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6-Deoxy-*allo*-Nojirimycin in the racemic and D-Series, 6-Deoxy-D,L-*talo*-Nojirimycin, their 1-Deoxyderivatives and 6-Deoxy-2-D,L-Allosamine *via* Hetero-*Diels-Alder* Cycloadditions.

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Abstract. *Diels-Alder* cycloaddition of hexadienal dimethylacetal **3** to achiral acylnitroso-dienophile **5a** gave the racemic cycloadducts **7a-c** and, to chiral chloronitroso-dienophile **6**, enantiomerically pure **D-10a** as sole adduct. Simple chemical transformations led to 6-deoxy-2-D,L-allosamine **15b**, to 6-deoxy-D,L and D-*allo*-nojirimycin **15a**, **D-15a**, to 6-deoxy-D,L-*talo*-nojirimycin **15c** as well as to their 1-deoxy-derivatives **16a**, **D-16a**, **16c** *via* their crystalline 1-deoxy-1-sulfonic acid derivatives (sulfite adducts). Amino-sugars **16a,c** are mixtures of α- and β-anomers and of the corresponding imines.

Introduction. - Piperidinose type aminosugars, like nojirimycin **1**, are potent glycosidase inhibitors which often possess more inhibitor activity than their 1-deoxy derivatives [1]; although relatively unstable, they are more interesting to synthesised than these latter ones for this reason. They are usually obtained by chemical modifications of carbohydrates, aminoacids, or some other chiral precursors [1]. More recently they could also be obtained *via* enzymatic syntheses [2]. *De novo* syntheses of aminosugars are seldom used [3,4]. In some previous publications we described the synthesis of aminodeoxylyxose [5], aminodeoxyallose and aminodeoxyribose derivatives [6] using a sequential four-step approach (*Scheme 1*) : hetero-*Diels-Alder* cycloaddition of 1,2-dihydropyridines **2** or of hexadienal dimethylacetal **3** with achiral acylnitroso dienophiles **5** followed by stereospecific osmylation of the primary cycloadducts, hydrogenolysis of the N-O bond and hydrolysis. Acylnitroso dienophiles **5** were prepared *in situ* by oxidation of the corresponding hydroxamic acids **4** with a periodate ammonium salt.

We describe herein a *de novo* synthesis of *N*-unsubstituted 5-amino-5,6-dideoxyallose in the racemic and chiral D-series from diene **3**, using racemic acylnitroso **5a** (R = OBn) and chiral chloronitroso dienophiles **6** respectively, according to a methodology we had already employed in the racemic *N*-acyl series [5,6]. The key feature in the present series is the isolation of the aminosugars as crystalline sulfur dioxide adducts. Two preliminary communications relating to these results have already been published [7]. The minor adducts led to 2-amino-2,6-dideoxy-D,L-allose and to 5-amino-5,6-dideoxy-D,L-talose. A similar methodology has been used recently to obtain directly the 1-deoxyaminoalloses **L-16a** in the L-series by *Wyatt* starting from chiral ephedrine derivative of sorbaldehyde with **5a** [8] and **D-16a** in the D-series by us from sorbaldehyde *O*-methyloxime with chiral **6** [9].

Hetero-Diels-Alder cycloaddition and osmylation (*Scheme 1*). -

a) Racemic series. - As we have already described, hetero Diels-Alder reactions of sorbaldehyde dimethylacetal **3** (80:20 mixture of the (2*E*,4*E*) **3a** and (2*E*,4*Z*) **3b** isomers) with nitroso dienophile **5a**, followed by osmylation, led to the major *cis* diol **8a** and to the minor *trans* adduct **7c** [6]. Actually regioisomer *cis* adduct **7b** (from the (2*E*,4*E*) diene **3a**) was also formed in minute amounts (so that the three primary adducts **7a**, **7b**, **7c** appeared in the 75:5:20 ratio) and gave the corresponding *cis*-diol **8b**. Diols **8a** and **8b** could be separated by fractional crystallisation or by chromatography of the *N*-deprotected (H_2/Pd-C) derivatives **9a** and **9b.**

Osmylation of the *trans*-adduct **7c** could be improved at 60°C in DMF/*t*-BuOH [10] for 3 days and led to **8c** in moderate yield only (20 %). Diols **8a** and **8c** have already been described and the mechanism of their

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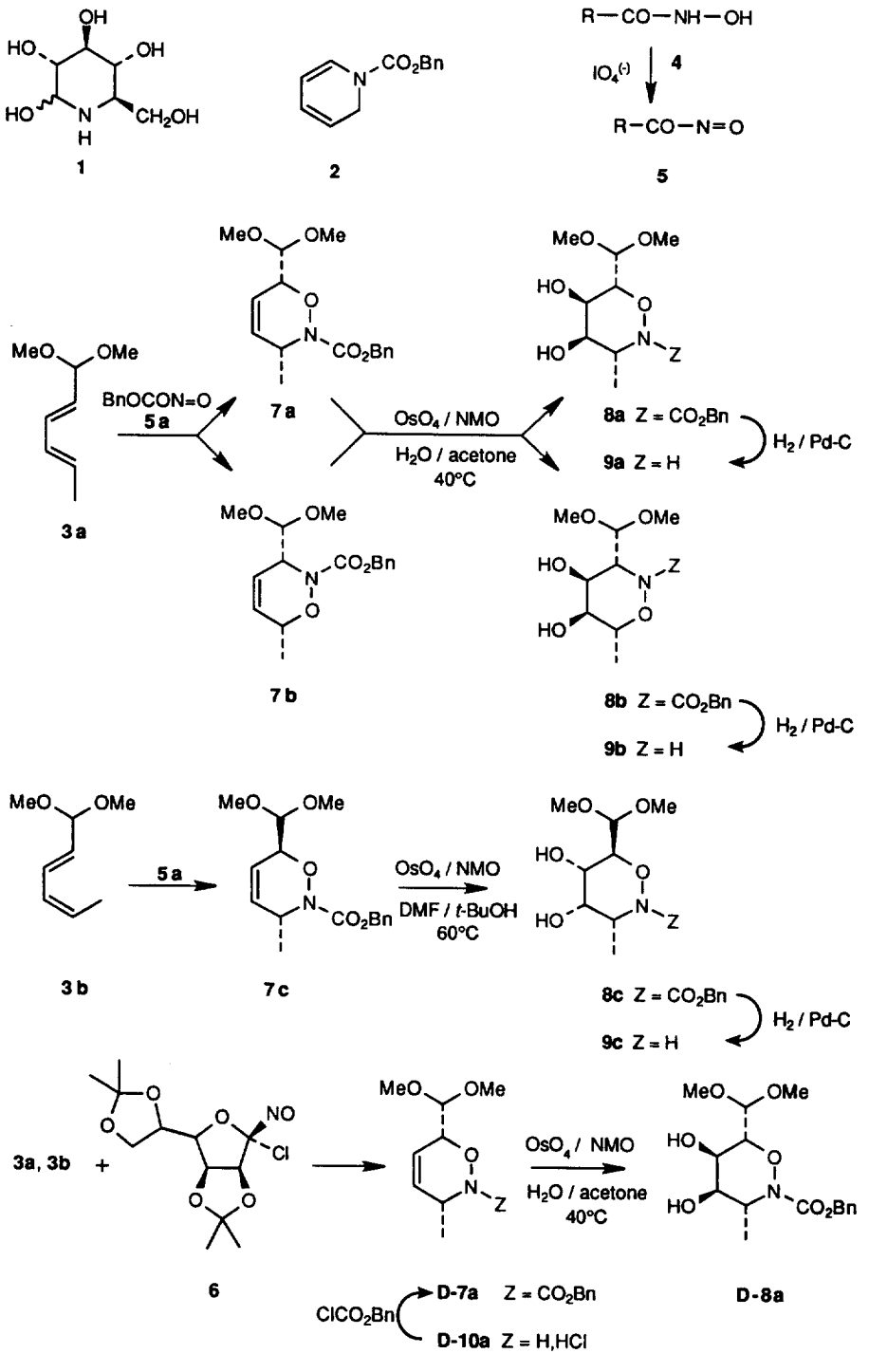
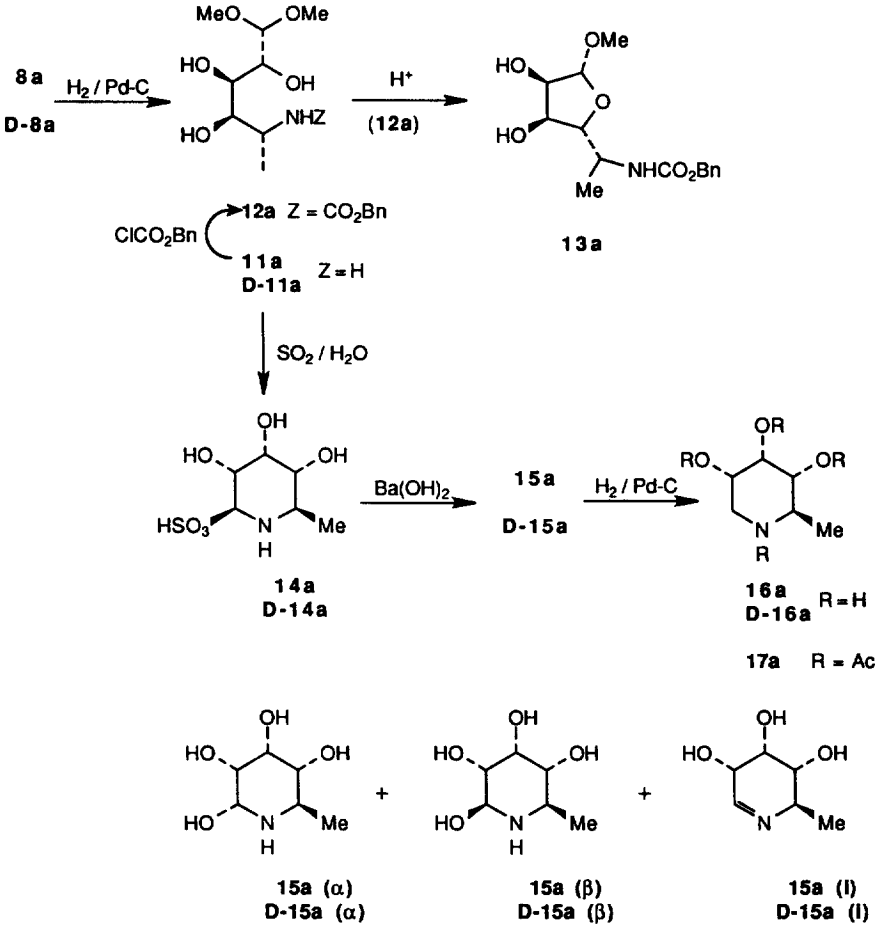

1
2
5
3a
7a
7b
8a Z = CO2Bn
9a Z = H
8b Z = CO2Bn
9b Z = H
3b
7c
8c Z = CO2Bn
9c Z = H
6
D-7a Z = CO2Bn
D-10a Z = H,HCl
D-8a
BnOCON=O
5a
OsO4 / NMO
H2O / acetone
40°C
H2 / Pd-C
DMF / t-BuOH
60°C
3a, 3b +
ClCO2Bn

Scheme 1

formation has been discussed previously [6]. In all three instances the bulky OsO_4 reagent approaches the double bond from the least hindered side, *i.e. anti* with respect to the dimethylacetal moiety.

b) Enantiomerically pure series. - The chloro-nitroso dienophile **6** derivated from D-mannose was reported [11] to give chiral adducts in good yield and with excellent enantioselectivity. The reaction of acetal **3** with dienophile **6** when performed under *Kresze's* conditions [11], *i.e.* in $MeOH/CHCl_3$ solution, led to deacetalisation [9], even at -10 °C. Deacetalisation could be avoided in a mixture of anhydrous methanol and methyl *ortho*-formate (*i.e.* in acetalisation conditions). We assume that **6** catalysed the acetalisation/deacetalisation reaction and the (*E*)/(*Z*) isomerisation so that cycloadditions proceeded with both dienacetal **3** and hexadienal itself and, under these experimental conditions, led to *Diels-Alder cis*-cycloadduct **D-10a** as the only formed adduct together with dehydratation into 3-hydroxy-6-methylpyridine ; this secondary reaction was minimised when the reaction time did not exceed 3 h ; after separation from the D-mannose derivatives by aqueous extraction, **D-10a** was *N*-protected as **D-7a** and osmylated to yield enantiomerically pure **D-8a** as the only detectable diol after chromatography (35 % overall yield from **3**) [12].

5-Amino-5,6-dideoxyallose, in the racemic and D-series (*Scheme 2*). -



Scheme 2

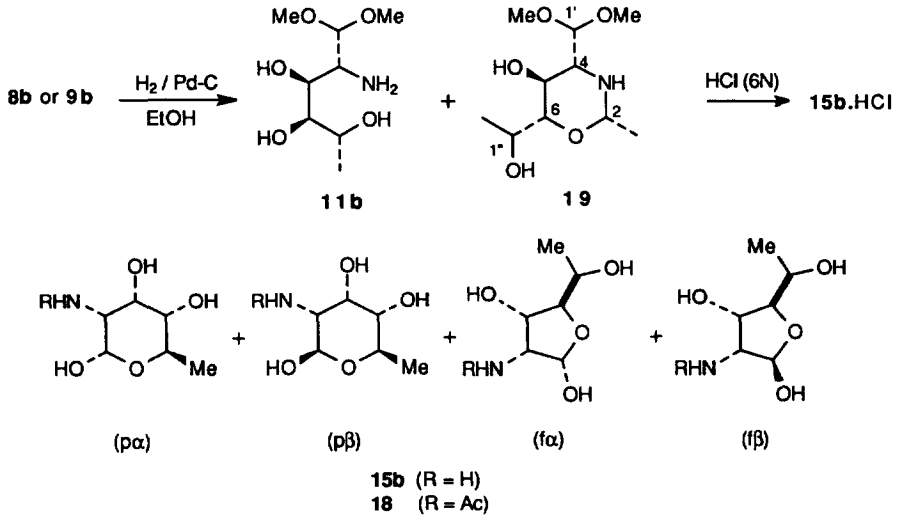
a) Hydrogenolysis of the N-O bond and formation of a,β-furanoside. - Catalytic double hydrogenolysis over Pd/C of the major racemic diol **8a** has already been described [6] ; addition of the catalyst in two stages gave better results. *N*-Deprotection led to **9a** after 30 min, hydrogenolysis of the N-O bond was much slower and gave the acyclic compound **11a** (characterised as its tetraacetyl derivative [6]).

Acid-catalysed transformation of compound **11a** by *trans*-etherification at the C(4) hydroxyl group to furanoside could easily be studied as follows : *N*-protection of **11a** with benzyl chloroformate in the presence of sodium carbonate led to the linear amide **12a** which underwent spontaneous but slow transformation into the amino-β-furanoside **13a** which was characterised as its diacetate. This transformation occurred instantaneously in formic acid at rt.

b) Sulfite adduct of aminoallose. - Using *Paulsen*'s methodology for the isolation of piperidinoses as sulfite adducts [13], hydrolysis of the linear amino-sugar **11a** with sulfurous acid (SO_2 in water) led to a multistep transformation : type **13a** furanose intermediates were formed instantaneously and evolved slowly to give after 3 days at 40°C the crystalline cyclic SO_2-adduct **14a** as the β-anomer in excellent yield (90 %).

Treatment of **14a** with $Ba(OH)_2$ (1 equivalent) in aqueous solution led to the precipitation of $BaSO_3$ and to the formation of 5-amino-5,6-dideoxy-D,L-allose (6-deoxy-D,L-*allo*-nojirimycin) **15a**, actually as a 37:53:10 mixture of the two α- and β-anomers **15a**(α), **15a**(β) and of the corresponding imine **15a**(i). Catalytic hydrogenolysis (Pd/C) of this latter mixture gave quantitatively piperidinetriol **16a**, *i.e.* 1,6-dideoxy-D,L-*allo*-nojirimycin which was characterised as its tetraacetate derivative **17a**.

c) Chiral series. - The same reaction sequence as applied to **D-8a** led sequentially to the crystalline sulfite adduct **D-14a**, to free amino-D-allose **D-15a**, to 1-deoxyderivative **D-16a** and to its tetraacetyl derivative **D-17a**. Using a similar but more straightforward reaction sequence, compounds **D-16a** and **D-17a** have also been obtained by us [7,9] and their enantiomers **L-16a** and **L-17a** by *Wyatt* [8].



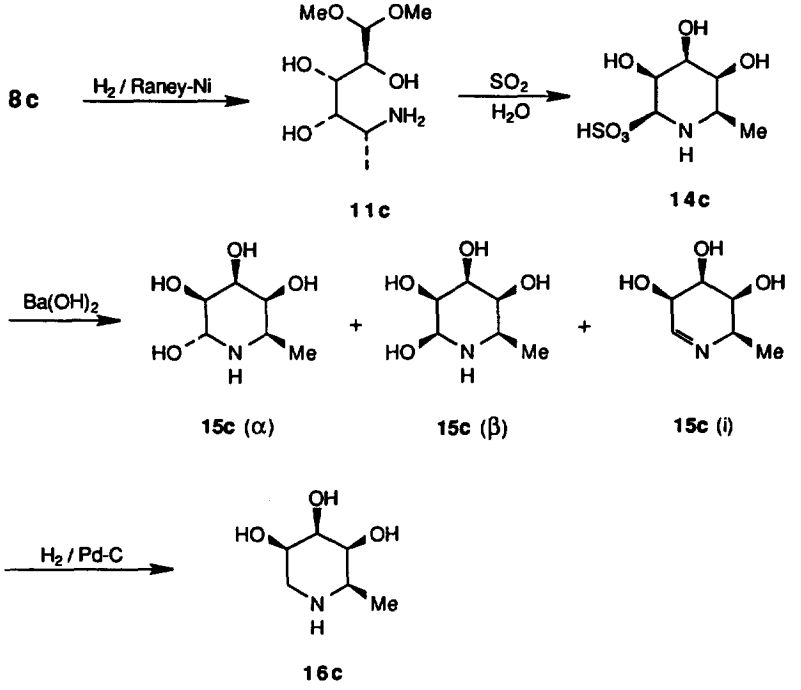
Scheme 3

2-Amino-2,6-dideoxy-D,L-allose. - 2-Amino-2-deoxy-hexoses occur widely in nature ; for example D-glucosamine is the main constituent of chitine [14]. 2-Amino-2,6-dideoxy-D-allose is also a known compound [15,16].

Starting from the minor *cis*-diol regioisomer **8b**, the synthesis of racemic 2-amino-2,6-dideoxy-D,L-allose could be achieved using a similar methodology as above (*Scheme 3*) : catalytic hydrogenolysis of **8b** over Pd/C gave linear acetal **11b** which was hydrolysed (HCl 6N) at once to give allosamine **15b** as a 15:75:8:2 mixture of α-pyranose (pα), β-pyranose (pβ), α-furanose (fα) and β-furanose (fβ), respectively. This result is similar to the equilibrium which had been observed with D-allosamine [17] and **15b** was likewise characterised as its *N*-acetyl derivative **18** (Ac_2O in aqueous methanol in the presence of $CaCO_3$ [17]). The acetylated compound appeared as a crystalline mixture of the pyranose and furanose anomers.

Remark : During the hydrogenolysis of **8b** in EtOH, cyclic amino ether **19** was formed in variable yields along with linear acetal **11b**, this being due to the formation of acetaldehyde *via* dehydrogenation of ethanol. Compound **19** was characterised by its ^{1}H-NMR spectrum only ; its hydrolysis led to the same products as **11b** did.

5-Amino-5,6-dideoxy-D,L-talose (*Scheme 4*). - The synthesis in the D,L-talose series is similar to the one we applied in the D,L-allose series. Hydrogenolysis of the minor *trans*-diol **8c** over Pd/C led to *N*-deprotection only. In order to cleave the N-O bond, Raney nickel had to be used ; but even so it did not lead to a clean reaction. Therefore the resulting crude linear acetal **11c** was hydrolysed with aqueous SO_2 at 40 °C for 4 d to give the crystalline sulfite adduct **14c** in moderate yield (27 %). Free 6-deoxy-D,L-*talo*-nojirimycine **15c** and its 1-deoxy derivative **16c** were obtained as in the D,L-allose series (see above). Compound **15c** appeared as a 62:35:3 mixture of the α- and β-anomers **15c** (α), **15c** (β) and of the corresponding imine **15c** (i).



Scheme 4

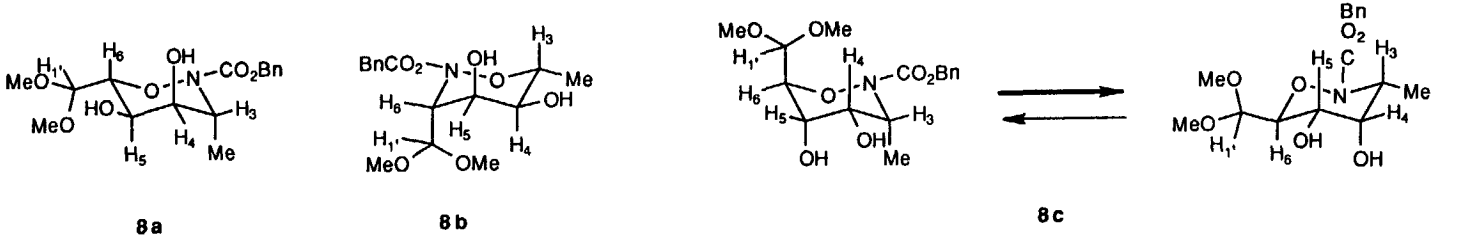
Absolute configuration and enantiomeric purity. - The absolute configuration of enantiomerically pure adduct **D-10a** was assigned by analogy to the one *Kresze* had determined with some similar adducts, including an adduct obtained from ethyl sorbate. In this case, *Kresze* had etablished the (3*R*,6*R*) configuration [11].

The fact that deoxysugar **D-16a** is the enantiomer of the known L-isomer [8] represents an independent proof of the (3*R*,6*R*) configuration which was assigned to **D-10a**.

Table 1 . ^{1}H-NMR data ($CDCl_3$) of oxazane-diols **8a-c**, **9a-c**, δ in ppm, *J* in Hz. 250 MHz, 300 K, internal standard TMS.

	H-C(1')	H-C(3)	H-C(4)	H-C(5)	H-C(6)	Me	OMe	CH_2[a]	*J* (1',3)	*J* (1',6)	*J* (3,Me)	*J* (3,4)	*J* (4,5)	*J* (5,6)	*J* (6,Me)
8a[b,c]	4.53	4.54	3.85	4.06	4.16	1.31	3.44 3.50	5.17 5.24		4.8	7.1	2.2	3.2	9.7	
8b[c,d]	4.60	4.43	4.15	3.49	4.03	1.30	3.36 3.40	5.20 5.21	7.4			2.7	3.4	9.1	6.2
8c	4.51	3.87	3.87	4.13	3.87	1.58	3.37 3.45	5.18 5.20		5.5	7.3	e	e	e	
8c[c,f]	4.38	3.69	3.59	3.74	4.29	1.53	3.07 3.16	5.12		5.0	7.2	2.6	3.5	7.6	
9a[g]	4.46	3.21	3.78	3.99	3.75	1.29	3.48 3.51			5.1	7.2	2.9	3.3	9.1	
9b	4.70	3.17	4.02	3.37	3.83	1.27	3.48 3.43		8.0			4.1	3.5	8.2	6.4
9c	4.46	2.82	3.77	3.65	3.99	1.18	3.47 3.43			5.5	6.7	1.7	3.6	9.7	

a) Benzyl CH_2, *J* =12.4 ; 5 arom.H : *ca* 7.35. b) 2 OH : 2.76, 3.44. c) 333 K. d) OH-C(4) : 2.19, OH-C(5) : 2.20 ; *J* (4,OH-4)=3.0, *J* (5,OH-5)=7.4. e) not determined.
f) in C_6D_6. g) 2 OH, 1 NH : 1.66, 2.89, 4.46.



8a **8b** **8c**

Figure 1

Enantiomeric purity of oxazine **D-10a** was determined *via* its diols, *i.e.* by comparison of the racemic form **8a** [6] and the D-form **D-8a**, by HPLC using a chiral column (Chiralpack AD column). The enantiomeric purity proved to be greater than 99%.

Structural and conformational analyses. Structure assignments of the racemic *cis* **7a** and *trans* **7c** adducts had been made in a preceding publication [6]. As to the minor regioisomer **7b**, its diol **8b** was amenable to structural ^{1}H-NMR study. Spectral data of the chiral compounds were identical to those of the racemic ones.

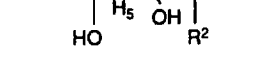
a) Oxazane diols 8a, 8b, and 8c. ^{1}H-NMR data of diols **8a-c** are collected in *Table 1*. Structural assignment (configuration and conformation) of the diacetates of **8a** and of **8c** had been ascertained previously [6]. The structure of regioisomer **8b** was determined by ^{1}H-^{13}C correlation NMR spectroscopy : the C(6) atom, which is connected to an oxygen and appears at 76.3 ppm, carries the methyl group, whereas C(3) atom at 62.8 ppm is connected to the N-atom and carries the acetal group.

The conformation of the diols **8a,b** is determined by the axial position of the C(3)-substituent (methyl group in **8a**, acetal group in **8b**), which is due to the severe steric interaction with the neighbouring N(2)-acyl group [18], an effect we had already observed previously [6] (*Figure 1*). The large magnitude of ^3J(5,6) and the rather small one of ^3J(4,5) indicate that H-C(5) and H-C(6) appear in a *trans*-diaxial geometry and H-C(4) in an equatorial position. As to diol **8c**, the magnitude of ^3J(5,6) indicates an equilibrium between two chair conformations, the one in which the two substituents are equatorial being predominant (*ca.* 60%).

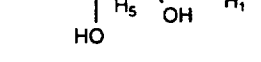
b) Aminosugars. ^{1}H-NMR data of the herein described new aminosugars are collected in *Table 2*.

- *Methyl furanoside* **13a**. This compound, which was formed from the linear sugar acetal **12a**, was characterised by one methoxy group only and the presence of an amide NH signal at *ca.* 4.9 ppm which coupled with the H-C(5) proton. These data and the clearcut deshielding of the H-C(2) and H-C(3) protons in the diacetyl derivative, suggested a furanose structure in the α-configuration, as deduced from the absence of the ^3J(1,2) coupling which corresponds to two *trans* oriented protons [19].

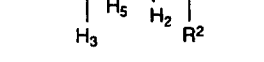
- Allo- *and* talo-*nojirimycin series.* ^{1}H-NMR data indicate that these compounds are all in the $^4C_1$(D) conformation, the Me-C(6) group being equatorial (*Figure 2*) ; in a given series, the *J* values are similar.



14a $R^1 = SO_3H$, $R^2 = H$
15a (α) $R^1 = H$, $R^2 = OH$
15a (β) $R^1 = OH$, $R^2 = H$
16a $R^1 = R_2 = H$



15a (i)



14c $R^1 = SO_3H$, $R^2 = H$
15c (α) $R^1 = H$, $R^2 = OH$
15c (β) $R^1 = OH$, $R^2 = H$
16c $R^1 = R_2 = H$

Figure 2

In the allose series, H-C(2), H-C(4), H-C(5) are axial, H-C(3) is equatorial as indicated by the large magnitude of ^3J(1a,2) and ^3J(4,5) and by a clear W-coupling ^4J(1a,3). The sulfite adduct **14a** as well as the major anomer of aminosugar **15a** appear in their β-configuration. The imine form **15a**(i) appears in the corresponding $^4H_3$(D) half-chair conformation.

In the talose series, all coupling constants are small and the structures could only be deduced by chemical correlation from diol **8c** ; one notices a ^4J(2,4) W-coupling between the two equatorial protons H-C(2) and H-C(4). The β-configuration of the sulfite adduct **14c** and of the major anomer of aminosugar **15c** was deduced by analogy with the allose series. The imine form **15c**(i) occurred in too minute amounts to be analysed.

Table 2 . ^{1}H-NMR data (D_2O) of amino-sugars **13a, 14a-16a, 14c-16c, 18**, δ in ppm, *J* in Hz. 250 MHz, 300 K, internal standard D_4-TSP.

	He-C(1)	Ha-C(1)	H-C(2)	H-C(3)	H-C(4)	H-C(5)	Me	*J* (1e,2)	*J* (1a,2)	*J* (1e,3)	*J* (2,3)	*J* (2,4)	*J* (3,4)	*J* (4,5)	*J* (5,Me)
13a[a]	4.78		3.98	4.26	3.79	3.84	1.33	0			4.8		6.5	6.5	6.4
14a[b]		4.23	4.11	4.18	3.68	3.49	1.43		10.6		2.5		2.5	10.6	6.4
15a(α)	4.62		3.67	4.08	3.24	3.22	1.16	3.5		1.3	3.1		*ca* 2.5	10.0	6.0
15a(β)		4.40	3.36	4.09	3.28	2.96	1.14		8.8		3.0		3.0	10.2	6.4
15a(i)[c]	7.56		4.06	4.25	3.51	3.53	1.34	1.8		0.9	3.7		*ca* 3.0	9.0	6.6
16a[d]	2.82	2.70	3.71	4.06	3.23	2.75	1.12	5.3	11.0	1.0	2.8		2.7	10.0	6.4
14c		4.33	4.57	3.85	3.99	3.55	1.47		1.5		3.1	1.3	3.5	1.8	6.7
15c(α)	4.74		3.83	3.87	3.74	3.22	1.13	2.8			3.2	1.6	3.2	1.6	6.6
15c(β)		4.27	3.90	*ca* 3.66	*ca* 3.66	2.75	1.15		1.7		f	f	f	1.2	6.7
15c(i)	7.84		f	f	f	f	1.36	f		f	f	f	f	f	7.3
16c[e]	3.20	2.91	4.01	3.74	3.84	2.98	1.22	2.8	1.9		3.2	1.6	3.2	1.6	6.7
18(pα)[g]	5.10		4.01	f	f	4.15	1.29	3.8		0.8	3.2		f	9.9	6.4
18(pβ)[g]		4.93	3.77	4.06	3.43	3.86	1.28		8.7		2.9		3.0	9.8	6.3
18(fα)[g]	5.47		4.16	4.28	f	3.94	1.23	4.6			6.8		2.5	3.7	6.5
18(fβ)[g]	5.27		4.05	4.39	3.81	3.94	1.24	5.2			6.1		3.6	4.9	6.5

a) OMe : 3.34 ; NH : 4.88 ; *J* (5,NH)=7.8. b) Lit.[7]. c) *J* (1,5)=2.6. d) *J* (1a,1e)=12.2. e) *J* (1a,1e)=14.3. f) not determined. g) NAc : 2.08 (pα) ; 2.05 (pβ), 2.10 (fα), 2.08 (fβ).

- *6-Deoxy-2-allosamine 15b*. This product appears as a mixture of the α- and β-anomers both of the pyranose and the furanose forms. Comparison of the ^{1}H-NMR data of the *N*-acetyl derivative **18** with those of the known *N*-acetyl-2-D-allosamine [17] allows us to assign the α- and β-pyranose forms and the α- and β-furanose forms **18**(pα), **18**(pβ), **18**(fα), **18**(fβ), respectively. Due to similar *J* values, the pyranose forms **18**(pα) and **18**(pβ) are in the same $^4C_1$(D) conformation as the α- and β-anomers of the aminoallose **15a**.

Conclusion. - We have presented a six-step synthesis of 6-deoxy-*allo*nojirimycin **15a** from sorbaldehyde in acceptable overall yield (35% in racemic and 20% in D series). No limitations were given from the auxiliaries **5a** and **6** or from the diene **3** which are easily synthesised on a 100 g scale. Extension of this methodology to other amino-sugars, particuliary the 6-hydroxylated ones, seems possible as long as the corresponding diene is available. A more straightforward synthesis from sorbaldehyde of the 1-deoxy derivative **D-16a** has been reported by us [9] with better overall yield (32%) and of this L-enantiomer **L-16a** by *Wyatt* [8] with only 10% yield.

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EXPERIMENTAL PART

General. Flash chromatography (FC) : silica gel (*Merck 60*, 230-400 mesh). TLC : Al-roll silica gel (*Merck 60*, F_{254}). M.p. : *Kofler* hot bench or *Büchi-SMP20* apparatus, corrected. IR spectra (ν in cm^{-1}) : *Perkin-Elmer 157-G*, $[\alpha]_D$ values : *Schmidt-Haensch Polartronic Universal* polarimeter. HPLC measurements : liquid chromatograph *Hewlett-Packard 190*. ^{1}H- and ^{13}C-NMR (62.9 MHz) spectra : *Bruker AC-F250*, usually at 300 K ; tetramethylsilane (TMS) or sodium trimethylsilylpropionate-D_4 (D_4-TSP) in D_2O (^{1}H-NMR) and $CDCl_3$, C_6D_6, CD_3OD, or (in D_2O) CH_3OH or dioxane ($\delta_{(CDCl_3)}$ = 77.0, $\delta_{(C_6D_6)}$ = 128.0, $\delta_{(CD_3OD)}$ = 49.0, in D_2O $\delta_{(CH_3OH)}$ = 50.0, $\delta_{(dioxane)}$ = 67.4 with respect to TMS (^{13}C-NMR) as internal references ; δ in ppm and *J* in Hz. ^{13}C-NMR assignments were ascertained by ^{1}H-^{13}C correlation measurements. High resolution (HR)-MS were measured on a *MAT-311* spectrometer at the University of Rennes. Microanalyses were carried out by the Service Central de Microanalyses of the CNRS, F-69390 Vernaison, France.

Reagents and solvents. Raney-Ni (slurry in H_2O), 5 % Pd/C catalyst, methyl *o*-formate, benzyl chloroformate, acetic anhydride, *N*-methylmorpholine-*N*-oxide (NMO), OsO_4, *t*-butyl hydroperoxide, sulfur dioxide gas, were purchased from Fluka, hexa-2,4-dienal from Lancaster, formic acid, $CaCO_3$, $Ba(OH)_2.8H_2O$ from Prolabo ; usual solvents were freshly distilled, CH_2Cl_2 was kept over Na_2CO_3. Standard OsO_4 solution was prepared according to lit.[6,20] [OsO_4 (1 g) and 70% *t*-BuOOH (1 ml) in *t*-BuOH (200 ml)]. Hydrogenolyses were carried out at atmospheric pressure.

Racemic cyclic diols

Benzyl 6c-(dimethoxymethyl)-4t,5t-dihydroxy-3r-methyl-1,2-oxazane-2-carboxylate (8a) and its regioisomer benzyl 3r-(dimethoxymethyl)-4t,5t-dihydroxy-6c-methyl-1,2-oxazane-2-carboxylate (8b). Same procedure as in lit [6] : to a stirred soln of the crude mixture of adducts **7a**, **7b**, **7c** (prepared according to lit.[6] from dienes **3** [6] (5.0 g, 35 mmol)), in acetone (160 ml) and H_2O (96 ml) were added NMO (7.1 g, 53 mmol, 1.5 eq) and the standard OsO_4 soln (35 ml). After 1 day at 40°C, some Na_2SO_3 was added and the soln was extracted with AcOEt (3x200 ml), the organic layer washed by brine (4x50 ml), dried ($MgSO_4$) and evaporated to give crude diol (13.3 g) which crystallised at 0°C. Washing with Et_2O gave pure **8a** (6.2 g, 52 %). The mother liquors were resolved by FC on SiO_2 (150 g) (AcOEt/Cyclohexane 1:1, then AcOEt) to give impure **7c** [6] (3.2 g ; *ca.* 2.0 g, 15-20 %, after purification by FC) and a 2:1 mixture of **8a, 8b** (2.0 g, 17 %), which were separated and purified by fractional crystallisation in benzene for **8b**, in *i*-PrOH for **8a**.

8a [6]: ^{1}H-NMR : *Table 1*. ^{13}C-NMR ($CDCl_3$, selected data) : 55.3 C(3) ; 64.2 C(5) ; 68.7 C(4) ; 76.0 C(6).

8b : colourless crystals. Mp = 129-130°C (benzene). IR(KBr) : 3455, 3345, 2935, 2835, 1683, 1450, 1412, 1313, 1268, 1254, 1123, 1098, 1072, 1022, 951, 761, 746, 700. ^{1}H-NMR : *Table 1*. ^{13}C-NMR : ($CDCl_3$, 333 K), 156.2, CO-N(2) ; 136.3, arom.C subst. ; 128.5, 128.1, arom.C*o,m* ; 127.9, arom.C*p* ; 101.7 C(1') ; 76.3 C(6) ; 70.6 C(5) ; 67.9, benzyl. CH_2 ; 66.2 C(4) ; 62.8 C(3) ; 54.9, 54.3, 2 OMe ; 16.1 Me-C(6). Anal. calc. for $C_{16}H_{23}NO_7$ (341.35) : C 56.29, H 6.79, N 4.10 ; found : C 56.6, H 6.8, N 4.1.

Benzyl 6t-(dimethoxymethyl)-4c,5c-dihydroxy-3r-methyl-1,2-oxazane-2-carboxylate (8c). To a soln of **7c** (1.9 g, 6.2 mmol) in DMF (25 ml) and *t*-BuOH (25 ml) were added at 0°C NMO (4.2 g, 31.1 mmol, 5 eq.) and the standard OsO_4 soln (6.2 ml). The soln was stirred at 60°C for 3 d, some Na_2SO_3 was added and the solvent evaporated. FC (AcOEt / cyclohexane 3:7, then AcOEt) gave **7c** (0.7 g, 37 %) and **8c** (0.42 g, 20 %).
8c : colourless resin. Identical physical data as in lit.[6]. ^{1}H-NMR : *Table 1*.

6c-(Dimethoxymethyl)-4t,5t-dihydroxy-3r-methyl-1,2-oxazane (9a) and its regioisomer 3r-(dimethoxymethyl)-4t,5t-dihydroxy-6c-methyl-1,2-oxazane (9b). A soln of a 2:1 mixture of **8a, 8b** (0.2 g, 0.6 mmol) in EtOH (2 ml) was hydrogenolysed over 5 % Pd/C (12 mg) at 40°C for 0.5 h. The catalyst was removed by centrifugation, the solvent evaporated and the residu resolved by FC (AcOEt) to give **9b** (33 mg, 27 %) and **9a** (87 mg, 72 %).
9a : colourless resin, characterised by ^{1}H-NMR. IR($CHCl_3$) : 3520, 2940, 2840, 1135, 1075. ^{1}H-NMR : *Table 1*.
9b : colourless crystals. Mp = 118-9°C (AcOEt). IR(KBr) : 3475, 3240, 2930, 2830, 1277, 1090, 1075, 1055, 1037, 965, 945, 906, 833, 810, 792. ^{1}H-NMR : *Table 1*. Anal. calc. for $C_8H_{17}NO_5$ (207.23) : C 46.37, H 8.27, N 6.76 ; found : C 46.7, H 8.3, N 6.6.

Enantiomerically pure cyclic diols.
(3R,6R)-6-(Dimethoxymethyl)-3-methyl-3,6-dihydro-2H-1,2-oxazine (D-10a) and benzyl (3R,6R)-6-(dimethoxymethyl)-3-methyl-3,6-dihydro-2H-1,2-oxazine-2-carboxylate (D-17a). **3** (8.5 g, 60 mmol, 1eq.) was added to a soln of **6** [11] (18.0 g, 58.5 mmol) in anh. MeOH (60 ml) and methyl *o*-formate (60 ml) at -10°C. After 3 h, **D-10a** was extracted with 10 % aq. NaCl soln (3x) and the aq. soln washed with Et_2O (3x). To the stirred aq. soln of **D-10a** were added $ClCO_2Bn$ (8.2 ml, 58 mmol, 1 eq.) and Na_2CO_3 (12.4 g, 11.7 mmol, 2 eq.). After 3 h at rt, the soln was extracted with CH_2Cl_2, the organic phase dried ($MgSO_4$) and evaporated to give crude **D-7a** (11.4 g, 63 %). **D-10a** could be isolated by evaporation of its aq. soln, extraction with CH_2Cl_2 and evaporation of the solvent. **D-7a** could be purified by FC (AcOEt/cyclohexane 1:1).

The same procedure when applied to the non-protected hexa-2,4-dienal gave **D-7a** in *ca.* 50% yield.
D-7a : colourless oil. $[\alpha]_D^{20} = -87$ (c=1, $CHCl_3$). Identical ^{1}H-NMR ($CDCl_3$) as in lit.[6] for **7a**.
D-10a : colourless oil, characterised by ^{1}H-NMR ($CDCl_3$) : 5.54 (d, H-C(1')) ; 4.96 (m, H-C(6)) ; 5.97 (m, H-C(5)) ; 6.03 (m, H-C(4)) ; 4.15 (m, H-C(3)) ; 3.49 (s, 2 OMe) ; 1.60 (d, Me-C(3)). J(1',6)=5.4, J(3,Me)=6.9, J(3,4)=2.1, J(3,5)=1.8, J(3,6)=2.3, J(4,5)=10.4, J(4,6)=2.1, J(5,6)=2.8.

Benzyl (3R)-6c-(dimethoxymethyl)-4t,5t-dihydroxy-3r-methyl-1,2-oxazane-2-carboxylate (D-8a). Crude **D-7a** (11.4 g, 37 mmole) was osmylated using the same procedure as for racemic **7a** in acetone (100 ml), H_2O (50 ml) with NMO (7.5 g, 56 mmole, 1.5 eq.) and standard OsO_4 soln (37 ml), for 1 day at 40°C to give after FC (AcOEt/cyclohexane 1:1) pure **D-8a** (6.7 g, 35 % from **3**).
D-8a : colourless resin, $[\alpha]_D^{20} = -33$ (c=1, $CHCl_3$). IR($CHCl_3$) : 3500, 2970, 2940, 2830, 1710, 1300, 1130, 1075. Anal. calc. for $C_{16}H_{23}NO_7$ (341.35) : C 56.29, H 6.79, N 4.10 ; found : C 56.4, H 6.9, N 4.3.

HPLC determination of enantiomeric excess : Chiralpak AD Daicel Column ; solvent : *i*-PrOH/hexane, 20:80. Retention time (intensity) for the racemic **8a** : (+)-**8a**, Rt_1=10.7 mn (236) ; (-)-**8a**, Rt_2=12.7 mn (235) ; for the enantiomerically pure **D-8a** : 10.3 mn (0.2) ; 10.7 mn (0.5) ; 12.5 mn (279). E.e. > 99.5 %. (k'_1=1.66, k'_2=2.15, k'_2/k'_1=1.3, resolution =1.15, flow rate = 0.8 ml/mn ; detection : λ=254 nm ; temperature : 26°C).

Amino-D,L-allose series.

5-Amino-5,6-dideoxy-D,L-allose dimethylacetal (11a). A soln of **8a** (0.5 g, 1.5 mmol) in EtOH (5 ml) was hydrogenolysed at rt for 1 day over 5 % Pd/C (30 mg and another 30 mg after 8 h). The catalyst was removed by centrifugation, evaporation of the solvent gave **11a** (0.33 g, quant).

11a : colourless oil. ^{1}H-NMR ($CDCl_3$, 330 K) : 4.53 (dd, *J*=1.0, 2.9, H-C(1)) ; 3.77 (m, H-C(2)) ; 3.50 (m, 2 OMe, H-C(3), H-C(4)) ; 3.22 (quint., *J*=6.6, H-C(5)) ; 1.20 (d, *J*=6.6, Me(6)). It has been characterised as its tetraacetyl derivative [6].

5-(Benzyloxycarbonyl)amino-5,6-dideoxy-D,L-allose dimethylacetal (12a). Procedure according to lit.[21]. To a stirred soln of crude **11a** (0.33 g, 1.5 mmol) in aq. 1 M. Na_2CO_3 (3 ml, 2 eq) was added $ClCO_2Bn$ (0.41 ml, 3 mmol, 2 eq.) and the soln stirred overnight at rt. Extraction with AcOEt and evaporation of the solvent led to a resin (0.6 g) which was purified by FC (AcOEt/cyclohexane 1:1) to give **12a** (0.21 g, 42 %).

12a : colourless resin, unstable due to cyclisation into **13a**. IR($CHCl_3$) : 3430, 2995, 2935, 2835, 1705, 1510, 1455, 1230, 1125, 1070, 1060, 695. ^{1}H-NMR ($CDCl_3$, 300 K) : 7.35 (m, 5 arom. H) ; 5.27 (d, NH) ; 5.10 (s, benzyl CH_2) ; 4.48 (d, H-C(1)) ; 4.09 (m, H-C(5)) ; 3.80 (dd, H-C(4)) ; 3.76 (dd, H-C(2)) ; 3.65 (t, H-C(3)) ; 3.51, 3.50 (2s, 2 OMe) ; *ca* 3.1 (broad s, 3 OH), 1.20 (d, Me(6)) ; *J*(1,2)=5.2, *J*(2,3)=6.5, *J*(3,4)=8.4, *J*(4,5)=2.8, *J*(5,NH)=8.8, *J*(5,Me)=6.8.

Tetraacetate of 12a (cf lit.[6]). **11a** (0.1 g, 0.29 mmol) in pyridine (0.56 ml) and Ac_2O (0.28 ml, 2.9 mmol, 10 eq.) was left to react for 1 day at rt. Addition of MeOH and evaporation, addition of toluene and evaporation gave the tetraacetate (0.14 g, 92 %) which was purified by FC (AcOEt/cyclohexane 1:1) as a colourless resin (0.124 g, 90 %). ^{1}H-NMR ($CDCl_3$, 300 K) : 7.35 (m, 5 arom H) ; 5.35 (dd, H-C(2)) ; 5.21 (m, H-C(3)) ; 5.17 (m, H-C(4)) ; 5.09 (s, CH_2) ; 4.52 (d, H-C(1)) ; 4.04 (quint., H-C(5)) ; 3.39, 3.31 (2s, 2 OMe), 2.09 (s, 3 Ac) ; 1.13 (d, Me(6)) ; *J*(1,2)=6.6, *J*(2,3)=3.8, *J*(3,4)=6.6, *J*(4,5)=3.3, *J*(5,Me)=6.9. Anal. calc. for $C_{22}H_{31}NO_{10}$ (469.48) : C 56.28, H 6.66, N 2.98 ; found : C 56.5, H 6.7, N 3.1.

*Methyl 5-(benzyloxycarbonyl)amino-5,6-dideoxy-β-D,L-*allo*-furanoside (13a).* **12a** (50 mg) was dissolved in 90 % formic acid (0.5 ml). After 3 mn, hexane was added and the solvents were evaporated. Purification by FC (AcOEt) gave **13a** (44 mg, 98 %).

13a : colourless resin. IR($CHCl_3$) : 3440, 2940, 2835, 1705, 1510, 1450, 1230, 1110, 1085, 1055, 1025, 940, 695, ^{1}H-NMR : *Table 2*.

Diacetate of 13a : A soln of **13a** (78 mg, 0.25 mmol) in pyridine (0.2 ml) and Ac_2O (0.1 ml, 1 mmole, 4 eq.) was stirred overnight at rt and then evaporated after addition of some MeOH to give the diacetate as colourless needles (84 mg, 84 %). Mp = 110°C (*i*-PrOH/*i*-Pr_2O). IR(KBr) : 3305 2980, 2950, 1742, 1680, 1443, 1382, 1330, 1290, 1238, 1220, 1103, 1055, 1035. ^{1}H-NMR ($CDCl_3$): 7.35 (m, 5 arom. H) ; 5.31 (t, H-C(3)) ; 5.20 (d, H-C(2)) ; 5.09 (s, CH_2) ; 4.94 (d, NH) ; 4.84 (s, H-C(1)) ; 4.14 (t, H-C(4)) ; 3.93 (m, H-C(5)) ; 3.36 (s, OMe) ; 2.10, 2.00 (2s, 2 OAc) ; 1.21 (d, Me(6)) ; *J*(1,2)=0.9, *J*(2,3)=4.9, *J*(3,4)=7.5, *J*=5.2, *J*(5,NH)=8.6, *J*(5,Me)=6.7. Anal. calc. for $C_{19}H_{25}O_8N$ (395.4) : C 57.71, H 6.37, N 3.54 ; found : C 57.8, H 6.3, N 3.5.

*5-Amino-1,5,6-trideoxy-β-D,L-*allo*-pyranose-1-sulfonic acid (14a)* (cf lit.[13]). A soln of **11a** (obtained *via* hydrogenolysis of **8a** (0.5 g, 1.5 mmol)) in H_2O (2.5 ml) was stirred under SO_2 atmosphere in a glass vessel at 40°C for 2.5 days. White crystals appeared which, after dilution with EtOH (1 ml) and storage at 0°C, were collected and washed with EtOH and Et_2O to give **14a** (0.27 g, 81 %). Further crops were obtained by reaction of SO_2 at 0°C with the mother liquors (30 mg, 9 %).

14a : colourless cystals. Mp. = 225-230°C (dec) (H_2O/EtOH). IR(KBr) 3450, 3360, 3000, 2830, 1585, 1460, 1285, 1255, 1225, 1208, 1185, 1150, 1050, 820, 690, 540. ^{1}H-NMR : *Table 2*. ^{13}C-NMR (D_2O) : 68.1 C(1) ; 68.5 C(2) ; 71.8 C(3) ; 70.6 C(4) ; 52.8 C(5) ; 15.0 Me(6). Anal. calc. for $C_6H_{13}NO_6S$ (227.23) : C 31.71, H 5.76, N 6.16, S 14.11 ; found : C 31.9, H 5.9, N 6.4, S 14.1.

*5-Amino-5,6-dideoxy-D,L-*allo*-pyranose (6-deoxy-D,L-*allo*-nojirimycin) (15a).* $Ba(OH)_2.8H_2O$ (80 mg, 0.25 mmol, 1.1 eq) was added to a soln of **14a** (50 mg, 0.22 mmol) in H_2O (1 ml) and the suspension stirred for 2 h

at rt. Insoluble $BaSO_3$ was removed by centrifugation to give an aq. soln of **15a** as a mixture of three compounds **15a**(α), **15a**(β), **15a**(i) (37:53:10, pH= *ca.* 8, 300 K) ; see theoretical part. ^{1}H-NMR : *Table 2*.

1,5-Imino-1,5,6-trideoxy-D,L-allitol (16a). The previous aq. soln of **15a** was hydrogenolysed over 5 % Pd/C (5 mg) for 1-2 h at rt. The catalyst was removed by centrifugation and water evaporated to give **16a** (33 mg, quant.).
16a : yellowish resin. ^{1}H-NMR : *Table 2* (similary data as for the L-enantiomer in lit.[8]). ^{1}H and ^{13}C-NMR (D_2O) : identical data as in lit.[9] for the D-enantiomer.
Tetraacetyl-derivative (17a) : same procedure as for the diacetyl derivative of **13a**, with **16a** (65 mg, 0.44 mmol) in pyridine (0.85 ml) and Ac_2O (0.42 ml, 4.4 mmol, 10 eq.) at rt overnight to give **17a** (87 mg, 62 %) after crystallisation in *i*-Pr_2O/*i*-PrOH as colourless crystals. Mp = 120-1°C (*i*-Pr_2O/*i*-PrOH). IR(KBr) : 2982, 1737, 1635, 1435, 1368, 1250, 1227, 1058. ^{1}H-NMR ($CDCl_3$, 340 K) : 5.18 (m, 2H) ; 5.06 (m, 1H) ; 4.72 (broad s, H-C(5)) ; 4.36 (broad s, Ha-C(1)) ; 3.23 (d, *J*=14.5, Hb-C(1)) ; 1.99, 2.05, 2.06, 2.08 (4 Ac) ; 1.30 (d, *J*=7.3, Me(6)). Anal. calc. for $C_{14}H_{21}NO_7$ (315.32) : C 53.32, H 6.71, N 4.44 ; found : C 53.5, H 6.7, N 4.6.

Chiral amino-D-allose series.
*5-Amino-1,5,6-trideoxy-β-D-*allo*pyranose-1-sulfonic acid (D-14a).* Same procedure as in the racemic series. **D-8a** (0.53 g, 1.6 mmol) in EtOH (5 ml) was hydrogenolysed over 5 % Pd/C (30 mg and another 30 mg after 8h) at 50°C for 1 day. The catalyst was removed and evaporation of the solvent gave crude **D-11a**. which was hydrolysed with SO_2 in H_2O (5 ml) at 40°C for 4 days to give **D-14a** (0.21 g, several crops, 60 %).
D-14a : colourless crystals. Mp = 215-220°C (dec.) (H_2O/EtOH). $[\alpha]_D^{20}$ = −10 (c=1, H_2O). IR(KBr) : 3380, 3020, 2830, 1642, 1578, 1450, 1270, 1237, 1205, 1180, 1145, 1043, 1008, 817, 689. Anal. calc. for $C_6H_{13}NO_6S$ (227.23) : C 31.71, H 5.76, N 6.16, S 14.11 ; found : C 31.7, H 6.0, N 6.1, S 13.9. (Some inexact data in lit.[7b]).

*5-Amino-5,6-dideoxy-D-allose (6-deoxy-D-*allo*-nojirimycin)* (**D-15a**). Same procedure as for racemic **15a** with **D-14a** (50 mg, 0.22 mmol) in H_2O (0.5 ml) and $Ba(OH)_2.8H_2O$ (80 mg, 0.25 mmol) to give an aq. soln of **D-15a** as a mixture of **D-15a**(a), **D-15a**(b), **D-15a**(i) ; see theoretical part.

1,5-Imino-1,5,6-trideoxy-D-allitol (**D-16a**). The aq. soln of **D-15a** was hydrogenolysed over 5 % Pd/C (5 mg) at rt. for 1-2 h. The catalyst was removed and H_2O evaporated to give **D-16a** (33 mg, quant.).
D-16a : yellowish resin. $[\alpha]_D^{20}$ = +17 (c=1, H_2O).
Tetraacetyl derivative (D-17a) : same procedure as for the racemic **17a** with **D-16a** (33 mg, 0.22 mmol) to give **D-17a** (40 mg, 58 %) as colourless crystals. Mp = 120°C (*i*-PrOH/*i*-Pr_2O). $[\alpha]_D^{23}$ = +6 (c=1, $CHCl_3$) (lit.[9] : Mp = 120°C, $[\alpha]_D^{16}$ = +7 (c=1, $CHCl_3$)) (lit.[8] : Mp = 119-120°C, $[\alpha]_D$ = −4 (c=0.23, $CHCl_3$) for the L-enantiomer). IR(KBr) : 2970, 1745, 1730, 1650, 1440, 1373, 1250, 1228, 1070, 1055. Anal. calc. for $C_{14}H_{21}NO_7$ (315.32) : C 53.32, H 6.71, N 4 44 ; found : C 52.9, H 6.8, N 4.4.

D,L-Allosamine series.
*2-Amino-2,6-dideoxy-D,L-allose dimethylacetal (11b) and (*2RS,*1"*SR*)-4c-(dimethoxymethyl)-5t-hydroxy-6c-(1"-hydroxyethyl)-2r-methyl-1,3-oxazane (19).* **8b** (0.122 g, 0.36 mmol) was hydrogenolysed in EtOH (1 ml) over 5 % Pd/C (8 mg and another 8 mg after 8 h) at 50°C for 1 day. The catalyst was removed by centrifugation and the solvent evaporated to give a mixture in variable proportions of **11b** and **19** (79 mg, quant.). A similar mixture was obtained from **9b**.
11b : characterised by ^{1}H-NMR ($CDCl_3$, 300 K) : 4.50 (d, H-C(1)) ; 3.90 (quint., H-C(5)) ; 3.59 (dd, H-C(3)) ; 3.52 (s, 2 OMe) ; 3.43 (t, H-C(4)) ; 3.01 (dd, H-C(2)) ; 1.24 (d, Me(6)). *J*(1,2)=3.3, *J*(2,3)=8.5, *J*(3,4)=6.9, *J*(4,5)=6.5, *J*(5,Me)=6.3.

19 : characterised by ^{1}H-NMR ($CDCl_3$, 300 K) : 4.43 (d, H-C(1')) ; 4.27 (q, H-C(2)) ; 3.94 (quint., H-C(1'')); 3.59 (t, H-C(5)) ; 3.53, 3.48 (2s, 2 OMe) ; 3.20 (dd, H-C(6)) ; 2.94 (dd, H-C(4)) ; 1.30 (d, Me(2'')) ; 1.28 (d, Me-C(2)). *J*(1',4)=3.5, *J*(1'',Me(2''))=6.4, *J*(1'',6)=6.2, *J*(2,Me-C(2))=5.6, *J*(4,5)=9.3, *J*(5,6)=9.1.

2-Amino-2,6-dideoxy-D,L-allose (15b). A soln of **11b** and **19** (79 mg, 0.36 mmol) in H_2O (1 ml) and conc. HCl (1 ml) was heated at 50°C for 1 day and then evaporated to give **15b**.HCl (0.1 g, quant.) as hygroscopic crystals (mixture of α,β-pyranose and α,β-furanose anomers, 15:75:8:2).
N-acetyl derivative 18 (according to lit.[17]) : to the stirred soln of the crude **15b**.HCl (0.36 mmol) in H_2O (1 ml) and MeOH (0.1 ml) was added $CaCO_3$ (36 mg, 0.36 mmol, 1 eq.) and Ac_2O (0.07 ml, 0.74 mmol, 2 eq.). After 16 h at rt under Ar, the soln was evaporated and the residue purified by FC on SiO_2 (10 g) (AcOEt/ EtOH 9:1) to give after recrystallisation in EtOH/Et_2O (1:2) pure **18** (42 mg, 97 %) as colourless crystals. Mp = 170-1°C. (lit.[16] : 169-170°C for the D-compound). IR(KBr) : 3430, 3330, 3180, 2890, 1655, 1550, 1385, 1210, 1168, 1155, 1072, 1050, 705. ^{1}H-NMR : *Table 2* (mixture of α,β-pyranose and α,β-furanose anomers, 17:67:10:6). Anal. calc. for $C_8H_{15}NO_5$: C 46.82, H 7.37, N 6.83 ; found : C 46.4, H 7.1, N 6.9.

Amino-D,L-talose series.
*t-6-(Dimethoxymethyl)-c-4,c-5-dihydroxy-r-3-methyl-1,2-oxazane (9c), 5-amino-5,6-dideoxy-D,L-talose dimethylacetal (11c) and 5-amino-5,6-dideoxy-β-D,L-*talo*-pyranose-1-sulfonic acid (14c).*
Reduction over Pd/C. **8c** (69 mg, 0.2 mmol) was hydrogenolysed in EtOH (0.7 ml) over 5 % Pd/C (5 mg, and another 5 mg after 7 h) for 1 day at 40°C. **9c** was the only observed product.
Reduction over Raney-Ni. **8c** (0.29 g, 0.86 mmol) was hydrogenolysed in EtOH (3 ml) over Raney-Ni (1.4 g wet, previously activated under H_2) at rt for 6 h. The catalyst was removed by centrifugation and the solvent evaporated to give crude **11c** (180 mg, quant.), which was hydrolysed with SO_2 in H_2O (2 ml) as for **11a** at 40°C for 4 days to give **14c** (0.114 g, 59 %).
9c : characterised by ^{1}H-NMR : *Table 1.*
11c : characterised by ^{1}H-NMR (CD_3OD, 300 K) : 4.51 (d, H-C(1)) ; 3.73, 3.70 (m, H-C(2), H-C(3)) : 3.59 (dd, H-C(4)) ; 3.44, 3.47 (2s, 2 OMe) ; 3.22 (dq, H-C(5)) ; 1.16 (d, Me(6)) ; *J*(1,2)=4.4, *J*(2,3)=6.0, *J*(3,4)= *ca.* 5.7, *J*(4,5)= *ca.* 2.3, *J*(5,Me)=6.8.
14c : colourless crystals. Mp = 260-5°C (H_2O/EtOH). IR(KBr) : 3485, 3440, 3340, 3160, 3070, 1430, 1245, 1205, 1152, 1115, 1048, 1017, 990, 938, 627. ^{1}H-NMR : *Table 2.* Anal. calc. for $C_6H_{13}NO_6S$: C 31.71, H 5.76, N 6.16, S 14.11 ; found : C 31.9, H 5.6, N 6.2, S 14.40.

*5-Amino-5,6-D,L-*talo*-pyranose (6-deoxy-D,L-*talo*-nojirimycin) (15c).* Same procedure as for **15a** with **14c** (50 mg, 0.22 mmol) in H_2O (1 ml) and $Ba(OH)_2.8H_2O$ (80 mg, 0.25 mmol) to give an aq soln of **15c** as a mixture of **15c**(α), **15c**(β), **15c**(i) (62:35:3 at 300 K, pH= *ca.* 8) ; see theoretical part. ^{1}H-NMR : *Table 2.*

1,5-Imino-1,5,6-trideoxy-D,L-talitol (16c). Same procedure as for **16a** with **15c** (38 mg, 0.22 mmol) in H_2O (1ml) and 5 % Pd/C (5 mg) for 1 h to give **16c** (32 mg, quant.).
16c : colourless resin. ^{1}H-NMR : *Table 2.* MS (m/z(%)): 147(6), 129 (7), 112 (9), 73 (14), 58 (19), 57 (100), 56 (43). HR-MS calc. for $C_6H_{13}NO_3$: 147.08954 ; found : 147.0889.

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12. In reply to some questions which has been raised by the referees, we can say : as a consequence of the short reaction time (3 h), some nitroso-derivative **6** remained in the organic phase together with the diacetonide of D-mannono-lactone, the normal final product of transformation of **6** [11]. Recycling of this lactone was not described and direct synthesis through its thiolactone seems to be difficult (see Hürzeler, M.; Bernet, Br.; Vasella, A. *Helv. Chim. Acta* **1993**, 76, 995). Attempts to replace the acetal protecting group of **3** by a 1,3-dioxane group led to the same reaction pathway (in $CHCl_3$/MeOH), *i.e.* a immediate deprotection into sorbaldehyde. We have tried to use other chiral nitroso dienophiles derived from mandelic acid or from pyrrolidines (Defoin, A.; Brouillard-Poichet, A.; Streith, J. *Helv. Chim. Acta* **1992**, *75*, 109) without any reaction occurring, most probably because the diene **3** was not reactive enough. No attempts have been made to use the chiral auxiliaries derived from camphor (Gouverneur, V.; Dive, G.; Ghosez, A. *Tetrahedron : Asymmetry* **1991**, *2*, 1173 ; Martin, St.,F.; Hartmann, M.; Josey, J.A. *Tetrahedron Lett.* **1992**, *33*, 3583.
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