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One-Pot Tandem Strecker Reaction and Iminocyclisations: Syntheses of Trihydroxypiperidine α-Iminonitriles

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Unbranched, and α- and β-methyl-branched, trihydroxypiperidine α-iminonitriles have been obtained in a single step from protected 5-*O*-tosylate pentoses. This reaction comprises a one-pot tandem Strecker reaction and iminocyclisation. These trihydroxypiperidine α-iminonitriles are precursors to trihydroxypipecolic acids. No formation of pyrrolidine products was observed.

Introduction

Iminosugars are monosaccharide analogues that have an endocyclic nitrogen in place of oxygen, and they are immensely important due to their inhibition of glycosidases and other carbohydrate-processing enzymes.[1] The biological properties of trihydroxypipecolic acids,[2] iminosugar mimics of uronic acids, have sparked interest in their synthesis. *gluco*-Configured BR1 **1** (Figure 1) has been isolated in Nature from both *Baphia racemosa*[3] and *Baphiopsis parviflora*.[4] This trihydroxypipecolic acid has subsequently received some synthetic attention,[5–13] it has also been shown to inhibit both human liver β-D-glucuronidase and α-L-iduronidase,[14] and it has demonstrated antimetastatic properties.[15] The *galacto*-configured epimer (i.e., **2**) has also shown promising inhibitory activity.[16,17] Other derivatives of hydroxylated pipecolic acids have also been studied, including hydroxymethyl-branched derivative **3**, which showed potent activity towards β-*N*-acetylglucosaminidase (human placenta, IC_{50} 90 nM).[18] Therefore, there is an increasing interest in the development of efficient synthetic routes that allow access to these, and related, pipecolic acid targets. It was envisaged that trihydroxypiperidine α-iminonitriles **4** would serve as flexible precursors to trihydroxypipecolic acids. This paper describes the development of a new one-pot method comprising a key tandem Strecker reaction and iminocyclisation (TSI), which leads to trihydroxypiperidine α-iminonitriles − potential precursors to trihydroxypipecolic acids and their functional analogues. The expansion of the method to encompass the formation of α- and β-methyl-branched trihydroxypiperidine α-iminonitriles is also described.

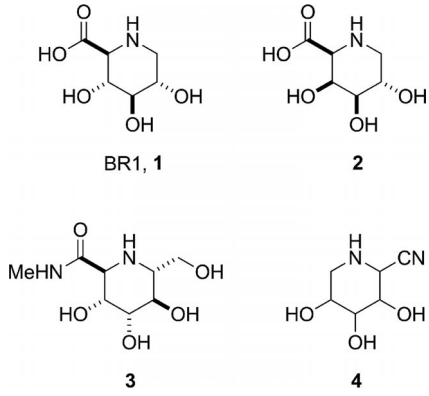

Figure 1. Iminosugar pipecolic acids and amide; piperidine α-iminonitrile precursor.

Results and Discussion

It was proposed that trihydroxypiperidine α-iminonitrile **I** would be obtained by the treatment of C-5-activated hemiacetal **V** with an amine and cyanide in a single synthetic step (Scheme 1). This would proceed by formation of open-chain imine **IV**, with subsequent intramolecular displacement or attack by cyanide to form iminium **II** or α-aminonitrile **III** intermediates, respectively; thus cyanide addition can precede or follow the formation of the piperidine ring. Similar strategies have been used to access piperidine α-iminonitriles.[5,19–34] However, in these cases, the addition of cyanide and the iminocyclisation were conducted separately, and not in a single one-pot procedure. A one-pot method has been successfully used in the synthesis of pyrrolidine-based iminosugars.[35]

Tosyl hemiacetal **6** (Scheme 2, a), readily accessible from D-ribose **5**,[36] was the ideal starting point. Reaction of tosyl hemiacetal **6** with benzylamine and potassium cyanide did not result in the formation of a piperidine α-iminonitrile, but gave instead the 1,5-anhydro compound (i.e., **7**; 78%)

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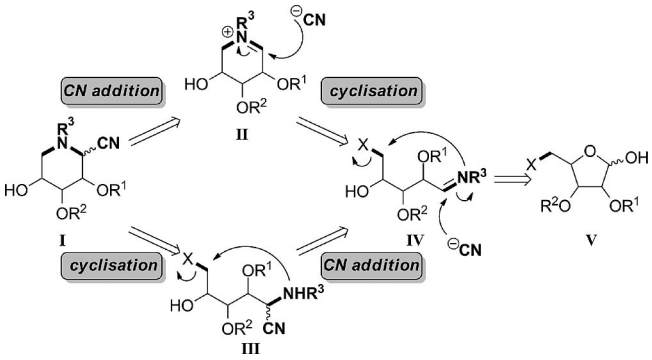


Scheme 1. Retrosynthesis of trihydroxypiperidine α-iminonitriles.

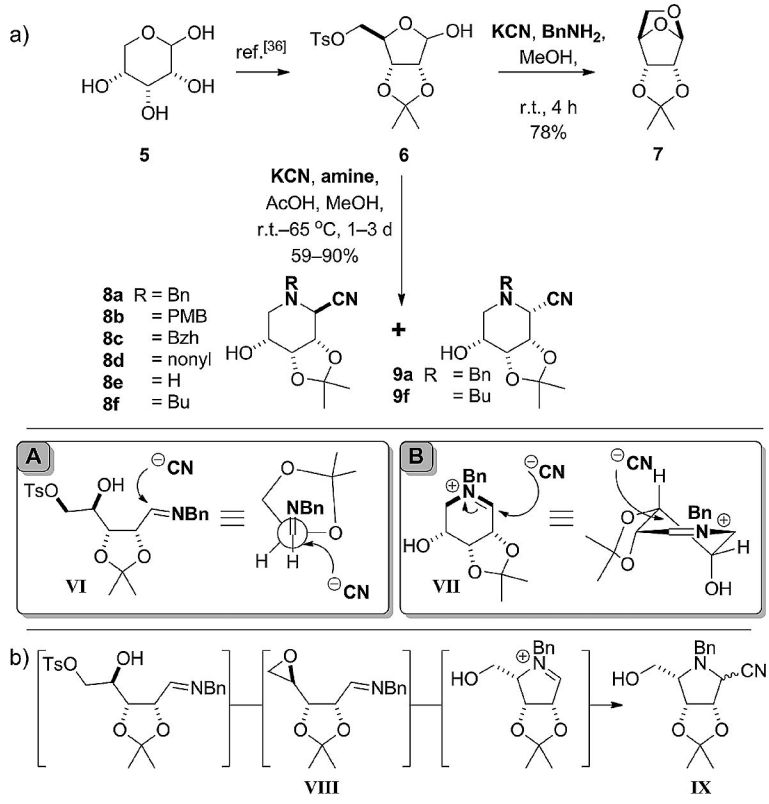
arising from intramolecular displacement under the basic reaction conditions. Neutralisation with acetic acid prevented the base-catalysed reaction, and led to the completely stereoselective formation of piperidine α-iminonitrile **8a** (65%, Table 1, entry 1) by the first tandem Strecker reaction and iminocyclisation (TSI). Competing formation of pyrrolidine by-products **IX** (Scheme 2, b) via epoxide **VIII** was not observed.[35,37] The structure of piperidine α-iminonitrile **8a** was unequivocally established by X-ray diffraction[38] and NOE enhancements (Figure 2). From the proposed reaction pathways shown in Scheme 1, the observed specificity in the cyanide addition may arise from attack on either the open-chain imine **VI**[29] (**A**), or the cyclic iminium ion **VII** (**B**), so rationales based on kinetic attack by cyanide are highly tentative. This is in analogy with the multistep Kiliani reaction in which diastereoselectivity is rationalised by Felkin–Anh-directed approach by cyanide.[39,40]

Table 1. Reaction conditions for the formation of piperidine α-iminonitriles.

Entry	Amine	*T* [°C]	Yield [%]	**8**:**9**
1	$BnNH_2$	r.t.	65	1:0
2	$BnNH_2$	40	90	>19:1[a]
3	$BnNH_2$	65	82	1.7:1[a]
4	$PMBNH_2$	r.t.	90	1:0
5	$PMBNH_2$	r.t.	73[b]	1:0
6	$BzhNH_2$	r.t.	79[c]	1:0
7	$NonylNH_2$	r.t.	65	1:0
8	NH_4OAc	35	59	1:0
9	$BuNH_2$	r.t.	60	4.8:1[a]

[a] Ascertained by integration of ^{1}H NMR spectra. [b] TMSCN used as cyanide source. [c] Based on recovered starting material (b.r.s.m.).

An increase in the temperature of the TSI reaction (Table 1, entries 2–3) led to an increase in the yield (82–90%), but also to a decrease in the stereoselectivity of the cyanide addition (**8**/**9**, 1.7:1). 4-Methoxybenzylamine ($PMBNH_2$) gave a better result at room temp., with the highly stereoselective formation of **8b** (90%, Table 1, entry 4). Switching to trimethylsilyl cyanide (TMSCN, Table 1, entry 5) resulted in a decreased yield (73%). The excellent 90% yield obtained with $PMBNH_2$ is an improvement over previous two-step methods to synthesise piperi-



Scheme 2. a) Tandem Strecker reaction and iminocyclisation (TSI) giving access to trihydroxypiperidine α-iminonitriles from D-ribose; b) potential route to pyrrolidine by-products.

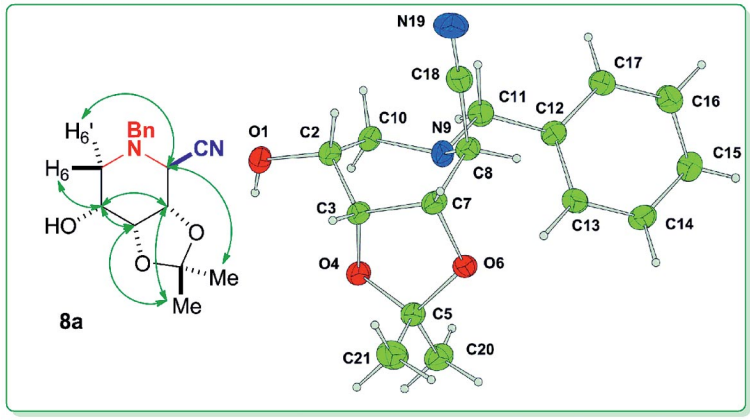
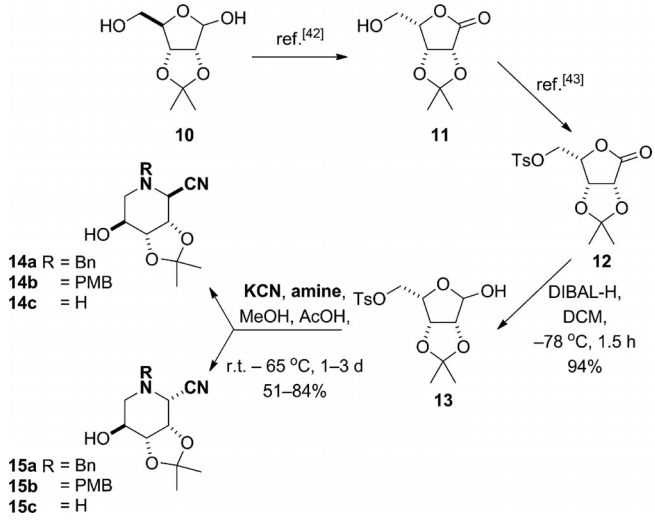


Figure 2. X-ray diffraction structure[38] and NOE enhancements of piperidine α-iminonitrile **8a** (arrows show correlations between protons).

dine α-iminonitriles, which usually proceeded in only moderate yields (<70%).[5,20–26,28–34] The best two-step yields were reported by Paulsen (73%)[19] and Wong (78%).[27] The secondary alkylamine benzhydrylamine ($BzhNH_2$; Table 1, entry 6), nonylamine (Table 1, entry 7), and ammonium acetate[41] (Table 1, entry 8) all gave the corresponding piperidine α-iminonitrile products with complete diastereoselectivity, in moderate to excellent yields [i.e., **8c** (79%), **8d** (65%), and **8e** (59%), respectively]. Only with butylamine was a non-stereoselective reaction observed, and in this case, a mixture of piperidine α-iminonitriles **8f/9f** (4.8:1, 60%) was formed (Table 1, entry 9).

To assess the tolerance of the TSI conditions towards different substrates, C-4-epimeric *lyxo*-configured tosyl hemiacetal **13** was prepared (Scheme 3). The synthesis of tosyl L-lyxonolactone **12** has been previously reported from 2,3-acetonide **10** via lactone **11**.[42,43] Subsequent reduction of lactone **12** with diisobutylaluminium hydride (DIBAL-H) gave the desired L-*lyxo* configured tosyl hemiacetal (i.e., **13**) in a 94% yield. Subjection of this compound to the TSI conditions with benzylamine gave a separable mixture of epimeric piperidine α-iminonitriles **14a** and **15a** (1:1, 77%, Table 2, entry 1), in contrast to the stereoselective reaction of the *ribo* epimer. This reaction was also performed on the enantiomeric system (1:1, 82%). An identical result was seen with $PMBNH_2$, and piperidine α-iminonitriles **14b** and **15b** (1:1, 82%) were formed (Table 2, entry 2), and similarly for the enantiomeric system (1:1, 84%). It is tentatively proposed that the formation of epimer **15** may arise from attack by cyanide on an alternative boat-like iminium intermediate (Figure 3). An increase in temperature (Table 2, entries 3–4) led to an increase in the formation of the Felkin–Anh product (i.e., **14b**), which is the opposite result to that seen for D-ribose, where a decrease in the Felkin–Anh product (i.e., **8a**) was observed (Scheme 2). Finally, reaction of tosyl hemiacetal **13** with ammonium acetate proceeded only at elevated temperature (40 °C), and gave a mixture of piperidine α-iminonitriles **14c** and **15c** (1.8:1, 51%, Table 2, entry 5).



Scheme 3. Tandem Strecker reaction and iminocyclisation (TSI) giving access to trihydroxypiperidine α-iminonitriles from L-lyxonolactone.

Table 2. Reaction conditions for the formation of piperidine α-iminonitriles.

Entry	Amine	*T* (°C)	Yield [%]	**14**:**15**
1	$BnNH_2$	r.t.	77 (82)[a]	1:1 (1:1)[b]
2	$PMBNH_2$	r.t.	82 (84)[a]	1:1 (1:1)[b]
3	$PMBNH_2$	40	84 (85)[a]	1.4:1 (2:1)[b]
4	$PMBNH_2$	65	83 (88)[a]	2:1 (2.3:1)[b]
5	NH_4OAc	40	51[c]	1.8:1[d]

[a] Yield with enantiomeric starting material. [b] Ratio with enantiomeric starting material. [c] Reaction not performed for the enantiomer. [d] Ascertained by integration of ^1H NMR spectra.

The 2-*C*-methyl-branched lactone derivative of D-ribose **16** is readily accessible from D-glucose,[40,44–46] and it would permit access to β-branched piperidine α-iminonitriles and an assessment of the compatibility of the TSI conditions towards more sterically demanding substrates (Scheme 4). Tosyl lactone **18** was prepared from methyl-branched

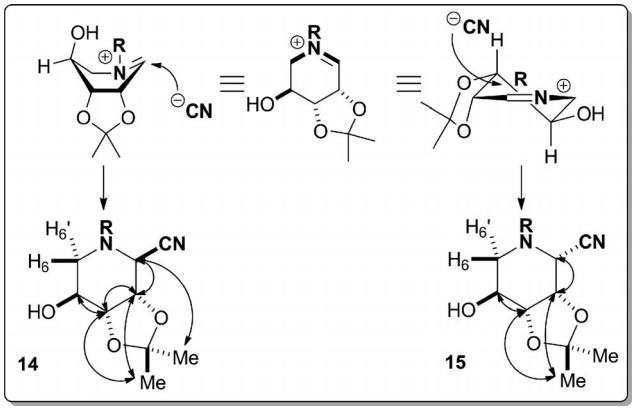


Figure 3. Reaction rationale and NOE enhancements of the piperidine α-iminonitriles **14** and **15** (arrows show correlations between protons).

Table 3. Reaction conditions for the formation of piperidine α-iminonitriles.

TSI from tosyl hemiacetal **19**				
Entry	Amine	*T* [°C]	Yield [%]	**20**:**21**
1	$BnNH_2$	r.t.	51	1:0
2	$BnNH_2$	40	79	15:1[a]
3	$BnNH_2$	65	73	4.4:1[a]
4	$PMBNH_2$	r.t.	68	1:0
5	$PMBNH_2$	40	79	>19:1[a]
6	NH_4OAc	40	71	1:0
TSI from tosyl hemiacetal **24**				
Entry	Amine	*T* [°C]	Yield [%]	**25**:**26**
7	$PMBNH_2$	50	73	1:3.8 [a]
8	NH_4OAc	50	–[b]	–

[a] Ascertained by the integration of ^1H NMR spectra. [b] Decomposed.

16,[47,48] and reduction with DIBAL-H gave the desired tosyl hemiacetal substrate (i.e., **19**; 94%). Reaction under the TSI conditions at room temp. with benzylamine gave β-methyl-branched piperidine α-iminonitrile **20a** selectively in a moderate yield (51%, Table 3, entry 1), as confirmed by X-ray diffraction[49] and NOE enhancements (Figure 4). The addition of the methyl branch resulted in a lower yield of the TSI product, and the reaction required a longer time at room temp. Heating led to a significant increase in the yield but also to a loss of selectivity (Table 3, entries 2–3).

$PMBNH_2$ proved to be a better nucleophile, and piperidine α-iminonitrile **20b** was formed in higher yield at room temp. with complete stereoselectivity (68%, Table 3, entry 4). Increasing the reaction temperature to 40 °C (Table 3, entry 5) resulted in an identical yield to that obtained with benzylamine, but with an enhanced diastereoselectivity (>19:1, compared to 15:1). Reaction with ammonium acetate gave product **20c** stereoselectively (71%, Table 3, entry 6).

As with the unbranched systems, inversion of the configuration at C-4 has been described previously, and C-4-inverted lyxonolactone **22** can be formed from ribonolactone

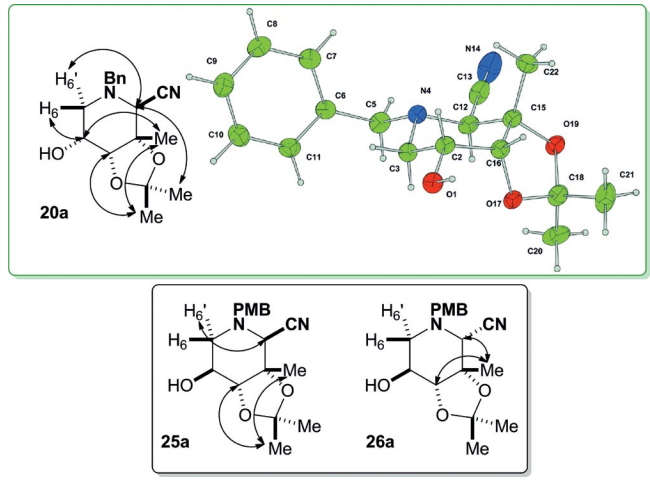
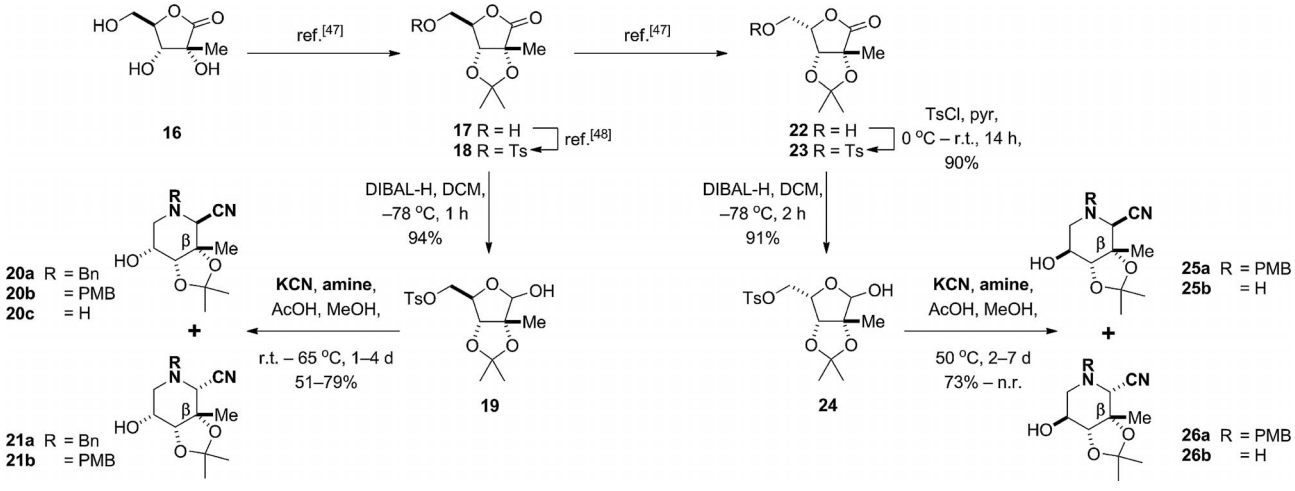


Figure 4. X-ray diffraction structure[49] of piperidine α-iminonitrile **20a**, and NOE enhancements of **20a**, **25a**, and **26a** (arrows show correlations between protons).

17.[47] The C-5 hydroxy group of lactone **22** was subsequently activated as the tosylate to give **23** (90%), and the



Scheme 4. Access to β-branched trihydroxypiperidine α-iminonitriles.

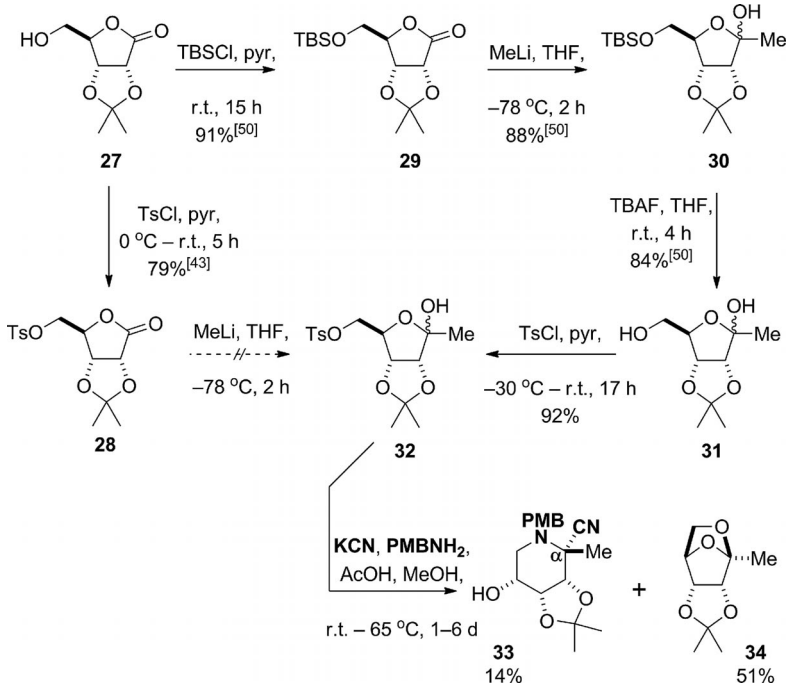
lactone moiety was reduced with DIBAL-H to give tosyl hemiacetal **24** (91%). The reaction with $PMBNH_2$ under the TSI conditions proved sluggish, and only proceeded at elevated temperature to give a mixture of piperidine α-iminonitriles **25a** and **26a** (1:3.8, 73%, Table 3, entry 7). The structure of each of these compounds was confimed by NOE analysis (Figure 4). The presence of the methyl branch in this case led to a selectivity opposite to that seen in the unbranched system (**15/16**, 2:1, Table 2). The reaction with ammonium acetate did not result in an isolable product.

Following the synthesis of piperidine α-iminonitriles containing a β-tertiary centre, the feasibility of constructing an α-tertiary centre under the TSI conditions was assessed, and this required access to the tosyl hemiacetal of 1-*C*-methyl-branched D-ribose (1-deoxy-D-psicose) **32** (Scheme 5). The C-5 hydroxy group of protected lactone **27** was activated as the tosylate to give **28** (79%),[43] but subsequent treatment with methyllithium met with failure. In an alternative route, the C-5 hydroxy group of lactone **27** was protected as a silyl ether by treatment with *tert*-butyldimethylsilyl chloride (TBSCl) and pyridine to give **29** (91%), and subsequent treatment with methyllithium successfully led to protected ketose **30** (88%).[50] The silyl ether was cleaved with TBAF (tetrabutylammonium fluoride) (84%),[50] and lactol **31** was activated as the tosylate to give **32** (92%). The reaction of tosyl hemiacetal **32** with $PMBNH_2$ under the TSI conditions proved to be extremely sluggish, but at elevated temperature and with long reaction times, α-methyl-branched piperidine α-iminonitrile **33** was formed, albeit in a low yield (14%). This demonstrated that a tertiary centre could be established under the TSI conditions; however, despite attempted optimisation, the 2,6-anhydro species **34** (51%) was the major product. The propensity for 1-deoxy-D-psicose to form anhydro derivatives has been described previously.[51] In contrast to the parent unbranched system, the presence of the α-methyl branch resulted in the selective formation of the unexpected epimer (the NOE enhancements of this compound were comparable to those observed for **9a**).

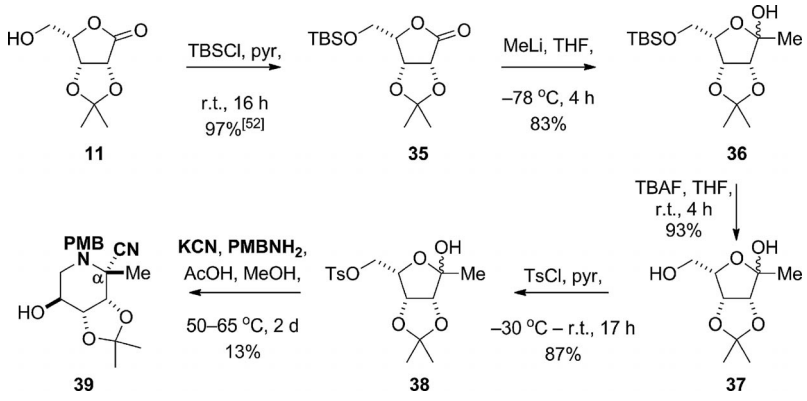
Similarly, *lyxo*-configured lactone **11** was protected as silyl ether **35** (97%, Scheme 6),[52] and addition of methyllithium gave protected ketose **36** (83%). TBAF-induced silyl deprotection gave lactol **37** (93%), which underwent C-5-activation to give tosylate **38** (87%). Again, this ketose substrate proved slow to react, and high temperatures were required to induce a TSI and formation of α-branched piperidine α-iminonitrile **39** (13%; the NOE enhancements of this compound were comparable to those observed for **16a**).

Having achieved the introduction of methyl branches at the α- and β-positions, the possibility of introducing both methyl branches was probed. 2-*C*-Methyl-branched lactone **17** (Scheme 7) was protected as silyl ether **40** (91%), and addition of methyllithium gave protected, branched ketose **41** (70%). Deprotection of the silyl ether in **41** with TBAF gave lactol **42** (85%), along with the unexpected formation of 2,6-anhydro by-product **43** (5%). C-5-Activation gave tosyl hemiacetal **44** (76%), again accompanied by by-product **43** (6%). Unfortunately, subjection of tosyl hemiacetal **44** to the TSI conditions did not give any ofthe desired α,β-dimethyl-branched piperidine α-iminonitrile (i.e., **45**). The only product observed was the 2,6-anhydro species (i.e., **43**; 70%).

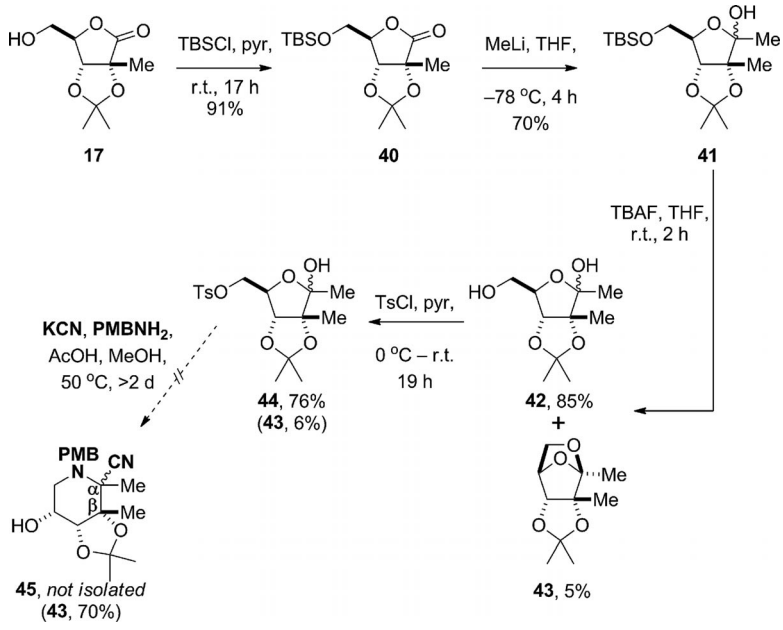
In a similar approach, *lyxo*-configured 2-*C*-methyl-branched lactone **22** (Scheme 8) was protected as silyl ether **46** (97%), and subsequent addition of methyllithium gave



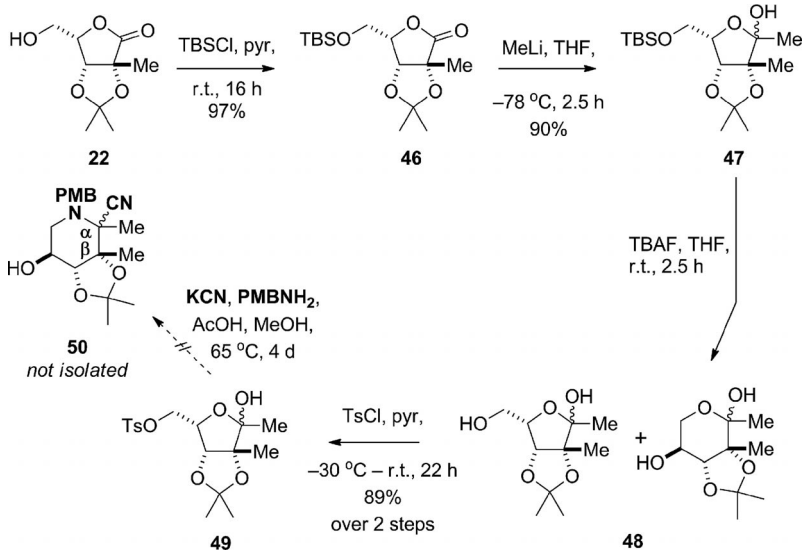
Scheme 5. Access to a D-*ribo*-configured, α-branched trihydroxypiperidine α-iminonitrile.



Scheme 6. Access to an L-*lyxo*-configured, α-branched trihydroxypiperidine α-iminonitrile.



Scheme 7. Towards an α,β-dimethyl-branched trihydroxypiperidine α-iminonitrile.



Scheme 8. Towards an α,β-dimethyl-branched trihydroxypiperidine α-iminonitrile.

protected, branched ketose **47** (90%). In contrast to previous systems, TBAF-mediated deprotection of the silyl group led to a mixture of pyranose and furanose hemiacetals **48**, but chemoselective esterfication with tosyl chloride specifically gave the furanose tosylate hemiacetal **49** (89%). This substrate was subjected to the TSI conditions, but despite the inability of this substrate to give an anhydro byproduct, the additional steric crowding prevented the formation of any TSI products.

Conclusions

This paper describes the synthesis of eight tosyl hemiacetals by short synthetic routes, and the development of a one-pot tandem Strecker reaction and iminocyclisation (TSI) methodology to give both unbranched and α- and β-methyl-branched piperidine α-iminonitriles. The unbranched piperidine α-iminonitriles were formed in good yields − higher than those achieved in previous methods over two steps. Increased branching of the substrates led to lower overall yields. These compounds are precursors to biologically relevant trihydroxypipecolic acids and related iminosugars. Under all TSI conditions, *no competing pyrrolidine ring formation* was observed; thus piperidine ring closure competes successfully with the formation of epoxides. Many of these reactions showed considerable diastereostereoselectivity in the cyanide addition. Work towards accessing an α,β-dimethyl-branched piperidine α-iminonitrile has also been described, and the results indicate a limitation to this strategy for the formation of highly branched carbon systems.

Experimental Section

General Methods: All commercially sourced reagents were used as supplied. Unless otherwise stated, all reactions were performed under an inert atmosphere (argon or nitrogen). Thin-layer chromatography (TLC) was performed on aluminium sheets coated with 60 F_{254} silica. Plates were visualised using a spray of cerium(IV) sulfate (0.2% w/v) and ammonium molybdate (5%) in sulfuric acid (2 M aq.). Flash chromatography was performed on Sorbsil C60 40/60 silica. Melting points were recorded on a Kofler hot block. Concentrations for optical rotations are quoted in g 100 mL^{-1}. ^{1}H and ^{13}C NMR spectra were assigned by using 2D COSY, HSQC, and HMBC spectra. Residual signals from the solvents were used as an internal reference. HRMS measurements were made using a micrOTOF mass analyser.

General Procedure for Tandem Strecker Reaction and Iminocyclisation (TSI): A solution of acetic acid in methanol (1:5, v/v; 3.4 mmol) was added to a solution of amine (2.2 mmol) or ammonium acetate (22.0 mmol), potassium cyanide (1.2 mmol), and tosyl hemiacetal (1.0 mmol) in methanol (8 mL) under argon. The reaction mixture was stirred until the starting material had been consumed [as judged by TLC analysis (toluene/acetone or dichloromethane/diethyl ether)]. The reaction mixture was concentrated in vacuo, the residue was dissolved in CH_2Cl_2, and this solution was washed with aqueous sodium hydrogen carbonate. The crude product was purified by flash chromatography (toluene/acetone).

1,5-Anhydro-2,3-*O*-isopropylidene-D-ribose (7): Benzylamine (70 μL, 0.64 mmol) and potassium cyanide (23 mg, 0.35 mmol) were added to a solution of tosylates **6**[36] (100 mg, 0.29 mmol) in anhydrous methanol (2 mL) at room temp. After 4 h, TLC analysis (49:10:1, toluene/acetone/triethylamine) indicated the complete consumption of the starting materials (R_f = 0.45) and the formation of a single product (R_f = 0.62). The reaction mixture was filtered through glass fibre (GF/B), and the filtrate was concentrated in vacuo. The crude residue was purified by flash chromatography (49:1 to 47:3, toluene/acetone) to give 1,5-anhydro compound **7** (39 mg, 78%) as a white crystalline solid. Selected data: $[\alpha]_D^{25}$ = –72.1 (c = 1.0, acetone) [ref.[53] $[\alpha]_D^{25}$ = –64.7 (c = 1.00, acetone)], m.p. 62–63 °C [ref.[53] m.p. 60–61 °C]. ^{1}H NMR [400 MHz, $(CD_3)_2$CO, 20 °C]: δ = 5.32 (s, 1 H, 1-H), 4.66 (d, $J_{4,5b}$ = 3.5 Hz, 1 H, 4-H), 4.41 (d, $J_{2,3}$ = 5.6 Hz, 1 H, 2-H), 4.21 (d, $J_{3,2}$ = 5.6 Hz, 1 H, 3-H), 3.32 (d, $^2J_{5a,5b}$ = 7.2 Hz, 1 H, 5a-H), 3.28 (dd, $^2J_{5b,5a}$ = 7.2, $J_{5b,4}$ = 3.5 Hz, 1 H, 5b-H), 1.34, 1.23 [2 s, 2× 3 H, C$(CH_3)_2$] ppm. ^{13}C NMR [100 MHz, $(CD_3)_2$CO, 20 °C]: δ = 112.3 [$C(CH_3)_2$], 100.5 (C-1), 82.2 (C-3), 80.2 (C-2), 78.4 (C-4), 63.5 (C-5), 26.4, 25.5 [C($CH_3)_2$] ppm.

2-*N*-Benzyl-2,6-dideoxy-2,6-imino-3,4-*O*-isopropylidene-D-allononitrile (8a) and 2-*N*-Benzyl-2,6-dideoxy-2,6-imino-3,4-*O*-isopropylidene-D-altrononitrile (9a)

Method A (room temp.): See General Procedure. Benzylamine (0.21 mL, 1.92 mmol), potassium cyanide (68 mg, 1.05 mmol), and tosylate **6**[36] (300 mg, 0.87 mmol) at room temp. for 16 h gave α-iminonitrile **8a** (164 mg, 65%) as a pale yellow crystalline solid.

Method B (40 °C): See General Procedure. Benzylamine (0.24 mL, 2.20 mmol), potassium cyanide (76 mg, 1.17 mmol), and tosylate **6** (335 mg, 0.97 mmol) at 40 °C for 17 h gave a >19:1 (A:B) inseparable mixture of α-iminonitriles **8a** and **9a** (238 mg, 68%) as a pale yellow oil that crystallised on standing.

Method C (65 °C): See General Procedure. Benzylamine (0.22 mL, 2.01 mmol), potassium cyanide (72 mg, 1.11 mmol), and tosylate **6** (315 mg, 0.92 mmol) at 65 °C for 17 h gave a 1.7:1 (A:B) inseparable mixture of α-iminonitriles **8a** and **9a** (237 mg, 82%) as a pale yellow oil that crystallised on standing.

Data for α-iminonitrile **8a**: HRMS (ESI): calcd. for $[C_{16}H_{20}N_2O_3 + Na]^+$ 311.1366; found 311.1365, m.p. 69–71 °C. $[\alpha]_D^{20}$ = +20.3 (c = 1.75, MeOH). IR (film): $\tilde{\nu}$ = 3461, 2234 cm^{-1}. ^{1}H NMR [500 MHz, $(CD_3)_2$CO, 20 °C]: δ = 7.35–7.29 (m, 5 H, H-Ar), 4.47 (dd, $J_{4,3}$ = 5.3, $J_{4,5}$ = 3.3 Hz, 1 H, 4-H), 4.44 (a-t, $J_{3,2}$ = $J_{3,4}$ = 5.8 Hz, 1 H, 3-H), 4.06 (d, $^2J_{gem}$ = 13.2 Hz, 1 H, CHa 2-*N*-Bn), 3.97–3.95 (m, 1 H, 5-H), 3.59 (d, $^2J_{gem}$ = 13.2 Hz, 1 H, CHb 2-*N*-Bn), 3.52 (d, $J_{2,3}$ = 6.1 Hz, 1 H, 2-H), 2.70 (dd, $^2J_{6a,6b}$ = 11.1, $J_{6a,5}$ = 4.8 Hz, 1 H, 6a-H), 2.40 (a-t, $^2J_{6b,6a}$ = $J_{6b,5}$ = 10.2 Hz, 1 H, 6b-H), 1.50, 1.34 [2 s, 2× 3 H, C$(CH_3)_2$] ppm. ^{13}C NMR (100 MHz, CD_3CN, 20 °C): δ = 137.7 (C-*i* 2-*N*-Bn), 130.0, 129.4, 128.6 (C-Ar), 118.5 (CN), 111.1 [$C(CH_3)_2$], 76.1 (C-3), 75.3 (C-4), 65.4 (C-5), 59.8 (CH_2 2-*N*-Bn), 56.5 (C-2), 52.1 (C-6), 27.5, 26.0 [C($CH_3)_2$] ppm. MS (ESI): m/z (%) = 599 (35) $[2M + Na]^+$, 311 (100) $[M + Na]^+$.

Partial data for the inseparable **8a^A/9a^B** mixtures: ^{1}H NMR [400 MHz, $(CD_3)_2$CO, 20 °C]: δ = 7.38–7.16 (m, 10 H, H^A-Ar, H^B-Ar), 4.57 (a-t, $J_{4,3}$ = $J_{4,5}$ = 4.8 Hz, 1 H, 4^B-H), 4.48 (dd, $J_{4,3}$ = 5.3, $J_{4,5}$ = 3.3 Hz, 1 H, 4^A-H), 4.44 (a-t, $J_{3,2}$ = $J_{3,4}$ = 5.8 Hz, 1 H, 3^A-H), 4.40 (dd, $J_{3,2}$ = 7.9, $J_{3,4}$ = 5.4 Hz, 1 H, 3^B-H), 4.20 (br. d, $J_{2,3}$ = 7.9 Hz, 1 H, 2^B-H), 4.06 (d, $^2J_{gem}$ = 13.2 Hz, 1 H, CHa^A 2-*N*-Bn), 3.99–3.91 (m, 2 H, 5^A-H, 5^B-H), 3.73 (d, $^2J_{gem}$ = 13.4 Hz, 1 H, CHa^B 2-*N*-Bn), 3.71 (d, $^2J_{gem}$ = 13.4 Hz, 1 H, CHb^B 2-*N*-Bn), 3.60 (d, $^2J_{gem}$ = 13.2 Hz, 1 H, CHb^A 2-*N*-Bn), 3.52 (d, $J_{2,3}$ = 6.1 Hz, 1 H, 2^A-H), 2.71 (a-dd, $^2J_{6a,6b}$ = 11.1, $J_{6a,5}$ = 4.8 Hz, 2 H, 6a^A-H,

6a^B-H), 2.56 (a-t, $^2J_{6b,6a} = J_{6b,5}$ = 10.4 Hz, 1 H, 6b^B-H), 2.40 (a-t, $^2J_{6b,6a} = J_{6b,5}$ = 10.2 Hz, 1 H, 6b^A-H), 1.68, 1.35 [2 s, 2× 3 H, C(CH$_3$)^B], 1.50, 1.34 [2 s, 2× 3 H, C(CH$_3$)^A, C(CH$_3$)^B] ppm. ^{13}C NMR [100 MHz, (CD$_3$)$_2$CO, 20 °C]: δ = 138.2 (C^B-*i* 2-*N*-Bn), 137.7 (C^A-*i* 2-*N*-Bn), 129.8, 129.7, 129.6, 129.4, 129.3, 129.0, 128.4, 128.4 (C^A-Ar, C^B-Ar), 118.7 (CN^A, CN^B), 111.1 [*C*(CH$_3$)$_2^B$], 110.9 [*C*(CH$_3$)$_2^A$], 76.4 (C-3^A), 75.9 (C-4^A), 75.1 (C-4^B), 72.8 (C-3^B), 66.6 (C-5^B), 65.6 (C-5^A), 60.0 (CH$_2^B$ 2-*N*-Bn), 59.9 (CH$_2^A$ 2-*N*-Bn), 57.0 (C-2^B), 56.9 (C-2^A), 52.2 (C-6^A), 49.8 (C-6^B), 27.7, 26.0 [C(*C*H$_3$)$_2^A$], 26.2, 25.8 [C(*C*H$_3$)$_2^B$] ppm.

2,6-Dideoxy-2,6-imino-3,4-*O*-isopropylidene-2-*N*-(4-methoxybenzyl)-D-allononitrile (8b)

Method A (KCN): See General Procedure. 4-Methoxybenzylamine (0.25 mL, 1.92 mmol), potassium cyanide (85 mg, 1.31 mmol), and tosylate **6** (300 mg, 0.87 mmol) at room temp. for 19 h gave α-iminonitrile **8b** (250 mg, 90%) as a white crystalline solid.

Method B (TMSCN): See General Procedure. 4-Methoxybenzylamine (0.19 mL, 1.45 mmol), trimethylsilyl cyanide (0.18 mL, 1.45 mmol), and tosylate **6** (200 mg, 0.58 mmol) at room temp. for 24 h gave α-iminonitrile **8b** (136 mg, 73%) as a white crystalline solid.

Data for α-iminonitrile **8b**: HRMS (ESI): calcd. for [C$_{17}$H$_{22}$N$_2$O$_4$ + Na]$^+$ 341.1472; found 341.1467. $[\alpha]_D^{20}$ = +36.1 (*c* = 2.41, CHCl$_3$), m.p. 142–144 °C. IR (film): $\tilde{\nu}$ = 3482, 2221 cm^{-1}. ^{1}H NMR (400 MHz, CDCl$_3$, 20 °C): δ = 7.25 (d, *J* = 8.5 Hz, 2 H, H-Ar), 6.89 (d, *J* = 8.5 Hz, 2 H, H-Ar), 4.39 (a-t, $J_{3,2} = J_{3,4}$ = 4.8 Hz, 1 H, 3-H), 4.31 (a-t, $J_{4,3} = J_{4,5}$ = 4.8 Hz, 1 H, 4-H), 3.92 (d, $^2J_{gem}$ = 13.1 Hz, 1 H, CHa 2-*N*-PMB), 3.92–3.88 (m, 1 H, 5-H), 3.81 (s, 3 H, CH$_3$ 2-*N*-PMB), 3.70 (d, $J_{2,3}$ = 4.0 Hz, 1 H, 2-H), 3.57 (d, $^2J_{gem}$ = 13.1 Hz, 1 H, CHb 2-*N*-PMB), 2.78 (dd, $^2J_{6a,6b}$ = 12.0, $J_{6a,5}$ = 3.5 Hz, 1 H, 6a-H), 2.60 (dd, $^2J_{6b,6a}$ = 12.0, $J_{6b,5}$ = 7.1 Hz, 1 H, 6b-H), 2.37 (d, $J_{OH,5}$ = 9.9 Hz, 1 H, 5-OH), 1.57, 1.38 [2 s, 2× 3 H, C(CH$_3$)$_2$] ppm. ^{13}C NMR (100 MHz, CDCl$_3$, 20 °C): δ = 159.5 (C-*p* 2-*N*-PMB), 130.5 (C-Ar), 127.6 (C-*i* 2-*N*-PMB), 116.3 (CN), 114.2 (C-Ar), 110.8 [*C*(CH$_3$)$_2$], 74.5 (C-3), 73.8 (C-4), 65.3 (C-5), 58.9 (CH$_2$ 2-*N*-PMB), 55.4 (CH$_3$ 2-*N*-PMB), 54.6 (C-2), 51.8 (C-6), 26.8, 26.0 [C(*C*H$_3$)$_2$] ppm. MS (ESI): *m*/*z* (%) = 329 (92) [M + Na]$^+$, 307 (100) [M + H]$^+$.

2-*N*-Benzhydryl-2,6-dideoxy-2,6-imino-3,4-*O*-isopropylidene-D-allononitrile (8c): See General Procedure. Benzhydrylamine (0.14 mL, 0.79 mmol), potassium cyanide (52 mg, 0.79 mmol), and tosylate **6** (109 mg, 0.32 mmol) at room temp. for 3 d gave α-iminonitrile **8c** (78 mg, 68%; 79% b.r.s.m.) as a white crystalline solid, and recovered starting material **6** (15 mg, 14%). Data for α-iminonitrile **8c**: HRMS (ESI): calcd. for [C$_{22}$H$_{24}$N$_2$O$_3$ + Na]$^+$ 387.1679; found 387.1683. $[\alpha]_D^{20}$ = +5.6 (*c* = 1.05, CHCl$_3$), m.p. 152–154 °C. IR (film): $\tilde{\nu}$ = 3461, 2251 cm^{-1}. ^{1}H NMR (400 MHz, CDCl$_3$, 20 °C): δ = 7.48–7.45 (m, 4 H, H-Ar), 7.35–7.30 (m, 4 H, H-Ar), 7.27–7.21 (m, 2 H, H-Ar), 4.74 (s, 1 H, CH 2-*N*-Bzh), 4.39 (dd, $J_{3,4}$ = 6.1, $J_{3,2}$ = 1.8 Hz, 1 H, 3-H), 4.34 (dd, $J_{4,3}$ = 6.1, $J_{4,5}$ = 4.3 Hz, 1 H, 4-H), 4.03 (br. s, 1 H, 2-H), 3.99 (br. s, 1 H, 5-H), 2.92 (dd, $^2J_{6a,6b}$ = 12.2, $J_{6a,5}$ = 6.4 Hz, 1 H, 6a-H), 2.63 (dd, $^2J_{6b,6a}$ = 12.2, $J_{6b,5}$ = 4.0 Hz, 1 H, 6b-H), 2.50 (br. s, 1 H, 5-OH), 1.70, 1.38 [2 s, 2× 3 H, C(CH$_3$)$_2$] ppm. ^{13}C NMR (100 MHz, CDCl$_3$, 20 °C): δ = 140.7, 139.6 (C-*i* 2-*N*-Bzh), 129.3, 129.0, 128.2, 128.1, 127.8, 127.8 (C-Ar), 115.5 (CN), 110.8 [*C*(CH$_3$)$_2$], 74.3 (C-3), 73.4 (C-4), 73.0 (CH 2-*N*-Bzh), 65.2 (C-5), 52.5 (C-2), 49.9 (C-6), 26.4, 25.6 [C(*C*H$_3$)$_2$] ppm. MS (ESI): *m*/*z* (%) = 387 (100) [M + Na]$^+$.

2,6-Dideoxy-2,6-imino-3,4-*O*-isopropylidene-2-*N*-nonyl-D-allononitrile (8d): See General Procedure. Nonylamine (0.21 mL, 1.15 mmol), potassium cyanide (75 mg, 1.15 mmol), and tosylate **6** (158 mg, 0.46 mmol) at room temp. for 2 d gave α-iminonitrile **8d** (55 mg, 65%) as a pale yellow oil. HRMS (ESI): calcd. for [C$_{18}$H$_{32}$N$_2$O$_3$ + Na]$^+$ 347.2305; found 347.2298. $[\alpha]_D^{20}$ = –10.1 (*c* = 1.11, CHCl$_3$). IR (film): $\tilde{\nu}$ = 3448, 2247 cm^{-1}. ^{1}H NMR (400 MHz, CDCl$_3$, 20 °C): δ = 4.35 (dd, $J_{3,4}$ = 5.3, $J_{3,2}$ = 4.0 Hz, 1 H, 3-H), 4.28 (dd, $J_{4,3}$ = 5.3, $J_{4,5}$ = 4.0 Hz, 1 H, 4-H), 3.90 (a-dt, $J_{5,6b}$ = 7.0, $J_{5,4} = J_{5,6a}$ = 3.8 Hz, 1 H, 5-H), 3.74 (d, $J_{2,3}$ = 4.0 Hz, 1 H, 2-H), 2.75 (dd, $^2J_{6a,6b}$ = 12.0, $J_{6a,5}$ = 3.7 Hz, 1 H, 6a-H), 2.69 [dt, $^2J_{gem}$ = 12.6, *J* = *J* = 7.2 Hz, 1 H, NC*H*a(CH$_2$)$_7$CH$_3$], 2.60 (dd, $^2J_{6b,6a}$ = 12.0, $J_{6b,5}$ = 7.2 Hz, 1 H, 6b-H), 2.52 [dt, $^2J_{gem}$ = 12.6, *J* = *J* = 7.2 Hz, 1 H, NC*H*b(CH$_2$)$_7$CH$_3$], 1.56, 1.37 [2 s, 2× 3 H, C(CH$_3$)$_2$], 1.47 [quin., *J* = 7.1 Hz, 2 H, NCH$_2$C*H*$_2$(CH$_2$)$_6$CH$_3$], 1.28–1.24 [m, 12 H, N(CH$_2$)$_2$(C*H*$_2$)$_6$CH$_3$], 0.86 [s, 3 H, N(CH$_2$)$_8$C*H*$_3$] ppm. ^{13}C NMR (100 MHz, CDCl$_3$, 20 °C): δ = 116.3 (CN), 110.7 [*C*(CH$_3$)$_2$], 74.6 (C-4), 73.8 (C-3), 65.3 (C-5), 55.5 (C-2), 55.2 [N*C*H$_2$(CH$_2$)$_7$CH$_3$], 51.9 (C-6), 31.9, 29.6, 29.5, 29.3, 27.1, 26.7, 22.7 [NCH$_2$(*C*H$_2$)$_7$CH$_3$], 26.6, 26.0 [C(*C*H$_3$)$_2$], 14.2 [N(CH$_2$)$_8$*C*H$_3$] ppm. MS (ESI): *m*/*z* (%) = 360 (45) [M + K]$^+$, 347 (100) [M + Na]$^+$, 325 (55) [M + H]$^+$.

2,6-Dideoxy-2,6-imino-3,4-*O*-isopropylidene-D-allononitrile (8e): See General Procedure. Ammonium acetate (356 mg, 4.62 mmol), potassium cyanide (76 mg, 1.15 mmol), and tosylate **6** (159 mg, 0.46 mmol) at room temp. for 1 d, then at 35 °C for 1 d, gave α-iminonitrile **8e** (54 mg, 59%) as a pale yellow oil. HRMS (ESI): calcd. for [C$_9$H$_{14}$N$_2$O$_3$ + Na]$^+$ 221.0897; found 221.0901. $[\alpha]_D^{20}$ = –32.1 (*c* = 2.77, CHCl$_3$). IR (film): $\tilde{\nu}$ = 3292, 2249 cm^{-1}. ^{1}H NMR (400 MHz, CDCl$_3$, 20 °C): δ = 4.40 (a-t, $J_{4,3} = J_{4,5}$ = 4.7 Hz, 1 H, 4-H), 4.25 (dd, $J_{3,2}$ = 6.8, $J_{3,4}$ = 5.1 Hz, 1 H, 3-H), 3.89 (a-dt, $J_{5,6b}$ = 8.7, $J_{5,4} = J_{5,6a}$ = 4.4 Hz, 1 H, 5-H), 3.71 (d, $J_{2,3}$ = 6.8 Hz, 1 H, 2-H), 3.02 (dd, $^2J_{6a,6b}$ = 12.5, $J_{6a,5}$ = 4.7 Hz, 1 H, 6a-H), 2.76 (dd, $^2J_{6b,6a}$ = 12.5, $J_{6b,5}$ = 8.7 Hz, 1 H, 6b-H), 1.54, 1.38 [2 s, 2× 3 H, C(CH$_3$)$_2$] ppm. ^{13}C NMR (100 MHz, CDCl$_3$, 20 °C): δ = 118.7 (CN), 110.6 [*C*(CH$_3$)$_2$], 74.5 (C-4), 74.4 (C-3), 65.3 (C-5), 49.6 (C-2), 46.3 (C-6), 27.6, 25.9 [C(*C*H$_3$)$_2$] ppm. MS (ESI): *m*/*z* (%) = 370 {100) [M + (M – CN$^-$)]$^+$}, 221 (25) [M + Na]$^+$, 199 (10) [M + H]$^+$.

2-*N*-Butyl-2,6-dideoxy-2,6-imino-3,4-*O*-isopropylidene-D-allononitrile (8f) and 2-*N*-Butyl-2,6-dideoxy-2,6-imino-3,4-*O*-isopropylidene-D-altrononitrile (9f): See General Procedure. Butylamine (0.13 mL, 1.31 mmol), potassium cyanide (86 mg, 1.31 mmol), and tosylate **6** (180 mg, 0.52 mmol) at room temp. for 2 d gave a 4.8:1 (A:B) mixture of α-iminonitriles **8f**^{A} and **9f**^{B} (80 mg, 60%) as a pale yellow oil. HRMS (ESI): calcd. for [C$_{13}$H$_{22}$N$_2$O$_3$ + Na]$^+$ 277.1523; found 277.1520. IR (film): $\tilde{\nu}$ = 3332, 2241 cm^{-1}. ^{1}H NMR (400 MHz, CDCl$_3$, 20 °C): δ = 4.47 (t, $J_{4,3} = J_{4,5}$ = 5.2 Hz, 1 H, 4^B-H), 4.34 (a-t, $J_{3,2} = J_{3,4}$ = 5.1 Hz, 1 H, 3^A-H), 4.31 (dd, $J_{3,2}$ = 8.1, $J_{3,4}$ = 5.2 Hz, 1 H, 3^B-H), 4.28 (a-t, $J_{4,3} = J_{4,5}$ = 5.0 Hz, 1 H, 4^A-H), 4.02 (d, $J_{2,3}$ = 8.1 Hz, 1 H, 2^B-H), 3.89 (br. s, 2 H, 5^A-H, 5^B-H), 3.71 (d, $J_{2,3}$ = 4.3 Hz, 1 H, 2^A-H), 2.78 (dd, $^2J_{6a,6b}$ = 11.9, $J_{6a,5}$ = 6.6 Hz, 1 H, 6a^B-H), 2.74 (dd, $^2J_{6a,6b}$ = 11.9, $J_{6a,5}$ = 3.8 Hz, 1 H, 6a^A-H), 2.69 [dt, $^2J_{gem}$ = 12.7, *J* = *J* = 7.8 Hz, 1 H, NC*H*a^A(CH$_2$)$_2$CH$_3$], 2.71–2.66 [m, 1 H, NC*H*b^B(CH$_2$)$_2$CH$_3$], 2.58 (dd, $^2J_{6b,6a}$ = 11.9, $J_{6b,5}$ = 7.3 Hz, 1 H, 6b^A-H), 2.51 [dt, $^2J_{gem}$ = 12.7, *J* = *J* = 7.8 Hz, 1 H, NC*H*a^A(CH$_2$)$_2$CH$_3$], 2.61–2.43 [m, 2 H, NC*H*b^B(CH$_2$)$_2$CH$_3$, 6b^B-H], 1.73, 1.37 [2 s, 2× 3 H, C(CH$_3$)$_2^B$], 1.54, 1.36 [2 s, 2× 3 H, C(CH$_3$)$_2^A$], 1.46 (a-quin., *J* = 7.3 Hz, 4 H, NCH$_2$C*H*$_2$CH$_2$CH$_3^A$, NCH$_2$C*H*$_2$CH$_2$CH$_3^B$), 1.31 [sext, *J* = 7.3 Hz, 4 H, N(CH$_2$)$_2$C*H*$_2$CH$_3^A$, N(CH$_2$)$_2$C*H*$_2$CH$_3^B$], 0.90 [t, *J* = 7.3 Hz, 3 H, N(CH$_2$)$_3$C*H*$_3^A$], 0.87 [t, *J* = 7.3 Hz, 3 H, N(CH$_2$)$_3$C*H*$_3^B$] ppm. ^{13}C NMR (100 MHz, CDCl$_3$, 20 °C): δ = 116.3 (CN^A), 116.3 (CN^B), 112.2 [*C*(CH$_3$)$_2^B$], 110.7 [*C*(CH$_3$)$_2^A$], 74.6 (C-4^B), 73.8 (C-4^A), 73.6 (C-3^A), 71.9 (C-3^B), 66.0 (C-5^B), 65.2 (C-5^A), 56.7 (C-2^B), 55.5 (C-2^A), 55.1 [N*C*H$_2$(CH$_2$)$_2$CH$_3^B$], 54.8 [N*C*H$_2$(CH$_2$)$_2$CH$_3^A$],

51.8 (C-6^A), 49.8 (C-6^B), 29.2 ($NCH_2CH_2CH_2CH_3^B$), 28.6 ($NCH_2CH_2CH_2CH_3^A$), 26.7, 25.9 [$C(CH_3)_2^A$], 25.9, 25.7 [$C(CH_3)_2^B$], 20.2 [$N(CH_2)_2CH_2CH_3^A$, $N(CH_2)_2CH_2CH_3^B$], 13.9 [$N(CH_2)_3CH_3^A$, $N(CH_2)_3CH_3^B$] ppm. MS (ESI): *m/z* (%) = 290 (15) [M + K]$^+$, 277 (100) [M + Na]$^+$, 255 (65) [M + H]$^+$.

2,3-*O*-Isopropylidene-5-*O*-*p*-tolylsulfonyl-L-lyxofuranose (13): Diisobutylaluminium hydride (1.5 M in toluene; 5.4 mL, 8.06 mmol) was added dropwise over 15 min to a solution of lactone **12**[42,43] (2.3 g, 6.71 mmol) in anhydrous dichloromethane (25 mL) at –78 °C. The reaction mixture was stirred for 1.5 h, after which TLC analysis (5:1, toluene/acetone) indicated the complete consumption of the starting material (R_f = 0.47) and the formation of a major product (R_f = 0.56). The reaction mixture was diluted with ethyl acetate (100 mL) and warmed to room temp., and a mixture of water and saturated sodium potassium tartrate solution (1:3; 100 mL) was added. The biphasic mixture was stirred vigorously for 1.5 h, after which the phases were separated, and the aqueous layer was extracted with ethyl acetate (6× 25 mL). The combined organic fractions were dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (3:1 to 1:4, cyclohexane/ethyl acetate) to give lactols **13** (2.17 g, 94%) as a white crystalline solid, as a 5.6:1 (A:B) mixture of anomers. HRMS (ESI): calcd. for [$C_{15}H_{20}O_7S$ + Na]$^+$ 367.0822; found 367.0826, m.p. 116–118 °C. $[\alpha]_D^{20}$ = –7.0 (*c* = 1.11, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3459, 1359, 1175 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 7.80 (d, *J* = 8.3 Hz, 4 H, H^A-Ar, H^B-Ar), 7.34 (d, *J* = 8.1 Hz, 4 H, H^A-Ar, H^B-Ar), 5.36 (s, 1 H, 1^A-H), 4.99 (d, $J_{1,2}$ = 3.3 Hz, 1 H, 1^B-H), 4.72 (dd, $J_{3,2}$ = 5.8, $J_{3,4}$ = 3.6 Hz, 1 H, 3^A-H), 4.67 (dd, $J_{3,2}$ = 6.3, $J_{3,4}$ = 3.5 Hz, 1 H, 3^B-H), 4.58 (d, $J_{2,3}$ = 5.8 Hz, 1 H, 2^A-H), 4.50 (dd, $J_{2,3}$ = 6.3, $J_{2,1}$ = 3.4 Hz, 1 H, 2^B-H), 4.36 (a-q, $J_{4,3}$ = $J_{4,5}$ = $J_{4,5a}$ = 4.0 Hz, 1 H, 4^A-H), 4.30 (a-dd, ^2J = 10.6, *J* = 4.3 Hz, 2 H, 5a^A-H, 5a^B-H), 4.18 (dd, $^2J_{5b,5a}$ = 10.6, $J_{5b,4}$ = 7.6 Hz, 1 H, 5b^A-H), 4.13 (dd, $^2J_{5b,5a}$ = 10.6, $J_{5b,4}$ = 6.1 Hz, 1 H, 5b^B-H), 3.80 (td, $J_{4,5b}$ = $J_{4,5a}$ = 6.1, $J_{4,3}$ = 3.5 Hz, 1 H, 4^B-H), 2.44 (s, 6 H, CH_3^A 5-*O*-Ts, CH_3^B 5-*O*-Ts), 1.40, 1.31 [2 s, 2× 3 H, $C(CH_3)_2^B$], 1.33, 1.25 [2 s, 2× 3 H, $C(CH_3)_2^A$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 145.1 (C^A-*p* 5-*O*-Ts, C^B-*p* 5-*O*-Ts), 132.8 (C^A-*i* 5-*O*-Ts, C^B-*i* 5-*O*-Ts), 129.9 (C^B-Ar), 129.9 (C^A-Ar), 128.2 (C^A-Ar, C^B-Ar), 113.7 [$C(CH_3)_2^B$], 113.0 [$C(CH_3)_2^A$], 101.3 (C-1^A), 97.2 (C-1^B), 85.4 (C-2^A), 79.6 (C-3^A), 79.2 (C-3^B), 78.6 (C-2^B), 77.7 (C-4^A), 73.4 (C-4^B), 68.2 (C-5^A), 67.3 (C-5^B), 25.9, 24.7 [$C(CH_3)_2^A$], 25.8, 24.9 [$C(CH_3)_2^B$], 21.8 (CH_3^A 5-*O*-Ts, CH_3^B 5-*O*-Ts) ppm. MS (ESI): *m/z* (%) = 367 (100) [M + Na]$^+$. For the enantiomer: M.p. 116–118 °C. $[\alpha]_D^{20}$ = +6.1 (*c* = 2.39, $CHCl_3$).

2-*N*-Benzyl-2,6-dideoxy-2,6-imino-3,4-*O*-isopropylidene-L-talononitrile (14a) and 2-*N*-Benzyl-2,6-dideoxy-2,6-imino-3,4-*O*-isopropylidene-L-galactononitrile (15a): See General Procedure. Benzylamine (0.14 mL, 1.31 mmol), potassium cyanide (85 mg, 1.31 mmol), and tosylate **13** (180 mg, 0.52 mmol) at room temp. for 3 d gave separable α-iminonitriles **14a** (56 mg, 37%) and **15a** (60 mg, 40%) as colourless oils.

Data for α-iminonitrile **14a**: HRMS (ESI): calcd. for [$C_{16}H_{20}N_2O_3$ + Na]$^+$ 311.1366; found 311.1368. $[\alpha]_D^{20}$ = +3.1 (*c* = 1.20, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3476, 2251 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 7.36–7.28 (m, 5 H, H-Ar), 4.40 (dd, $J_{3,4}$ = 5.2, $J_{3,2}$ = 3.6 Hz, 1 H, 3-H), 4.10 (a-t, $J_{4,3}$ = $J_{4,5}$ = 5.7 Hz, 1 H, 4-H), 3.92 (d, $^2J_{gem}$ = 13.1 Hz, 1 H, CHa 2-*N*-Bn), 3.90–3.87 (m, 2 H, 2-H, 5-H), 3.65 (d, $^2J_{gem}$ = 13.1 Hz, 1 H, CHb 2-*N*-Bn), 2.72 (dd, $^2J_{6a,6b}$ = 12.3, $J_{6a,5}$ = 4.1 Hz, 1 H, 6a-H), 2.52 (dd, $^2J_{6b,6a}$ = 12.3, $J_{6b,5}$ = 8.2 Hz, 1 H, 6b-H), 1.52, 1.36 [2 s, 2× 3 H, $C(CH_3)_2$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 135.9 (C-*i* 2-*N*-Bn), 129.0, 128.8, 128.1 (C-Ar), 115.6 (CN), 110.7 [$C(CH_3)_2$], 78.0 (C-4), 74.4 (C-3), 68.8 (C-5), 59.3 (CH_2 2-*N*-Bn), 55.1 (C-2), 51.8 (C-6), 28.1, 26.4 [$C(CH_3)_2$] ppm. MS (ESI): *m/z* (%) = 311 (100) [M + Na]$^+$, 289 (50) [M + H]$^+$. For the enantiomer: $[\alpha]_D^{20}$ = –5.7 (*c* = 1.39, $CHCl_3$).

Data for α-iminonitrile **15a**: HRMS (ESI): calcd. for [$C_{16}H_{20}N_2O_3$ + Na]$^+$ 311.1366; found 311.1364. $[\alpha]_D^{20}$ = +13.5 (*c* = 1.15, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3461, 2252 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 7.37–7.30 (m, 5 H, H-Ar), 4.34 (dd, $J_{3,2}$ = 7.8, $J_{3,4}$ = 5.8 Hz, 1 H, 3-H), 4.27 (dd, $J_{4,3}$ = 5.7, $J_{4,5}$ = 2.2 Hz, 1 H, 4-H), 4.06 (a-q, $J_{5,4}$ = $J_{5,6a}$ = $J_{5,6b}$ = 2.5 Hz, 1 H, 5-H), 4.02 (dd, $J_{2,3}$ = 7.8, $J_{2,6a}$ = 0.9 Hz, 1 H, 2-H), 3.75 (d, $^2J_{gem}$ = 12.9 Hz, 1 H, CHa 2-*N*-Bn), 3.68 (d, $^2J_{gem}$ = 12.9 Hz, 1 H, CHb 2-*N*-Bn), 3.04 (br. dd, $^2J_{6a,6b}$ = 12.9, $J_{6a,5}$ = 2.2 Hz, 1 H, 6a-H), 2.76 (br. d, $^2J_{6b,6a}$ = 13.2 Hz, 1 H, 6b-H), 1.70, 1.36 [2 s, 2× 3 H, $C(CH_3)_2$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 135.9 (C-*i* 2-*N*-Bn), 129.2, 129.0, 128.3 (C-Ar), 115.8 (CN), 111.0 [$C(CH_3)_2$], 75.5 (C-4), 69.7 (C-3), 65.5 (C-5), 59.9 (CH_2 2-*N*-Bn), 56.1 (C-2), 50.7 (C-6), 26.0, 25.5 [$C(CH_3)_2$] ppm. MS (ESI): *m/z* (%) = 311 (100) [M + Na]$^+$, 289 (45) [M + H]$^+$. For the enantiomer: $[\alpha]_D^{20}$ = –17.2 (*c* = 1.24, $CHCl_3$).

2,6-Dideoxy-2,6-imino-3,4-*O*-isopropylidene-2-*N*-(4-methoxybenzyl)-L-talononitrile (14b) and 2,6-Dideoxy-2,6-imino-3,4-*O*-isopropylidene-2-*N*-(4-methoxybenzyl)-L-galactononitrile (15b)

Method A (r.t.): See General Procedure. 4-Methoxybenzylamine (0.31 mL, 2.40 mmol), potassium cyanide (156 mg, 2.40 mmol), and tosylate **13** (331 mg, 0.96 mmol) at room temp. for 2 d gave α-iminonitriles **14b** (124 mg, 41%) and **15b** (126 mg, 41%) as pale yellow oils. α-Iminonitrile **15b** crystallised on standing to form a white crystalline solid.

Method B (40 °C): See General Procedure. 4-Methoxybenzylamine (0.31 mL, 2.40 mmol), potassium cyanide (156 mg, 2.40 mmol), and tosylate **13** (330 mg, 0.96 mmol) at 40 °C for 30 h gave α-iminonitriles **14b** (150 mg, 49%) and **15b** (107 mg, 35%) as pale yellow oils. α-Iminonitrile **15b** crystallised on standing to form a white crystalline solid.

Method C (65 °C): See General Procedure. 4-Methoxybenzylamine (0.34 mL, 2.62 mmol), potassium cyanide (171 mg, 2.62 mmol), and tosylate **13** (361 mg, 1.05 mmol) at 65 °C for 1 d gave α-iminonitriles **14b** (187 mg, 56%) and **15b** (90 mg, 27%) as pale yellow oils. α-Iminonitrile **15b** crystallised on standing to form a white crystalline solid.

Data for α-iminonitrile **14b**: HRMS (ESI): calcd. for [$C_{17}H_{22}N_2O_4$ + Na]$^+$ 341.1472; found 341.1474. $[\alpha]_D^{20}$ = +37.6 (*c* = 1.95, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3482, 2260 cm^{-1}. ^{1}H NMR (500 MHz, $CDCl_3$, 20 °C): δ = 7.25 (d, *J* = 8.6 Hz, 2 H, H-Ar), 6.87 (d, *J* = 8.6 Hz, 2 H, H-Ar), 4.40 (dd, $J_{3,4}$ = 5.3, $J_{3,2}$ = 3.3 Hz, 1 H, 3-H), 4.10 (a-t, $J_{4,3}$ = $J_{4,5}$ = 5.6 Hz, 1 H, 4-H), 3.89 (d, $J_{2,3}$ = 3.3 Hz, 1 H, 2-H), 3.86 (br. s, 1 H, 5-H), 3.82 (d, $^2J_{gem}$ = 13.1 Hz, 1 H, CHa 2-*N*-PMB), 3.80 (s, 3 H, CH_3 2-*N*-PMB), 3.58 (d, $^2J_{gem}$ = 13.1 Hz, 1 H, CHb 2-*N*-PMB), 2.71 (dd, $^2J_{6a,6b}$ = 12.2, $J_{6a,5}$ = 4.3 Hz, 1 H, 6a-H), 2.51 (dd, $^2J_{6b,6a}$ = 12.2, $J_{6b,5}$ = 8.7 Hz, 1 H, 6b-H), 1.51, 1.36 [2 s, 2× 3 H, $C(CH_3)_2$] ppm. ^{13}C NMR (125 MHz, $CDCl_3$, 20 °C): δ = 159.3 (C-*p* 2-*N*-PMB), 130.2 (C-Ar), 127.8 (C-*i* 2-*N*-PMB), 115.4 (CN), 114.1 (C-Ar), 110.5 [$C(CH_3)_2$], 78.1 (C-4), 74.3 (C-3), 68.8 (C-5), 58.6 (CH_2 2-*N*-PMB), 55.3 (CH_3 2-*N*-PMB), 54.6 (C-2), 51.7 (C-6), 28.0, 26.3 [$C(CH_3)_2$] ppm. MS (ESI): *m/z* (%) = 341 (100) [M + Na]$^+$, 319 (15) [M + H]$^+$. For the enantiomer: $[\alpha]_D^{20}$ = –38.2 (*c* = 1.84, $CHCl_3$).

Data for α-iminonitrile **15b**: HRMS (ESI): calcd. for [$C_{17}H_{22}N_2O_4$ + Na]$^+$ 341.1472; found 341.1468, m.p. 84–86 °C. $[\alpha]_D^{20}$ = –72.4 (*c* = 1.73, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3488, 2230 cm^{-1}. ^{1}H NMR

(500 MHz, $CDCl_3$, 20 °C): δ = 7.22 (d, J = 8.6 Hz, 2 H, H-Ar), 6.87 (d, J = 8.6 Hz, 2 H, H-Ar), 4.31 (dd, $J_{3,2}$ = 7.8, $J_{3,4}$ = 5.8 Hz, 1 H, 3-H), 4.26 (dd, $J_{4,3}$ = 5.6, $J_{4,5}$ = 2.0 Hz, 1 H, 4-H), 4.05 (br. s, 1 H, 5-H), 4.00 (dd, $J_{2,3}$ = 7.8, $J_{2,6a}$ = 1.0 Hz, 1 H, 2-H), 3.80 (s, 3 H, CH_3 2-*N*-PMB), 3.69 (d, $^2J_{gem}$ = 12.6 Hz, 1 H, CHa 2-*N*-PMB), 3.61 (d, $^2J_{gem}$ = 12.6 Hz, 1 H, CHb 2-*N*-PMB), 3.02 (dd, $^2J_{6a,6b}$ = 12.9, $J_{6a,2}$ = 1.0 Hz, 1 H, 6a-H), 2.76 (br. d, $^2J_{6b,6a}$ = 12.9 Hz, 1 H, 6b-H), 2.58 (br. s, 1 H, 5-OH), 1.70, 1.36 [2 s, 2× 3 H, $C(CH_3)_2$] ppm. ^{13}C NMR (125 MHz, $CDCl_3$, 20 °C): δ = 159.6 (C-*p* 2-*N*-PMB), 130.4 (C-Ar), 127.8 (C-*i* 2-*N*-PMB), 115.8 (CN), 114.3 (C-Ar), 111.0 [$C(CH_3)_2$], 75.6 (C-4), 69.7 (C-3), 65.5 (C-5), 59.2 (CH_2 2-*N*-PMB), 55.9 (C-2), 55.4 (CH_3 2-*N*-PMB), 50.5 (C-6), 26.0, 25.6 [$C(CH_3)_2$] ppm. MS (ESI): *m*/*z* (%) = 341 (100) $[M + Na]^+$, 319 (20) $[M + H]^+$. For the enantiomer: M.p. 84–86 °C. $[\alpha]_D^{20}$ = +70.1 (*c* = 1.65, $CHCl_3$).

2,6-Dideoxy-2,6-imino-3,4-*O*-isopropylidene-L-talononitrile (14c) and 2,6-Dideoxy-2,6-imino-3,4-*O*-isopropylidene-L-galactononitrile (15c): See General Procedure. Ammonium acetate (546 mg, 7.09 mmol), potassium cyanide (115 mg, 1.77 mmol), and tosylate **13** (244 mg, 0.71 mmol) at 40 °C for 3 d gave an inseparable 1.8:1 (A:B) mixture of α-iminonitriles **14c**^{A} and **15c**^{B} (71 mg, 51%) as a pale yellow oil. HRMS (ESI): calcd. for $[C_9H_{14}N_2O_3 + Na]^+$ 221.0897; found 221.0895. IR (film): $\tilde{\nu}$ = 3488, 2234 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 4.34 (a-t, $J_{3,2}$ = $J_{3,4}$ = 5.6 Hz, 1 H, 3^B-H), 4.30 (dd, $J_{3,2}$ = 7.0, $J_{3,4}$ = 5.1 Hz, 1 H, 3^A-H), 4.27 (d, $J_{2,3}$ = 5.3 Hz, 1 H, 2^B-H), 4.20–4.17 (m, 2 H, 4^A-H, 4^B-H), 3.96–3.91 (m, 2 H, 5^A-H, 5^B-H), 3.73 (d, $J_{2,3}$ = 7.0 Hz, 1 H, 2^A-H), 3.22 (dd, $^2J_{6a,6b}$ = 13.4, $J_{6a,5}$ = 3.3 Hz, 1 H, 6a^B-H), 2.93 (dd, $^2J_{6a,6b}$ = 13.6, $J_{6a,5}$ = 3.3 Hz, 1 H, 6a^A-H), 2.88 (dd, $^2J_{6b,6a}$ = 13.6, $J_{6b,5}$ = 4.5 Hz, 1 H, 6b^A-H), 2.78 (dd, $^2J_{6b,6a}$ = 13.4, $J_{6b,5}$ = 4.5 Hz, 1 H, 6b^B-H), 1.61, 1.36 [2 s, 2× 3 H, $C(CH_3)_2{}^B$], 1.49, 1.35 [2 s, 2× 3 H, $C(CH_3)_2{}^A$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 118.5 (CN^A), 118.3 (CN^B), 110.7 [$C(CH_3)_2{}^B$], 110.5 [$C(CH_3)_2{}^A$], 76.5 (C-4^A), 76.2 (C-4^B), 72.9 (C-3^A), 70.5 (C-3^B), 66.2 (C-5^A, C-5^B), 49.9 (C-2^A), 48.4 (C-2^B), 46.8 (C-6^A), 45.1 (C-6^B), 28.2, 26.2 [$C(CH_3)_2{}^A$], 26.6, 25.4 [$C(CH_3)_2{}^B$] ppm. MS (ESI): *m*/*z* (%) = 221 (100) $[M + Na]^+$, 199 (85) $[M + H]^+$.

2,3-*O*-Isopropylidene-2-*C*-methyl-5-*O*-*p*-tolylsulfonyl-D-ribofuranose (19): Diisobutylaluminium hydride (1.5 M in toluene; 12.0 mL, 17.5 mmol) was added dropwise over 15 min to a solution of lactone **18**[47,48] (5.2 g, 14.6 mmol) in anhydrous dichloromethane (50 mL) at –78 °C. The reaction mixture was stirred for 1 h, after which TLC analysis (2:1, cyclohexane/ethyl acetate) indicated the incomplete consumption of the starting material (R_f = 0.54) and the formation of a major product (R_f = 0.50). The reaction mixture was diluted with ethyl acetate (200 mL) and warmed to room temp., and a mixture of water and saturated sodium potassium tartrate solution (1:3; 200 mL) was added. The biphasic mixture was stirred vigorously for 2.5 h, after which the phases were separated, and the aqueous layer was extracted with ethyl acetate (6× 50 mL). The combined organic fractions were dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (19:1 to 1:1, cyclohexane/ethyl acetate) to give lactols **19** (4.9 g, 94%) as a yellow oil, as a 2:1 mixture of anomers (A:B). HRMS (ESI): calcd. for $[C_{16}H_{22}O_7S + Na]^+$ 381.0978; found 381.0973. $[\alpha]_D^{20}$ = +6.4 (*c* = 1.52, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3485, 1363, 1177 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 7.79 (a-t, J = 8.6 Hz, 4 H, H^A-Ar, H^B-Ar), 7.36 (a-d, J = 8.3 Hz, 4 H, H^A-Ar, H^B-Ar), 5.24 (d, $J_{1,OH}$ = 4.3 Hz, 1 H, 1^B-H), 4.93 (d, $J_{1,OH}$ = 10.1 Hz, 1 H, 1^A-H), 4.40 (d, $J_{3,4}$ = 1.0 Hz, 1 H, 3^A-H), 4.24–4.21 (m, 3 H, 3^B-H, 4^A-H, 4^B-H), 4.13 (dd, $^2J_{5a,5b}$ = 10.6, $J_{5a,4}$ = 2.5 Hz, 1 H, 5a^A-H), 4.16–4.12 (m, 1 H, 5a^B-H), 4.09–4.02 (m, 1 H, 5b^B-H), 4.05 (dd, $^2J_{5b,5a}$ = 10.6, $J_{5b,4}$ = 3.5 Hz, 1 H, 5b^A-H), 3.82 (d, $J_{OH,1}$ = 10.1 Hz, 1 H, 1^A-OH), 2.93 (d, $J_{OH,1}$ = 4.3 Hz, 1 H, 1^B-OH), 2.45 (s, 6 H, $CH_3{}^A$ 5-*O*-Ts, $CH_3{}^B$ 5-*O*-Ts), 1.51, 1.43 [2 s, 2× 3 H, $C(CH_3)_2{}^A$], 1.49 (s, 3 H, 2-$CH_3{}^A$), 1.42, 1.39 [2 s, 2× 3 H, $C(CH_3)_2{}^B$], 1.40 (s, 3 H, 2-$CH_3{}^B$) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 145.5 (C^A-*p* 5-*O*-Ts), 145.3 (C^B-*p* 5-*O*-Ts), 132.7 (C^B-*i* 5-*O*-Ts), 132.3 (C^A-*i* 5-*O*-Ts), 130.2 (C^A-Ar), 130.1 (C^B-Ar), 128.2 (C^B-Ar), 128.1 (C^A-Ar), 114.1 [$C(CH_3)_2{}^B$], 113.2 [$C(CH_3)_2{}^A$], 104.8 (C-1^B), 102.4 (C-1^A), 91.8 (C-2^B), 88.0 (C-2^A), 87.5 (C-3^B), 86.5 (C-3^A), 83.0 (C-4^B), 79.3 (C-4^A), 70.5 (C-5^A), 69.9 (C-5^B), 28.2, 27.8 [$C(CH_3)_2{}^B$], 27.3, 27.0 [$C(CH_3)_2{}^A$], 21.8 (2-$CH_3{}^A$), 21.7 ($CH_3{}^A$ 5-*O*-Ts, $CH_3{}^B$ 5-*O*-Ts), 20.2 (2-$CH_3{}^B$) ppm. MS (ESI): (%) = 739 (100) $[2M + Na]^+$, 381 (22) $[M + Na]^+$.

2-*N*-Benzyl-2,6-dideoxy-2,6-imino-3,4-*O*-isopropylidene-3-*C*-methyl-D-allononitrile (20a) and 2-*N*-Benzyl-2,6-dideoxy-2,6-imino-3,4-*O*-isopropylidene-3-*C*-methyl-D-altrononitrile (21a)

Method A (r.t.): See General Procedure. Benzylamine (0.20 mL, 1.84 mmol), potassium cyanide (70 mg, 1.07 mmol), and tosylate **19** (300 mg, 0.84 mmol) at room temp. for 4 d gave α-iminonitrile **20a** (130 mg, 51%) as a pale yellow oil that crystallised on standing.

Method B (40 °C): See General Procedure. Benzylamine (0.20 mL, 1.84 mmol), potassium cyanide (70 mg, 1.07 mmol), and tosylate **19** (300 mg, 0.84 mmol) at 40 °C for 2 d gave a 15:1 (A:B) mixture of α-iminonitriles **20a**^{A} and **21b**^{B} (201 mg, 79%) as a pale yellow oil that crystallised on standing.

Method C (65 °C): See General Procedure. Benzylamine (0.20 mL, 1.84 mmol), potassium cyanide (70 mg, 1.07 mmol), and tosylate **19** (300 mg, 0.84 mmol) at 65 °C for 1 d gave a 4.4:1 (A:B) mixture of α-iminonitriles **20a**^{A} and **21b**^{B} (185 mg, 73%) as a pale yellow oil that crystallised on standing.

Data for α-iminonitrile **20a**: HRMS (ESI): calcd. for $[C_{17}H_{22}N_2O_3 + Na]^+$ 325.1523; found 325.1522, m.p. 121–122 °C (ethyl acetate/cyclohexane). $[\alpha]_D^{20}$ = +39.7 (*c* = 5.5, MeOH). IR (film): $\tilde{\nu}$ = 3427, 2239 cm^{-1}. ^{1}H NMR [500 MHz, $(CD_3)_2CO$, 20 °C]: δ = 7.38–7.28 (m, 5 H, H-Ar), 4.18 (d, $J_{4,5}$ = 3.2 Hz, 1 H, 4-H), 4.16 (d, $^2J_{gem}$ = 13.2 Hz, 1 H, CHa 2-*N*-Bn), 4.05 (br. s, 1 H, 5-OH), 3.88–3.84 (m, 1 H, 5-H), 3.56 (s, 1 H, 2-H), 3.52 (d, $^2J_{gem}$ = 13.2 Hz, 1 H, CHb 2-*N*-Bn), 2.72 (dd, $^2J_{6a,6b}$ = 10.7, $J_{6a,5}$ = 5.7 Hz, 1 H, 6a-H), 2.28 (a-t, $^2J_{6b,6a}$ = $J_{6b,5}$ = 10.9 Hz, 1 H, 6b-H), 1.57 (s, 3 H, 3-CH_3), 1.48, 1.35 [2 s, 2× 3 H, $C(CH_3)_2$] ppm. ^{13}C NMR [125 MHz, $(CD_3)_2CO$, 20 °C]: δ = 137.8 (C-*i* 2-*N*-Bn), 129.7, 129.2, 128.3 (C-Ar), 118.2 (CN), 110.0 [$C(CH_3)_2$], 81.3 (C-4), 80.5 (C-3), 65.4 (C-5), 62.0 (C-2), 60.0 (CH_2 2-*N*-Bn), 53.3 (C-6), 28.3, 26.7 [$C(CH_3)_2$], 20.4 (3-CH_3) ppm. MS (ESI): *m*/*z* (%) = 627 (100) $[2M + Na]^+$, 325 (87) $[M + Na]^+$, 303 (32) $[M + H]^+$.

Data for the mixture of α-iminonitriles **20a**^{A} and **21b**^{B}: HRMS (ESI): calcd. for $[C_{17}H_{22}N_2O_3 + Na]^+$ 325.1523; found 325.1520. IR (film): $\tilde{\nu}$ = 3441, 2241 cm^{-1}. ^{1}H NMR [400 MHz, $(CD_3)_2CO$, 20 °C]: δ = 7.39–7.13 (m, 10 H, H^A-Ar, H^B-Ar), 4.24 (d, $J_{4,5}$ = 4.5 Hz, 1 H, 4^B-H), 4.18 (d, $J_{4,5}$ = 3.2 Hz, 1 H, 4^A-H), 4.16 (d, $^2J_{gem}$ = 13.2 Hz, 1 H, CHa^A 2-*N*-Bn), 4.16 (d, $^2J_{gem}$ = 12.5 Hz, 1 H, CHa^B 2-*N*-Bn), 4.05–4.07 (m, 2 H, 5^A-OH, 5^B-OH), 3.98–3.83 (m, 2 H, 5^A-H, 5^B-H), 3.71 (s, 1 H, 2^B-H), 3.56 (s, 1 H, 2^A-H), 3.55 (d, $^2J_{gem}$ = 12.5 Hz, 1 H, CHb^B 2-*N*-Bn), 3.52 (d, $^2J_{gem}$ = 13.2 Hz, 1 H, CHb^A 2-*N*-Bn), 2.72 (dd, $^2J_{6a,6b}$ = 10.7, $J_{6a,5}$ = 5.7 Hz, 1 H, 6a^A-H), 2.71 (dd, $^2J_{6a,6b}$ = 10.6, $J_{6a,5}$ = 5.0 Hz, 1 H, 6a^B-H), 2.31 (a-t, $^2J_{6b,6a}$ = $J_{6b,5}$ = 11.4 Hz, 1 H, 6b^A-H), 2.28 (a-t, $^2J_{6b,6a}$ = $J_{6b,5}$ = 11.1 Hz, 1 H, 6b^B-H), 1.68 (s, 3 H, 3-$CH_3{}^B$), 1.57 (s, 3 H, 3-$CH_3{}^A$), 1.48, 1.35 [2 s, 2× 3 H, $C(CH_3)_2{}^A$], 1.43, 1.37 [2 s, 2× 3 H, $C(CH_3)_2{}^B$] ppm. ^{13}C NMR [100 MHz, $(CD_3)_2CO$, 20 °C]: δ = 138.1 (C^B-*i* 2-*N*-Bn), 137.8 (C^A-*i* 2-*N*-Bn), 129.7, 129.7, 129.5, 129.3, 129.3, 129.2, 129.0, 128.4, 128.3, 128.1 (C^A-Ar, C^B-Ar), 118.1

(CN^A), 117.2 (CN^B), 110.5 [$C(CH_3)_2{}^B$], 110.0 [$C(CH_3)_2{}^A$], 81.3 (C-4^A, C-4^B), 80.5 (C-3^A), 79.8 (C-3^B), 66.2 (C-5^B), 65.4 (C-5^A), 62.4 (C-2^B), 61.9 (C-2^A), 60.1 ($CH_2{}^B$ 2-*N*-Bn), 59.9 ($CH_2{}^A$ 2-*N*-Bn), 53.2 (C-6^A), 50.3 (C-6^B), 28.3, 26.7 [C(CH_3)$_2{}^A$], 26.4, 26.0 [C(CH_3)$_2{}^B$], 21.4 (3-$CH_3{}^B$), 20.4 (3-$CH_3{}^A$) ppm. MS (ESI): *m*/*z* (%) = 627 (85) [2M + Na]$^+$, 325 (100) [M + Na]$^+$, 303 (40) [M + H]$^+$.

2,6-Dideoxy-2,6-imino-3,4-*O*-isopropylidene-2-*N*-(4-methoxybenzyl)-3-*C*-methyl-D-allononitrile (20b)

Method A (r.t.): See General Procedure. 4-Methoxybenzylamine (0.28 mL, 2.14 mmol), potassium cyanide (75 mg, 1.15 mmol), and tosylate **19** (340 mg, 0.95 mmol) at room temp. for 3 d gave α-iminonitrile **20b** (208 mg, 68%) as a white crystalline solid.

Method B (40 °C): See General Procedure. 4-Methoxybenzylamine (0.28 mL, 2.14 mmol), potassium cyanide (75 mg, 1.15 mmol), and tosylate **19** (340 mg, 0.95 mmol) at 40 °C for 2 d gave α-iminonitrile **20b** (250 mg, 79%; >95% b.r.s.m.) as a white crystalline solid.

Data for α-iminonitrile **20b**: HRMS (ESI): calcd. for [$C_{18}H_{24}N_2O_4$ + Na]$^+$ 355.1628; found 355.1623, m.p. 150–152 °C. $[\alpha]_D^{20}$ = +35.6 (*c* = 0.99, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3384, 2230 cm^{-1}. ^{1}H NMR (500 MHz, $CDCl_3$, 20 °C): δ = 7.22 (d, *J* = 8.6 Hz, 2 H, H-Ar), 6.87 (d, *J* = 8.6 Hz, 2 H, H-Ar), 4.13 (d, $J_{4,5}$ = 3.9 Hz, 1 H, 4-H), 4.13 (d, $^2J_{gem}$ = 12.8 Hz, 1 H, CHa 2-*N*-PMB), 3.88–3.84 (m, 1 H, 5-H), 3.81 (s, 3 H, CH_3 2-*N*-PMB), 3.43 (d, $^2J_{gem}$ = 12.8 Hz, 1 H, CHb 2-*N*-PMB), 3.36 (s, 1 H, 2-H), 2.85 (dd, $^2J_{6a,6b}$ = 11.0, $J_{6a,5}$ = 5.9 Hz, 1 H, 6a-H), 2.17 (a-t, $^2J_{6b,6a}$ = $J_{6b,5}$ = 10.9 Hz, 1 H, 6b-H), 1.60 (s, 3 H, 3-CH_3), 1.51, 1.39 [2 s, 2× 3 H, C(CH_3)$_2$] ppm. ^{13}C NMR (125 MHz, $CDCl_3$, 20 °C): δ = 159.3 (C-*p* 2-*N*-PMB), 130.5 (C-Ar), 128.0 (C-*i* 2-*N*-PMB), 117.1 (CN), 114.0 (C-Ar), 110.2 [$C(CH_3)_2$], 80.2 (C-4), 80.0 (C-3), 65.2 (C-5), 61.0 (C-2), 59.1 (CH_2 2-*N*i-PMB), 55.4 (CH_3 2-*N*-PMB), 52.8 (C-6), 28.2, 26.7 [C(CH_3)$_2$], 20.5 (3-CH_3) ppm. MS (ESI): *m*/*z* (%) = 355 (100) [M + Na]$^+$, 333 (45) [M + H]$^+$.

2,6-Dideoxy-2,6-imino-3,4-isopropylidene-3-*C*-methyl-D-allononitrile (20c): See General Procedure. Ammonium acetate (508 mg, 6.59 mmol), potassium cyanide (107 mg, 1.65 mmol), and tosylate **19** (236 mg, 0.66 mmol) at 40 °C for 4 d gave α-iminonitrile **20c** (93 mg, 71%) as a pale yellow oil. HRMS (ESI): calcd. for [$C_{10}H_{16}N_2O_3$ + Na]$^+$ 235.1053; found 235.1058. $[\alpha]_D^{20}$ = –19.1 (*c* = 1.52, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3321, 2240 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 4.15 (d, $J_{4,5}$ = 3.8 Hz, 1 H, 4-H), 4.11 (br. s, 1 H, 5-OH), 3.83 (ddd, $J_{5,6b}$ = 10.7, $J_{5,6a}$ = 5.7, $J_{5,4}$ = 3.8 Hz, 1 H, 5-H), 3.70 (s, 1 H, 2-H), 3.06 (dd, $^2J_{6a,6b}$ = 11.7, $J_{6a,5}$ = 5.7 Hz, 1 H, 6a-H), 2.68 (a-t, $^2J_{6b,6a}$ = $J_{6b,5}$ = 11.5 Hz, 1 H, 6b-H), 1.52, 1.38 [2 s, 2× 3 H, C(CH_3)$_2$], 1.51 (s, 3 H, 3-CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 117.8 (CN), 110.0 [$C(CH_3)_2$], 80.6 (C-4), 79.2 (C-3), 66.0 (C-5), 54.5 (C-2), 47.7 (C-6), 28.3, 26.8 [C(CH_3)$_2$], 18.6 (3-CH_3) ppm. MS (ESI): *m*/*z* (%) = 235 (100) [M + Na]$^+$, 213 (82) [M + H]$^+$.

2,3-*O*-Isopropylidene-2-*C*-methyl-5-*O*-*p*-tolylsulfonyl-L-lyxono-1,4-lactone (23): *p*-Toluenesulfonyl chloride (2.8 g, 14.8 mmol) was added in one portion to a solution of lactone **22**[47] (1.2 g, 5.93 mmol) in pyridine (6 mL) at 0 °C. The reaction mixture was allowed to warm to room temp. and stirred for 14 h, after which TLC analysis (2:3, cyclohexane/ethyl acetate) indicated the complete consumption of the starting material (R_f 0.43) and the formation of a major product (R_f = 0.86). The reaction mixture was diluted with ethyl acetate (100 mL) and washed with hydrochloric acid (2 M aq.; 3× 20 mL). The organic phase was dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (19:1 to 7:3, cyclohexane/ethyl acetate) to give tosylate **23** (1.91 g, 90%) as a clear, viscous gel. HRMS (ESI): calcd. for [$C_{16}H_{20}O_7S$ + Na]$^+$ 379.0822; found 379.0819. $[\alpha]_D^{25}$ = –41.6 (*c* = 2.87, $CHCl_3$). IR (film): $\tilde{\nu}$ = 1792, 1364, 1190 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 7.80 (d, *J* = 8.2 Hz, 2 H, H-Ar), 7.36 (d, *J* = 8.2 Hz, 2 H, H-Ar), 4.62 (ddd, $J_{4,5b}$ = 7.3, $J_{4,5a}$ = 5.1, $J_{4,3}$ = 3.3 Hz, 1 H, 4-H), 4.41 (d, $J_{3,4}$ = 3.3 Hz, 1 H, 3-H), 4.36 (dd, $^2J_{5a,5b}$ = 11.1, $J_{5a,4}$ = 5.1 Hz, 1 H, 5a-H), 4.25 (dd, $^2J_{5b,5a}$ = 11.1, $J_{5b,4}$ = 7.3 Hz, 1 H, 5b-H), 2.45 (s, 3 H, CH_3 5-*O*-Ts), 1.53 (s, 3 H, 2-CH_3), 1.34, 1.33 [2 s, 2× 3 H, C(CH_3)$_2$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 175.4 (C-1), 145.5 (C-*p* 5-*O*-Ts), 132.3 (C-*i* 5-*O*-Ts), 130.1 (C-Ar), 128.2 (C-Ar), 113.8 [$C(CH_3)_2$], 82.9 (C-2), 80.1 (C-3), 75.1 (C-4), 66.8 (C-5), 26.8, 26.7 [C(CH_3)$_3$], 21.8 (CH_3 5-*O*-Ts), 18.1 (2-CH_3) ppm. MS (ESI): *m*/*z* (%) = 395 (48) [M + K]$^+$, 379 (100) [M + Na]$^+$.

2,3-*O*-Isopropylidene-2-*C*-methyl-5-*O*-*p*-tolylsulfonyl-L-lyxofuranose (24): Diisobutylaluminium hydride (1.5 M in toluene; 4.3 mL, 6.33 mmol) was added dropwise over 10 min to a solution of lactone **23** (1.88 g, 5.28 mmol) in dichloromethane (20 mL) at –78 °C. The reaction mixture was stirred for 2 h, after which TLC analysis (5:1, toluene/acetone) indicated the complete consumption of the starting material (R_f = 0.60) and the formation of a major product (R_f = 0.49). The reaction mixture was diluted with ethyl acetate (100 mL) and warmed to room temp. A mixture of water and sodium potassium tartrate solution (1:3; 100 mL) was added, and the biphasic mixture was stirred vigorously for 2.5 h. The phases were separated, and the aqueous layer was extracted with ethyl acetate (6× 30 mL). The organic fractions were combined, dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (19:1 to 7:3, cyclohexane/ethyl acetate) to give lactols **24** (1.73 g, 91%), as a 2:1 (A:B) anomeric mixture, as a white crystalline solid. HRMS (ESI): calcd. for [$C_{16}H_{22}O_7S$ + Na]$^+$ 381.0978; found 381.0973, m.p. 112–114 °C. $[\alpha]_D^{25}$ = +4.9 (*c* = 2.6, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3493, 1361, 1190 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 7.82–7.79 (m, 4 H, H-Ar), 7.34 (d, *J* = 8.1 Hz, 4 H, H-Ar), 5.19 (s, 1 H, 1^B-H), 4.63 (br. s, 1 H, 1^A-H), 4.37 (ddd, $J_{4,5b}$ = 7.6, *J* = 4.0, *J* = 3.3 Hz, 1 H, 4^B-H), 4.30–4.26 (m, 3 H, 3^A-H, 5a^A-H, 5a^B-H), 4.18 (dd, $^2J_{5b,5a}$ = 10.4, $J_{5b,4}$ = 7.6 Hz, 1 H, 5b^B-H), 4.17 (dd, $^2J_{5b,5a}$ = 10.4, $J_{5b,4}$ = 6.3 Hz, 1 H, 5b^A-H), 3.82 (a-td, *J* = *J* = 6.1, *J* = 3.3 Hz, 2 H, 3^B-H, 4^A-H), 2.44 (s, 6 H, $CH_3{}^A$ 5-*O*-Ts, $CH_3{}^B$ 5-*O*-Ts), 1.46 (s, 3 H, 2-$CH_3{}^B$), 1.43 (s, 3 H, 2-$CH_3{}^A$), 1.39, 1.38 [2 s, 2× 3 H, C(CH_3)$_2{}^A$], 1.33, 1.31 [2 s, 2× 3 H, C(CH_3)$_2{}^B$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 145.1 (C^A-*p* 5-*O*-Ts), 145.0 (C^B-*p* 5-*O*-Ts), 132.8 (C^B-*i* 5-*O*-Ts), 132.7 (C^A-*i* 5-*O*-Ts), 129.9, 128.3 (C^A-Ar, C^B-Ar), 113.5 [$C(CH_3)_2{}^A$], 113.4 [$C(CH_3)_2{}^B$], 103.3 (C-1^B), 101.3 (C-1^A), 92.4 (C-2^B), 86.6 (C-2^A), 86.0 (C-3^B), 84.5 (C-3^A), 77.4 (C-4^B), 72.8 (C-4^A), 68.1 (C-5^B), 67.1 (C-5^A), 27.7, 27.4 [C(CH_3)$_2{}^B$], 26.9, 26.8 [C(CH_3)$_2{}^A$], 21.8 ($CH_3{}^A$ 5-*O*-Ts), 21.6 ($CH_3{}^B$ 5-*O*-Ts) ppm. MS (ESI): *m*/*z* (%) = 397 (50) [M + K]$^+$, 381 (100) [M + Na]$^+$.

2,6-Dideoxy-2,6-imino-3,4-*O*-isopropylidene-2-*N*-(4-methoxybenzyl)-3-*C*-methyl-L-talononitrile (25a) and 2,6-Dideoxy-2,6-imino-3,4-*O*-isopropylidene-2-*N*-(4-methoxybenzyl)-3-*C*-methyl-L-galactononitrile (26a): See General Procedure. 4-Methoxybenzylamine (0.18 mL, 1.40 mmol), potassium cyanide (91 mg, 1.40 mmol), and tosylate **24** (200 mg, 0.59 mmol) at 50 °C for 2 d gave an inseparable 3.8:1 (A:B) mixture of α-iminonitriles **25a**^{A} and **26a**^{B} (142 mg, 73%) as a yellow oil. HRMS (ESI): calcd. for [$C_{18}H_{24}N_2O_4$ + Na]$^+$ 355.1628; found 355.1625. IR (film): $\tilde{\nu}$ = 3389, 2239 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 7.21 (d, *J* = 8.6 Hz, 4 H, H-Ar), 6.86 (d, *J* = 8.6 Hz, 4 H, H-Ar), 4.15 (d, $^2J_{gem}$ = 13.1 Hz, 1 H, CHa^B 2-*N*-PMB), 4.02 (br. d, $J_{5,OH}$ = 6.8 Hz, 1 H, 5^A-H), 4.00–3.98 (m, 2 H, 4^A-H, 4^B-H), 3.96–3.91 (m, 1 H, 5^B-H), 3.78 (s, 6 H, $CH_3{}^A$ 2-*N*-PMB, $CH_3{}^B$ 2-*N*-PMB), 3.69 (d, $^2J_{gem}$ = 12.8 Hz, 1 H, CHa^A 2-*N*-PMB), 3.60 (s, 1 H, 2^A-H), 3.58 (d, $^2J_{gem}$ = 12.8 Hz,

1 H, CHb^A 2-*N*-PMB), 3.47 (d, $^2J_{gem}$ = 13.1 Hz, 1 H, CHb^B 2-*N*-PMB), 3.36 (s, 1 H, 2^B-H), 3.02 (dd, $^2J_{6a,6b}$ = 13.1, $J_{6a,5}$ = 1.5 Hz, 1 H, 6a^A-H), 2.75 (dd, $^2J_{6a,6b}$ = 12.4, $J_{6a,5}$ = 2.5 Hz, 1 H, 6a^B-H), 2.51 (br. d, $^2J_{6b,6a}$ = 13.1 Hz, 1 H, 6b^A-H), 2.40 (dd, $^2J_{6b,6a}$ = 12.4, $J_{6b,5}$ = 1.8 Hz, 1 H, 6b^B-H), 2.29 (br. d, $J_{OH,5}$ = 6.8 Hz, 1 H, 5^A-OH), 1.66 (s, 3 H, 3-CH$_3^A$), 1.65 (s, 3 H, 3-CH$_3^B$), 1.44 [s, 3 H, C(CH$_3$)^B], 1.39 [s, 3 H, C(CH$_3$)^A], 1.36 [s, 3 H, C(CH$_3$)^A], 1.35 [s, 3 H, C(CH$_3$)^B] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 159.5 (C^A-*p* 2-*N*-PMB), 159.3 (C^B-*p* 2-*N*-PMB), 130.5 (C^B-Ar), 130.2 (C^A-Ar), 128.0 (C^A-*i* 2-*N*-PMB), 127.6 (C^B-*i* 2-*N*-PMB), 116.9 (CN^B), 116.0 (CN^A), 114.2 (C^A-Ar), 114.1 (C^B-Ar), 109.9 [*C*(CH$_3$)$_2^A$], 109.4 [*C*(CH$_3$)$_2^B$], 80.5 (C-4^A), 80.1 (C-4^B), 78.3 (C-3^B), 76.7 (C-3^A), 65.2 (C-5^A), 64.7 (C-5^B), 62.1 (C-2^B), 61.7 (C-2^A), 59.2 (CH$_2^A$ 2-*N*-PMB), 58.9 (CH$_2^B$ 2-*N*-PMB), 55.3 (CH$_3^A$ 2-*N*-PMB, CH$_3^B$ 2-*N*-PMB), 53.3 (C-6^B), 50.5 (C-6^A), 28.1, 26.7 [C(*C*H$_3$)$_2^B$], 26.3 (3-CH$_3^A$), 26.1, 25.7 [C(*C*H$_3$)$_2^A$], 21.8 (3-CH$_3^B$) ppm. MS (ESI): *m*/*z* (%) = 371 (25) [M + K]$^+$, 355 (100) [M + Na]$^+$, 333 (55) [M + H]$^+$.

2,3-*O*-Isopropylidene-5-*O*-*p*-tolylsulfonyl-D-ribono-1,4-lactone (28):[43] A solution of *p*-toluenesulfonyl chloride (4.6 g, 23.9 mmol) in pyridine (6 mL) was added dropwise to a solution of lactone **27**[42] (1.5 g, 7.97 mmol) in pyridine (8 mL) at 0 °C. The reaction mixture was allowed to warm to room temp. and stirred for 5 h, after which TLC analysis (2:3, cyclohexane/ethyl acetate) indicated the complete consumption of the starting material (R_f = 0.56) and the formation of a major product (R_f = 0.80). The reaction mixture was diluted with ethyl acetate (150 mL) and washed with hydrochloric acid (2 M aq.; 3× 30 mL). The organic phase was dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (19:1 to 1:1, cyclohexane/ethyl acetate) to give tosylate **28** (2.17 g, 79%) as a white crystalline solid. HRMS (ESI): calcd. for $[C_{15}H_{18}O_7S + Na]^+$ 365.0665; found 365.0663, m.p. 112–116 °C [ref.[43] m.p. 116–118 °C]. $[\alpha]_D^{20}$ = –18.2 (*c* = 1.20, acetone) [ref.[43] $[\alpha]_D^{24}$ = –15.5 (*c* = 2.4, acetone)]. IR (film): $\tilde{\nu}$ = 1793, 1369, 1180 cm^{-1}. ^{1}H NMR (400 MHz, CD_3CN, 20 °C): δ = 4.89 (d, $J_{2,3}$ = 5.8 Hz, 1 H, 2-H), 4.81 (d, $J_{3,2}$ = 5.8 Hz, 1 H, 3-H), 4.69 (a-t, $J_{4,5a}$ = $J_{4,5b}$ = 3.3 Hz, 1 H, 4-H), 4.38 (dd, $^2J_{5a,5b}$ = 12.4, $J_{5a,4}$ = 3.0 Hz, 1 H, 5a-H), 4.25 (dd, $^2J_{5b,5a}$ = 12.4, $J_{5b,4}$ = 3.6 Hz, 1 H, 5b-H), 2.45 (s, 3 H, CH$_3$ 5-*O*-Ts), 1.38, 1.32 [2 s, 2× 3 H, C(CH$_3$)$_2$] ppm. ^{13}C NMR (100 MHz, CD_3CN, 20 °C): δ = 174.5 (C-1), 147.1 (C-*p* 5-*O*-Ts), 132.9 (C-*i* 5-*O*-Ts), 131.3 (C-Ar), 128.9 (C-Ar), 114.3 [*C*(CH$_3$)$_2$], 80.3 (C-3), 78.3 (C-4), 75.9 (C-2), 70.1 (C-5), 26.9, 25.5 [C(*C*H$_3$)$_2$], 21.8 (CH$_3$ 5-*O*-Ts) ppm. MS (ESI): *m*/*z* (%) = 397 (47) [M + MeOH + Na]$^+$, 365 (100) [M + Na]$^+$, 360 (35) [M + NH$_4$]$^+$.

5-*O*-*tert*-Butyldimethylsilyl-2,3-*O*-isopropylidene-D-ribono-1,4-lactone (29):[50] *tert*-Butyldimethylsilyl chloride (1.8 g, 12.0 mmol) was added to a solution of lactone **27**[42] (1.5 g, 7.97 mmol) in pyridine (15 mL) at room temp. The reaction mixture was stirred for 15 h, after which TLC analysis (2:1, cyclohexane/ethyl acetate) indicated the complete consumption of the starting material (R_f = 0.24) and the formation of a major product (R_f = 0.83). The reaction mixture was diluted with ethyl acetate (100 mL) and washed with hydrochloric acid (2 M aq.; 3× 25 mL). The organic phase was dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (19:1 to 9:1, cyclohexane/ethyl acetate) to give silyl ether **29** (2.2 g, 91%) as a white crystalline solid. HRMS (ESI): calcd. for $[C_{14}H_{26}O_5Si + Na]^+$ 325.1442; found 325.1436, m.p. 68–70 °C [ref.[50] m.p. 70–71 °C]. $[\alpha]_D^{20}$ = –51.7 (*c* = 1.1, $CHCl_3$) [ref.[50] $[\alpha]_D^{23}$ = –49.0 (*c* = 1.16, $CHCl_3$)]. IR (film): $\tilde{\nu}$ = 1775 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 4.73 (d, $J_{2,3}$ = 5.8 Hz, 1 H, 2-H), 4.71 (d, $J_{3,2}$ = 5.8 Hz, 1 H, 3-H), 4.60 (br. s, 1 H, 4-H), 3.89 (dd, $^2J_{5a,5b}$ = 11.4, $J_{5a,4}$ = 1.5 Hz, 1 H, 5a-H), 3.80 (br. d, $^2J_{5b,5a}$ = 11.4 Hz, 1 H, 5b-H), 1.48, 1.39 [2 s, 2× 3 H, C(CH$_3$)$_2$], 0.88 [s, 9 H, SiC(CH$_3$)$_3$], 0.07, 0.06 [2 s, 2× 3 H, Si(CH$_3$)$_2$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 174.2 (C-1), 113.0 [*C*(CH$_3$)$_2$], 82.3 (C-4), 78.4 (C-3), 75.8 (C-2), 62.9 (C-5), 26.8, 25.6 [C(*C*H$_3$)$_2$], 25.7 [SiC(*C*H$_3$)$_3$], 18.2 [Si*C*(CH$_3$)$_3$], –5.7, –5.8 [Si(CH$_3$)$_2$] ppm. MS (ESI): *m*/*z* (%) = 325 (100) [M + Na]$^+$, 320 (78) [M + NH$_4$]$^+$.

6-*O*-*tert*-Butyldimethylsilyl-1-deoxy-3,4-*O*-isopropylidene-D-psicofuranose (30):[50] Methyllithium (1.6 M in Et_2O; 4.75 mL, 7.56 mmol) was added dropwise over 15 min to a solution of lactone **29** (2.2 g, 6.87 mmol) in THF (20 mL) at –78 °C. The reaction mixture was stirred for 2 h, after which TLC analysis (5:1, cyclohexane/ethyl acetate) indicated the consumption of the starting material (R_f = 0.71) and the formation of a major product (R_f = 0.62). Water (20 mL) was added dropwise to the reaction mixture, and the resulting biphasic mixture was allowed to warm to room temp. and stirred for a further 15 min. Ethyl acetate was added (50 mL), the phases were separated, and the aqueous layer was extracted with ethyl acetate (3× 50 mL). The organic fractions were combined, dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (39:1 to 4:1, cyclohexane/ethyl acetate) to give lactol **30** (2.04 g, 88%) as a white crystalline solid, as a single anomer. HRMS (ESI): calcd. for $[C_{15}H_{30}O_5Si + Na]^+$ 341.1755; found 341.1750, m.p. 42–44 °C. $[\alpha]_D^{20}$ = –21.0 (*c* = 1.15, $CHCl_3$) [ref.[50] $[\alpha]_D^{21}$ = –13.1 (*c* = 0.99, $CHCl_3$)]. IR (film): $\tilde{\nu}$ = 3445 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 5.16 (s, 1 H, 2-OH), 4.80 (br. d, $J_{4,3}$ = 5.8 Hz, 1 H, 4-H), 4.44 (d, $J_{3,4}$ = 5.8 Hz, 1 H, 3-H), 4.26 (br. s, 1 H, 5-H), 3.80 (dd, $^2J_{6a,6b}$ = 11.1, $J_{6a,5}$ = 1.8 Hz, 1 H, 6a-H), 3.76 (dd, $^2J_{6b,6a}$ = 11.1, $J_{6b,5}$ = 2.0 Hz, 1 H, 6b-H), 1.52, 1.50 [2 s, 2× 3 H, C(CH$_3$)$_2$], 1.35 (s, 3 H, 1-H), 0.93, [s, 9 H, SiC(CH$_3$)$_3$], 0.15, 0.14 [2 s, 2× 3 H, Si(CH$_3$)$_2$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 112.4 [*C*(CH$_3$)$_2$], 106.5 (C-2), 88.0 (C-3), 85.8 (C-5), 82.0 (C-4), 64.9 (C-6), 25.7 [SiC(*C*H$_3$)$_3$], 26.6, 25.1 [C(*C*H$_3$)$_2$], 21.2 (C-1), 18.2 [Si*C*(CH$_3$)$_3$], –5.7, –5.8 [Si(CH$_3$)$_2$] ppm. MS (ESI): *m*/*z* = 341 (100) [M + Na]$^+$.

1-Deoxy-3,4-*O*-isopropylidene-D-psicofuranose (31):[50] Tetra-*n*-butylammonium fluoride (1 M in THF; 8.2 mL, 8.2 mmol) was added dropwise to a solution of silyl ether **30** (2 g, 6.28 mmol) in THF (20 mL) at room temp. The reaction mixture was stirred for 4 h, after which TLC analysis (1:1, cyclohexane/ethyl acetate) indicated the complete consumption of the starting material (R_f = 0.93) and the formation of a major product (R_f = 0.30). The reaction mixture was concentrated in vacuo, and the crude residue was purified by flash chromatography (3:1:0 to 0:9:1, cyclohexane/ethyl acetate/methanol) to give lactol **31** (1.08 g, 84%) as a colourless oil, which crystallised on standing to form a white solid. HRMS (ESI): calcd. for $[C_9H_{16}O_5 + Na]^+$ 227.0890; found 227.0890, m.p. 73–75 °C [ref.[50] m.p. 72–74 °C]. $[\alpha]_D^{20}$ = –11.1 (*c* = 0.95, $CHCl_3$) [ref.[50] $[\alpha]_D^{21}$ = –15.0 (*c* = 1.11, $CHCl_3$)]. IR (film): $\tilde{\nu}$ = 3388 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 4.89 (d, $J_{4,3}$ = 5.9 Hz, 1 H, 4-H), 4.47 (d, $J_{3,4}$ = 5.9 Hz, 1 H, 3-H), 4.29 (br. s, 1 H, 5-H), 3.80–3.68 (m, 2 H, 6a-H, 6b-H), 1.54, 1.50 [2 s, 2× 3 H, C(CH$_3$)$_2$], 1.33 (s, 3 H, 1-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 112.4 [*C*(CH$_3$)$_2$], 106.7 (C-2), 87.0 (C-3), 86.2 (C-5), 82.0 (C-4), 63.7 (C-6), 26.5, 24.9 [C(*C*H$_3$)$_2$], 22.3 (C-1) ppm. MS (ESI): *m*/*z* (%) = 227 (100) [M + Na]$^+$.

1-Deoxy-3,4-*O*-isopropylidene-6-*O*-*p*-tolylsulfonyl-D-psicofuranose (32): A solution of *p*-toluenesulfonyl chloride (583 mg, 3.06 mmol) in pyridine (1 mL) was added dropwise to a solution of lactol **31** (500 mg, 2.45 mmol) in pyridine (4 mL) at –30 °C. The reaction mixture was warmed to 0 °C after 1 h, and after a further 1 h, it

was warmed to room temp. After 6 h at room temp. TLC analysis (1:1, cyclohexane/ethyl acetate) indicated the partial consumption of the starting material (R_f = 0.30) and the formation of a major product (R_f = 0.66). The reaction mixture was cooled to 0 °C and an additional portion of *p*-toluenesulfonyl chloride was added (230 mg, 1.21 mmol). After 15 min, the reaction mixture was warmed to room temp. and stirred for 17 h. After this time, TLC analysis indicated the complete consumption of the starting material and the presence of the major product. The reaction mixture was diluted with ethyl acetate (100 mL) and washed with hydrochloric acid (2 M aq.; 3× 20 mL). The organic phase was dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (9:1 to 7:3, cyclohexane/ethyl acetate) to give tosylate **32** (812 mg, 92%) as a pale yellow oil, which crystallised on standing to give a white crystalline solid, as a 2.6:1 (A:B) ratio of anomers. HRMS (ESI): calcd. for $[C_{16}H_{22}O_7S + Na]^+$ 381.0978; found 384.0972, m.p. 80–82 °C. $[\alpha]_D^{20}$ = –63.7 (*c* = 4.08, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3500, 1365, 1177 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 7.81–7.75 (m, 4 H, H^A-Ar, H^B-Ar), 7.36–7.31 (m, 4 H, H^A-Ar, H^B-Ar), 4.68 (dd, $J_{4,3}$ = 6.7, $J_{4,5}$ = 4.0 Hz, 1 H, 4^B-H), 4.64 (br. d, $J_{4,3}$ = 5.7 Hz, 1 H, 4^A-H), 4.42 (d, $J_{3,4}$ = 5.7 Hz, 1 H, 3^A-H), 4.41 (d, $J_{3,4}$ = 6.7 Hz, 1 H, 3^B-H), 4.24 (br. a-t, $J_{5,6}$ = $J_{5,6a}$ = 6.6 Hz, 1 H, 5^A-H), 4.19–4.03 (m, 5 H, 5^B-H, $6a^A$-H, $6a^B$-H, $6b^A$-H, $6b^B$-H), 2.54 (s, 3 H, $CH_3{}^B$ 6-*O*-Ts), 2.45 (s, 3 H, $CH_3{}^A$ 6-*O*-Ts), 1.57, 1.40 [2 s, 2× 3 H, $C(CH_3)_2{}^B$], 1.48 (s, 3 H, 1^A-H), 1.45, 1.30 [2 s, 2× 3 H, $C(CH_3)_2{}^A$], 1.36 (s, 3 H, 1^B-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 145.2 (C^A-*p* 6-*O*-Ts, C^B-*p* 6-*O*-Ts), 132.9 (C^A-*i* 6-*O*-Ts), 132.5 (C^B-*i* 6-*O*-Ts), 130.0, 128.2 (C^A-Ar, C^B-Ar), 116.1 [$C(CH_3)_2{}^B$], 113.1 [$C(CH_3)_2{}^A$], 107.7 (C-2^A), 102.3 (C-2^B), 85.7 (C-3^A), 83.9 (C-3^B), 83.0 (C-5^A), 82.5 (C-4^A), 81.0 (C-4^B), 78.9 (C-5^B), 70.4 (C-6^A), 69.1 (C-6^B), 26.6, 25.9 [$C(CH_3)_2{}^B$], 26.6, 25.3 [$C(CH_3)_2{}^A$], 25.0 (C-1^B), 22.9 (C-1^A), 21.8 ($CH_3{}^A$ 6-*O*-Ts, $CH_3{}^B$ 6-*O*-Ts) ppm. MS (ESI): *m*/*z* (%) = 381 (100) $[M + Na]^+$.

2,6-Dideoxy-2,6-imino-3,4-*O*-isopropylidene-2-*N*-(4-methoxybenzyl)-2-*C*-methyl-D-altrononitrile (33) and 2,6-Anhydro-1-deoxy-3,4-*O*-isopropylidene-D-psicofuranose (34): See General Procedure. 4-Methoxybenzylamine (0.18 mL, 1.40 mmol), potassium cyanide (91 mg, 1.40 mmol), and tosylate **32** (200 mg, 0.56 mmol) at room temp. for 1 d, and at 40 °C for 2 d, gave α-iminonitrile **33** (R_f = 0.47; 26 mg, 14%) as a yellow oil, and anhydro compound **34** (R_f = 0.68; 54 mg, 51%) as a volatile, white crystalline solid.

Data for α-iminonitrile **33**: HRMS (ESI): calcd. for $[C_{18}H_{24}N_2O_4 + Na]^+$ 355.1628; found 355.1626. $[\alpha]_D^{20}$ = –12.9 (*c* = 0.89, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3460, 2221 cm^{-1}. ^1H NMR (500 MHz, $CDCl_3$, 20 °C): δ = 7.18 (d, *J* = 8.5 Hz, 2 H, H-Ar), 6.86 (d, *J* = 8.5 Hz, 2 H, H-Ar), 4.50 (a-t, $J_{4,3}$ = $J_{4,5}$ = 5.2 Hz, 1 H, 4-H), 3.99 (d, $^2J_{gem}$ = 13.2 Hz, 1 H, CHa 2-*N*-PMB), 3.88 (d, $J_{3,4}$ = 5.7 Hz, 1 H, 3-H), 3.80 (s, 3 H, CH_3 2-*N*-PMB), 3.83–3.78 (m, 1 H, 5-H), 3.17 (d, $^2J_{gem}$ = 13.2 Hz, 1 H, CHb 2-*N*-PMB), 2.78 (dd, $^2J_{6a,6b}$ = 11.9, $J_{6a,5}$ = 6.0 Hz, 1 H, 6a-H), 2.48 (a-t, $^2J_{6b,6a}$ = $J_{6b,5}$ = 11.7 Hz, 1 H, 6b-H), 1.77, 1.41 [2 s, 2× 3 H, $C(CH_3)_2$], 1.68 (s, 3 H, 2-CH_3) ppm. ^{13}C NMR (125 MHz, $CDCl_3$, 20 °C): δ = 159.2 (C-*p* 2-*N*-PMB), 129.9 (C-Ar), 129.7 (C-*i* 2-*N*-PMB), 119.3 (CN), 114.1 (C-Ar), 111.4 [$C(CH_3)_2$], 80.4 (C-3), 74.1 (C-4), 65.6 (C-5), 62.9 (C-2), 55.5 (CH_3 2-*N*-PMB), 53.4 (CH_2 2-*N*-PMB), 49.2 (C-6), 26.1, 25.5 [$C(CH_3)_2$], 25.7 (2-CH_3) ppm. MS (ESI): *m*/*z* = 371 (12) $[M + K]^+$, 355 (100) $[M + Na]^+$.

Selected Data for **34**: M.p. 102–104 °C [ref.[51] m.p. 105–106 °C (hexane)]. $[\alpha]_D^{20}$ = –65.4 (*c* = 1.1, $CHCl_3$)] (*c* = 1.13, $CHCl_3$) [ref.[51] $[\alpha]_D$ = –78.1. ^1H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 4.58 (d, $J_{5,6a}$ = 4.0 Hz, 1 H, 5-H), 4.38 (d, $J_{4,3}$ = 5.5 Hz, 1 H, 4-H), 4.10 (d, $J_{3,4}$ = 5.5 Hz, 1 H, 3-H), 3.52 (dd, $^2J_{6a,6b}$ = 7.1, $J_{6a,5}$ = 4.0 Hz, 1 H, 6a-H), 3.35 (d, $^2J_{6b,6a}$ = 7.1 Hz, 1 H, 6b-H), 1.59 (s, 3 H, 1-H), 1.45, 1.29 [2 s, 2× 3 H, $C(CH_3)_2$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 112.1 [$C(CH_3)_2$], 107.3 (C-2), 82.7 (C-3), 80.8 (C-4), 78.1 (C-5), 64.5 (C-6), 26.2, 25.5 [$C(CH_3)_2$], 14.0 (C-1) ppm.

5-*O*-*tert*-Butyldimethylsilyl-2,3-*O*-isopropylidene-L-lyxono-1,4-lactone (35): *tert*-Butyldimethylsilyl chloride (2.4 g, 15.9 mmol) was added to a solution of lactone **11** (2.0 g, 10.6 mmol) in pyridine (20 mL) at room temp. The reaction mixture was stirred for 16 h, after which TLC analysis (2:1, cyclohexane/ethyl acetate) indicated the complete consumption of the starting material (R_f = 0.11) and the formation of a major product (R_f = 0.71). The reaction mixture was diluted with ethyl acetate (150 mL) and washed with hydrochloric acid (2 M aq.; 3× 40 mL). The organic phase was dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (49:1 to 9:1, cyclohexane/ethyl acetate) to give silyl ether **35** (3.13 g, 97%) as a white crystalline solid. HRMS (ESI): calcd. for $[C_{14}H_{26}O_5Si + Na]^+$ 325.1442; found 325.1438, m.p. 85–87 °C [for the enantiomer: ref.[52] m.p. 90–91 °C]. $[\alpha]_D^{20}$ = –39.6 (*c* = 1.37, $CHCl_3$) [for the enantiomer: ref.[52] $[\alpha]_D^{20}$ = +54.9 (*c* = 1.03, $CHCl_3$)]. IR (film): $\tilde{\nu}$ = 1773 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 4.80 (br. s, 2 H, 2-H, 3-H), 4.51 (a-t, $J_{4,5a}$ = $J_{4,5b}$ = 6.8 Hz, 1 H, 4-H), 3.98 (dd, $^2J_{5a,5b}$ = 10.6, $J_{5a,4}$ = 6.3 Hz, 1 H, 5a-H), 3.93 (dd, $^2J_{5b,5a}$ = 10.6, $J_{5b,4}$ = 7.3 Hz, 1 H, 5b-H), 1.46, 1.38 [2 s, 2× 3 H, $C(CH_3)_2$], 0.90 [s, 9 H, $SiC(CH_3)_3$], 0.09 [s, 6 H, $Si(CH_3)_2$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 173.9 (C-1), 114.2 [$C(CH_3)_2$], 79.5 (C-4), 76.2, 75.9 (C-2, C-3), 61.0 (C-5), 26.9, 26.0 [$C(CH_3)_2$], 25.9 [$SiC(CH_3)_3$], 18.5 [$SiC(CH_3)_3$], –5.2, –5.4 [$Si(CH_3)_2$] ppm. MS (ESI): *m*/*z* (%) = 325 (10) $[M + Na]^+$, 357 (100) $[M + MeOH + Na]^+$.

6-*O*-*tert*-Butyldimethylsilyl-1-deoxy-3,4-*O*-isopropylidene-L-tagatofuranose (36): Methyllithium (1.6 M in Et_2O; 7.8 mL, 12.4 mmol) was added dropwise to a solution of lactone **35** (3.13 g, 10.4 mmol) in THF (40 mL) at –78 °C. The reaction mixture was stirred for 4 h, after which TLC analysis (5:1, cyclohexane/ethyl acetate) indicated the complete consumption of the starting material (R_f = 0.40) and the formation of a major product (R_f = 0.38). Water (30 mL) and ethyl acetate (200 mL) were added slowly, and the mixture was stirred vigorously at room temp. The phases were separated, and the aqueous layer was extracted with ethyl acetate (3× 100 mL). The organic fractions were combined, dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (49:1 to 9:1, cyclohexane/ethyl acetate) to give lactols **36** (2.73 g, 83%) as a white crystalline solid, as a 4.1:1 (A:B) anomeric mixture. HRMS (ESI): calcd. for $[C_{15}H_{30}O_5Si + Na]^+$ 341.1755; found 341.1755, m.p. 66–72 °C. $[\alpha]_D^{20}$ = –8.1 (*c* = 1.32, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3430 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 4.77 (dd, $J_{4,3}$ = 5.8, $J_{4,5}$ = 3.8 Hz, 1 H, 4^A-H), 4.72 (dd, $J_{4,3}$ = 6.1, $J_{4,5}$ = 3.5 Hz, 1 H, 4^B-H), 4.43 (d, $J_{3,4}$ = 5.8 Hz, 1 H, 3^A-H), 4.25 (d, $J_{3,4}$ = 6.1 Hz, 1 H, 3^B-H), 4.16 (a-td, $J_{5,6a}$ = $J_{5,6b}$ = 6.4, $J_{5,4}$ = 4.0 Hz, 1 H, 5^A-H), 3.93 (dd, $^2J_{6a,6b}$ = 10.6, $J_{6a,5}$ = 5.6 Hz, 1 H, $6a^A$-H), 3.90 (dd, $^2J_{6a,6b}$ = 10.6, $J_{6a,5}$ = 7.1 Hz, 1 H, $6a^B$-H), 3.78 (a-dd, ^2J = 10.6, *J* = 6.6 Hz, 2 H, $6b^A$-H, $6b^B$-H), 3.66 (ddd, $J_{5,6a}$ = 7.1, $J_{5,6b}$ = 5.3, $J_{5,4}$ = 3.8 Hz, 1 H, 5^B-H), 1.52, 1.35 [2 s, 2× 3 H, $C(CH_3)_2{}^B$], 1.51 (s, 3 H, 1^A-H), 1.38 (s, 3 H, 1^B-H), 1.44, 1.30 [2 s, 2× 3 H, $C(CH_3)_2{}^A$], 0.90 [s, 9 H, $SiC(CH_3)_3{}^A$], 0.89 [s, 9 H, $SiC(CH_3)_3{}^B$], 0.08 [s, 6 H, $Si(CH_3)_2{}^A$], 0.06 [s, 6 H, $Si(CH_3)_2{}^B$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 112.8 [$C(CH_3)_2{}^B$], 112.6 [$C(CH_3)_2{}^A$], 105.3 (C-2^A), 102.3 (C-2^B), 85.5 (C-3^A), 82.4 (C-3^B), 80.7 (C-4^A), 79.9 (C-5^A), 79.9 (C-4^B), 77.0 (C-5^B), 61.6 (C-6^A), 61.0 (C-6^B), 26.3 [$SiC(CH_3)_3{}^B$], 26.1 [$SiC(CH_3)_3{}^A$], 26.0, 25.0 [$C(CH_3)_2{}^A$], 26.1, 24.9 [$C(CH_3)_2{}^B$], 22.8 (C-1^A), 22.2 (C-1^B), 18.7 [$SiC(CH_3)_3{}^A$], 18.5 [$SiC(CH_3)_3{}^B$], –5.1 ($SiCH_3{}^A$), –5.2

($SiCH_3^A$, $SiCH_3^B$), –5.3 ($SiCH_3^B$) ppm. MS (ESI): *m/z* (%) = 341 (100) $[M + Na]^+$.

1-Deoxy-3,4-*O*-isopropylidene-L-tagatofuranose (37): Tetra-*n*-butylammonium fluoride (1 M in THF; 11.0 mL, 11.0 mmol) was added dropwise to a solution of silyl ethers **36** (2.68 g, 8.41 mmol) at room temp. The reaction mixture was stirred for 18 h, after which TLC analysis (5:1, cyclohexane/ethyl acetate) indicated the complete consumption of the starting materials (R_f = 0.38) and the formation of a major product (baseline). The reaction mixture was concentrated in vacuo. The crude residue was purified by flash chromatography (3:1:0 to 0:9:1, cyclohexane/ethyl acetate/methanol) to give lactol **37** (1.60 g, 93%) as a white crystalline solid, as a single anomer. HRMS (ESI): calcd. for $[C_9H_{16}O_5 + Na]^+$ 227.0890; found 227.0895, m.p. 130–131 °C. $[\alpha]_D^{20}$ = –19.0 (*c* = 1.55, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3359 cm^{-1}. ^1H NMR (400 MHz, CD_3OD, 20 °C): δ = 4.79 (dd, $J_{4,3}$ = 5.8, $J_{4,5}$ = 3.9 Hz, 1 H, 4-H), 4.36 (d, $J_{3,4}$ = 5.8 Hz, 1 H, 3-H), 4.12 (ddd, $J_{5,6b}$ = 6.8, $J_{5,6a}$ = 5.1, $J_{5,4}$ = 3.9 Hz, 1 H, 5-H), 3.80 (dd, $^2J_{6a,6b}$ = 11.4, $J_{6a,5}$ = 5.1 Hz, 1 H, 6a-H), 3.68 (dd, $^2J_{6b,6a}$ = 11.4, $J_{6b,5}$ = 6.8 Hz, 1 H, 6b-H), 1.42 (s, 3 H, 1-H), 1.41, 1.30 [2 s, 2× 3 H, $C(CH_3)_2$] ppm. ^{13}C NMR (100 MHz, CD_3OD, 20 °C): δ = 113.5 [$C(CH_3)_2$], 105.8 (C-2), 87.2 (C-3), 82.0 (C-4), 80.4 (C-5), 61.3 (C-6), 26.4, 24.9 [$C(CH_3)_2$], 22.2 (C-1) ppm. MS (ESI): *m/z* (%) = 227 (100) $[M + Na]^+$.

1-Deoxy-3,4-*O*-isopropylidene-6-*O*-*p*-tolylsulfonyl-L-tagatofuranose (38): A solution of *p*-toluenesulfonyl chloride (1.5 g, 7.84 mmol) in pyridine (2 mL) was added dropwise to a solution of lactol **37** (800 mg, 3.92 mmol) in pyridine (8 mL) at 0 °C. After 30 min, the reaction mixture was warmed to room temp. and stirred for a further 16 h, after which TLC analysis (5:1, toluene/acetone) indicated the complete consumption of the starting material (R_f = 0.09) and the formation of a major product (R_f = 0.56). The reaction mixture was diluted with ethyl acetate (200 mL) and washed with hydrochloric acid (2 M aq.; 3× 30 mL). The organic phase was dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (19:1 to 7:3, cyclohexane/ethyl acetate) to give tosylate **38** (1.22 g, 87%) as a white crystalline solid, as a single anomer. HRMS (ESI): calcd. for $[C_{16}H_{22}O_7S + Na]^+$ 381.0978; found 381.0975, m.p. 90–92 °C. $[\alpha]_D^{20}$ = –4.6 (*c* = 2.05, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3489, 1364, 1177 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 7.80 (d, 2 H, H-Ar), 7.33 (d, 2 H, H-Ar), 4.73 (dd, $J_{4,3}$ = 5.8, $J_{4,5}$ = 3.8 Hz, 1 H, 4-H), 4.40 (d, $J_{3,4}$ = 5.8 Hz, 1 H, 3-H), 4.28 (dd, $^2J_{6a,6b}$ = 11.4, $J_{6a,5}$ = 3.8 Hz, 1 H, 6a-H), 4.27 (dt, $J_{5,6b}$ = 8.3, $J_{5,4}$ = $J_{5,6a}$ = 3.8 Hz, 1 H, 5-H), 4.14 (dd, $^2J_{6b,6a}$ = 11.4, $J_{6b,5}$ = 8.3 Hz, 1 H, 6b-H), 2.44 (s, 3 H, CH_3 6-*O*-Ts), 1.46 (s, 3 H, 1-H), 1.34, 1.25 [2 s, 2× 3 H, $C(CH_3)_2$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 145.0 (C-*p* 6-*O*-Ts), 132.9 (C-*i* 6-*O*-Ts), 129.9 (C-Ar), 128.3 (C-Ar), 113.0 [$C(CH_3)_2$], 105.7 (C-2), 85.3 (C-3), 80.5 (C-4), 76.5 (C-5), 68.3 (C-6), 26.1, 24.8 [$C(CH_3)_2$], 22.4 (C-1), 21.8 (CH_3 6-*O*-Ts) ppm. MS (ESI): *m/z* (%) = 381 (100) $[M + Na]^+$.

2,6-Dideoxy-2,6-imino-3,4-*O*-isopropylidene-2-*N*-(4-methoxybenzyl)-2-*C*-methyl-L-galactononitrile (39): See General Procedure. 4-Methoxybenzylamine (0.18 mL, 1.40 mmol), potassium cyanide (91 mg, 1.40 mmol), and tosylate **38** (201 mg, 0.56 mmol) at 65 °C for 2 d gave recovered starting material **38** (69 mg, 34%) and α-iminonitrile **39** (25 mg, 13%; 20% b.r.s.m.) as a yellow oil. HRMS (ESI): calcd. for $[C_{18}H_{24}N_2O_4 + Na]^+$ 355.1628; found 355.1622. $[\alpha]_D^{20}$ = +34.1 (*c* = 1.13, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3478, 2230 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 7.19 (d, *J* = 8.6 Hz, 2 H, H-Ar), 6.88 (d, *J* = 8.6 Hz, 2 H, H-Ar), 4.26 (dd, $J_{4,3}$ = 5.6, $J_{4,5}$ = 1.3 Hz, 1 H, 4-H), 4.05 (d, $^2J_{gem}$ = 12.6 Hz, 1 H, CHa 2-*N*-PMB), 3.96 (d, $J_{3,4}$ = 5.6 Hz, 1 H, 3-H), 3.92 (br. s, 1 H, 5-H), 3.80 (s, 3 H, CH_3 2-*N*-PMB), 3.17 (d, $^2J_{gem}$ = 12.6 Hz, 1 H, CHb 2-*N*-PMB), 2.88 (dd, $^2J_{6a,6b}$ = 13.5, $J_{6a,5}$ = 1.8 Hz, 1 H, 6a-H), 2.74 (dd, $^2J_{6b,6a}$ = 13.5, $J_{6b,5}$ = 2.4 Hz, 1 H, 6b-H), 2.25 (br. d, $J_{OH,5}$ = 7.3 Hz, 1 H, 5-OH), 1.74, 1.38 [2 s, 2× 3 H, $C(CH_3)_2$], 1.73 (s, 3 H, 2-CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 159.3 (C-*p* 2-*N*-PMB), 130.2 (C-Ar), 129.3 (C-*i* 2-*N*-PMB), 119.0 (CN), 114.4 (C-Ar), 111.1 [$C(CH_3)_2$], 78.1 (C-3), 76.0 (C-4), 64.7 (C-5), 63.4 (C-2), 55.4 (CH_3 2-*N*-PMB), 53.3 (CH_2 2-*N*-PMB), 49.4 (C-6), 26.1 [$C(CH)_3$], 25.6 [2-CH_3, $C(CH)_3$] ppm. MS (ESI): *m/z* (%) = 371 (25) $[M + K]^+$, 355 (100) $[M + Na]^+$.

5-*O*-*tert*-Butyldimethylsilyl-2,3-*O*-isopropylidene-2-*C*-methyl-D-ribono-1,4-lactone (40): *tert*-Butyldimethylsilyl chloride (2.8 g, 18.5 mmol) was added in one portion to a solution of lactone **17** (2.5 g, 12.4 mmol) at room temp. The reaction mixture was stirred for 17 h, after which TLC analysis (1:1, cyclohexane/ethyl acetate) indicated the complete consumption of the starting material (R_f = 0.53) and the formation of a major product (R_f = 0.91). The reaction mixture was diluted with ethyl acetate (150 mL) and washed with hydrochloric acid (2 M aq.; 3× 50 mL). The organic phase was dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (19:1 to 9:1, cyclohexane/ethyl acetate) to give silyl ether **40** (3.56 g, 91%) as a white crystalline solid. HRMS (ESI): calcd. for $[C_{15}H_{28}O_5Si + Na]^+$ 339.1598; found 339.1596, m.p. 50–52 °C. $[\alpha]_D^{25}$ = –19.5 (*c* = 1.49, $CHCl_3$). IR (film): $\tilde{\nu}$ = 1787 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 4.50 (s, 1 H, 3-H), 4.48 (a-t, $J_{4,5a}$ = $J_{4,5b}$ = 2.3 Hz, 1 H, 4-H), 3.91 (dd, $^2J_{5a,5b}$ = 11.6, $J_{5a,4}$ = 3.0 Hz, 1 H, 5a-H), 3.84 (dd, $^2J_{5b,5a}$ = 11.6, $J_{5b,4}$ = 1.8 Hz, 1 H, 5b-H), 1.63 (s, 3 H, 2-CH_3), 1.44, 1.42 [2 s, 2× 3 H, $C(CH_3)_2$], 0.89 [s, 9 H, $SiC(CH_3)_3$], 0.08, 0.07 [2 s, 6 H, $Si(CH_3)_2$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 176.3 (C-1), 113.0 [$C(CH_3)_2$], 83.3 (C-4), 82.9 (C-2), 82.8 (C-3), 63.4 (C-5), 27.0, 27.0 [$C(CH_3)_2$], 26.1 [$SiC(CH_3)_3$], 20.1 (2-CH_3), 18.8 [$SiC(CH_3)_3$], –5.2, –5.5 [$Si(CH_3)_2$] ppm. MS (ESI): *m/z* (%) = 339 (100) $[M + Na]^+$, 334 (75) $[M + NH_4]^+$.

6-*O*-*tert*-Butyldimethylsilyl-1-deoxy-3,4-*O*-isopropylidene-3-*C*-methyl-D-psicofuranose (41): Methyllithium (1.6 M in Et_2O; 6.5 mL, 10.4 mmol) was added dropwise to a solution of lactone **40** (3.0 g, 9.48 mmol) in THF (30 mL) at –78 °C. The reaction mixture was stirred for 4 h, after which TLC analysis (5:1, cyclohexane/ethyl acetate) indicated the complete consumption of the starting material (R_f = 0.73) and the formation of a major product (R_f = 0.81). Water (30 mL) and ethyl acetate (75 mL) were added slowly, and the resulting biphasic mixture was warmed to room temp. The phases were separated, and the aqueous layer was extracted with ethyl acetate (3× 75 mL). The organic fractions were combined, dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (19:1 to 9:1, cyclohexane/ethyl acetate) to give lactol **41** (2.20 g, 70%) as a colourless oil, as a single anomer. HRMS (ESI): calcd. for $[C_{16}H_{32}O_5Si + Na]^+$ 355.1911; found 355.1911. $[\alpha]_D^{25}$ = +4.5 (*c* = 3.79, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3398 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 4.97 (s, 1 H, 3-H), 4.48 (d, $J_{4,5}$ = 1.3 Hz, 1 H, 4-H), 4.15 (a-q, $J_{5,4}$ = $J_{5,6a}$ = $J_{5,6b}$ = 1.5 Hz, 1 H, 5-H), 3.78 (dd, $^2J_{6a,6b}$ = 11.1, $J_{6a,5}$ = 1.5 Hz, 1 H, 6a-H), 3.73 (dd, $^2J_{6b,6a}$ = 11.1, $J_{6b,5}$ = 1.8 Hz, 1 H, 6b-H), 1.47 (s, 3 H, 1-H), 1.45, 1.43 [2 s, 2× 3 H, $C(CH_3)_2$], 1.42 (s, 3 H, 3-CH_3), 0.92 [s, 9 H, $SiC(CH_3)_3$], 0.13 [s, 6 H, $Si(CH_3)_2$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 112.9 [$C(CH_3)_2$], 107.6 (C-2), 93.5 (C-3), 87.6 (C-4), 85.0 (C-5), 65.2 (C-6), 29.1, 27.9 [$C(CH_3)_2$], 25.9 [$SiC(CH_3)_3$], 20.8 (C-1), 20.6 (3-CH_3), 18.5 [$SiC(CH_3)_3$], –5.8 [$Si(CH_3)_2$] ppm. MS (ESI): *m/z* (%) = 355 (100) $[M + Na]^+$.

1-Deoxy-3,4-*O*-isopropylidene-3-*C*-methyl-D-psicofuranose (42) and 2,6-Anhydro-1-deoxy-3,4-*O*-isopropylidene-3-*C*-methyl-D-psicofur-

anose (43): Tetra-*n*-butylammonium fluoride (1 M in THF; 7.2 mL, 7.2 mmol) was added dropwise to a solution of lactol **41** (1.82 g, 5.47 mmol) at room temp. The reaction mixture was stirred for 2 h, after which TLC analysis (1:1, cyclohexane/ethyl acetate) indicated the complete consumption of the starting material (R_f = 0.91) and the formation of major (R_f = 0.34) and minor (R_f = 0.95) products. The reaction mixture was concentrated in vacuo. The crude residue was purified by flash chromatography (3:1:0 to 0:9:1, cyclohexane/ethyl acetate/methanol) to give lactols **42** (R_f = 0.34, 1.02 g, 85%) as a colourless oil, as a 1:1 (A:B) mixture of anomers, and 2,6-anhydro compound **43** (R_f = 0.95, 55 mg, 5%) as a volatile, white crystalline solid.

Data for lactols **42**: HRMS (ESI): calcd. for $[C_{10}H_{18}O_5 + Na]^+$ 241.1046; found 241.1041. $[\alpha]_D^{25}$ = –53.1 (*c* = 1.92, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3286 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 4.57 (d, $J_{4,5}$ = 1.2 Hz, 1 H, 4^B-H), 4.48 (br. d, $J_{5,6a}$ = 4.0 Hz, 1 H, 5^A-H), 4.18–4.17 (m, 1 H, 5^B-H), 4.01 (br. s, 1 H, 4^A-H), 3.82–3.68 (m, 2 H, $6a^B$-H, $6b^B$-H), 3.56 (dd, $^2J_{6a,6b}$ = 9.8, $J_{6a,5}$ = 4.3 Hz, 1 H, $6a^A$-H), 3.33 (d, $^2J_{6b,6a}$ = 9.8 Hz, 1 H, $6b^A$-H), 1.52 (s, 3 H, 3-$CH_3{}^B$), 1.50 (s, 3 H, 3-$CH_3{}^A$), 1.46 [s, 3 H, $C(CH_3)^B$], 1.45 [s, 6 H, 1^B-H, $C(CH_3)^A$], 1.43 [s, 3 H, $C(CH_3)^B$], 1.40 [s, 3 H, $C(CH_3)^A$], 1.37 (s, 3 H, 1^A-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 112.9 [$C(CH_3)_2{}^A$], 112.4 [$C(CH_3)_2{}^B$], 109.3 (C-2^B), 107.7 (C-2^A), 93.0 (C-3^A), 89.7 (C-3^B), 87.6 (C-4^B), 86.0 (C-4^A), 85.4 (C-5^B), 78.5 (C-5^A), 63.8 (C-6^A), 63.8 (C-6^B), 28.8, 27.8 [$C(CH_3)_2{}^B$], 27.9, 27.2 [$C(CH_3)_2{}^A$], 22.9 (3-$CH_3{}^B$) 21.9 (3-$CH_3{}^A$), 20.4 (C-1^B), 19.8 (C-1^A) ppm. MS (ESI): *m*/*z* (%) = 217 (100) $[M - H]^-$.

Selected Data for 2,6-anhydro compound **43**: M.p. 44–46 °C [sublimes]. $[\alpha]_D^{25}$ = –15.1 (*c* = 1.1, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 4.46 (d, $J_{5,6a}$ = 4.3 Hz, 1 H, 5-H), 4.00 (s, 1 H, 4-H), 3.54 (dd, $^2J_{6a,6b}$ = 7.3, $J_{6a,5}$ = 4.3 Hz, 1 H, 6a-H), 3.32 (d, $^2J_{6b,6a}$ = 7.3 Hz, 1 H, 6b-H), 1.51 (s, 3 H, 1-H), 1.42, 1.36 [2 s, 2× 3 H, $C(CH_3)_2$], 1.39 (s, 3 H, 3-CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 112.4 [$C(CH_3)_2$], 109.3 (C-2), 89.7 (C-3), 86.1 (C-4), 78.5 (C-5), 63.8 (C-6), 27.9, 27.2 [$C(CH_3)_2$], 19.8 (3-CH_3), 12.4 (C-1) ppm.

1-Deoxy-3,4-*O*-isopropylidene-3-*C*-methyl-6-*O*-*p*-tolylsulfonyl-D-psicofuranose (44) and 2,6-Anhydro-1-deoxy-3,4-*O*-isopropylidene-3-*C*-methyl-D-psicofuranose (43): A solution of *p*-toluenesulfonyl chloride (890 mg, 4.67 mmol) in pyridine (2 mL) was added dropwise to a solution of lactols **42** (510 mg, 2.34 mmol) in pyridine (4 mL) at –30 °C. After 30 min, the reaction mixture was warmed to 0 °C, and after a further 1 h, it was warmed to room temp. After 19 h at room temp., TLC analysis (5:1, toluene/acetone) indicated the complete consumption of the starting materials (R_f = 0.20) and the formation of a major product (R_f = 0.60) and a minor product (R_f = 0.64). The reaction mixture was diluted with ethyl acetate (100 mL) and washed with hydrochloric acid (2 M aq.; 3× 25 mL). The organic phase was dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (99:1 to 9:1, toluene/acetone) to give tosylates **44** (660 mg, 76%) as a white, waxy solid, as a 2:1 (A:B) ratio of anomers, and 2,6-anhydro compound **43** (28 mg, 6%) as a volatile, white crystalline solid.

Data for tosylates **44**: HRMS (ESI): calcd. for $[C_{17}H_{24}O_7S + Na]^+$ 395.1135; found 395.1131, m.p. 92–94 °C. $[\alpha]_D^{25}$ = +13.7 (*c* = 3.12, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3487, 1369, 1190 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 7.81–7.77 (m, 4 H, H^A-Ar, H^B-Ar), 7.36–7.34 (m, 4 H, H^A-Ar, H^B-Ar), 4.32–4.31 (m, 1 H, 4^B-H), 4.27–4.09 (m, 7 H, 4^A-H, 5^A-H, 5^B-H, $6a^A$-H, $6a^B$-H, $6b^A$-H, $6b^B$-H), 2.44 (s, 6 H, $CH_3{}^A$ 6-*O*-Ts, $CH_3{}^B$ 6-*O*-Ts), 1.54 (s, 3 H, $CH_3{}^B$), 1.43–1.38 (m, 18 H, $CH_3{}^A$, $CH_3{}^B$), 1.28 (s, 3 H, $CH_3{}^B$) ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 145.3 (C^B-*p* 6-*O*-Ts), 145.1 (C^A-*p* 6-*O*-Ts), 132.9 (C^A-*i* 6-*O*-Ts), 132.6 (C^B-*i* 6-*O*-Ts), 130.0 (C^B-Ar), 130.0 (C^A-Ar), 128.2 (C^A-Ar), 128.1 (C^B-Ar), 115.8 [$C(CH_3)_2{}^B$], 113.4 [$C(CH_3)_2{}^A$], 108.4 (C-2^A), 104.2 (C-2^B), 92.1 (C-3^A), 89.8 (C-3^B), 88.2 (C-4^A), 86.6 (C-4^B), 81.4 (C-5^A), 77.6 (C-5^B), 70.6 (C-6^A), 69.1 (C-6^B), 28.9, 27.8 [$C(CH_3)_2{}^A$], 27.0, 26.2 [$C(CH_3)_2{}^B$], 22.8 (C-1^B), 22.5 (C-1^A), 21.8 ($CH_3{}^A$ 6-*O*-Ts, $CH_3{}^B$ 6-*O*-Ts), 21.3 (3-$CH_3{}^B$), 20.4 (3-$CH_3{}^A$) ppm. MS (ESI): *m*/*z* (%) = 395 (100) $[M + Na]^+$.

2,6-Anhydro-1-deoxy-3,4-*O*-isopropylidene-3-*C*-methyl-D-psicofuranose (43): See General Procedure. 4-Methoxybenzylamine (0.17 mL, 1.32 mmol), potassium cyanide (86 mg, 1.32 mmol), and tosylate **44** (197 mg, 0.53 mmol) at 45 °C for 2 d gave anhydro compound **43** (74 mg, 70%) as a volatile, white crystalline solid.

5-*O*-*tert*-Butyldimethylsilyl-2,3-*O*-isopropylidene-3-*C*-methyl-L-lyxono-1,4-lactone (46): *tert*-Butyldimethylsilyl chloride (1.32 g, 8.75 mmol) was added to a solution of lactone **22** (1.18 g, 5.84 mmol) in pyridine (6 mL) at room temp. The reaction mixture was stirred for 16 h, after which TLC analysis (1:1, cyclohexane/ethyl acetate) indicated the complete consumption of the starting material (R_f = 0.20) and the formation of a major product (R_f = 0.88). The reaction mixture was diluted with ethyl acetate (150 mL) and washed with hydrochloric acid (2 M aq.; 40 mL). The organic phase was dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (39:1 to 9:1, cyclohexane/ethyl acetate) to give silyl ether **46** (1.78 g, 97%) as a white crystalline solid. HRMS (ESI): calcd. for $[C_{15}H_{28}O_5Si + Na]^+$ 339.1598; found 339.1592, m.p. 46–48 °C. $[\alpha]_D^{20}$ = –41.1 (*c* = 2.38, $CHCl_3$). IR (film): $\tilde{\nu}$ = 1789 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 4.42 (a-td, $J_{4,5a}$ = $J_{4,5b}$ = 6.2, $J_{4,3}$ = 3.3 Hz, 1 H, 4-H), 4.39 (d, $J_{3,4}$ = 3.3 Hz, 1 H, 3-H), 3.95 (dd, $^2J_{5a,5b}$ = 10.9, $J_{5a,4}$ = 5.8 Hz, 1 H, 5a-H), 3.93 (dd, $^2J_{5b,5a}$ = 10.9, $J_{5b,4}$ = 6.6 Hz, 1 H, 5b-H), 1.54 (s, 3 H, 2-CH_3), 1.42, 1.38 [2 s, 2× 3 H, $C(CH_3)_2$], 0.90 [s, 9 H, $SiC(CH_3)_3$], 0.09 [s, 6 H, $Si(CH_3)_2$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 176.5 (C-1), 113.1 [$C(CH_3)_2$], 83.0 (C-2), 80.5 (C-3), 78.5 (C-4), 61.0 (C-5), 27.0, 26.8 [$C(CH_3)_2$], 25.9 [$SiC(CH_3)_3$], 18.4 [$SiC(CH_3)_3$], 18.2 (2-CH_3), –5.2, –5.4 [$Si(CH_3)_2$] ppm. MS (ESI): *m*/*z* (%) = 339 (100) $[M + Na]^+$.

6-*O*-*tert*-Butyldimethylsilyl-1-deoxy-3,4-*O*-isopropylidene-3-*C*-methyl-L-tagatofuranose (47): Methyllithium (1.6 M in Et_2O; 4.1 mL, 6.52 mmol) was added dropwise to a solution of lactone **46** (1.72 g, 5.43 mmol) in THF (17 mL) at –78 °C. The reaction mixture was stirred for 2.5 h, after which TLC analysis (5:1, cyclohexane/ethyl acetate) indicated the complete consumption of the starting material (R_f = 0.48) and the formation of a major product (R_f = 0.47). Water (15 mL) and ethyl acetate (100 mL) were added slowly, and the vigorously stirred, biphasic mixture was warmed to room temp. The phases were separated, and the aqueous layer was extracted with ethyl acetate (3× 75 mL). The organic fractions were combined, dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (39:1 to 9:1, cyclohexane/ethyl acetate) to give lactols **47** (1.62 g, 90%) as a white crystalline solid, as a 2.4:1 (A:B) mixture of anomers. HRMS (ESI): calcd. for $[C_{16}H_{32}O_5Si + Na]^+$ 355.1911; found 355.1906, m.p. 78–80 °C. $[\alpha]_D^{20}$ = +1.9 (*c* = 1.35, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3455 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 4.39 (d, $J_{4,5}$ = 3.5 Hz, 1 H, 4^A-H), 4.36 (d, $J_{4,5}$ = 3.3 Hz, 1 H, 4^B-H), 4.15 (a-td, $J_{5,6a}$ = $J_{5,6b}$ = 6.0, $J_{5,4}$ = 3.5 Hz, 1 H, 5^A-H), 3.93 (dd, $^2J_{6a,6b}$ = 10.4, $J_{6a,5}$ = 5.7 Hz, 1 H, $6a^A$-H), 3.90 (dd, $^2J_{6a,6b}$ = 9.8, $J_{6a,5}$ = 7.3 Hz, 1 H, $6a^B$-H), 3.80 (dd, $^2J_{6b,6a}$ = 10.4, $J_{6b,5}$ = 6.3 Hz, 1 H, $6b^A$-H), 3.79 (dd, $^2J_{6b,6a}$ = 9.8, $J_{6b,5}$ = 5.3 Hz, 1 H, $6b^B$-H), 3.64 (ddd, $J_{5,6a}$ = 7.3, $J_{5,6b}$ = 5.3, $J_{5,4}$ = 3.3 Hz, 1 H, 5^B-H), 1.50, 1.47 [2 s, 2× 3 H, $C(CH_3)_2{}^B$], 1.47 (s, 6 H, 3-$CH_3{}^A$, 3-$CH_3{}^B$), 1.44 (s, 3 H, 1^A-H), 1.43, 1.40 [2 s, 2× 3 H, $C(CH_3)_2{}^A$], 1.34 (s, 3 H, 1^B-

H), 0.90 [s, 9 H, $SiC(CH_3)_3{}^A$], 0.90 [s, 9 H, $SiC(CH_3)_3{}^B$], 0.08 [s, 6 H, $Si(CH_3)_2{}^A$], 0.06 [s, 6 H, $Si(CH_3)_2{}^B$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 112.9 [$C(CH_3)_2{}^B$], 112.8 [$C(CH_3)_2{}^A$], 106.4 (C-2^A), 104.2 (C-2^B), 92.2 (C-3^A), 89.0 (C-3^B), 86.8 (C-4^A), 85.8 (C-4^B), 79.0 (C-5^A), 76.1 (C-5^B), 61.4 (C-6^A), 60.9 (C-6^B), 27.9, 27.4 [$C(CH_3)_2{}^A$], 27.2, 25.9 [$C(CH_3)_2{}^B$], 26.2 [$SiC(CH_3)_3{}^A$], 26.1 [$SiC(CH_3)_3{}^B$], 22.7 (3-$CH_3{}^A$), 21.0 (3-$CH_3{}^B$), 20.7 (C-1^A), 20.3 (C-1^B), 18.7 [$SiC(CH_3)_3{}^A$], 18.5, [$SiC(CH_3)_3{}^B$], –5.1, –5.3 [$Si(CH_3)_2{}^A$], –5.1 [$Si(CH_3)_2{}^B$] ppm. MS (ESI): *m/z* (%) = 355 (100) $[M + Na]^+$.

1-Deoxy-3,4-*O*-isopropylidene-3-*C*-methyl-L-tagatofuranose/1-deoxy-3,4-*O*-isopropylidene-3-*C*-methyl-L-tagatopyranose (48): Tetra-*n*-butylammonium fluoride (1 M in THF; 6.2 mL, 6.2 mmol) was added dropwise to a solution of lactols **47** (1.59 g, 4.78 mmol) at room temp. The reaction mixture was stirred for 2.5 h, after which TLC analysis (5:1, cyclohexane/ethyl acetate) indicated the complete consumption of the starting materials (R_f = 0.52) and the formation of a major product (baseline). The reaction mixture was concentrated in vacuo to give crude lactols **48** as a white crystalline solid, which was used without further purification. Partial data for the mixture of lactols **48**: HRMS (ESI): calcd. for $[C_{10}H_{18}O_5S + Na]^+$ 241.1046; found 241.1051, m.p. 100–102 °C. $[\alpha]_D^{20}$ = –16.8 (*c* = 1.33, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3448 cm^{-1}. MS (ESI): *m/z* (%) = 241 (100) $[M + Na]^+$.

1-Deoxy-3,4-*O*-isopropylidene-3-*C*-methyl-6-*O*-*p*-tolylsulfonyl-L-tagatofuranose (49): A solution of *p*-toluenesulfonyl chloride (699 mg, 3.67 mmol) in pyridine (1 mL) was added dropwise to a solution of crude lactols **48** (400 mg, 1.83 mmol) in pyridine (4 mL) at –30 °C. After 30 min, the reaction mixture was warmed to 0 °C and stirred for 1 h, and then it was allowed to warm to room temp. The reaction mixture was stirred for a further 22 h, after which TLC analysis (5:1, cyclohexane/ethyl acetate) indicated the complete consumption of the starting materials (baseline) and the formation of a major product (R_f = 0.30). The reaction mixture was diluted with ethyl acetate (50 mL) and washed with hydrochloric acid (2 M aq.; 15 mL). The aqueous phase was extracted with ethyl acetate (3× 30 mL). The organic fractions were combined, dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude residue was purified by flash chromatography (9:1 to 7:3, cyclohexane/ethyl acetate) to give tosylates **49** (678 mg, 89% over two steps) as a colourless, viscous oil, as a 3.3:1 (A:B) ratio of anomers. HRMS (ESI): calcd. for $[C_{17}H_{24}O_7S + Na]^+$ 395.1135; found 395.1134. $[\alpha]_D^{20}$ = –1.3 (*c* = 1.24, $CHCl_3$). IR (film): $\tilde{\nu}$ = 3500, 1364, 1176 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$, 20 °C): δ = 7.80 (d, *J* = 8.3 Hz, 4 H, H^A-Ar, H^B-Ar), 7.34 (d, *J* = 8.3 Hz, 4 H, H^A-Ar, H^B-Ar), 4.36–4.35 (m, 2 H, 4^A-H, 4^B-H), 4.30–4.23 (m, 3 H, 5^A-H, $6a^A$-H, $6a^B$-H), 4.15 (dd, $^2J_{6b,6a}$ = 11.6, $J_{6b,5}$ = 8.3 Hz, 1 H, $6b^A$-H), 4.13 (dd, $^2J_{6b,6a}$ = 11.6, $J_{6b,5}$ = 3.5 Hz, 1 H, $6b^B$-H), 3.82 (a-td, $J_{5,4}$ = $J_{5,6a}$ = 6.1, $J_{5,6b}$ = 3.5 Hz, 1 H, 5^B-H), 2.44 (s, 6 H, $CH_3{}^A$ 6-*O*-Ts, $CH_3{}^B$ 6-*O*-Ts), 1.44 (s, 3 H, 3-$CH_3{}^A$), 1.41 (s, 3 H, 1^A-H), 1.41 [s, 3 H, $C(CH_3)^B$], 1.38 [s, 6 H, 1^B-H, $C(CH_3)^B$], 1.34 [s, 3 H, $C(CH_3)^A$], 1.30, 1.30 [2 s, 2× 3 H, 3-$CH_3{}^B$, $C(CH_3)^A$] ppm. ^{13}C NMR (100 MHz, $CDCl_3$, 20 °C): δ = 144.9 (C^A-*p* 6-*O*-Ts, C^B-*p* 6-*O*-Ts), 132.9 (C^A-*i* 6-*O*-Ts, C^B-*i* 6-*O*-Ts), 129.9 (C^A-Ar, C^B-Ar), 128.3, 128.3 (C^A-Ar, C^B-Ar), 113.4 [$C(CH_3)_2{}^B$, $C(CH_3)_2{}^A$], 106.8 (C-2^A), 104.9 (C-2^B), 99.7 (C-3^A), 92.4 (C-3^B), 86.5 (C-4^A), 85.5 (C-4^B), 75.6 (C-5^A), 73.0 (C-5^B), 68.2 (C-6^A), 67.6 (C-6^B), 27.8, 27.3 [$C(CH_3)_2{}^A$], 27.1, 27.1 [$C(CH_3)_2{}^B$], 22.3 (C-1^A), 21.8 ($CH_3{}^A$ 6-*O*-Ts, $CH_3{}^B$ 6-*O*-Ts), 20.9 (C-1^B), 20.5 (3-$CH_3{}^A$), 20.3 (3-$CH_3{}^B$) ppm. MS (ESI): *m/z* (%) = 395 (100) $[M + Na]^+$.

Supporting Information (see footnote on the first page of this article): ^1H and ^{13}C NMR spectra of all new compounds; HMBC and NOE spectra of specific piperidine α-iminonitriles.

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