cyclization had not taken place was shown by covalent sulfonate absorption at 8.55 μ and a 3:1 ratio of nitrogen to sulfur. Attempts to ring close XVII with boiling pyridine to XIX or the isomeric 2-hydroxylamino imidazoline led to tars. Cyclization with methanolic sodium methoxide led to imine derivatives; this could now be anticipated since the hydroxyguanidine group can form an anion. A mixture of XVIII and XX was obtained from which 41% of crystalline XX[2] could be isolated; the presence of some other product in the mother liquor, presumably the base sensitive XVIII, was shown by basic hydrolysis to give the imine IX in 39% yield (Scheme IV).

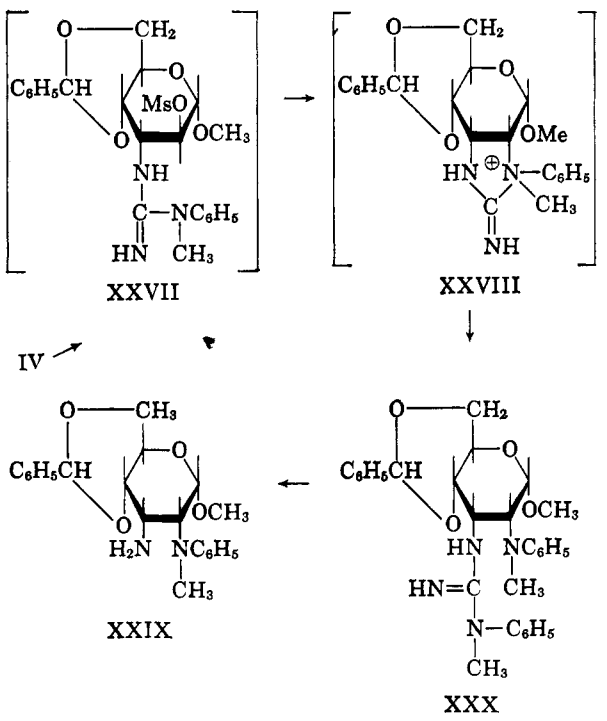
Aniline added slowly to the triple bond of the cyanamido mesylate (IV); after 1 day in boiling alcohol IV was still present showing that the aniline was a sufficiently weak base not to cyclize IV to the imine VI. After 2–5 days in boiling alcohol, depending on the ratio of aniline to IV, the C≡N absorption near 4.5 μ had disappeared; when processed by washing a chloroform solution with dilute base, the resultant product contained no sulfonate bands. Thus, ring closure of the presumed amidine (XXI) with elimination of methanesulfonate was more rapid from the addition of aniline to IV. Although this analytically pure amidine could not be crystallized, its infrared spectrum clearly showed it to be different from the isomeric amidino imine (XXII), formed by addition of aniline to the cyano imine (VI). This aniline addition product of IV could be either the imino imidazolidine (XXIII) or the anil (XXIV) or a mixture of the two (Scheme V).

Both XXII and XXIII (or XXIV) were stable to boiling 2 *N* aqueous sodium hydroxide. However, that ring closure to XXIII had occurred predominantly could be shown by hydrolysis to the *N*-phenyl diaminoalloside (XXV) in 72% yield with 30% potassium hydroxide in 50% ethanol at 140° for 4 days. The relatively high yield of 52% for three steps from IV (average yield, 80%) indicated that little, if any, cyclization to the isomeric imidazoline (XXIV) had occurred.

The addition of *N*-methylaniline to the cyanamide (IV) was then investigated, since cyclization of the adduct (XXVII) might be expected to occur by NH attack rather than form the quaternary salt (XXVIII). Surprisingly, basic hydrolysis of the ring closed product gave the crystalline *N*-methylanilino sugar derivative (XXIX) in 34% over-all yield from IV rather than the diamine XXVI. Presumably the intermediate adduct (XXVII) cyclized to the quaternary salt (XXVIII), then XXVIII further reacted with *N*-methylaniline to give the methanesulfonate salt of XXX as an oil (Scheme VI). The only evidence that

(10) J. U. Nef, *Ann.*, **280**, 320 (1894); N. P. Buu-Hoï and J. Lecocq, *Bull. soc. chim. France*, 139 (1946).

SCHEME VI



XXX had formed was based on the loss of a C=NH$^+$ bond in the infrared at 6.0 μ when XXX was converted to the free base; no C=O absorbtion appeared in the free base, thus indicating that *N*-methylaniline had split the quaternerized imidazolidine to XXX. This reaction sequence was not investigated in further detail.

Although the phenyl group was not removed to provide XXVI, further work will be necessary to see if a labile (to basic hydrolysis or oxidation) substituted phenyl group can be employed successfully in such a transformation.

Experimental[11]

Methyl 4,6-*O*-Benzylidene-*N*-cyano-2,3-dideoxy-2,3-imino-α,D-allopyranoside (VI).—To a solution of 1.00 g. of IV in 20 ml. of ethanol was added 10 ml. of concentrated ammonia water. The mixture became momentarily yellow; then the product separated to yield 0.46 g. (61%), m.p. 183–184°. Recrystallization from ethanol gave white needles identical with an authentic sample of VI.[2]

From the filtrate, after standing overnight, could be isolated the amidine (VIII)–methanesulfonate, identical with an authentic sample described subsequently.

Methyl *N*-Amidino-4,6-*O*-benzylidene-2,3-dideoxy-2,3-imino-α,D-allopyranoside (VIII). A.—To a warm solution of 150 mg. of VI in 5 ml. of ethanol was added 5 ml. of concentrated ammonia water. After being refluxed for 10 min., the solution was allowed to stand overnight at ambient temperature. The amidine base (VIII) was collected on a filter and washed with aqueous alcohol to yield 110 mg. (69%), m.p. 242–243°. Recrystallization from hot *N*,*N*-dimethylformamide by addition of water gave white crystals of unchanged melting point; $[\alpha]^{22}D$ + 97 ± 3° (0.29%); λ_{max} 2.95, 3.15 (NH), 6.20 (C=N), 6.40 (NH), 13.41, 14.45 (C_6H_5—), and no C≡N near 4.5 μ.

Anal. Calcd. for $C_{15}H_{19}N_3O_4$: C, 59.1; H, 6.27; N, 13.8. Found: C, 59.1; H, 6.07; N, 13.6.

B.—To a warm solution of 500 mg. of IV in 10 ml. of ethanol was added 5 ml. of concentrated ammonia water. After being warmed to about 50° for 5 min., the solution was allowed to stand overnight at ambient temperature. The white crystals that had separated were collected by filtration and washed with dilute alcohol to yield 85 mg. (19%) of amidine free base identical with preparation A.

The combined filtrate and washings were spin evaporated *in vacuo* and the residue extracted with two 20-ml. portions of chloroform. The combined extracts, washed with two 20-ml. portions of water and dried with magnesium sulfate, were spin evaporated *in vacuo*. The oily residue was crystallized from ethyl acetate–petroleum ether (b.p. 30–60°) to yield 300 mg. (58%) of VIII methanesulfonate salt, m.p. 199–201°; λ_{max} 2.90, 3.17, 3.25 (NH), 6.00 (C=NH$^+$), 6.55 (NH_2), 7.31, 8.18 (ionic sulfonate), 13.3, 14.15 (C_6H_5—), and no C≡N near 4.5 μ.

Anal. Calcd. for $C_{16}H_{23}N_2O_7S$: C, 47.9; H, 5.79; N, 10.5; S, 8.00. Found: C, 47.9; H, 5.72; N, 10.4; S, 7.98.

C.—To a solution of 200 mg. of the methanesulfonate salt of VIII, prepared by method B, in 5 ml. of 95% ethanol was added 1 ml. of 1 *N* methanolic sodium methoxide. Immediate precipitation took place. The amidine free base (VIII) was collected on a filter and washed with ethanol to yield 130 mg. (85%), m.p. 240–241°; its infrared spectrum was identical with that of preparation A.

D.—A solution of 600 mg. of amidine free base (VIII), prepared by method A, in 2 ml. of concentrated ammonia water containing 200 mg. of methanesulfonic acid was spin evaporated *in vacuo*. Crystallization of the gummy residue from ethyl acetate gave 620 mg. (79%) of the methanesulfonate salt of VIII, m.p. 198–199°, that was identical with preparation B.

Ammonium methanesulfonate in excess ammonia water was used rather than aqueous methanesulfonic acid in order to preserve the acid-sensitive benzylidene group.

Methyl 4,6-*O*-Benzylidene-2,3-dideoxy-2,3-imino-α,D-allopyranoside (IX).—A mixture of 250 mg. of VIII, 3 ml. of 2 *N* aqueous sodium hydroxide, 10 ml. of water, and 10 ml. of 2-methoxyethanol was refluxed for 3 hr., then processed as described earlier for IX[2,3] to yield 150 mg. (70%) of white crystals, m.p. 143–144°, that were identical with an authentic sample of IX.[3]

Methyl 2-*O*-Acetyl-4,6-*O*-benzylidene-3-deoxy-3-ureido-α,D-altropyranoside (XIV).—A mixture of 1.00 g. of XII,[7] 5 ml. of reagent pyridine, and 0.70 ml. of acetic anhydride was stirred in an ice bath until solution was complete; then it was allowed to stand about 18 hr. at 0–3° in a stoppered flask. After dilution with 25 ml. of water, the mixture was extracted with three 20-ml. portions of chloroform. The combined extracts, washed with two 20-ml. portions of water and dried with magnesium sulfate, were spin evaporated *in vacuo* leaving 0.75 g. (66%) of a glass that could not be crystallized; λ_{max}^{film} 2.85, 2.95, 3.11 (NH), 5.77 (ester C=O), 6.05 (amide C=O), 6.60 (amide II), and 13.3, 14.3 μ (C_6H_5—).

Anal. Calcd. for $C_{17}H_{22}N_2O_7$: C, 55.7; H, 6.06; N, 7.65. Found: C, 55.9; H, 6.12; N, 7.42.

Methyl 2-*O*-Acetyl-4,6-*O*-benzylidene-3-cyanamido-3-deoxy-α,D-altropyranoside (XIII). A.—To a stirred solution of 700 mg. (XIV) in 5 ml. of reagent pyridine cooled in an ice bath was added 0.2 ml. of methanesulfonyl chloride. After standing about 18 hr. at 0–3° in a stoppered flask, the mixture was poured into 20 ml. of ice–water and processed as described for XIV. The chloroform residue was spin evaporated with toluene (two 10-ml. portions) to remove the last traces of pyridine. Recrystallization from alcohol gave 400 mg. (60%) of white needles, m.p. 176–177°; $[\alpha]^{22}D$ +65 ± 1° (1.02%); λ_{max} 3.14 (NH), 4.51 (C≡N), 5.80 (ester C=O), 8.23 (ester C—O—C), 13.3, 14.4 (C_6H_5—), and no urea carbonyl near 6 μ.

Anal. Calcd. for $C_{17}H_{20}N_2O_6$: C, 58.6; H, 5.79; N, 8.05. Found: C, 58.5; H, 5.84; N, 7.94.

B.—Acetylation of 300 mg. of XI (prepared from X) in 2 ml. of reagent pyridine with 0.2 ml. of acetic anhydride at room temperature for 18 hr., then work-up, as described for XIV, gave 230 mg. (67%) of recrystallized product, m.p. 176–177°, that was identical with preparation A.

Methyl 4,6-*O*-Benzylidene-3-cyanamido-3-deoxy-α,D-altropyranoside (XI). A.—To a mixture of 5.0 g. of X[4] and 100 ml. of ethanol was added 1.0 g. of cyanogen bromide. The mixture was heated on a steam bath at about 70° for 1 hr., then spin evaporated *in vacuo*. The residue was partitioned between 25 ml. of chloroform and 50 ml. of water. The separated aqueous

(11) Melting points were taken in capillary tubes in a Mel-Temp block; those below 230° are corrected. Infrared spectra were determined in Nujol mull, unless otherwise indicated, with a Perkin-Elmer 137B spectrophotometer. Optical rotations were determined in a 1-dm. microtube in *N*,*N*-dimethylformamide and concentrations are recorded in %. Petroleum ether was a fraction boiling at 30–60°.

layer was extracted with additional chloroform (two 25-ml. portions). The combined chloroform extracts were washed with two 25-ml. portions of water. The combined aqueous layer and washings were made basic with 2 *N* sodium hydroxide, then spin evaporated *in vacuo* to about 25 ml.; 1.5 g. (30%) of unchanged X separated from the solution.

The chloroform solution, dried with magnesium sulfate, was spin evaporated *in vacuo*. Recrystallization from ethanol gave 2.0 g. (73% based on cyanogen bromide or 52% based on X not recovered) of white needles, m.p. 175–176°; $[\alpha]^{22}D$ + 85 ± 1° (0.62%); λ_{max} 2.89, 3.05 (NH, OH), 4.51 (C≡N), and 13.1, 14.3 μ (C_6H_5—).

Anal. Calcd. for $C_{15}H_{18}N_2O_5$: C, 58.8; H, 5.93; N, 9.15. Found: C, 58.8; H, 6.05; N, 8.95.

B.—A solution of 250 mg. of XIII (prepared from XIV) in 5 ml. of ethanol was diluted with 10 ml. of 3 *N* aqueous ammonia, then warmed at about 60° for 30 min. The cooled solution was extracted with three 20-ml. portions of chloroform. The combined extracts, washed with two 20-ml. portions of water and dried with magnesium sulfate, were spin evaporated *in vacuo* leaving 200 mg. (91%) of a white solid. Recrystallization from alcohol gave 158 mg. (72%) of product, m.p. 175–176°, that was identical with preparation A.

Methyl 4,6-*O*-Benzylidene-3-deoxy-3-(3-hydroxyguanidino)-2-*O*-mesyl-α,D-altropyranoside (XVII).—A solution of 2.0 g. of IV and 0.36 g. of hydroxylamine hydrochloride in 20 ml. of pyridine was refluxed for 10 min., then cooled, diluted with 30 ml. of water, and extracted with three 25-ml. portions of chloroform. The combined extracts, washed with three 20-ml. portions of water and dried with magnesium sulfate, were spin evaporated *in vacuo*. The last traces of pyridine were removed by spin evaporation of two 10-ml. portions of toluene *in vacuo* to yield 2.0 g. (92%) of a glass that was estimated to be about 80% pure by combustion analyses; λ_{max}^{film} 2.85, 2.95, 2.99 (NH, OH), 6.05 (C=N), 6.31 (NH), 6.59 (N—O), 7.41, 8.53 (sulfonate, 13.3, 14.3 (C_6H_5—), and no C≡N near 4.5 μ.

Anal. Calcd. for $C_{16}H_{23}N_3SO_8$: N, 10.07; S, 7.68; N:S, 3.0. Found: N, 8.35; S, 6.46; N:S, 2.9.

When XVII was refluxed in pyridine, tar formation occurred before appreciable amounts of the covalent mesylate had disappeared. When 1.00 g. of XVII in 20 ml. of methanol and 4 ml. of 1 *N* sodium methoxide were warmed to 50° on a steam bath, then cooled, sodium methanesulfonate separated. When processed by chloroform–water, then crystallized from ethanol, 300 mg. (41%) of XX, m.p. 197–198°, was obtained that was identical with an authentic sample.[2] Evaporation of the filtrate and hydrolysis of the residue with 0.5 *N* sodium hydroxide gave 250 mg. (39%) of the imino alloside (IX), m.p. 143–144°, that was identical with an authentic sample.[3]

Methyl 4,6-*O*-Benzylidene-2,3-dideoxy-2,3-imino-*N*-(phenylamidino)-α,D-altropyranoside (XXII).—A solution of 450 mg. of VI and 0.30 ml. of aniline in 10 ml. of ethanol was refluxed for 3 days. The solvent was removed *in vacuo* and the residue partioned between 20 ml. each of water and chloroform. The aqueous layer was extracted with additional two 20-ml. portions of chloroform. The combined chloroform extracts, washed with two 20-ml. portions of water and dried with magnesium sulfate, were spin evaporated *in vacuo*. The residue was extracted with four 20-ml. portions of warm petroleum ether (b.p. 30–60°) to remove aniline, which left 450 mg. (76%) of a glass; λ_{max}^{film} 2.95 (NH), 6.05, 6.27, 6.70 (NH, C=N, C_6H_5—), 13.3, 14.4 (C_6H_5—), no C≡N near 4.5, and no bands at 6.15 and 6.35 μ (present in the isomeric XXIII).

Anal. Calcd. for $C_{21}H_{23}N_3O_4$: C, 66.2; H, 6.09; N, 11.0. Found: C, 66.1; H, 6.13; N, 10.8.

4′,6′-*O*-Benzylidene-2-imino-1′-*O*-methyl-1-phenyl-α,D-allopyrano[2′,3′:5,4]imidazolidine (XXIII).—A solution of 500 mg. of IV and 0.5 ml. (4 equiv.) of aniline in 15 ml. of ethanol was refluxed for 5 days when C≡N absorption near 4.5 μ finally had disappeared. The solvent was spin evaporated *in vacuo*. The residue was processed as described for XXII with an additional washing of the combined chloroform extracts with 25 ml. of 0.2 *N* aqueous sodium hydroxide prior to the water washings to yield 355 mg. (72%) of a glass; λ_{max}^{film} 2.95 (NH), 6.15, 6.29, 6.35, 6.73 (C=N, NH, C_6H_5—), 13.3, 14.4 (C_6H_5—), no C≡N near 4.5, no sulfonate near 7.4 and 8.5, and no band at 6.05 μ (present in XXII).

Anal. Calcd. for $C_{21}H_{23}N_3O_4$: C, 66.2; H, 6.09; N, 11.0. Found: C, 66.4; H, 6.21; N, 10.9.

When the aniline was increased to 8 equiv./mole in 12 ml. of alcohol per gram of IV, the reaction was complete in 2 days.

Methyl 3-Amino-2-anilino-4,6-*O*-benzylidene-2,3-dideoxy-α,D-allopyranoside (XXV).—To a solution of 0.75 g. of XXIII in 10 ml. of ethanol in a steel bomb was added a solution of 10 g. of potassium hydroxide in 10 ml. of water. The contents were sealed and heated at 130–140° for 4 days. The bomb contents were spin evaporated *in vacuo* to about one-half volume when the product began to separate. The crystalline product (0.5 g.) was collected on a filter and washed with water. Recrystallization from ethanol gave 0.48 g. (72%) of pure product as white needles, m.p. 166–167°; $[\alpha]^{23}D$ −2.7 ± 0.4° (0.9%); λ_{max} 2.94, 3.03 (NH), 6.22 (NH, phenyl), and 6.52, 6.68, 13.3, 14.3, 14.45 μ (phenyl).

Anal. Calcd. for $C_{20}H_{24}N_2O_4$: C, 67.4; H, 6.81; N, 7.87. Found: C, 67.1; H, 6.71, N, 7.74.

Methyl 3-Amino-4,6-*O*-benzylidene-2,3-dideoxy-3-(*N*-methylanilino)-α-D-allopyranoside (XXIX).—Treatment of 1.00 g. of IV with 2 ml. of *N*-methylaniline in 15 ml. of boiling ethanol for 2 days, as described for XXIII, gave 1.00 g. of crude methanesulfonate salt of a base presumed to be XXX. Conversion to the free base and hydrolysis with potassium hydroxide as described for the preparation of XXV gave a solution which was concentrated by spin evaporation *in vacuo* to remove ethanol. Extraction of the aqueous mixture with three 25-ml. portions of chloroform left 0.50 g. of residue after evaporation of the dried extracts. Recrystallization from ethyl acetate–petroleum ether (b.p. 30–60°) afforded 0.32 g. (34% based on IV) of white crystals, m.p. 143–144°; λ_{max} 2.93 (NH), 6.26 (NH, phenyl), and 6.39, 6.70, 13.3, 13.4, 14.4 μ (phenyl).

Anal. Calcd. for $C_{21}H_{26}N_2O_4$: C, 68.2; H, 7.09; N, 7.57. Found: C, 68.1; H, 7.12; N, 7.66.

Attempts to add phenylhydrazine or *N*,*N*-dimethyl-*p*-phenylenediamine to the triple bond of IV gave dark tars.

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